2011
Specialty Crop Block Grant Program – Farm Bill (SCBGP-FB)
FINAL REPORT

USDA, AMS Agreement No:
Specialty Crop Agreement No. 12-25-B-1215

State of California
Department of Food and Agriculture
1220 N Street
Sacramento, CA 95814

Contacts:

Crystal Myers, Manager
Federal Funds Management Office
Email: crystal.myers@cdfa.ca.gov
Phone: (916) 657-3231
Fax: (916) 653-0206

Susan Ichiho, SCBGP Manager
Federal Funds Management Office
Email: susan.ichiho@cdfa.ca.gov
Phone: (916) 657-3231
Fax: (916) 653-0206

Date Submitted:
February 18, 2015

California Department of Food and Agriculture
2011 Specialty Crop Block Grant Program –Farm Bill
CFDA # 10.170
Final Report

TABLE OF CONTENTS

SPECIALTY CROP BLOCK GRANT PROJECTS

Project 1	The Regents of the University of California, Davis	1
Project 2	Kids Growing Strong/California Garden Clubs, Inc.	7
Project 3	County of San Joaquin	16
Project 4	The Centennial Farm Foundation	21
Project 5	Community Alliance with Family Farmers	28
Project 6	California Strawberry Commission	33
Project 7	California Avocado Commission	41
Project 8	California Bountiful Foundation	45
Project 9	Fresno County Economic Opportunities Commission	50
Project 10	The Regents of the University of California, Davis, Olive Center	55
Project 11	San Benito County Ag in the Classroom	61
Project 12	National Ag Science Center	65
Project 13	The Regents of the University of California, Davis	69
Project 14	Ag Innovations Network	77
Project 15	University of California Cooperative Extension	84
Project 16	University Corporation at Monterey Bay	88
Project 17	The Regents of the University of California, Davis	93
Project 18	The Regents of the University of California, Davis	104
Project 19	U.S. Department of Agriculture, Agricultural Research Service	116
Project 20	The Regents of the University of California, Davis	120
Project 21	U.S. Department of Agriculture, Agricultural Research Service	127
Project 22	San Luis Obispo Bee Company	130
Project 23	Wine Institute	138
Project 24	Lake County Winegrape Commission	149
Project 26	High Sierra Resource Conservation and Development Council, Inc.	161
Project 27	Calaveras Winegrape Alliance	169
Project 28	The Regents of the University of California, Davis	175
Project 29	California Citrus Mutual	179
Project 30	The Regents of the University of California, Davis, Olive Center	185
Project 31	California Department of Food and Agriculture	191
Project 32	The Regents of the University of California, Agricultural Issues Center	195
Project 33	Wine Institute	200
Project 34	California Blueberry Commission	206
Project 35	California Leafy Green Product Handler Marketing Agreement	212
Project 36	Solano County	216
Project 37	Northern California Regional Land Trust	221
Project 38	National Hmong American Farmers	234
Project 39	Sacramento Area Council of Governments	239
Project 40	Mandela Market Place	249
Project 41	Sacramento Neighborhood Housing Services, Inc.	256
Project 42	Ecology Center	263

California Department of Food and Agriculture
2011 Specialty Crop Block Grant Program –Farm Bill
CFDA # 10.170
Final Report

TABLE OF CONTENTS

Project 43	Life Lab Science Program	270
Project 44	Rural Innovations in Social Economics, Inc.	279
Project 45	Central Coast Ag Network	284
Project 46	North Coast Opportunities, Inc.	289
Project 47	Trust for Conservation Innovation	299
Project 48	California State University, Chico	306
Project 49	People's Grocery	318
Project 50	Ceres Community Project	325
Project 51	U.S. Department of Agriculture, Agricultural Research Service	331
Project 52	The Regents of the University of California, Riverside	336
Project 53	The Regents of the University of California, Berkeley	343
Project 54	The Regents of the University of California, Davis	358
Project 55	The Regents of the University of California, Davis	363
Project 56	U.S. Department of Agriculture, Agricultural Research Service	367
Project 57	The Regents of the University of California, Davis	377
Project 58	The Regents of the University of California, Davis	385
Project 59	The Regents of the University of California, Riverside	392
Project 60	The Regents of the University of California, Riverside	400
Project 61	The Regents of the University of California, Riverside	405
Project 62	Soil Born Farms	412
Project 63	The Regents of the University of California, Davis, Center for Produce Safety	425
Project 64	The Regents of the University of California, Davis, Center for Produce Safety	430
Project 65	The Regents of the University of California, Davis, Center for Produce Safety	435
Project 66	The Regents of the University of California, Davis, Center for Produce Safety	441
Project 67	The Regents of the University of California, Davis, Center for Produce Safety	447
Project 68	The Regents of the University of California, Davis, Center for Produce Safety	452
Project 69	The Regents of the University of California, Davis, Center for Produce Safety	457
Project 70	The Regents of the University of California, Davis, Center for Produce Safety	465
Project 71	The Regents of the University of California, Davis, Center for Produce Safety	470
Project 72	The Regents of the University of California, Davis, Center for Produce Safety	477
Project 73	California Department of Food and Agriculture	483
Project 74	California Department of Food and Agriculture	487
Project 75	California Department of Food and Agriculture	491
Project 76	California Department of Food and Agriculture	499
Project 77	Buy California Marketing Agreement	502
Project 78	California Department of Food and Agriculture	506
Project 79	California Department of Food and Agriculture	511
Project 80	California Department of Food and Agriculture	515
Project 81	California Department of Food and Agriculture	519
Project 82	California Department of Food and Agriculture	522

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 1	**Project Title:** Helping Small, Latino, and Hmong specialty crop producers to profit from new values based marketing channels	
Grant Recipient: Regents of the University of California, Davis	**Grant Agreement No.:** SCB11001	**Date Submitted:** December 2012
Recipient Contact: Gail Feenstra	**Telephone:** (530) 754-8550	**Email:** Gwfeenstra@ucdavis.edu

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

A new market is emerging in the produce industry that is driven by consumer demand for products with values attached of "local," "sustainable," "family farmed," "ethnic," and "identity preserved." The distribution industry, non-profits, and farmer organizations are mobilizing to meet this demand. They need appropriately prepared farmers to make these “values based supply chains” (VBSCs) succeed. Small, Hmong, Mien, and Latino farmers are a rapidly growing segment of California's agricultural landscape. However, many do not understand how to create an effective marketing plan with authentic branding messages. They face barriers when communicating with buyers. A grant from the California Specialty Crop Block Grant program has made it possible to create an outreach and education program targeting this clientele.

The University of California, Davis (UCD) discovered that workshops are weak tools with this audience. Therefore focus was instead on experiential learning by introducing the growers to buyers during three tours of produce marketing districts in San Francisco, Los Angeles, and Sacramento. The tours were preceded by short workshops that were taught by native speakers or with translators. Growers were assisted in creating an edited profile to give to buyers that provided their unique marketing profile and basic information about what they grow, their farm, their story, and how to make contact. The workshops, in collaboration with UC Farm Advisors, targeted 80-100 farmers who, as early adopters, influence other producers in their communities. Evaluations completed during the workshops, and several months after the tours helped UCD assess the number of marketing connections and other impacts that occurred as a result of the project.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

Local support from community leaders was enlisted in Sacramento and Fresno, but not in San Diego. However, UC Cooperative Extension (UCCE) advisors were involved in all regions. The workshop curriculum was then modified to meet local requirements in Fresno (Hmong), Sacramento (Mein), and San

Diego (Latino and small farmer). Workshop marketing materials were developed and distributed including a public service announcement broadcast on Hmong radio in Fresno, direct mailings in Fresno and Sacramento and multiple e-mail broadcasts in all regions. A flyer and newsletter announcement was distributed through allied organizations including Rare Fruit Growers and the Strawberry Commission. Three short workshops were conducted with one in each region (Sacramento, Fresno and San Diego). In an effort to enhance the project's ability to achieve its goals, each workshop was matched with a bus tour to visit buyers who represent market opportunities in San Francisco for Fresno growers, in Sacramento for Mien growers, and in Los Angeles for San Diego small farmers. In aggregate, targets for attendees were met. An original target of 100 (all three workshops and tours) was exceeded by 15 grower participants (115 total). Finally, attendees completed evaluations for both the workshops and the tours.

After discussion with collaborators and the Specialty Crop Block Grant Program (SCBGP), some modifications were made in the project that changed the criteria by which outcomes were measured. The emphasis shifted from a workbook and workshop format to more experiential learning during market tours. The quality of the outreach and positive impact on the farmers was greatly improved. Experiencing markets, talking to buyers, and evaluating successful pack and grade during market tours is an effective outreach and teaching tool for farmers. Because of the addition of market tours, workshops were made shorter, and emphasized the grower profile (or story) and on how to overcome barriers to communication with buyers. UC Sustainable Agriculture Research and Education Program (SAREP) organized three market tours so that the growers could see the markets for themselves and talk to different kinds of potential buyers. The farm advisors and collaborators made it clear that the target audience of Hmong, Mien, and Latino growers will likely not complete a written workbook, checklist, and action plan. Instead plans were made to follow up with the most engaged participants to help them with their "profile" and assist them directly with market planning and contacts.

In all three regions, the Farm Advisor collaborators were delivering comprehensive, and funded, programs to train small growers about Food Safety; therefore, this project (UC SAREP) discussed it only in the context of it being a requirement for success. This freed UCD to allocate resources to organizing and funding the tours. The Sacramento and Fresno workshops were combined with planned strawberry grower meetings thereby increasing attendance and leveraging a private resource, (the Strawberry Commission), and fulfilling the Food Safety training segment. In San Diego the Farm Bureau hosted the event and presented their new virtual food hub program, and a successful local grower presented about a values-added marketing channel strategy.

During the final months of the project, all outstanding activities described in the work plan were completed. Some activities were modified as discussed above. Four workshops, (one was added in Sacramento), were conducted and three market tours were added to the project. Growers who requested follow up or consultation were contacted or visited. The results and lessons learned were discussed during presentations to the California State Board of Food and Agriculture, on the CDFA website, at the 6th National Small Farm Conference in Memphis, and through various reports and publications at the county level.

This project created an opportunity for 122 growers who attended workshops; 54 went on the tours where they made at least six direct contacts each with buyers. Twenty-four case files were created that document ongoing consultative work; 4 growers will shift to their own label vs marketing through shipper packers; and 16 unique marketing stories with pictures were published and distributed to growers. Many growers benefited from the consultation but did not want or need assistance with a "story." At least 10 grower / buyer relationships were formed that resulted or will result in sales this year or next; several growers have attended food safety courses and at least one has been Good Agricultural Practice (GAP) certified.

Most of the goals for "Measurable Outcomes" were achieved, but metrics don't describe the outcomes of this project. The personal encounters, the success stories, the thank you letters from growers, and the ongoing interest from distributors and retail chains tell the full story.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Activities:	Performance Indicator:	Results
1. Meet and enlist support from community leaders who work with specific farmer populations	Contact names of community leaders and early adopters in that region and written summary of contacts	**Fresno -** (Lao American Association, Hmong-American Growers, partnered with Strawberry Commission for workshop) **San Diego -** (Farm Bureau and Rare Fruit Growers) **Central Coast** – many contacts but failed in the end to mount event (CE in San Luis Obispo, Santa Barbara, and Ventura counties; Hansen Agricultural Center; Daniel Ibarra, PCA, Santa Barbara Growers Association, Ventura Farmers Market) **Sacramento** – (partnered with Strawberry Commission during workshop)
2. Collect baseline information from farmers at each workshop	Onsite baseline marketing information collected (orally) and documented.	Yes
3. Immediate content evaluation after each of four workshops	80-100 workshop evaluation results (knowledge, attitude, intention changes)	Completed evaluation with: 1) pre-workshop questions (show of hands) 2) post workshop evaluation form 3) post tour evaluation form 4) Interview / consultation evaluation form completed by interviewer
4. Use evaluations to improve next 2 workshops	Specific improvements identified; used to revise curriculum for next 2 workshops.	See Action 3 above
5. Immediate content evaluation after each of two workshops	40-50 workshop evaluations results (knowledge, attitude, intention changes)	Yes

6. Unique "story"/ profile created by farmer participants as part of workshop and immediately afterwards	60-75 farmer "stories"/ profiles created (from all 4 workshops)	Completed direct interviews using a tool with 24 of the most committed producers. Consulted on marketing plans and completed stories as required by grower needs based on story worksheets completed during the workshop.
7. Action plan including food safety checklist completed by farmer participants	50 action plans with food safety checklists completed (from all 4 workshops)	Food Safety and certification was discussed as a requirement to sell wholesale, however checklists were not created because far more complete Food Safety education programs are being presented to these specific farmers by our Farm Advisor collaborators in each region. Action plans are integrated into the consultative interview and recorded on the Interview and #2 evaluation tool.
8. Telephone follow-ups with growers who attended re: use of marketing materials, action plans, checklists and connections with potential buyers.	Quantitative and qualitative results on use of marketing materials, action plans, checklists; 30 growers connect with new potential buyers	Telephone interview, consultation, and second evaluation is completed. Sacramento growers participated in a meeting with buyers, using their stories on September 11. Between the three market tours, direct recommendations during consultations, and two follow up workshops, the target of 30 growers making new contacts with potential buyers has been greatly exceeded. The shift from our planned pedantic approach to a consultative one is a much deeper intervention than simply providing a "story" and a checklist.
9. Follow up with UCCE collaborators in each county re: change in interest in these markets, participation of target groups	Quantitative and qualitative results from 4 interviews to be included in analysis.	Final evaluation from our Collaborators in the three regions complete.
10. Analyze all data	Summary report for regional collaborators and interested farmers	A case management database was developed to track progress and contacts with each grower consulted. Other data from evaluations and attendance counts were compiled for reporting and project outreach
11. Project outreach	Curriculum and lessons learned available to statewide UCCE, ag NGOs. - press release, ANR newsletter, website	Oral presentation at the 6th National Farm Conference in September 2012. Presentation to California State Board of Food and Agriculture.
12. Project management	Meeting reports and notes	Two formal meetings among all collaborators have been completed. There have been many phone meetings and small group meetings.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

The primary beneficiaries were 122 small and Hmong or Mien growers in Fresno, Southern California, and Sacramento Valley. They are early adopters and leaders in these communities. Many farmers learn first from successful neighbors, especially in the case of non-native speakers. UCD employed a culturally sensitive and personal approach that adapts adult learning techniques to train these leaders and early adopters, and has the potential to cause a ripple effect within these farm communities and contribute to broad economic impact.

The target audience was the 68,500 small farms in California. A growing number of these are ethnic minority farmers. At least 25,000 people have emigrated from Laos to Fresno County alone and comprise an estimated 2,000 farm operations in the state. (Land use and ownership patterns make precise numbers unavailable for this group). Ethnic minorities comprise 35% of Fresno farm operators, 19% in San Diego, 12% in San Luis Obispo, and 17% in Sacramento. Like the waves of immigrants before them, these people will become the successful and productive farmers of tomorrow. However UCD found these producers to have a poor understanding of the emerging values-based market channels that are emerging statewide.

Secondary beneficiaries of these workshops were the neighboring farmers, distributors and aggregators who are beginning to explore values-based supply chains, food hubs and other new distribution entities. Ultimately, institutional and retail buyers and consumers statewide will benefit from markets that can provide more ethnically diverse, fresh fruits and vegetables to meet a rising demand for these products.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

This project was a clear success. The collaborators were enthusiastic about continuing the work. The growers have been equally enthusiastic. It was well received by the California State Board of Food and Agriculture during its October 2, 2012 meeting and at the 6th National Small Farm Conference. When the project was conceived there was no formal plan to extend it beyond a single grant cycle. By the end of the project, the collaborators agreed that this formula for outreach to minority farmers works and will be equally effective for small and beginning farmers. It is scalable and can be replicated. Funds to expand and extend to make the project sustainable will be sought from SCBG and other sources.

Observations, Conclusions and recommendations:

1. Workshops and workbooks don't move growers to change nearly as well as experiences and tours.
2. Each grower has different needs and will respond to personal consultations much better than a pedantic classroom experience designed around the instructor's perception of common needs. This is also the only way to adapt to the broad range of English skills and general business sophistication.

3. Buyers really want to talk to growers and will enthusiastically welcome a visit, but the organization of these visits can be time consuming and the bus tours expensive.
4. Demand for product with values and story attached exceeds the supply.
5. A program that focuses on a few specific committed farmers will have much more total impact than one designed to reach many farmers with a shallow intervention. Once the early adopters engage, other farmers see the success and learn. Once a buyer has invested in opening a relationship with one grower they will seek similar relationships with others.
6. The market tours provided the highest value to growers. However, travel time to and from the terminal markets took a lot of time in a one-day tour. It would have been even better if there were more time for visiting buyers. The tours need to be two days long unless they are very local as in the Sacramento markets for Sacramento valley growers.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

These documents are provided as an attachment to the final report. They are drawn from a larger report prepared to support a staff visit by CDFA near the conclusion of the project:

- **Sample - Story, Action Plan Tool**
  Staff used a tool to help guide the consultative follow-up with growers. This is an example used with one grower, by permission, with name stricken.
- **Workshop Handout with story worksheet**
  Handout used in workshops.
- **Story Examples**
  Samples of grower stories, (profiles) that they use to market values-added product.
- **Marketing contacts and tour stops**
  Listing of specific buyers who hosted tours. Many other buyers were visited quickly during terminal market walk through.

USDA Project No.: 02	**Project Title:** Presenting California Specialty Crops to Families through Interactive Garden-to-Kitchen-to-Table Activities and Mixed-Media Educational Tools	
Grant Recipient: Kids Growing Strong	**Grant Agreement No.:** SCB11002	**Date Submitted:** December 2014
Recipient Contact: Maryanne Lucas	**Telephone:** (415) 531-3746	**Email:** mlucas@kidsgrowingstrong.org

Project Summary

People are interested in healthy living and choosing better foods for their families. Much of the burden of nutrition education is being placed upon schools. Schools cannot succeed alone. Parents must know how to make proper purchasing and preparation decisions.

At the time the grant proposal was submitted, 176 parents were randomly surveyed at the San Francisco Flower & Garden Show. 121 adults knew that table beets were a vegetable but only 88 could actually identify a beet and less than half that number knew how to prepare fresh beets. Similar results were found for other specialty crops including several types of squash, eggplant, sweet potato and even cucumbers. Everyone was amazed to find that only 36 out of 103 children knew that 'French fries' were potatoes. Because 95% of the children in California live in urban areas, there is a growing disconnect between families and their source of food and lack of awareness for the important role that farmers and agriculture paly in everyone's life.

This disconnect has several unexpected and deleterious consequences including (1) under-informed consumers who are unaware of the consequences of their food choices (2) an under-valuation of farmers and the important role agriculture has to play in our lives, (3) a food system that makes decisions based on profit margins rather than the health of communities (4) produce availability that offers less than optimal nutritional value and (5) increased stress on local, sustainably conscientious, specialty crop growers.

People are currently very interested in healthy living and in choosing better foods for their families. The news media and contemporary society in general, have made the problem a topic for public discussion. Government officials have been actively seeking solutions. Schools have stepped up to the problem and are including nutrition education in classrooms and healthy food in lunch menus. But schools and legislative action cannot succeed without community and family support. Healthy eating habits must originate in the home and be sustained in the family and community. Fresh produce must be available in the community.

Parents must know how to make proper purchasing and preparation decisions and children must be engaged in the process in order to create interest and establish positive consumption behaviors. This project was designed to facilitate familial and community solutions.

Project Approach

The following list outlines the major milestones designated in the workplan without reference to the lead-up activities that needed to be completed before the following could be executed.

- A course outline, training manual, educational materials, and activities kits that follow specified learning points were created. More than 850 Leader training kits were assembled.

- A leader & training/webinar section was created on the website. Online training modules that include pre- and post- training tests were developed, tested and posted on the website along with outlines and downloadable materials. The modules have been accessed by more than 3,000 viewers in addition to the Leaders in training.
- Handouts were created for the public education. More than 1,000,000 pieces were produced, distributed and continue to be so.
- Materials needed for displays were determined. The displays must be large and eye-catching but easily transportable. Components were either purchased or created from scratch. Several versions of each were created. Sets of these displays are stored in regional locations so they can be easily borrowed by Leaders throughout the state when needed for local community events.
- 1500 specialty crop identification tests called the **"***Lunch Detective ID Survey*" were created and distributed through classrooms in areas scattered throughout the state. 1327 were completed and returned. Outreach included specialty crop taste-test activities and handouts.
- Twenty-six training workshops were conducted. Pre-evaluation tests were administered at the start of each session to establish benchmarks. Post-workshop tests showed increases in learning across the board. This increase in learning increased over time as the course was continually refined. During the Oct 2012- Mar 2013 period, post-workshop scores reflected a 33% increase in specific knowledge about specialty crops. During the final period, Oct 2013-Mar 2014, post-workshop tests reflected a 51% increase in specific knowledge. This "specific knowledge" included correct identification of assorted specialty crops, the season of harvest for the specialty crops identified, its nutritional value, recommended preparation techniques (bake, boil, fresh, etc.) and an interesting characteristic or memorable fact about the specialty crops covered. In addition, "abbreviated workshops" were developed. These workshops are of shorter duration and distributed fewer materials. This more modest level will be sustainable in the future through self-funding without further grant funding. Four of these workshops serving an additional 203 students were conducted.
- Events initiated and/or conducted by Leaders were held throughout the state. Staff attended Leader-lead events in every region, evaluated performance and offered suggestions and advice. 114 Leader events were monitored by staff. Though the events varied with each location, the focus of the participation, and activities performed at the events, were all very similar. Here follows representative examples to illustrate the type of activities that Leaders carry out:
  - <u>Huskie Get-Fit Fair at Heritage Oak Elementary</u>, Roseville, CA
    Distributed specialty crop bookmarks with seeds: *Powered by Produce Activity* and Colors Make Us Strong (Used specialty crops to demonstrate how calories are derived from food and how to balance the calories consumed with calories expended): *Colors Make Us Strong Activity* (Presented a variety of in-season specialty crops for tasting and for playing (i.e., decorating a Mr. Potato Head) with companion recipe handouts)
  - <u>Kids Garden Club</u>; Ridgecrest Community Center, Ridgecrest, CA (Ongoing, monthly: Approx. 25 kids per month) Planting activities appropriate for each month; *Good Guys in the Garden Activities* to demonstrate how specialty crops require pollinators and how pollinators in return perform services for the specialty crops; Distribute specialty crop bookmarks with seeds appropriate for planting in month of meeting.
  - <u>Master Gardeners Harvest Fair</u>, Carmichael, CA (Estimated of about 1,000 people

served; 468 projects kits completed) Worked with Master Gardeners to present planting activities with broccoli and cabbage; *Good Guys in the Garden Activities* to demonstrate how specialty crops require pollination and how pollinators in return perform services for the specialty crops; Distributed specialty crop bookmarks with seeds.

- Mercy Hospital Family Health Expo, Folsom, CA
  Planting activities with green beans and radishes; *Good Guys in the Garden Activities* to demonstrate how specialty crops require pollination and how pollinators in return perform services for the specialty crops; distributed specialty crop bookmarks with seeds.
- Summer Fun in the Park event, Oakland, CA (Central activity fair where kids from surrounding Oakland Park & Rec programs are bused to one area for a day of joint summer activities) Distributed specialty crop bookmarks with seeds: *Powered by Produce Activity* (Used specialty crops to demonstrate how calories are derived from food and how to balance the calories consumed with calories expended): Planting activities with green beans and radishes; *Good Guys in the Garden Activities* to demonstrate how specialty crops require pollination and how pollinators in return perform services for the specialty crops (over 1,000 kids attended).
- Community Pioneer Day, Paradise, CA (approx. 350 kids served/ 275 families) Planting activity of local Fall specialty crops (brassicas); *Good Guys in the Garden Activities* to demonstrate how specialty crops require pollination and how pollinators in return perform services for the specialty crops.
- Petaluma Farmers Market, Petaluma, CA: ongoing. One Kids Growing Strong specialty crop activity per month. One month may be planting seeds appropriate for the season, another month is a scavenger hunt to locate certain crops within the market, another is a crop identification game with prizes (usually fresh specialty crop fruit in season)…all activities strictly related to specialty crops.
- Shalom Christian Academy Garden Pre-school Project, San Jose, CA: An ongoing project wherein 35 students are coached to plant and grow specialty crops in their on-site garden. The crops are harvested, prepared and eaten together.
- Girl Scouts Heart of Central California (GSHCC) Anniversary Jamboree, CAL EXPO, Sacramento, CA Distributed specialty crop bookmarks with seeds: *Powered by Produce Activity* and Colors Make Us Strong (Used specialty crops to demonstrate how calories are derived from food and how to balance the calories consumed with calories expended) Over 1500 girls served in 6 hours.
- Heirloom Seed Expo, Sonoma, CA Regional 3-day event attended by 18,000 people. Approx. 4250 specialty crop planting projects (broccoli, cabbage and peas) are done with general show attendees and children who attend “Kids Garden Day.
- Carmel Valley Garden Club Garden Fair, Carmel Valley, CA Approximately 1000 people are reached over 2-days during this spring fair. 465 individual planting activities with tomatoes and squash are planted; *Good Guys in the Garden Activities* to demonstrate how specialty crops require pollination and how pollinators in return perform services for the specialty crops; distributed specialty crop bookmarks with seeds.

- A “Review & Renew” conference was held in March of 2014 in San Francisco at the San Mateo County Event Center. 473 Leaders and guests attended. A full schedule of workshops and seminars promoted understanding and consumption of specialty crops along with hints and tips to use specialty crop grant materials to inspire healthy living.

Only crops listed on the USDA list of Specialty Crops for California were used in activities and materials related to, or created for, this project.

Three times in three years during five days in March of each year, the San Francisco Flower & Garden Show (a project partner) provided in-kind support of 2,400 sq. ft. Kids Growing Strong exhibit space titled "*The Best in the World: California Grown"* (in-kind value = $75,000+). Three times in three years during three days in October of each year, Baker Creek Seeds hosted a smaller, 400 square foot version of the same display at the Heirloom Seed Exposition. These displays attracted a lot of attention among the 200,000+ show-goers and directly involved over 20,000 kids and their families in hands-on growing, preparing and sampling of specialty crops.

Gardens and displays valued at more than $10,000 were created in cooperation with the American Community Gardening Association (statewide), LifeLab (Santa Cruz), Lyngso Garden Materials (Redwood City), Malibu Compost (statewide) and Santa Clara County, San Diego County and San Mateo County Master Gardeners. WebTech Therapy donated time and talent valued at over $20,000 to create and maintain the website and the internet-based, interactive learning modules.

Growers throughout the state provided seeds and plants for grant activities. Major among them donating more than $50,000 worth of materials were Lassen Canyon Nursery (Redding: 10,000 strawberry crowns); Peaceful Valley Farms (Grass Valley), Singing Frogs Farm (Sebastopol), David Sasaki Nursery (Oxnard), Veggielution (San Jose), (collectively donating thousands of tomato, pepper, broccoli, cabbage and kale plants) and the Petaluma Seed Bank, and Grow Organic ($4,000 worth of specialty crop seeds). These major donors were augmented by hundreds of growers, gardeners, garden club members, Master Gardeners, merchants, libraries and other organizations around the state who donated space and materials to contribute to the overall success of the project at venues small and large throughout California.

Goals and Outcomes Achieved

This project was wide in scope and in geographic reach, requiring the participation and cooperation of many individuals and organizations throughout the state. A great deal of time and effort was expended to identify partners and cooperators, to identify and recruit experts in the various fields needed to be included in the curriculum, to create and refine the curriculum to best serve the goals of the project, and to identify specific locations and the exact venue where workshops would be held.

Creating the supporting educational materials and activities required research as well as creative development. The information to be presented in handouts and activities had to be gathered, then distilled and refined. The creation of artwork, writing of copy, layout and production was a major effort in this project. In the final analysis, it is these materials that emerged as the greatest benefit of the program. They are in high demand and are used by thousands of people of all ages. They can be reproduced and used long into the future extending the outreach of the project in terms of people served as well as time.

The purpose of the grant was to have local Leaders conduct outreach in their communities and to provide on-going support for their efforts. Many Leaders needed a specific "roadmap" with a timeline and detailed instructions. Event plans, annotated activity guides and general guidelines had to be created. All the materials such as posters, display materials, props and supplies had to assembled whether purchased completed or created from scratch. This was no small feat considering that Leaders in every region of the state need to be served.

The existing website had to be redesigned to accommodate the needs of the project and the online learning modules. The modules themselves had to be conceived, researched, written, illustrated, compiled and tested. This whole process required outside assistance and considerable training for staff as well as a continuous effort to update the site and respond to inquiries submitted through the website.

All in all, fulfilling this grant was a tremendous effort that took a lot of work and cooperation of more than 500 people in addition to the Leaders in training.

The outcomes were designed and measured within the grant period, but will extend beyond.

The project goals as stated in the proposal and actual results are stated in the following items. In every case, project goals were met or exceeded.

GOAL 1: Develop a statewide network of Specialty Crop (SC) Leader/Advocates throughout California:

a) conduct 24 seminars throughout the state Actual: 30 workshops were held
b) training at least 30 SC Leaders per workshop (720 total) who shall be knowledgeable about California SC's.

TARGET:

a) 24 training seminars were held with at least 95% (684) SC Leader/trainees completing the program. *ACHIEVED*
Actual: 768 Leaders were trained which is 12.2% higher than goal
b) Target of a 40% mean increase in specific knowledge areas *(areas include* SC cultivation, nutritional value, preparation; presentation techniques; and project management strategies) *as measured by comparing the number of correct answers on pre- and post-seminar evaluations*. *ACHIEVED*
Actual: a 51% post- workshop increase which is 11% higher than the target goal

GOAL 2: Establish a collaborative of partner organizations.

TARGET:

Establish 144 key stakeholder partnerships. *ACHIEVED*
Actual: 165 partnerships established. (72 with signed memorandum of understanding's (MOU's) on file.)

GOAL 3: Increase PUBLIC AWARENESS of the use and benefits of SC's as measured by:

a) Pre & post-workshop SC identification surveys for children under 12.
b) Length of time SC workshops holds attendees attention.
c) Website hits of longer than five-seconds duration.

TARGET:

a) A random sampling of 1200 elementary students will score a 25% increase on post- workshop SC identification test. *ACHIEVED*
Actual: 1327 SC identification tests were competed and returned reflecting a minimum of a 25% increase in knowledge
b) A random sampling of 1200 attendees per public event will participate

in event workshops for at least 12 minutes. *ACHIEVED*
Actual: A random sampling of 1330 attendees at 38 monitored local Leader events showed 93% participated 12 minutes or more. In fact, the median is 12.6 minutes and the average is 13.9 minutes. Participation at a single event, the 2014 San Francisco Flower & Garden Show, demonstrated that participation in the activities averaged 16 minutes with no attendee participating in the activities less than 9 minutes. This is 33% HIGHER than the grant goal.

c) Hits of longer than 5-seconds duration on the SC section of the Kids Growing Strong website will increase by 25% over the October, 2011 level. *ACHIEVED*
Actual: The goal was exceeded with an increase of 43% increase over the 2011 level.

A statewide network of 768 Specialty Crop Leaders has been established throughout California. 96% of those Leaders achieved at least a 40% mean increase in specific Specialty Crop knowledge as demonstrated by pre and post-workshop testing. The actual average increase is now 51%, which is 5% over the previous level and 11% higher than the target goal. 100% of these Leaders have participated in specialty crop education events in their communities using/distributing project materials.

Beneficiaries

The primary beneficiaries of this project are the specialty crop growers throughout California. The outreach program of this project impacted between 10,000-15,000 adult/youth garden club members and partners who actively participated in the program. Through this program, a core volunteer force has inspired several hundred thousand people to increase consumption of California-grown specialty crops and substantially increased the sales of specialty crops throughout the state.

Other beneficiaries include the people trained to be leaders (who will continue to conduct the program beyond the project duration), the schools and students that participating in the program, and individuals who attended events at which project displays and activities were conducted.

Lessons Learned

People have very good intentions, but good intentions are not enough to sustain a successful project. Getting people to follow-through is a challenge, especially in volunteer situations. The grant included surveys by teachers and reports to be completed by students. It was a struggle to get teachers to actively participate by returning surveys and to get Leaders to fill out paper work and evaluations and report back after events. Requiring a deposit to obtain materials, and then returned after-event reports are submitted, has been found to be helpful.

The expectations of stakeholders and partners were an unexpected outcome of the project. The educational materials, activity kits and seeds bookmarks are in extremely high demand. “Everybody wants the stuff.” It is a challenge to keep up with fulfillment (delivery of materials.) Also, the question arises whether or not all of the materials being distributed are being used effectively. It was finally decided that allocation of materials had to be controlled through the use of formal requests listing intended use of materials. In this way, the amount of materials created/supplied could be controlled and the probability of their best use could be judged.

Further, even if the materials end up not being used as "effectively" as hoped, it can be argued it is still a win situation. All project materials relate only to specialty crops, so the more people who come into contact with the materials, the more people are likely to learn about (and consume) specialty crops at some level.

A significant challenge encountered was the online training structure. A major component of the training was to be completed via online courses. Students were asked to complete online training within a specified period of time. Through monitoring, it was noticed that the number of students participating in the on-site workshops did not correlate to the number of students completing the online coursework as indicated by the number of students completing the tests. Interviews revealed that (a) a majority of prospective leaders (~68%) were intimidated by testing and (b) a significant number (44%) found the mechanics of the online training modules to be an obstacle to complete training. Bottom line: people, especially volunteers, don't like tests and will avoid them as much as possible. Also, people, especially older students, are not comfortable with computer learning. Using online testing may not be a good approach to evaluate the success/failure of a project. Creative alternative methods that do not create barriers to participation need to be devised.

Prospective students have budget and time restraints that make them reluctant to make a commitment that will extend over more than one day and require travel outside their local area. Prospective students seem very receptive to the flexibility afforded by online, 24/7 training that they can access as time permits and as often as they require. But the online training should be followed by local, on-site opportunities for hands-on practice under the guidance of trainers. There must be a significant "hands-on" and "interactive" component to the program. People need to keep moving and communicate to keep energy levels up and attention focused. Workshops MUST be limited to a maximum of 5-hours, with 3-hours being optimum, and held in as many venues as possible to make getting to the site fast and easy for attendee. Reduce barriers!

Additional Information

Project materials included the project tote bag with Leader resource binder and sample materials such as seed bookmarks, activity information cards, garden-in-a-carton project sample, a salad-to-go sample and other specially designed collateral included. Attached below is a selection of images to help convey the scope of the project.

Leader Training tote bag and binder with samples of materials created for project

Learning about "Specialty Crops" during project activity events

Typical gardening displays and activities held during public events for project

USDA Project No.: 3	Project Title: San Joaquin County AgVenture	
Grant Recipient: County of San Joaquin	**Grant Agreement No.:** SCB11003	**Date Submitted:** December 2013
Recipient Contact: Gary Stockel	**Telephone:** (209) 953-6000	**Email:** gstockel@sjgov.org

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

The AgVenture program consisted of three free field trips held in different areas of San Joaquin County (north, central, and south). In these three events, 1,350 specialty crop farmers, producers, and volunteers donated their time and expertise to bring educational presentations and displays to educate 11,000 third grade students from 142 schools in San Joaquin County. The program addressed the following two problems: the low nutritional indicators in San Joaquin County and the importance of agriculture in relation to the local economy. These problems were addressed by field trips where students were taught about San Joaquin County specialty crops, nutrition in relation to healthy living, and the importance of agriculture's role in history and economics. Volunteer presenters introduced students to healthy food choices, created an ongoing awareness of the importance of eating locally grown specialty crops, and addressed the role that students play as consumers in helping to maintain agriculture as a strong component of both the local and State economies.

The program was motivated by the importance of teaching San Joaquin County students the nutritional and economic benefits of eating locally grown specialty crops and the vital role agriculture plays in the local economy. In the past ten years, San Joaquin County has transformed from a primarily rural locale to a more suburban locale for Bay Area commuters. As a result, more students and residents are not aware of the importance of agriculture. This program exposes students, most for the first time, about agriculture as the backbone of the local economy. The program did not build on a previously funded Specialty Crop Block Grant.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

The Specialty Crop Block Grant provided funding for AgVenture's three field days for the 2011-12 year. AgVenture was able to accomplish all goals and outcomes during the grant period. The program partners have contributed to the success of the program. The partners provided the following services:

- County of San Joaquin: Provided program oversight, volunteer support, and provided $25,000 in financial support.
- San Joaquin Farm Bureau Federation: Provided lunch for volunteers at all three field days and volunteer support.
- U.C. Cooperative extension: Provided data analysis of pre-and post-tests, curriculum assistance and volunteer support.
- Natural Resources Conservation Service: Provided volunteer support.
- California Women for Agriculture: Provided volunteer support.
- San Joaquin County Office of Education: Provided grant and proposal development assistance, and volunteer support.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

The proposed goals and outcomes outlined in the proposal have been met. The program outcome measures were not long term. The following are the program goals and outcomes:

Goal 1: Provide all San Joaquin County third graders the opportunity to learn about San Joaquin County specialty crops, nutrition in relation to healthy living, and the importance of agriculture's role in history and economics through three free field trips**,** maintained at this level for the 2011-12 school year, as measured by the number of offered field days.

This goal has been met. The program served 11,000 third grade students from throughout the county. AgVenture provided three field days held on the following dates and locations:

- October 12, 2011 (South County- Manteca)
- January 25, 2012 (Central County-Stockton)
- March 7, 2012 (North County-Lodi)

Goal 2: Participating students will increase their knowledge of San Joaquin County specialty crops and nutrition in relation to healthy living by an increase of 10%, as measured by pre/post field day tests. (No baseline existed for this measure)

This goal has been met. Students were provided with pre-and post-test measuring their knowledge of nutrition in relation to healthy living, indicating an increase of 14%. Program partner, U.C. Cooperative Extension conducted the analysis of the pre-and post-tests.

Goal 3: Participating students will increase their knowledge of the importance of agriculture's role in history and the local economy by an increase of 10%, as measured by pre/post field day tests. (no baseline existed for this measure)

This goal has been met. Students were provided with pre-and post-test measuring their knowledge of the importance of agriculture's role in history and the local economy, indicating an increase of 11%.

Goal 4: AgVenture will create an ongoing field trip program that is a partnership between the agriculture industry, San Joaquin County, and County school district by increasing the level of support from the current level of 1,000 volunteers to recruiting at least 375 volunteers per AgVenture field day (over 1,100 volunteers) from the agriculture industry to contribute presentations and displays for students, and to help with program operations, as measured by partner database.

This goal has been met. AgVenture recruited 450 volunteers per field day for a total of 1,350. The AgVenture Coordinator in collaboration with the Agricultural Commissioner's office cross referenced specialty crop farmers with the US Department of Agriculture (USDA) eligible specialty crops to determine eligible specialty crop farmers. The AgVenture coordinator developed a partner database to track participation.

The AgVenture Coordinator met with representatives from the California Department of Food and Agriculture and provided them with a binder of children's letters illustrating the impact of the program. Example comments include:

- "I have never had olives before."
- "I didn't know walnuts were in a shell."
- "I found out blueberries are good for the heart."
- "Pomegranates can help you from having a heart attack."

The following activities were completed in order to achieve the performance goals and measurable outcomes for the program:

- The Ag Commissioner and the AgVenture Coordinator secured AgVenture field day locations and obtained all necessary insurance (October 2011).
- The AgVenture Coordinator purchased all the supplies for the program (October 2011).
- The AgVenture Coordinator mailed invitations to all San Joaquin County schools, specialty crop farmers, producers, and volunteers, and then coordinated registration (October 2011).
- The Ag Commissioner and the AgVenture Coordinator recruited 450 specialty crop farmers, producers and volunteers for each field day (October 2011).
- The AgVenture Coordinator distributed informational materials to students, parents, teachers and volunteers (October 2011).
- The AgVenture Coordinator developed pre/post field day tests (October 2011).
- The AgVenture Coordinator developed a bus schedule for transportation of students (October 2011).
- The AgVenture Coordinator arranged for portable bathrooms to be located at the South County field day in Manteca (October 2011).
- The AgVenture Coordinator conducted one-hour workshops with San Joaquin County teachers about information presented at the field and how to integrate it into lesson plans (October 2011).

- The Ag Commissioner and the AgVenture Coordinator conducted three field days for San Joaquin County third graders (South County-Nov. 2011, Central County-Feb. 2012, and North County-Mar. 2012).
- The AgVenture Coordinator in collaboration with San Joaquin County teachers conducted post-field day tests (South County-Nov. 2011, Central County-Feb. 2012, and North County-Mar. 2012).
- The AgVenture Coordinator prepared and disseminated a program final report (June-July 2012).

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

The AgVenture program directly benefited 11,000 third graders in San Joaquin County. The program also benefited 1,350 volunteers who had the opportunity to explain the importance of specialty crops to future consumers. The quantitative data illustrating how the beneficiaries were affected by the program is explained in the goals and outcomes section of this final report.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

The program learned numerous lessons this past year. The program attempted to have one-hour workshops with teachers to inform them about the information presented at the field day and how to integrate it into lesson plans. Unfortunately, it was too difficult to coordinate with over 142 school/teacher schedules to put on the workshops. In response, the AgVenture Coordinator mailed packets to all the school teachers prior to the field days to inform them on the day. This proved to be more efficient and teachers were more receptive to the information.

The program also experienced challenges with the Central County field day in Stockton. There was a bus driver layoff in the Stockton Unified School District, which resulted in 10 schools unable to attend the field day. The 10 schools were then served by the North County field day. As a result, the program was able to meet its outcomes.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

The AgVenture program received media coverage for each field day. The following links are to stories from local newspapers:

South County Media Coverage from the Manteca Bulletin:
http://www.mantecabulletin.com/archives/28174/

Central County Media Coverage from the Record and the Manteca Bulletin:
http://www.recordnet.com/apps/pbcs.dll/article?AID=/20120126/A_NEWS04/201260315&cid=sitesearch
http://www.mantecabulletin.com/archives/33230/

North County Media Coverage from the Lodi News Sentinel:
http://www.lodinews.com/news/article_bc6d0c73-58ba-55ac-805b-82e86906018a.html?mode=story

USDA Project No.: 4	Project Title: The Centennial Farm Specialty Crop Educational Project	
Grant Recipient: The Centennial Farm Foundation	**Grant Agreement No.:** SCB11004	**Date Submitted:** December 2014
Recipient Contact: Sarah Bartczak	**Telephone:** (714) 851-4464	**Email:** Sarah.bartczak@gmail.com

Project Summary

Agriculture is part of every Californian's daily life, but for many living in urban areas agriculture is taken for granted. The Centennial Farm ("Farm") was founded by leaders in the region's agriculture industry to re-form this connection through the youth. Teaching youth about agriculture helps them learn to make healthy choices and can help science come alive for many while presenting credible career options in the agriculture industry. Teaching young people about California specialty crops can teach them about the specific benefits of these crops, about the importance of consuming local crops and how they can potentially be involved in the specialty crop industry in the future. This project has enhanced the competitiveness of California specialty crops through Marketing / Agriculture Education by

- ✓ Promoting California specialty crops to encourage youth to seek them out in their daily lives; and
- ✓ Educating consumers about California specialty crops, thus increasing demand by the youth, their parents and teachers.

The need for agriculture education was higher than ever in Orange County. Orange County has come a long way from the orange grove covered suburb of Los Angeles, as today more people commute into Orange County to work, than commute out. This urbanization moves youth further away from seeing the agricultural roots of the County and how agriculture is present in their lives in so many ways. In addition, as budgets tighten, access to fresh fruits and vegetables becomes more difficult causing families to lose sight of the importance of fresh produce, as well as ways to get the produce locally. California specialty crops are a great solution to these issues, as local farms can provide high quality produce with easy access in families' own areas. The opportunity was perfect for the Centennial Farm to develop the Centennial Farm Specialty Crop Educational Program and teach about the specialty crops and their individual as well as collective importance. By reaching the younger audience, an overall improved understanding of California, and specifically local farming, can be built from the ground up as children share the lessons with peers and their families. This has important impacts on the participating children and indirectly their families as their overall nutrition improves. Further, this has an important impact on community and California specialty crop growers as their sustained interest, as well as specific knowledge about California specialty crops, helps to grow the market and expand support for California agriculture.

Project Approach

The following key activities were performed in line with the proposed Work Plan:

- Coordinate partnerships and integrate into programming
  The Centennial Farm began by building existing relationships and forming new partnerships to expand and enhance Farm programming, specifically partners related to California specialty crops. This included partnerships with OC Fair and Event Center, Newport Mesa Unified School District, City of Costa Mesa, Community Action Partnership, UCCE Master Gardeners, OC Bee Keepers, California Fruit Growers Association, Enrecos / VermiComposting, California Foundation for Agriculture in the

Classroom, Agrium / Seed Survivor Mobile, Irvine Youth Action Team, Mesa Consolidated Water District, and the OC Farm Bureau. All partners listed were involved specifically with California specialty crops at the Farm. For many partners their relationships focused on specific crops which were California specialty crops and therefore all their activities were related to California specialty crops. Others have a broader involvement in the Farm and so their activities were tracked, and specific staff time spent with them, as well as any expenses, was identified when it was directly related to California specialty crops. Further around 90% of the Farm's crops are California specialty crops, so it is easily identifiable which are specialty crops versus non-specialty crops for tracking purposes.

- Development of Signage and Exhibits featuring California Specialty Crops
  The first phase of signage and exhibit development began by updating all specialty crop bleacher signs located in plant gardens to exhibit the crop. Then enhanced signage was created for Target specialty crops (see Crop Schedules below) which identified the crops as specialty crops and included information such as where the crop grows in California, sales information, and what products/ by-products it gives, when applicable. Additional educational boards throughout the Farm were updated and topics were highlighted such as Locally Grown, Think California Grown, and Super Foods. Signage was maintained throughout the grant term and signage was enhanced each year for the Annual Orange County Fair, as well as for the Youth Expo in the spring. A final signage update was done in the last quarter of the grant to assure the sustainability and relevancy of the signage and the program beyond the term of the grant. All signage created through the grant exclusively featured California specialty crops, therefore tracking for this activity was simple.
- Adjust crop schedules where appropriate to feature California Specialty Crops
  The Centennial Farm gardens currently grow over 100 California specialty crops. For purposes of exhibits and curriculum, the Farm chose to particularly feature the following crops for the duration of the grant:
  - ✓ Summer Crops: Cucumbers, Tomatoes, Peppers, and Squash
  - ✓ Winter Crops: Lettuce, Broccoli, and Carrots

  In addition, the Centennial Farm especially highlighted the following crops throughout the school year. These crops were selected to showcase the region as well as California, and to be the most conducive to the program and the interests of participants:
  - ✓ Radishes – As they grow year-round, they are easy to plant and are fast growing; radishes are featured at the Seed Planting Stations for visiting students to plant and take home to learn how they grow.
  - ✓ Oranges – to highlight the citrus history in Orange County.
  - ✓ Strawberries – as they grow nearly year-round, they can be grow in highly visible areas throughout the farm, and are an easily recognizable fruit (and a favorite) to the students.
  - ✓ Honey/ Bees – In addition to a permanent exhibit Centennial Farm Foundation (CFF) partners with the OC Bee Keepers for volunteers to offer demonstrations, including during the OC Fair.
  - ✓ Roses – Easily grown in several locations throughout the fair, and recognizable to students.
  - ✓ Herb Garden – with rotating featured California Specialty Herbs.

  Far more California specialty crops grow through the Farm gardens, as around 90% of the Farm crops are California specialty crops. The listed crops were highlighted on signage and in curriculum and training, but all visitors to the farm are exposed to the over 100 specialty crops grown on site. As most crops are California specialty crops, the non-specialty crops are easily identifiable. Staff time and any expenses related to planting were tracked based on work done related specifically and directly related to

California specialty crops. All staff and volunteers were thoroughly trained to identify California specialty crops in the garden, both for purposes of educating visitors, as well as for tracking purposes.

- Development of Curriculum for School Tour Programs/ Ranch Afterschool Program
  California specialty crop information was immediately integrated into the standard curriculum for the tours, including information about the featured specialty crops (see Crop Schedules above). The formal curriculum development and review were delayed until the curriculum could be re-aligned with new Common Core education standards, making it more relevant for teachers to take back to their classrooms. At the end of 2013 and the beginning of 2014, qualified staff began the process of formally integrating lessons for the tours, take home materials, the Ranch After-School Program and special events such as the OC Fair.

  An example of a highlighted California specialty crop is the radish seed planting station, where radishes are planted by each child to take home, as they listen to volunteers describe how the plant will grow and talk about the radish in context of being a California specialty crop. Take home educational materials and the website were also updated and are currently being updated again, to maintain relevant information for parents, teachers and others.

  While some broader efforts were made to the curriculum for compliance, this was not related to the grant. However, new lessons were focused on California specialty crops. All staff time was tracked based on time spent directly on California specialty crops. The consultant was hired exclusively to review and consult on integrating the California specialty crops into the curriculum. Volunteers were regularly trained, including field trips to local farms to identify California specialty crops, to understand them and their critical importance in the economy and the community.

- Develop Program Evaluation Tools
  The CFF contracted with a professional program / grant evaluator to work with the Centennial Farm staff and leadership to develop evaluation tools and provide regular reports on program outcomes progress. Initial tools outlined in the Performance Monitoring Plan (PMP) were developed and the following tools / practices were developed, in line with the PMP:
  - ✓ School Participation Records were tracked for overall Farm participation. It was specifically assured that all schools were exposed to the specialty crop curriculum or they were not tracked as participants.
  - ✓ Ranch Afterschool Program Participation was tracked and it was assured that all participants took part in the specialty crop curriculum. Further the curriculum was tracked to see that they did receive the information.
  - ✓ OC Fair Exhibit Participation Records were tracked through the OC Fair surveys which showed that the Centennial Farm is consistently a popular attraction at the OC Fair. Signage assured that all visitors to the gardens were exposed to the key specialty crop lessons.
  - ✓ Curriculum Review - Initial curriculum review was done by qualified internal staff for initial integration. Lessons learned from integration will be used during professional review.
  - ✓ Take-Home Lessons Review - Take-Home Lessons have been reviewed and updated. This includes lessons for self-guided tours during public hours and Discovery Days. These lessons will also be professionally reviewed and adapted prior to the next school year.
  - ✓ Student Surveys proved difficult to manage and collect and so in order to obtain data, group verbal surveys were done during Discovery Days to find out what understanding they each gained and whether they were successfully being exposed to the California specialty crops.
  - ✓ Evaluation Reports were provided to the Centennial Farm Foundation Board at least once a year.

- ✓ Plans for program sustainability are developing, as the initial signage update is complete and new curriculum is now implemented. The program will continue to be available to Farm visitors and California specialty crops will be an important component as the farm looks to add more formal nutrition programming.

As discussed above, the effective tracking began with extensive training of staff and volunteers. Particularly staff learned to understand what was part of the SCBGP-funded program, as well as the identity of the California specialty crops currently growing at the Centennial Farm. Staff tracked their time which was directly related to California specialty crops. Expenses were also tracked to those that tied specifically to California specialty crops. Consultants were hired to work exclusively on outcomes related to the SCBGP project. As the gardens at the Centennial Farm have over 100 California specialty crops which accounts for around 90% of the crops at the Centennial Farm, those that are not specialty crops are easily identifiable both in the curriculum as well as for tracking purposes.

Partners are key to the success of the Centennial Farm Specialty Crop Educational Program, as they offer specialized expertise for the curriculum as well as for the care of the specialty crops. Partners offer an opportunity to enhance program components without hiring individual experts, while avoiding duplication of services and efforts in the community. Partners involved in the Centennial Farm Specialty Crop Educational Program include many related to specific crops or crop groups, while others like the OC Fair and the City of Costa Mesa offer broad support, but that is critical to the success of the specialty crop program. The involvement of partners also provided another opportunity to educate them about California specialty crops and to spread the message of their importance. All activities related to partners were tracked based on those directly related to California specialty crops.

The following is a list of key partners:

- OC Fair & Event Center
- Centennial Farm Foundation
- City of Costa Mesa
- UCCE Master Gardeners
- Newport-Mesa Unified School District
- California Rare Fruit Growers
- Orange County Beekeepers
- Saddleback College Horticulture Dept.
- American Begonia Society
- Mr. Fertilizer
- Cal Poly Pomona, College of Agriculture Education
- California Foundation for Agriculture in the Classroom
- Community Action Partnership of OC, 5-A-Day Power Play Campaign
- ENRECOS (Vermicomposting)
- South Coast Dahlia Society
- Orange County Gourd Society
- Southland Sod Farms
- OC Farm Bureau
- 2nd Harvest Food Bank
- Farm Fresh to You
- Saddleback Valley Bromeliad Society
- Mesa Water District

Goals and Outcomes Achieved

The work plan activities mentioned above enabled the Centennial Farm to implement the program through the following activities directed at achieving the target outcomes of the program:

- The Junior Farmers Tours were offered to classes of kindergarten through 3rd grade. The tours were booked nearly a year in advance and were at near capacity all three years of grant implementation. The tours are guided by a docent for each class who walks the students through the gardens and directly teaches about California specialty crops and their importance. The tours are hands-on, interactive and California state standard-based in order to make the lessons easily translate to the classroom for teachers. Students are able to touch and smell the crops as they learn, and even plant their own specialty crop to take home.

- Discovery Days are similar to the Jr. Farmers Tours except that they are directed at pre-schools, home schools, and some classes that could not participate in the Junior Farmer Tours. The Discovery Days are self-guided, with materials provided to teachers, and docents available at key stations throughout the farm, including areas to talk specifically about California specialty crops. This includes the touch station where students are encouraged to look, touch and smell the California specialty crops.
- The Ranch Afterschool Program is directed at fourth through sixth graders in local schools who participate in the afternoons for a full school year. The Centennial Specialty Crop Educational Program became a critical component as the students were able to learn in more depth about California specialty crops, their importance and the importance of supporting local farming. Additionally students each created and maintained their own garden which primarily focused on California specialty crops, to encourage them to think about where their food comes from, and also to encourage them to consider specialty crop farming in the future.
- The Annual Youth Expo happens in the Spring each year and is an event at the OC Fair and Event Center directed at youth. The Centennial Farm is a critical piece of the programming for the event, and while formal instruction does not take place, docents are stationed throughout the Farm to answer questions, and the signage and exhibits expose another 16,000 children annually to California specialty crops.
- The Annual OC Fair, like the Youth Expo, is an event at the OC Fair and Event Center of which the Centennial Farm is a critical component. Again there is no formal instruction however exhibits, docents and partner exhibits feature California specialty crops and expose over 1 million visitors to their importance.
- While all the activities involve components of the Centennial Farm which are not specifically California specialty crops, through exhibits, identifying the specialty crops in the garden, and trained staff and volunteers, the number of those exposed to lessons directly about California specialty crops can be measured, along with staff time and expense tracking which is tracked so only expenses related to California specialty crops were charged to the grant.

While the Outcome Targets were for the grant term, many of the results will be long-term and will sustain well past the end of the project duration. By integrating the lessons into the curriculum and developing the signage and crop schedules, the program can sustain until future program updates are required. Long term outcomes of impacting the youth in the community and teach about California specialty crops will be reached in years to come.

The following list gives the comparison of actual accomplishments with the goals established for this project:

- OUTCOME 1: TARGET - 100,000 annually (100% of farm visitors) will be exposed to the program. RESULTS – The Centennial Farm has consistently exceeded these numbers through their formal tours and walk-on visitors during the year, with 108,929 visiting the first year, 105,545 the second year and 100,438 the third year.
- OUTCOME 2: TARGETS - 90% of teachers surveyed will indicate improvement. Will collect surveys from 75% or 1,875 of teachers annually. RESULTS – Surveys were performed through an online service with incentives. Consistently well over 90% of the participating teachers rated the program

well and would recommend the program to others. Unfortunately collection rates remained under 20%. Due to the nature of the program being a one-day commitment, and teachers having hectic schedules, the goal of collecting 75% was too high. Consistently the program received feedback such as "My students came back to the classroom with big smiles and a lot of information to share about the farm. I can't wait to continue teaching the students about the farm. They now have a great experience to connect with the content being presented."

- OUTCOME 3: TARGETS - 75% of students surveyed annually (30,000) will indicate learning. Will collect surveys from 40% or 40,000 of students annually. RESULTS – The student surveys from the Jr. Farmers Tours and Discovery Days were problematic as a good system for successfully collecting a significant amount of surveys could not be found due to the full day of activities for them, and their age. Instead focus groups / group interviews were done as the students toured the gardens. They were asked about their experience, if they saw new things and to identify some of the things they saw, which always included California specialty crops. This was not started until the 3rd year, so the collection rates were not realistic for this target either. However those who were interviewed responded positively and consistently identified California specialty crops that they were seeing for the first time, and that they would like to try to eat.
- OUTCOME 4: TARGET - 85% of students in the Ranch Afterschool Program annually will improve their knowledge of specialty crops. RESULTS – In Year 1 a simple survey was done showing that many knew some information about California specialty crops. In Year 2 a full pre-test was given at the beginning of the year, and were also given a post test at the end of their year. These tests showed that there was an 8% improved score from the pre-test. The collection rate for these tests was nearly 100%. Additionally parents were asked to complete surveys about their students' experiences on the Ranch Afterschool Program. Nearly 100% of the parent surveys were returned. 91% of the parents reported that their child's school performance and self-confidence improved from the program. More importantly to the Centennial Farm Specialty Crop Educational Program, 77% of parents reported that their child's eating habits had improved, while 73% said the whole family's eating had improved.

Overall, the target outcome of the program was to expose additional youth to California specialty crops, which was overwhelmingly met. The key activities brought the following to the Centennial Farm and were exposed to the Centennial Farm Specialty Crop Educational Program over the course of the Block Grant term:

- ✓ 110,904 through the Junior Farmers Tours
- ✓ 30,423 through the Discovery Days
- ✓ 171,820 through Farm Walk-ons
- ✓ 51,484 through the Youth Expo
- ✓ 1,033,049 through the OC Fair
- ✓ For a total impact of 1,401,035

The program was a success particularly in the reach it had to young people and the amount of people it touched. The unique signage drew visitors to the information and was a great addition to an already interactive experience.

Beneficiaries

Beyond the youth and visitors that directly visited the Centennial Farm, the beneficiaries include the visitors' peers and families to whom the message is carried about the California specialty crops that were seen and experienced at the Farm. Classes received information back at the school site about the students' experiences. The many partners that work with the Centennial Farm also gained experience and learned about California specialty crops through the program, as did the 1,590 docents that were trained in the curriculum. Overall the Centennial Farm Program had a broad reach even beyond the over a million visitors that directly participated.

A total of 1,401,035 people directly benefited from the project's accomplishments, including visitors, docents and key partners. An exponentially higher number was impacted indirectly by the message being carried on and communicated.

Lessons Learned

The program's greatest efficiency was that it was part of an existing infrastructure with an already existing audience to start, which could be built on. While this meant careful training, planning and tracking to be sure that all Centennial Farm Specialty Crop Educational Program time, expenses and deliverables were kept separate, which still allowed the Centennial Farm to have a huge impact in 3 years. An unfortunate lesson learned was that expectations for teacher and student evaluation tools were set too high at the beginning; therefore results for tracking rates were not met. However, a positive practice that came out of it was the group interviews that were done, which after some development, were successful in gathering outcomes and results.

The exhibits and overall program have inspired many, and the interactive and effective signage helped highlight California specialty crops to a broad audience. This had led CFF to their natural next step which will be exploring nutrition-focused programming which continues to highlight specialty crops and other agriculture, but will be highlighting nutritional benefits of specialty crops more directly including offering cooking classes and recipes.

As the one area not achieved was in the survey and tracking area, the lesson learned was that goals should have been set more realistically. Additionally creative solutions like the group interviews should have been part of the process from the beginning. As this was a new tool with a unique age group, it would have been beneficial starting with many different strategies, and then by the end of the program focus could be prioritized on the most effective methods.

Additional Information

See Attachment 1

USDA Project No.: 5	**Project Title:** A Family Farm Food Safety Outreach Program for CA Specialty Crop Growers	
Grant Recipient: Community Alliance with Family Farmers (CAFF)	**Grant Agreement No.:** SCB11005	**Date Submitted:** December 2014
Recipient Contact: Dave Runsten	**Telephone:** 530-756-8518 x 25	**Email:** dave@caff.org

Project Summary

Ever since the spinach industry was shut down in 2006, concern about food safety in produce has escalated rapidly. The passage in 2010 of the Food Safety Modernization Act has empowered the Food and Drug Administration (FDA) to dictate mandatory food safety measures for these crops in the next few years, and insurance requirements in the marketplace are already leading in this direction. All farmers face some potential risk from pathogenic bacteria, and hence the Community Alliance with Family Farmers (CAFF) believes that every farm needs a food safety plan.

Though large-scale commercial farms have already implemented such food safety practices, this is not the case with many small, organic, biodynamic, diversified, or direct-market farms. In a recent survey of such farms on California's North Coast, fewer than 20 percent had any experience with food safety issues and even fewer had written food safety plans. Since such a plan is increasingly a requirement for participation in commercial markets, these specialty crop farms are at risk of being shut out of markets. As a result, the project purpose was to reach out to the many thousands of farmers who do not have the funds to hire private consultants, do not sell in markets that currently require food safety plans, and require one-on-one assistance to create customized, written, and auditable farm food safety plans.

This project did not build on a previously approved SCBGP project.

Project Approach

CAFF created a food safety program in collaboration with other non-profit organizations and University of California (UC) Cooperative Extension. The project goal was to create written, auditable, farm-specific food safety plans for specialty crop growers. To achieve this goal, CAFF hired a project manager in February 2012. The project manager attended select workshops, webinars and event meetings to stay up-to-date with current information in the specialty crop farming industry and to be able to convey needs and requirements to growers. This information and feedback from workshops was incorporated into the future workshops and food safety plans. In addition, CAFF worked with contractors from UC Davis, UC Berkeley, and Wild Farm Alliance to develop and deliver food safety workshops for growers and professional personnel.

To conduct outreach to specialty crops growers throughout the state, CAFF delivered workshops, developed resources online, and conducted mailings to notify farmers of CAFF's offer to help them develop food safety plans. The food safety manager then followed up with growers to visit the farm, conduct mock audits, and develop customized food safety plans. CAFF worked with several organizations, such as UC Extensions and non-profits, to provide 30 food safety workshops for 817 specialty crop growers around the state (see Attachment A: Food Safety Workshops). Small- and medium-sized farmers were continuously contacted with descriptions of Good Agricultural Practices and encouraged to start a basic food safety program with documentation of their current practices. Online aides such as the website www.onfarmfoodsafety.org and other resources were made available to farmers through the CAFF website and by contacting the food safety manager for further one-on-one assistance. In addition, 4,000 direct market specialty crop farms in California were contacted about developing food safety plans through a targeted mailing. Staff also sent several food safety updates via email throughout the project to thousands of people. As a result, CAFF was able to assist 105 specialty crop growers in developing farm-specific food safety plans.

Activities and grant funds were used solely to enhance the competitiveness of specialty crops. Each grower was asked a number of questions to affirm that they were a specialty crop grower before assistance was extended. All growers assisted during this project were producers of specialty crops. All food safety plans, mock audits, GAP trainings and workshops were provided to growers of specialty crops and focused on customers' interest in on-farm food safety practices. Topics such as animals on the farm were addressed only insofar as they affected specialty crops. CAFF's food safety program (including the website, outreach and resources) has been a vital resource for these farmers to make their farming operations safe with regard to food safety.

Goals and Outcomes Achieved
CAFF surpassed all of the goals and outcomes targeted for this project. Below are the outcomes, associated activities, and results.

Outcome 1: Set up the resource center:
The resource center has been set up online at the CAFF website and in the Watsonville office. Food safety materials collected from government and non-government agencies were made available for reference at the Watsonville office. The materials were developed in cooperation with university, government, produce association, and private auditing sources, including the USDA-FDA-Cornell Produce Safety Alliance. Resources developed include:

- A manual on co-management of food safety and environmental impacts (see Attachment B: A Farmers' Guide to Food Safety and Conservation).
- A binder of food safety outreach materials customized for specific farming groups.
- The CAFF website contains materials and resources for downloading (see http://caff.org/programs/foodsafety/).

Outcome 2: Reach out to a large group of direct-market and other small and medium specialty crop farms (target 5,000):
Staff reached out to specialty crop growers through workshops and email over the two-year period. In the fall of 2013 CAFF mailed letters to 4,000 specialty crop growers in California, a list developed from both the CAFF farmer membership database, as well as listings provided by county Ag Commissioner offices for growers who hold Certified Producer Certificates. In addition, throughout the grant period staff have:

- Emailed the entire contact list (about 10,000 people) about this program
- Emailed a specific list of people who are interested in action alerts/policy about food safety news/regulations (about 2000 people)
- Placed articles/updates in the printed newsletter (sent to about 2000 people).

The response has been tremendous; since the mailing in fall 2013, CAFF has received inquiries from at least 5 growers a day to ask for support in developing their food safety plans.

Outcome 3: Hold a series of workshops for growers and one for Cooperative Extension and other professional personnel (target 200):
CAFF held or collaborated with partner organizations to deliver 30 workshops around the state. Five of these workshops were held to explain the proposed Food Safety Modernization Act rules to specialty crop growers, researchers and Agricultural Commissioners. To enhance the credibility of the program, audit agencies such as the California Department of Food and Agriculture, NSF International, and Primus Lab, encouraged CAFF to provide GAP training and a certificate of attendance. CAFF trainings have been widely accepted by buyers, audit agencies and growers as part of the specialty crop farm food safety program. CAFF worked with several partners to conduct outreach for the workshops. 157 key personnel of Cooperative Extension, food safety auditors and other food safety professionals; 36 produce buyers; and six managers of GAPs were notified of CAFF's program and helped connect them to workshops and food safety planning support. As a result, numbers reached were as follows:

- 817 growers and farm support staff attended food safety workshops.
- 18 UC Extension and county agencies (eg. Environmental Health) attended Train-the-Trainer workshops.
- 51 farm workers were trained in on-farm food safety Good Agriculture Practices (GAPs) and received certificates of attendance.

Outcome 4: Complete at least 50 customized on-farm food safety plans that cover the most important risk factors, such as water, workers, cattle, and land use:
CAFF has worked directly with 182 specialty crop growers regarding food safety (see Attachment C: Food Safety Contacts).

- Answered questions for 77 growers about food safety.
- Developed on-farm food safety plans with 77 growers who previously did not have a food safety plan.
- Worked with 28 growers to develop food safety plans to enable the farms to pass a third-party agency audit.

This project also disseminated on-farm food safety resources and information results through various activities that included:

- Conference call participation with the Produce Safety Alliance regarding food safety issues and train-the-trainer proposed structures.
- Workshops at the EcoFarm Conference regarding food safety; one-on-one consulting with farmers also took place.
- Food safety workshops and face-to-face food safety consulting / resource meetings with farmers were provided at the Small Farm Conference during this two year period.
- Food safety information and resources were posted on the CAFF website.

Beneficiaries
The beneficiaries are (1) small- to medium-scale California specialty crop growers, (2) purchasers of their products, such as consumers and restaurants, as well as (3) potential purchasers whose insurers require food safety plans, such as certain wholesalers, institutions, or stores. Staff estimate that the recently passed food

safety legislation that strengthens FDA authority over specialty crops could potentially affect 48,000 California farms. CAFF particularly targeted diverse farming groups including Latino, Chinese, Hmong, and young, beginning farmers. 182 growers benefitted from CAFF's food safety program directly, and many more continue to receive consultations, attend workshops, and develop customized food safety plans in the subsequent (2014-2015) project period. In addition, 36 produce buyers were contacted to notify them of CAFF's food safety program, allowing them to direct specialty crop growers in need of support to CAFF as a resource so they could become eligible suppliers. It is challenging to collect financial data from growers as they are not willing to share their revenues, so determining direct economic impact from having food safety plans was not a strategy CAFF used in this project. One grower did indicate that he was able to secure $24/box for his product instead of the usual $17/box because of the new food safety plan he had developed with CAFF. As new federal regulations require these plans, the growers who have developed food safety plans with CAFF will be able to maintain or grow their market share. Ultimately, thousands of end users – specialty crop consumers – have benefitted from eating safe products that come from farms with food safety plans in place.

Lessons Learned

The biggest challenge has been in getting the word out to growers prior to the finalization of the Food Safety Modernization Act (FSMA). When CAFF received this grant, staff anticipated that FSMA would be complete during the first quarter of the project, and specialty crop growers would need help in complying with the regulations. However, the comment period for FSMA was open through the duration of the grant. In the meantime, projections of federal regulations, buyer specifications, and consumer demand are driving grower interest in developing food safety plans. When regulations from FSMA are finalized, it will be important for farmers to have the resources, templates, online access, and in-person assistance to be able to create food safety plans that meet the demands of buyers.

All parties and agencies have been very cooperative in answering questions and providing direction wherever possible. Because food safety for many of the growers is a 'new' process/system and buyer requirements vary, time is needed for CAFF to learn the different certifying agency requirements, to create a process to support growers, and to work out the details on the ground. A key recommendation that emerged is that multi-agency collaborations should continue with food safety organizations, farm site visits, and workshops. This multi-stakeholder and on the ground approach is critical to ensuring that farmers get the support they need to meet new regulations. The demand for this program has increased exponentially in recent months after the recent outreach mailing, and CAFF is working to keep up with demand. CAFF plans to hire an additional food safety coordinator to support growers who are asking for more food safety planning support in 2014.

Additional Information

Atachment: A Farmer's Guide to Food Safety and Conservation

Specialty crop growers have provided many testimonials regarding CAFF's food safety program:

"As an entrepreneur/farmer, the thought of putting together such an extensive document that will pass an audit is a daunting thought. Especially when one is not exactly sure exactly what is needed or expected to avoid failure. To have Cathy with all of her experience, knowledge, and organization in this subject walk me through, provide the correct documentation, formats, logs, and procedures etc.

and get my FSP [food safety plan] started has saved me countless hours of researching, correcting mistakes, and organizing (which no doubt would not be as effectively organized as it is now) has relieved a HUGE stress on me."

- Jed Davis, Aqua Gardens Family Farm (Mendocino County)

"I attended a class on Food Safety hosted by CAFF, presented by Cathy Carlson outlining all the new rules and safety practices on November 4, 2013. At the meeting, it was stated that Ms. Carlson would be made available to farmers to ask further questions or to use to help develop a farm safety manual for individual farmers. What a wonderful service!! I called Ms. Carlson; set up a consultation; and on a specific day we went through a complete process of evaluating our small farm's practices in regards to water, soil, hygiene, surfaces, domestic and wild animals on our farm. After the meeting, within a day or so, she sent me the completed documents via email for me to print out. And I received in the mail a binder of information, labels and follow-up information for me to place all my completed safety plan documents into it and to make it a working, fluid, food safety continuing plan. She is so efficient and helpful, I would have been lost as to what to do to protect our farm; and convert the new legislation into our daily practices, without her advisement and help. I thank CAFF for providing this - one on one - help to small farmers.

- Paula Carli, Windmill Farm (Gridley, CA)

USDA Project No.: 6	Project Title: Food Safety Manager Certificate Program for California Strawberry Farms	
Grant Recipient: California Strawberry Commission	**Grant Agreement No.:** SCB11006	**Date Submitted:** December 2014
Recipient Contact: Annika Forester	**Telephone:** (805) 290-0280	**Email:** aforester@calstrawberry.org

Project Summary

Given the priority of keeping California strawberries safe for consumers all over the world, and given that no other formal training program had been developed specific to strawberry production, in 2008 the California Strawberry Commission (CSC) set out to provide a uniform food safety training program to serve as standard for all California strawberry growers. By 2010 the CSC Food Safety Training Program consisted of 3 classes, attended by employees from approximately 85% of California strawberry growing companies.

The purpose of this project was to further develop the CSC's widely popular food safety program into a more comprehensive 5-class Food Safety Certificate Program. The achievement of the CSC Food Safety Certificate (FSC) would signify that the holder had participated in all 5 classes and demonstrated a minimum standard of knowledge each topic area. The Food Safety Certificate would represent a significant achievement for the individual, as well as an assurance to employers, shippers, 3rd party auditors, and buyers that farming companies employed trained and knowledgeable people to manage food safety practices, decisions and documentation on strawberry ranches.

In 2010, when this proposal was submitted, apart from the existing three CSC food safety classes, no other strawberry-specific food safety training was available, and few strawberry growing companies had the resources to develop their own. At the same time, increasing customer demand for ever more demanding 3rd party audits, drove industry investment towards ensuring that all farms pass this annual pass/fail "test", largely focused on the preparation and presentation of written procedures and documentation. To ensure farming companies passed audits, a new category of middle manager emerged within shipping companies, dedicated, sometimes exclusively, to managing the paperwork demands of audit compliance. To balance this audit-focused effort, the CSC recognized that influencing the food safety culture on the ranch would require developing people on ranches, rather than those in offices. The CSC Food Safety Certificate was created to develop and recognize field-based leaders to focus on the daily best practices of all field personnel in order to reduce contamination potential at the ranch.

This project does not build upon a previously funded SCBGP project.

Project Approach

The proposal focused on tasks and activities in three general areas, each summarized below:

Area 1: Development and Delivery of Classes

As mentioned above, three classes had already been developed prior to, and two additional classes were developed during the grant cycle. All classes, plus assessment exams to accompany them, were delivered repeatedly in each of the four main strawberry growing districts in California: Santa Ana, Oxnard, Santa

Maria, and Watsonville. A participant who attended all five classes and passed all exams would earn the CSC Food Safety Certificate. A summary of each class' results and conclusions follows:

Class 1: Introduction to Food Safety (developed prior to grant cycle)
1385 participants attended in Santa Ana, Oxnard, Santa Maria and Watsonville, 762 of whom passed exam at one of 29 sessions delivered.

Class 2: Teaching Food Safety (developed prior to grant cycle)
1305 participants attended in Santa Ana, Oxnard, Santa Maria and Watsonville, 783 of whom passed exam at one of 22 sessions offered.

Class 3: Food Safety for Processing Harvest (developed prior to grant cycle)
979 participants attended in Santa Ana, Oxnard, Santa Maria and Watsonville, of whom 684 passed exam at one of 16 sessions offered.

Class 4: Tracking Food Safety (developed and launched 11/2011)
910 participants attended in Santa Ana, Oxnard, Santa Maria and Watsonville, of whom 689 passed exam at one of 15 sessions offered.

Class 5: Implementing Food Safety (developed and launched 11/2012)
893 participants attended in Santa Ana, Oxnard, Santa Maria and Watsonville, of whom 637 passed exam at one of 14 sessions delivered.

Class 6: Food Safety Update (developed and launched in late 2011)
1089 participants attended in Santa Ana, Oxnard, Santa Maria and Watsonville. As this class was not required for achievement of the FSC, there was no associated exam.

The project, overall, delivered value to the strawberry industry as evidenced by high attendance in all classes. Also, the introduction of the Food Safety Certificate as a new level of recognition was well received by participants and well regarded by their employers. Minor curriculum improvements to increase engagement and retention, to remove barriers to attendance, and to reduce the total number of hours required to complete all 5 classes will be made in the future.

Area 2: Develop and implement technology solutions to facilitate registration, tracking and performance of Food Safety Certificate Program participants

In November of 2011, the website was launched though which CSC staff and strawberry farming company representatives could register and track participant performance. The intent was to consolidate all meeting registration and participant information in this website (from the various methods used previously i.e. phone, email, fax, mail) and this was achieved from 2013 forward. However, due to budget constraints, not all desired website functions were developed, and many "bug fixes" were needed, once launched. While CSC administrative staff were able to use the website (through administrative, or "back end" access) it did not prove user-friendly enough to entice all, or even a majority of companies to use it independently or successfully. Regarding the website, it was concluded that the website never fully met the CSC's need to simplify processes and reporting. Considering the challenges faced by all users and the web developer's service and rates, a decision was made to abandon the system mid-season in 2014. Recommendations to try a new approach to provide a more effective and functional system will be discussed in the Lessons Learned section below.

In November 2011, a participant ID card system was implemented in Santa Ana, Oxnard, Santa Maria and Watsonville, to facilitate sign-in and record keeping processes during training events. Once in use, it was discovered that the target audience's characteristics made it difficult for the CSC registration and tracking processes to benefit from this system. Some of these characteristics included up to 30% "no-show" of participants enrolled (for whom cards had been printed), up to 30% "walk-in" participants (with no card printed), and about 50% of those who had received a card at a previous training event lost or forgot them at subsequent events. Given these challenges, it was decided was to abandon this system during the 2014 training season. A new method will be developed to achieve the same goals that is not card-dependent, and this will be discussed further in the Lessons Learned section below.

Area 3: Recognize individuals that achieve the FSC, their employers, and the shipping companies for whom they produce.

The CSC awarded a total of 352 Food Safety Certificates in Santa Ana, Oxnard, Santa Maria and Watsonville during the grant cycle (156 in 2013, and another 196 in 2014). Certificate holders worked for 85 different strawberry growing companies (56 in 2013, and 29 more in 2014). These results were reported to the individuals that earned the FSCs, their employers, and the shippers they supplied in 2013. Reporting for 2014 results are now in process.

The total number of certificates achieved was well below goals established in the project proposal. Many factors contributed to this. With overall exam pass rates averaging around 80%, the exam itself did not seem to be a barrier to certificate completion. The main cause, in conclusion, was inconsistent attendance. That is, many attended three or four classes, and yet lacked one or two more to achieve the certificate. Another factor may have been poor follow-through on the 5th class "take-home" exam. To pass the exam participants needed to meet with their employer for a conversation about what they learned and how to apply it at work, followed by the employer signing a form and returning it to the CSC. This class had the lowest pass rate (74%), and it may be presumed that participants lost focus or were otherwise unable to follow through. The root causes of both of these phenomena may be related to lack of grower understanding or commitment to having employees attend all of the classes, or to support them in completing the take-home exam. Additionally, it was discovered through shipper surveys, that few shippers were providing a directive to their growers to achieve the FSC. A more complete discussion of barriers to FSC achievement will continue in the sections on Goals and Lessons Learned.

Participation in the FSC program was limited to verified companies that produced strawberries.

No project partners collaborated outside of CSC staff.

Goals and Outcomes Achieved

As described above, all the classes were developed and delivered as proposed, or with minor modifications described in prior reports. Ninety-six class sessions (averaging 60 people per session) were offered during the grant cycle, with 1925 individuals, representing 186 companies, initially registered to attend at least one class.

352 individuals earned the FSC by attending and passing all 5 classes and their respective exams. These certificate holders represented 85 different farming companies.

As described above, both the registration website and the participant ID card system were created and implemented, as proposed, within the grant cycle.

Finally, all results of class and exam participation were reported to participants, growers, and shippers in 2013, and 2014 training season results are being reported now.

Long term outcome measures were not proposed, therefore not reported here.

Certificate Achievement
Despite overall high attendance at all classes, and high pass rates of all exams, within the project cycle only 14% of farming companies had employees that earned the FSC, far less than the proposed goal of 85%. Likewise, only a small minority of shippers affirmed that they require their strawberry-farming companies to have at least one employee with the FSC. Again, this is far less than the 85% target in the project proposal.

Consistent high attendance across all classes indicates strong interest in and support for the Food Safety training program within the California strawberry industry. The low certificate completion may be symptomatic of a range of issues, some subject to influence with potential for improvement, others not fully understood yet. Further discussion of this is in the Lessons Learned section below.

Technology Solutions for registration and tracking
Both the registration website and the ID card system were developed and implemented according to the proposal. However, attempted use during two training seasons only led to increasing frustration and eventual abandonment of both systems.

Problems with the website included design issues, lack of sufficient testing, lack of documentation, expensive support, failure to process data easily, and inability to provide meaningful data, frequent processing failures or other system errors. While CSC staff learned how to mitigate some of these challenges through trail and error or tedious workarounds, end users did not. The goal of having all users self-enter all participant data was never achieved.

Likewise, with the Participant ID card reader system, unanticipated challenges hampered full utilization of this technology. Some of these challenges included: up to 30% “no-show” (participants enrolled for whom cards had been printed, yet never attended), 30% “walk-in” (unanticipated participants who needed one printed), and 50% of those successfully issued cards lost or forgot them. These issues made printing cards entirely inefficient, and there was a high-rate of cards printed that got wasted, and an even higher rate of cards that needed to be printed or re-printed on-site (a loud and time consuming process). In the end, the sheer number of participant without cards forced us to revert to traditional paper and pencil sign in methods. In the end, printing cards became an extra effort that did not increase administrative productivity.

In the area of individual/company FSC achievement, this project made significant progress towards achieving the set target. Actual progress was 14%, while the goal was to have 85% of companies with at least one employee achieve the FSC during the project cycle. Nonetheless, the rate of certificate achievement grew by

132% from 2013 to 2014 (156 in 2013, and 192 more in 2014), and this indicates potential to continue to grow as the FSC program is promoted to farming companies and shippers.

The additional target of having 85% of shipping companies require the FSC for their strawberry growers was more difficult to meet. In fact, shipper survey efforts indicate while there is broad support for, and enthusiastic encouragement for growers to send employees to the FSC program, none of the major shippers have yet to *require* the FSC. A very small number (n <5) of the smallest grower-shipper operations did, however. This will be discussed in the Lessons Learned section.

Despite abandoning both technology solutions developed as proposed for this project, what was learned in the process was highly valuable and will enable development of a more effective system for the future. In this sense, progress was made towards the goal of developing on-line registration, and despite the setbacks, given what was learned, a more robust and effective system will be in place for future training seasons.

The major successful outcomes of this project include the development of a more comprehensive food safety training program consisting of 5, rather than only 3 classes. Also, high overall attendance (1595 total participants) in these classes is a positive outcome. High exam pass rates, averaging 80%, were another positive outcome. Steady progress was made towards increasing FSC achievement: 2014 showed a 132% increase in FSC achievement over the first year. For those who achieved the FSC, the significance of this achievement was meaningful: 2013 award ceremonies were happy and emotional events where whole families and the community celebrated the proud accomplishment of these individuals.

Beneficiaries

The strawberry industry was the primary beneficiary of this project because strawberry field employees attended the food safety classes, and many earned Food Safety Certificates. The shippers, suppliers, and all the distributors and consumers of California strawberries worldwide also benefitted from these efforts. Regardless of falling short of original targets, grower feedback told us that the individuals who attended the FSC programs during the grant cycle returned to their workplaces more conscientious and more empowered to follow the best food safety practices or correct risky situations they might encounter. In this respect, this project has resulted in a net positive for all those indicated above. Since the inception of the FSC no food borne illness outbreaks have been associated with California strawberries, and this is a benefit to the entire economy of the regions in which strawberries are grown in California.

The 1,595 participants, representing 186 companies, attended the food safety program during the grant cycle. In addition, 392 participants earned the Food Safety Certificates, which benefitted the 85 companies they represent.

Indirect beneficiaries include the many shippers, retailers, and consumers of strawberries grown by the companies above, where participation in training may contribute to reduced risk of food borne illness originating on these farms.

No direct positive financial impact can be inferred as a result of this project. However, the participation in this program may contribute to the avoidance of catastrophic damage to the California strawberry industry that would be associated with a food borne illness originating in California strawberries.

Lessons Learned

Unexpected outcomes that were an effect of implementing this program include the development of closer relationships with "Participant Coordinators", or those individuals within farming companies who coordinate training for their employees. Historically all CSC training programs have drawn high attendance, but until now little outreach was provided beyond simply announcing classes via print and email. With the interest in driving FSC achievement, close interaction was needed with Participant Coordinators in order to help them understand the importance of selective enrollment for those individuals who were lacking specific classes. These interactions permitted CSC staff more access to learn about how farming companies manage food safety, and this has allowed improved refinement and adaption of the program content to be more valuable to them. Through building these relationships, better promotion of other classes offered in other content areas (supervisor development, irrigation management), and better listening to strawberry growers' training needs was achieved.

In the original workplan a 6th class was proposed to be part of the FSC. However, early in the program development phase, it was decided that 5 classes were sufficient to cover specific food safety related-training that would comprise the required portion of the Certificate. It was decided that the 6th class would better serve as an update class, to address emerging issues that merited communication to our target audience, yet which could not be defined in a static curriculum. This decision would permit flexibility in the content of Class 6 to better meet ongoing learning needs, as well as to serve as a continuing education opportunity for those who had earned the FSC. In 2011 and 2012, a 6th class, billed as a "Food Safety Update", was offered in Santa Ana, Oxnard, Santa Maria and Watsonville. The focus of these sessions included updates around a recent outbreak of E. coli in strawberries in Oregon, as well as developments related to the Food Safety Modernization Act. In 2014, with no significant emerging issues, yet with a growing population of FSC holders, it was decided to turn the focus of the 6th class to leadership and innovation, and to limit it to only FSC holders. Due to the heavy turnover within the CSC in the 2013/2014 season, as well as on-going challenges with the registration system, this class was not delivered. It is currently calendared for delivery in the 2014/2015 season. The focus of this class will be to develop leadership and innovation skills among FSC holders, to more effectively supervise and take action to prevent contamination on the ranches where participant work.

Regarding FSC achievement, in hindsight, perhaps the 85% goal was unrealistic to achieve in only 2 training seasons. The target of 85% was chosen based on baseline data that approximately 85% of all CA strawberry farming companies had sent at least 1 employee to at least 1 of the 3 classes available up to that point. The challenge that requiring one person to attend ALL 5 classes, given the organizational culture of most farming companies, was not adequately considered. While farming companies are well accustomed to sending employees to compulsory training events, they do not typically have employee development programs consisting of a sequence of required classes. Without an employee development culture, most strawberry farming companies aren't adept at sending people selectively to specific classes. Instead, the "buckshot" method prevails: growers make decisions about who goes to training often at the last minute, and often in a landscape of volatile circumstances, such as the changing weather, staffing, or market demands.

Regarding technology, it was learned that rather than a website, a more specialized Learning Management System is what was really needed to manage registration, attendance, and performance. Given the characteristics of the audience (highly transient participants, somewhat transient growing companies, and transient relationships between growing companies and shippers), a more robust and flexible solution than what was created under the grant was needed. To address this, just after the end of the grant cycle, a Learning Systems Specialist was hired to create more sustainable solutions in this area, as well as to develop future on-line learning options.

Regarding the ID Card system, it was realized that this was a poor fit for the target audience. It was just hard for this population to retain the cards they were given for various reasons. Given the organizational culture of many farming companies, participants may not know until arriving at work that they will be attending training that day. Since food safety training happens during a short window of time every year, it is unlikely that they carry the ID card every day to work with them. Without advance notice, they are not likely to have it handy. Many others just lose their cards. Also, there is high turnover in the target audience population. With a few more years of participant tracking it may become easier characterize, but a significant percentage of participants that attend one year are never seen again. Similarly, there is a steady influx of new participants every year. Finally, again, given the organizational culture of farming companies, even when participants are pre-enrolled and a card is printed for them, up to 30% may not show up on the day of class. In the end, time required to manage an ID card system to be used only a few days a year is not a good fit for this context. With the help of the Learning Systems Support Specialist a card-free solution has already been conceived that will be implemented in the next training year.

Regarding the expectation to have 85% of farming companies have at least one employee achieve the FSC within the grant period, perhaps this was an unrealistic expectation as well. While many factors may have depressed overall FSC achievement numbers, the most significant was the inability of many participants to consistently attend all 5 classes. This is largely limited by the farming organizations where employee development culture is, for the most part, in its infancy. While farming businesses are used to sending employees, often en masse, to required compliance training, they are not accustomed to sending people selectively to training opportunities that require multiple days of attendance, much less where tests or "homework" are required.

Other barriers certainly included the participants' ability to pass written tests. Again, the target audience was mostly focused between crew leader and ranch manager level. This population, in general, was privileged with an average of 5-7 years of formal schooling in Mexico. Many participants were wholly unfamiliar with the multiple-choice test format. Despite all program promotion materials including explicit reading and writing skill requirements (participants must be able to speak, read, and write in Spanish), still plenty of companies sent employees who had severely limited reading skills. Again, this is largely attributed to the fact that few farming companies have job profiles or systems in place to screen employee literacy skills in the first place. It is not uncommon for some farm employees to have 20 or 30 years of successful tenure with an employer, to contribute to their company's success, yet still not be able to read. While pass rates for all tests was around 80% (of those who took the test), there were many who avoided taking tests at all, perhaps for fear of failure due to limited reading skills. The pattern that emerged across all multiple choice exams was not a typical bell curve. Rather, those who did not meet the 80% cut-off required for passing, typically 'failed hard'. In other words, the approximately 20% that scored below the passing threshold, tended to score well below, not even close to passing. From this, it may be inferred that participants had challenges far greater than not knowing the correct answer. It may be that they were functionally illiterate and were attempting to take the test anyway.

Limited literacy skills of farm field employees has long been a concern of the California Strawberry Commission's Grower Education team. With the exception of the FSC multiple choice exams, all classes were intentionally designed with the success and learning of all participants in mind, regardless of literacy level. The most advanced adult learning methods were utilized, stimulating group learning, interaction, generative learning, peer-to-peer teaching and so forth. Despite literacy limitations, all participants who attend FSC classes leave having learned a lot, and more importantly, with the knowledge, skills, attitudes and aspiration to improve food safety practices back at the farm. The exams were developed as an assurance or evidence that participants demonstrate a minimum level of knowledge about food safety. In hindsight, it may be concluded that the exams contribute little to participants' learning, and predict less about their capacity to think critically in a real-life situations, to make decisions, to direct others, or otherwise take actions to prevent contamination of strawberries on the farm. Given these concerns, the plan is to re-examine the role of the multiple-choice exam in the FSC program for the next training season. We will incorporate more authentic assessment opportunities into course design, as well as group assessments that permit all participants to learn while moving through assessment activities together.

Regarding the goal of having 85% of shippers require their growers to have an employee achieve the FSC, again, this too may have been an unrealistic goal. While shippers uniformly and enthusiastically support the FSC program, it is unlikely that major shippers will ever make the FSC a requirement for their growers. This is due to various factors that were not considered completely before setting this target. First, the largest shippers, and many of the medium ones, are all now in the business of supplying "the berry patch", including strawberries, raspberries, blackberries, and blueberries. Only some of the smallest shippers sell strawberries, exclusively. Among these larger shippers, many have established multi-person departments dedicated to managing food safety, most with staff in each growing district. Their concern extends beyond managing food safety in strawberries only, to managing food safety for all crops, In addition to this, each shipper must institute procedures and meet the audit specifications defined by each of their respective customers. All have developed their own approach to doing this, including many that have created mandatory "training" programs for their growers. In this environment, it is unlikely that any shipper will add additional requirements to only their strawberry growers, such as requiring only strawberry employees earn the FSC.

What was learned through the experience of implementing this project has contributed tremendously to the level of excellence and execution of the CSC food safety program and all CSC training programs. At the cost of great effort and determination, the CSC food safety program was expanded and improved, field supervisors gained new knowledge, skills and confidence and earned greater recognition for their learning and effort. Most importantly, a population of food safety leaders has been cultivated that will continue to strive to improve food safety conditions on their ranches now and into the future. Despite the significant set backs faced, this program will continue, and continue to improve. The CSC's outreach efforts with growing and shipping companies will continue, and CSC will continue to improve the value and impact of the learning programs offered.

Additional Information

None.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 07	**Project Title:** California Avocado Grower GAP Education Series	
Grant Recipient: California Avocado Commission	**Grant Agreement No.:** SCB11007	**Date Submitted:** December 2014
Recipient Contact: April Aymami	**Telephone:** (949) 341-1955	**Email:** aaymami@avocado.org

Project Summary

The purpose of the California Avocado Grower, Good Agriculture Practices (GAP) Education Series was to increase grower awareness of the food-safety practices outlined in the California Avocado Industry GAP Program, developed by the California Avocado Commission (CAC), and to facilitate grower compliance with GAP audits that may be required. Providing a safe, healthy product for consumers is the industry's highest priority. As food-safety requirements from governmental agencies, such as the Food Safety Modernization Act (FSMA), and customers continue increasing, grower education and compliance are essential. By providing a high level of training on GAP compliance, this project will help reduce the risk of a food-safety emergency related to avocados, which could be economically devastating to producers and local economies. Retailers and consumers will benefit by having avocados that could be sold and enjoyed with a sense of confidence.

Project Approach

Over the course of the last three years CAC has completed the following activities:

(1) Development of GAP educational series curriculum – Using the CAC-GAP manual as a guide, CAC developed seminar curriculum which highlighted not only the "why" GAP is important, but "how" a grower could become certified. Over the course of the grant period, the curriculum was revised based on the current status of GAP certification and requirements (based on evolution of the FSMA) with the seminars each year staying up-to-date on the current and most applicable information.

(2) Conduct seminars with simultaneous Spanish translation – CAC held GAP Educational seminars in 2012, 2013 and 2014. The two-hour seminars were held in three geographic locations (San Diego County, Ventura County and San Luis Obispo County) for a total of nine seminars over the grant period. Through these seminars CAC was able to reach over 700 avocado industry stakeholders, representing nearly 74 percent of California's avocado acreage. Simultaneous Spanish translation was provided at each of the nine seminars. In addition to the GAP seminars, CAC held four Good Harvesting Practices (GHP) educational seminars during this period to educate harvesters on the CAC-GHP program.

(3) Development of web-based grower GAP educational series – Using the materials created for the GAP manual and seminar curriculum, a web-based educational series was completed in May 2014. While originally thought to be a high priority in this project, Google analytics and grower surveys indicated that the California avocado industry did not utilize online and web-based tools as much as initially thought, and so focus was placed on the development of physical educational materials such as Quick-Start Guide, Self-Assessment and GAP/GHP Manual. Since the web-based program's launch on June 1, 2014 twelve individuals have accessed the training system, with only five of those finishing it through to completion.

(4) Development of train-the-trainer curriculum – Upon review of the GAP Educational seminar curriculum, CAC management determined that a separate "train the trainer" curriculum was not necessary and would potentially cause confusion. Therefore CAC requested that handler field representatives attend the 2013 Educational seminars and then a separate field rep. training was conducted immediately afterwards to

provide them with CAC's GAP Educational seminar curriculum (on a flash drive) as well as Quick-Start Guides and GAP Manuals to use when educating growers on CAC's GAP program.

In addition to the Work Plan activities listed above, CAC performed a major overhaul of the GAP/GHP manual early in the project and redesigned the "look and feel" of the manual to make it more visually appealing and organized, and developed a Quick-Start Guide and Quick-Start Self-Assessment as supplemental educational pieces. CAC's Quick-Start Guide, developed by Broadhead, and was awarded first place for Customer Brochures, Catalogs and Farmer Directed-Single at the Regional Best of National Agri-Marketing Association (NAMA) Competition for Region 1, 2012. In addition, CAC's overall Food Safety Education Program won a merit award for Customer Brochures and Catalogs at the NAMA National Competition, 2013.

As indicated in the original project proposal and scope of work, collaboration with the California Avocado Society (CAS) and avocado industry handlers was vital to the success of this project. The CAS assisted greatly in promoting the importance of the CAC-GAP program and certification through their weekly email and print newsletters as well as inviting CAC's Director, Issues Management (DIM) to present at seminars and annual meetings. The avocado industry handlers have continually promoted the importance of GAP to their growers by advertising CAC's GAP Education Seminars in their grower newsletters as well as attending special CAC handler training seminars on the CAC-GAP program. In addition, handlers encouraged their harvesting crews to attend the CAC Good Harvesting Practice (GHP) workshops held over the past three years. Promotion of these events, and support by these organizations, was a key importance to the outstanding attendance at all of the CAC GAP and GHP Educational workshops.

Goals and Outcomes Achieved

The primary goal of this project was to educate two-thirds of California avocado acreage on the CAC-GAP program. Through completion of a redesigned GAP/GHP manual and supplemental educational material (available in both English and Spanish), nine educational seminars, train-the-trainer education, and a web-based educational series, CAC was successfully able to educate nearly 74 percent of the avocado acreage, with roughly 40 percent of the acreage currently GAP certified. While it was originally envisioned that CAC would be capable of both educating two-thirds of the acreage and having that acreage achieve GAP compliance, throughout the course of the project it seems the second objective of GAP compliance is more of a long term goal, however the industry is well along the way with 40 percent currently GAP certified.

The goal for the California Avocado Grower GAP Education Series was to have two-thirds of the avocado acreage educated on CAC's GAP program and achieve GAP compliance. At the end of the three year grant period nearly 74 percent of the acreage attended a GAP Educational seminar, surpassing the goal by 7 percent, and 40 percent of the acreage was GAP certified, short of the goal, but a significant move in the right direction. To reiterate, a sign-in sheets at all GAP Educational seminars indicate an attendance that represented nearly 74 percent of the state's avocado acreage. Reports from USDA and other third-party auditing firms confirm roughly 40 percent of the avocado acreage as GAP certified.

With the GAP Educational seminars reaching over 700 growers, representing 74 percent of the industry, GAP's are a priority with nearly all of California's avocado growers. While the industry is not 100 percent

GAP certified, avocado growers understand the importance of delivering a product that is safe for the consumer and therefore, taking the steps towards achieving certification.

Beneficiaries

By educating California avocado growers on the importance of food safety and encouraging and promoting GAP audits, this project impacts every step along the food chain from farm to fork. Growers educated in food safety provide handlers, retailers, food-service operators and consumers a product that is safe to eat, while insuring the integrity of the California avocado brand. California currently has approximately 5,000 growers across 57,000 acres, and this project has helped greatly in educating the majority of those growers in the importance of food safety and GAP certification. Going beyond the immediate California industry, avocado consumption is expected to exceed 1.8 billion pounds in 2014, and so a food safety incident, whether originating from CA or another country of origin, it could have a detrimental impact on all suppliers of fresh avocados, retail/foodservice customers and consumers which confirms the many reasons of importance for this project.

Lessons Learned

The number one lesson learned is that while this project provided information, resources and opportunity to avocado growers, the project team cannot force the growers/handlers to fully participate. While the original project goal of two-thirds of the industry educated, and GAP certified was a great goal to aim towards, the project fell short on the certification component. In the end, the project team realized that while it is fairly easy to present information to the growers, the team cannot force the growers to take action in their groves. However, the progress made toward the certification goal was significant, and it would seem having an aggressive goal to begin with gave CAC extra incentive to be creative in coming up with ideas that encouraged certification, such as the additional educational materials, and the GAP Incentive Rebate program. With regard to the certification goal, the one thing CAC could have done differently would have been to not include actual GAP certification as a goal for the project at all, as the Commission has no control on actual GAP acreage certification. While, the initial goal could have been set lower, the project team believes that would have been a disservice to the avocado industry. The Commission's goal for the industry was, and still is, to have a majority of the acreage GAP certified. The only way to meet that goal is to have growers get GAP certified, and the Commission has done everything possible (short of revising legislation to make GAP certification mandatory) to educate, incentivize and encourage growers to become GAP certified, however at the end of the day, the decision is the growers' to make.

In the initial project proposal it was thought that the web component of this project would be extremely valuable and used throughout the industry. However, through a set of stakeholder focus group, held in conjunction with CAC's redesigned website project, it was discovered that many of the growers did not utilize online tools and were not as interested in web-tools as they were in hard copy publications and materials. Subsequently, the priority of the web-based component of this project was reduced and instead CAC focused on development of additional hard copy educational materials to supplement the GAP/GHP manuals.

Additional Information

Below are links to the GAP/GHP educational materials that were created utilizing grant funds. A hard copy of the materials is available in a single binder and can be mailed upon request.

GAP Resources

- Quick Start Guide
- Quick Start Self Assessment
- GAP Manual (Fillable PDF)
- GAP Checklist (Fillable PDF)
- GAP Forms (Fillable PDF)
- Buenas Practicas Agricolas Lista de Verificacion (Rellenable PDF)
- Manual de Buenas Practicas Agricolas (Rellenable PDF)
- Formularios y Registros (Rellenable PDF)
- GAP Workshop Presentation

GHP Resources

- GHP Pre- Audit Checklist (Fillable PDF)
- GHP Manual (Fillable PDF)
- GHP Buenas Practicas de Cosecha Lista de Verificacion (Rellenable PDF)
- GHP Manual de Buenas Practicas de Cosecha (Rellenable PDF)
- GHP Workshop Presentation
- Presentacion Del Taller GHP

Food Safety Self-Assessment Course

- http://www.californiaavocadogrowers.com/gap-food-safety/story.html

USDA Project No.: 8	Project Title: Consumer Education: California Country Television Program	
Grant Recipient: California Bountiful Foundation	**Grant Agreement No:** SCB11008	**Date Submitted:** December 2013
Recipient Contact: Dave Kranz Tracy Sellers	**Telephone:** (916) 561-5550 (916) 561-5550	**Email:** dkranz@cfbf.com tsellers@cfbf.com

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

Many Californians do not understand or appreciate the variety of specialty crops grown in the state. This is especially true in large metropolitan areas, where people may be less connected to their food sources. To help establish and solidify that connection, the California Country television program profiles farmers, marketers, chefs and other people involved in growing and enjoying California-grown food. [The title of the program was changed to California Bountiful in December 2011; the new title will be used throughout the remainder of this report.] Aired each week on a network of stations, the program has been produced as a public service since 1997. The California Farm Bureau Federation, on behalf of the California Bountiful Foundation, produces the program and distributes it to television markets.

The purpose of the project was to buy airtime for programs that focused exclusively on specialty crops and to enhance the audience for the program by purchasing airtime in Los Angeles and San Francisco, two markets where the program has been largely unavailable.

At a time of concern about food deserts in metropolitan areas, and about nutrition and obesity throughout the state and nation, it is important to provide Californians with information about the variety, healthfulness and availability of California-grown specialty crops. Such information is more readily accepted when presented in an entertaining, fast-paced format, which describes the approach taken by the California Bountiful television program.

The program creates goodwill for California specialty crop farmers and encourages viewers to seek out California-grown foods. Expanding its outreach into the state's largest television markets provided the opportunity to present that information to a larger audience.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

During October-December 2011, a Media Planner researched available airtimes and rates on television stations in target markets. In December, the California Farm Bureau Federation (CFBF) agreed to air the program beginning January 2012 on: KCAL, Los Angeles, Saturdays 4 p.m.; KRON, San Francisco, Fridays 11 a.m.; KUSI, San Diego, Saturdays 11 a.m.; KXTV, Sacramento, Fridays 11:30 a.m.; KSBW, Monterey/Salinas, Fridays 12:30 p.m. In January 2012, CFBF distributed news releases announcing the debut of the program on three new stations: KCAL, KRON and KUSI.

During calendar year 2012, California Bountiful produced 15 television programs that focused exclusively on specialty crops. Credits at the end of each specialty crop-only program included the acknowledgement, "Supported in part by a specialty crop grant administered by the California Department of Food and Agriculture." Each of those programs aired twice, for a total of 30 airings made possible by grant funds. In addition, CFBF, as part of its matching funds, purchased airtime for four exclusive specialty crop programs. The remaining 16 airings of California Bountiful during 2012 featured non-specialty crops, although specialty crops were also featured in each program. Time for those programs was purchased by CFBF.

Based on Nielsen ratings data supplied by the affiliate stations, the 30 specialty crop-only programs supported by grant funds reached a total audience of 1,612,584. The average weekly audience was 53,753. The four additional specialty crop programs aired during 2012, with airtime paid by CFBF, reached a total audience of 224,045 and an average weekly audience of 56,011.

Lower-than-anticipated airtime rates during 2012 allowed the program to air in Los Angeles for all 50 weeks, rather than the 29 weeks that had originally been planned. In addition, the lower airtime rates allowed purchase of airtime for four specialty crop-only programs that aired during January-March 2013. CFBF provided matching funds to support the four programs. The total audience for those four programs equaled 251,274; the weekly audience averaged 62,819.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

The Project Manager developed a schedule of programs for calendar year 2012 that featured 15 programs devoted entirely to specialty crops, with each program to be aired twice. Those programs were produced during the year and aired as scheduled. The Project Manager and Project Director worked to assure that grant money for airtime was directed only to the exclusive specialty crop programs. In addition, the schedule included programs featuring both specialty crops and non-specialty crops, with airtime for those programs paid by CFBF.

The Project Manager oversaw production of each weekly program and worked with the affiliate stations to produce promotional messages that appeared on air and on station websites. In addition, the Project Manager, who also serves as the program host, made special guest appearances on affiliated stations to promote the California Bountiful program and to demonstrate ways for consumers to use specialty crops. For example, during a guest appearance on the San Diego station's morning news program, the Project Manager discussed the value of California-grown tree fruit. During two guest appearances on a midday program broadcast by the Sacramento affiliate, the Project Manager described ways to shop for and use tree fruit and pears.

The Media Planner collected overnight ratings data in the four markets for which it is available (Los Angeles, San Francisco, San Diego and Sacramento), and worked with the Project Director and Project Manager to analyze the data and use it to evaluate viewership patterns and to coordinate with stations to increase viewership.

The Web Specialist collected and analyzed data for the California Bountiful website and social media channels.

The goal of the project was introduce urban and suburban residents to family farmers, educate consumers about production of California specialty crops and inform consumers about the importance of sustaining family farms in the state. Specifically by purchasing airtime in Los Angeles and expanding to year-round air dates in San Francisco, the project sought to extend the reach of the program to audiences that had not previously had access to it.

Based on Nielsen ratings data provided by the stations, the 30 specialty crop-only programs broadcast during 2012 reached a total audience of 419,253 in Los Angeles and 290,017 in San Francisco; the average weekly audience was 13,975 in Los Angeles and 9,667 in San Francisco. During the extended project dates during January-March 2013, the four specialty crop programs reached a total audience of 67,861 in Los Angeles and 30,445 in San Francisco; the average weekly audience was 16,965 in Los Angeles and 7,611 in San Francisco. Total audience for the 34 specialty crop programs aired in Los Angeles during the project period was 487,114; in San Francisco, total audience was 320,462.

Traffic to the California Bountiful website and social media channels was also used to help gauge the program's reach. [The California Bountiful website and social media sites also incorporate content from *California Bountiful* magazine.] During calendar year 2012, unique visitors to the California Bountiful website increased 37 percent; total visits increased 36 percent; and page views increased 50 percent. Analysis of the "visits" statistic by location showed website visits from Los Angeles rising 86 percent and those from San Francisco increasing 35 percent during 2012. The average reach of a post on the California Bountiful Facebook page rose from 200 to an average of 800 during 2012. The trends of increased traffic for both the website and Facebook page continued during the first quarter of 2013.

Additionally, data from this report will be used to establish baseline data for the succeeding 2012 Specialty Crop Block Grant Project 7.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

The project benefited California specialty crop farmers by expanding the audience for an informative, entertaining television program that introduced urban and suburban residents to family farmers and encouraged viewers to seek out California-grown foods. The project benefited viewers—and particularly urban and suburban viewers—by showing the variety of California-grown specialty crops, introducing diverse people who grow and market those crops, and providing viewers with recipes and other serving suggestions.

Farmers frequently discuss the need to reach out to the non-farm public and help those residents understand where their food comes from and how it moves from the farm to their table. During the course of this project, that information reached more than 1.86 million viewers on the 30 specialty crop programs aired during 2012 plus the four specialty crop programs aired during January-March 2013. In addition, the California Bountiful television program airs on two-dozen California broadcast and cable channels for which audience information is not collected, plus the national RFD-TV satellite service, where thousands of additional viewers watch the program each week.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

The main problem encountered during this project involved collection of consistent, comparable viewership data for each of the affiliate stations. The Project Director, Project Manager and Media Planner have acted on the basis of the data available, both to gauge viewership patterns and, where necessary, seek different time slots for the program. As project staff gained more experience working with the various affiliates, the data became more readily available.
Because of shifting program schedules on some affiliate stations, it has been difficult to maintain a constant air date and time for California Bountiful, which would help an audience find it on a consistent basis. Project staff has learned to work closely with the affiliates to keep ahead of schedule changes, so that the viewing audience can be alerted to changes via the California Bountiful website and social media.

Viewership levels on the San Francisco affiliate have lagged behind those for comparable stations in Los Angeles and San Diego. Because of the expense of air time in the San Francisco market, alternatives are limited, but the Media Planner has continued to seek ways to expand the audience there. In ongoing efforts to maximize viewership, the Media Planner arranged for different time slots in both Los Angeles and Sacramento. On the other hand, viewership on the San Diego affiliate was larger than anticipated, based on audience levels for a previous affiliate in that market.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

None.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 9	**Project Title:** A Guide to Promoting Asian Specialty Produce	
Grant Recipient: Fresno Economic Opportunities Commission	**Grant Agreement No.:** SCB11009	**Date Submitted:** December 2013
Recipient Contact: Jensen Vang	**Telephone:** (559) 263-1583	**Email:** jensen.vang@fresnoeoc.org

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

This project developed a *Guide to Promoting Asian Specialty Produce (Guide)* (Attachment 1), which lists vegetables and other specialty crops commonly grown in different Asian regions. The *Guide* codified names for each product, and provided recipes for distribution to growers, inspectors, and consumers statewide.

Since 2007 there has been a 57% increase in the number of Asian farmers producing Asian specialty crops sold statewide. Misunderstandings over the various names of the Asian specialty crops resulted in fines to producers. A resource identifying the names of Asian specialty crops presented in a consistent, accurate manner that is understood by both regulators and producers was essential to eliminating those misunderstandings and the resultant fines.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

The following activities were performed:

- Announced the project to partners and producers.
- Interviewed and visited producers.
- Developed a master file with information on Asian specialty vegetable photos, recipes, and other references.
- Contracted and worked with a graphics firm.
- Finalized the *Guide.*
- Printed and distributed the *Guide* to 70 partners and growers locally and statewide.
- Gathered outcomes and feedback from growers and partners.

After the *Guide* was developed and 5,000 copies printed, it was was distributed to local and statewide growers, inspectors, and consumers. Although most copies were distributed, a small number are in stock for interested individuals or groups.

The following people contributed to the *Guide* by writing, reviewing, editing, or providing photographs and farm expertise, and without their contributions, this *Guide* would not have been possible.

- Contributing Farmers
  - Tzexa Lee, Cherta Farms, Dewolf Ave and American Ave, Del Rey, CA
  - Tou Teng Thao, GT Florist, Elm Ave and Central Ave, Fresno, CA
  - Xia Thao Vang, Vaj Produce, Kings Canyon and Academy, Sanger, CA
  - Cha Lee Xiong, Cha Lee's Farm, North Ave and Del Rey Ave, Del Rey, CA
- Contributing Chef
  - Vimolluck (Oot) Tiyaamornwong, Chef, Food Services, Fresno Economic Opportunities Commission, Fresno, CA
- Contributing Partners
  - Lalo Acevedo, Retired, Small Farmer Advocate, Fresno, CA
  - Zoua Her, Hmong Interpreter, Fresno, CA
  - Richard Molinar, Farm Advisor, UC Cooperative Extension, Fresno, CA
  - Dr. Toulu Thao, Senior Management Analyst, U.S. Department of Housing & Urban Development, Fresno, CA
  - Sally Tripp, Area Specialist, Rural Development, U.S. Department of Agriculture, Fresno, CA
  - Michael Yang, Hmong Agricultural Assistant, UC Cooperative Extension, Fresno, CA
- Contributing Authors and Editors
  - Blong Lee, Manager, Fresno Community Development Financial Institution, Fresno, CA
  - Jennifer Sowerwine, Research Associate, UC Berkeley, Berkeley, CA
  - Jensen Vang, Food Systems Development Manager, Fresno Economic Opportunities Commission, Fresno, CA
  - Sam Vang, Soil Conservationist, USDA Natural Resources Conservation Service, Fresno, CA
  - Planning and Resource Development Office, Fresno Economic Opportunities Commission
    - Sally Gomez, Grant Writer, Fresno, CA
    - Rebecca Miller, Grant Writer, Fresno, CA
- Graphic Design
  - Yang Design, Fresno, CA
- Fresno Economic Opportunities Commission Communications Office:
  - Nasreen Riahizadeh, Media and Public Relations Specialist, Fresno, CA
  - Sareen Bedoyan, Marketing and Communications Coordinator, Fresno, CA
- Fresno Economic Opportunities Commission leadership team:
  - Juan Homer Leija, Board Chair
  - Brian Angus, Chief Executive Officer
  - Paul Mclain-Lugowski, Planning and Resource Development Office
  - Lynne Jones, Strategy and Communications Officer
  - Gary Joseph, Food Services/Transit Director

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Activities completed for the project were:

- Designed the *Guide* development process, which provided four steps to developing the *Guide* to final production.
- Requested bids and executed agreements for graphic services.
- Created and implemented work plans with graphic firm.
- Created four mock-ups of the *Guide* for final approval.
- Edited and revised the *Guide.*
- Promoted and distributed samples of the *Guide*.
- Hired an Asian specialty produce chef to conduct food taste sampling.
- Finalized research and data to close out the last *Guide* development phase.
- Created a partners list (locally and statewide) to distribute the *Guide*.
- Collected and conducted interviews and obtained feedback from the growers and partners for outcome results.

The project printed 5,000 copies of the *Guide*, instead of 3,588 copies, as originally proposed.

The *Guide* received positive feedbacks from inspectors, partners, and producers who received the *Guide.*

The project received positive feedback from all producers and regulators about the content of the *Guide* (list of vegetables, description of vegetables, other commonly known names for each type of vegetables, pictures) and the value of the manual. The feedback was used to complete the final version of the *Guide.*

Project baseline data was gathered by phone, face-to-face, emails, word of mouth, and referrals, which showed the project's progress towards meetings its set targets.

No regulatory violations relating to the naming of produce have occurred from the point when a draft *Guide* was distributed in April 2013 (over 6 months).

Within the *Guide*, the section "also known as" relates to the project and outcome: "no regulatory violations relating to the naming of produce." This is because each season, by CDFA rules, the SE Asian certified farmers' market producers (Hmong, Laos, Pilipino, Chinese, Thai, etc.) are required to register what they grow during their registration process. The names of their vegetables are then listed in their Certified Producers Certificate (CPC) which is used in all California counties the producers are doing business in.

There are many types (different ethnic background with different spoken languages) of SE Asian producers around California. The producers will typically list the vegetable they grow based on their ethnic familiarity. For instance, a Chinese farmer in Orange County would name "bok choy" in Chinese on his/her certificate and in the Agriculture Commissioner's office in Orange County. However, the exact same commodity would be named as "zaub ntsuag dawb" by a Hmong farmer in Fresno County and in the Fresno County Agricultural Commissioner's office.

The CDFA rules for naming what is grown by producers creates a misunderstanding between producers and other county agriculture inspectors. Asian crops are not standardized with the naming of the products for a consistent, accurate manner within all farmers markets, to be understood by regulators and producers alike.

FEOC anticipated a minimum 5% annual growth in production and sales of Asian specialty products each of the five years following distribution of the Guide. This data was captured informally. Staff couldn't get SE Asian farmers permission for FEOC to release any business information from their farms as it is confidential.
An example of the informal data collection: it was estimated that SE Asian farmers were making around $130 per market day. After the Guide distribution, the farmers claimed that their sales went from $130 to $150 per day and sold five bundles/units more vegetables than usual. The same customers that bought the farmers' vegetables also bought other items which on average increased their sales by $20 per day.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

Over 70 groups and other related entities benefited from the completion of this project. Specifically, the growers of Asian specialty crops benefited from the elimination of fines related to the naming of Asian specialty crops. See Attachment 1: Distribution List of Project Beneficiaries for more details.

5,000 copies of the *Guide* impacted growers, government agencies, consumers, and other sectors that had little or no knowledge of Asian Specialty Produce. See Attachment 1.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

- SE Asian producers, the primary beneficiaries of the project, had little or limited resources and information to complete such a project.

- The project relied heavily on graphic designing and editing. Recipe sampling was not part of the original proposal, but became a highly useful gauge of the value of the project.
- Due to design and printing complications the project timeline was extended multiple times. It is recommended that delays be built into the timeline for a project like this.
- For future projects that include data collection, project staff should make sure that the data they propose to collect isn't considered sensitive or confidential. In addition, grant applicants should do some form of a pre-survey to assess their ability to collect specific data prior to stating goals and expected outcomes.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

See attached.

USDA Project No.: 10	Project Title: Delivering best practices and sensory training to benefit California olive growers and processors	
Grant Recipient: The Regents of the University of California, Davis, Olive Center	**Grant Agreement No.:** SCB11010	**Date Submitted:** December 2014
Recipient Contact: Dan Flynn	**Telephone:** (530) 752-5170	**Email:** jdflynn@ucdavis.edu

Project Summary

The specific issue that this project addressed is a collective 'knowledge deficit' related to the growing, processing, and evaluation of olives: (1) olive growers and processors often are not aware of 'best practices' that improve production efficiency, (2) retailers and food service professionals are unaware of qualitative differences between California and imported table olives and olive oil, and (3) training for USDA inspectors, who regulate the quality of table olives and olive oil imported into the United States, does not address olive oil quality standards adopted by USDA in 2010.

The proposal's objectives were to: (1) help olive growers and olive oil processors increase production efficiency by adopting modern, cost-effective 'best practices' developed through agricultural research, (2) stimulate food-industry demand for California olive products by demonstrating that the products exceed grade standard requirements, and (3) assist USDA with enforcement of U.S. quality standards to assess new olive oil standards.

The proposal is important because California olive growers and processors are producing top-quality products yet are suffering loss of market share to subsidized and substandard imported products. The proposal is timely because: (1) an industry-wide strategic planning process led by the UC Davis Olive Center in 2010 found that addressing the 'knowledge deficit' was a top priority for industry stakeholders, (2) several UC Davis studies have found that imported olive products are of substandard quality, and (3) USDA adopted new olive oil standards in 2010, which made it necessary to update USDA inspectors with sensory training.

This project was not built on a previously funded SCBGP project.

Project Approach

The Work Plan specifies the following:

1. **Contact stakeholders/resources in CA for input (UCD, UCCE, COC, COOC, growers, distributors, retailers, etc.)**
   The project director worked with stakeholders in shaping the Best Practices material that the project director developed. The project director also sought peer-review of the draft material from UC Davis experts, and revised the material according to feedback provided through peer-review.
2. **Review UC and non-UC literature for digitizing and review, annotate and organize UC literature.**
   The project director worked with the key librarian at the campus to digitize the pertinent literature. The project director worked with volunteer and clerical staff in developing the searchable database of digitized UC literature. The project director determined that non-UC literature on the topic was so vast that instead the project team provided a search engine for Google Scholar.

3. **Post digitized UC literature to UC Davis Olive Center and UC Fruit and Nut Information Center websites.**
   The project director worked with the campus webmaster to post the digitized UC literature to the UC Davis Olive Center website: http://www.olivecenter.ucdavis.edu/research/publications. The project director determined that the database would not be suitable for the UC Fruit and Nut Research Information Center website because of its enlarged format, and that a simple link from the UC Fruit and Nut Research Information Center to the UC Davis Olive Center website would be sufficient.
4. **Develop food-service information and distribute at two events with the Culinary Institute of America and the National Association of the Specialty Food Trade.**
   The project director exceeded this component of the work plan by developing food-service information that included presentations and printed material at five events for the Culinary Institute of America, four events for the National Association of the Specialty Food Trade, four events with major national media, and one event at the Chef's Culinary Conference.
5. **Meet with task force for review and advice on five occasions.**
   The project director found that it was difficult to organize the task force for meetings as a group so he worked individually with task force members for review and advice on more than five occasions.
6. **Create clear, concise descriptions of best practices in orchard management, processing, etc. with links to additional information.**
   The project director spent more than one year developing clear, concise descriptions of best practices with links to additional information.
7. **Post Best Practices material to website and get material printed.**
   The project director worked with the campus webmaster to post Best Practices material in several sections in early 2014. Finalized material can be found here: http://www.olivecenter.ucdavis.edu/learn/best-practices
8. **Distribute and present Best Practices material at six industry events.**
   The project director's completion of Best Practices material in early 2014 limited the presentation of Best Practices material to four short courses and symposia in 2014. The Olive Center presented the Best Practices material at the California Olive Oil Council meeting in 2014. The project director has asked that the largest industry publication consider doing a story on the resource. At this time, the story has not yet been published because the material on the website needs to be refined and that must be completed before publicizing more widely. Still, the material has increased by 300-fold the amount of people receiving information on olives from UC Davis.
9. **Provide Best Practices sensory training material to USDA inspectors and invite for sensory training sessions.**
   The project director secured the services of a contractor to provide sensory training to USDA inspectors in charge of olive oil enforcement in the Fresno, California USDA office. In addition, training to USDA inspectors in ripe olive sensory analysis will continue after the project duration as other funding has been secured for that purpose.
10. **Present Best Practices material at six UC Davis Olive Center symposia and short courses.**
    The project director's completion of Best Practices material in early 2014 limited the presentation of Best Practices material to three short courses and symposia in 2014: short course at UC Davis (May), online short course (June), and food media symposia (March). The material will be presented at future UC Davis short courses and symposia.

11. **Survey millers and web page hits to assess penetration and effectiveness of Best Practices.**
The project director has delayed the survey until 2015 due to the delay in posting Best Practices on the website. The project director consulted with the campus webmaster on the number of visits the Best Practices material and digitized publications have received and determined that the website was receiving an average of 402 page hits per day, well exceeding the performance measure of about 250 additional page visits per year.

The project solely benefited olives.

The Musco Family Olive Company, Bell-Carter Foods, and the Olive Growers of California all supported providing the project director and contractor with $20,000 to augment the SCBGP grant for sensory training of USDA inspectors. The California Olive Oil Council provided opportunities for the project team to convey results of the project to the membership and directors of the council. The Corto Olive Company provided advice to the project director. California Olive Ranch provided opportunities to meet with food professionals and media. The Culinary Institute of America provided opportunities for the project director to present Best Practices information to food professionals.

Goals and Outcomes Achieved

There were three measurable outcomes identified in the proposal:

- **Improving production efficiency by five percent**
This performance measure was achieved, based on direct reports from processors who have received best practices information indicating to the project director that this information has helped increase their oil production yield by 5 to 10 percent. At least 90 percent of California's production volume (based on attendance at Olive Center courses and symposia) has benefited from the best practices provided by UC Davis, and last year the California olive oil sector achieved its highest yields and total production. The three main tasks aimed at achieving this measurable outcome were developing Best Practices, providing Best Practices at short courses and symposia, and making available key university publications digitally through a searchable database. The project director spent more than one year gathering and concisely preparing Best Practices information gleaned from core publications. The contractor selected to prepare the Best Practices was unable to accept the contract, and another could not be secured. As a result, the completion of this portion of the grant was delayed beyond the project duration. The project director also oversaw the development of a searchable database of digitized publications, which included meeting with a librarian on several occasions and overseeing the work of a volunteer. Due to the delay in posting Best Practices information this measurable outcome will be further studied as the material gains distribution, and completed outside of the project duration.
- **Increase by 50 percent the number of growers and processors who receive educational material online from UC Davis.**
This performance measure was achieved and greatly surpassed. The number of growers and processors receiving educational material has increased 300-fold in 2014 from the 2011 figures. This measure is based on the number of page hits that the Fruit and Nut Research Information Center website received on its olive pages at the start of the project, with the benchmark level set at the number of page hits in 2011, with a target of 50 percent above that number for 2014. The Fruit and Nut Research Information Center olive pages had 454 page hits in 2011. The UC Davis Olive Center website, with the addition of the Best Practices information and searchable database of digitized UC

olive publications, has had 29,011 page hits in the past 72 days alone (ending August 11, 2014), which is an average of 402 per day, which would lead to an annual total of 147,069 page hits.

The project director discussed the availability of the Best Practices data with industry stakeholders, had a surrogate present information about Best Practices at the 2014 annual meeting of the California Olive Oil Council, oversaw the redesign of the Olive Center website to accommodate the Best Practices information and searchable publication database, and presented Best Practices information at various short courses, meetings and symposia.

- **Increase from zero to 50 the number of food service professionals who receive (in 2012 and 2013) Best Practices material through the UC Davis Olive Center.**
  The project director exceeded this goal by 600 percent, reaching an annual average of 350 food professionals in 2012, 2013 and 2014. The project director let partners know of the director's interest in reaching more food professionals, and the partners made opportunities available. The project director incorporated the Best Practices material in presentations that reached an annual average of 350 food professionals in 2012, 2013, and 2014. In 2012 the project director developed food-service information that included presentations and printed material for the Culinary Institute of America at a day-long symposium, for high-volume foodservice providers at a campus visit, food professionals at the Winter Fancy Food Show, the largest foodservice distributor at a campus visit, and buyers and category managers at one of the nation's largest supermarket chains (540 people total). In 2013 the project director distributed Best Practices material at the Winter Fancy Food Show, made a presentation to high-volume foodservice providers for the Culinary Institute of America, made a presentation to the Northern California Dietitians Association, and made a presentation to the Chef's Culinary Conference (410 people total). In 2014 the project director distributed printed information at the winter and summer Fancy Food Shows (100 people total).

The following activities were also to be completed during the performance period:

- **Post final section of Best Practices material, and photos, to the Olive Center website.**
  The section concerns "Management of Olive Orchards." The project director had submitted the section for peer review, but there were delays in obtaining a response from a key peer reviewer due to the reviewer's schedule. Comments were received and the project director is in the process of refining the content accordingly. Once finalized, this section, with photos, will be placed on the website.
- **Provide Best Practices material to USDA officials and schedule a training session for USDA officials.**
  The project director met with USDA officials in June 2014 to provide them with Best Practices material. The project director met with contractor who received funding from ripe olive federal marketing order to help her organize training sessions in California with USDA officials. The project director also presented the training to USDA officials in October 2014 at USDA headquarters.
- **Survey web page hits to assess penetration and effectiveness of Best Practices.**
  The project director consulted with the campus webmaster on the number of visits the Best Practices material and digitized publications have received and determined that the website was receiving an average of 402 page hits per day, well exceeding the performance measure of about 250 additional page visits per year.
- **Present Best Practices material at major UC Davis Olive Center short courses.**
  The project director presented the material at major events in May and June 2014.

The project achieved the following major successful outcomes for the objectives identified in the project proposal:

- **Help olive growers and olive oil processors increase production efficiency by adopting modern, cost-effective 'best practices' developed through agricultural research.**
  The project advanced this objective by providing 158 UC Davis research publications on olive growing and processing free online for the first time, providing for free online Best Practices information that will help olive growers and processors increase quality and production efficiency and increasing by 300-fold the number of persons receiving educational material online from UC Davis.
- **Stimulate food-industry demand for California olive products by demonstrating that the products exceed grade standard requirements.**
  The project achieved this objective by increasing from zero to 350 the number of food service professionals who annually receive Best Practices material. The reputation of California olive oil has been enhanced nationally during the project period as indicated by California olive oil receiving a premium over the international commodity price and the favorable media coverage for California olive oil.
- **Assist USDA with enforcement of U.S. quality standards to assess new olive oil standards.**
  The project achieved this objective by providing expert training to USDA inspectors, whose proficiency was evaluated by professional sensory software.

Beneficiaries

The following groups benefitted from the completion of this project's accomplishments:

- Olive growers, large and small, hand-harvest and mechanical harvest.
- Olive processors, including the four largest in table olives and olive oil, as well as dozens of smaller olive oil processors.
- Retail buyers, which include importers, category managers, wholesale buyers and distributors.
- Food service professionals, which include chefs, wholesale buyers and distributors.
- USDA inspectors who evaluate quality, particularly with imported product.

The following beneficiaries were directly affected by the project's accomplishments:

- Up to 1,500 olive grower and processor beneficiaries, who now have access to Best Practices information and digitized olive publications, providing valuable information to improve quality and production efficiency.
- At least 1,050 food professional beneficiaries, which include chefs, retail buyers, importers, category managers, wholesale buyers and distributors who are working in retail, restaurants, and high-volume food service who better understand quality, how to safely store and display olive products, and how to ensure that the products meet USDA standards.
- At least 20 USDA inspector beneficiaries, who received expert training on olive oil sensory analysis through this project and who will be receiving similar annual training in the future.

Lessons Learned

LESSON #1: The project took more commitment from the project director than anticipated. The project director had to take on more workload than anticipated when a contractor declined to accept the contract. This development delayed implementation of the work plan.

LESSON #2: The project spurred higher outcomes than anticipated. The project director was motivated to initiate a searchable database for digitized articles and a redesign of the Olive Center website, both of which led to work plan delays but ultimately increased the value of the project.

An unexpected outcome of reaching more than 15 million consumers through providing Best Practices through major media outlets was significant. The project spurred the project leader to define Best Practices for consumers to augment the Best Practices for growers, processors and food professionals.

The goal of increasing production by five percent was not achieved during the time frame of the project, although the project leader believes that subsequent surveys will verify this outcome at a minimum. A lesson learned is that such an outcome measure, which was anticipated would require gathering three years of prior production data, assumes too much of the processor to produce that data and respond to a survey that would be time-consuming to administer.

Additional Information

To give a sense for what some olive processors think about the impact of the project, here are some unsolicited comments the UC Davis Olive Center received:

“My purpose in sending this note is to let you know that the work your group has been doing has begun to have a tremendous beneficial impact upon the level of customer awareness concerning the issue of olive oil quality. During my selling efforts at farmer's markets I have been amazed at how many people have become aware of the issues you have brought to the forefront. You are definitely having a positive impact in the marketplace...”

“After many years in the Farmer’s Market, the UC Davis Olive Center along with NPR are the most often referenced entities when olive oil is discussed. No other organizations are ever mentioned.”

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 11	**Project Title:** Expand Specialty Crops education and outreach in the schools and community.	
Grant Recipient: San Benito County Ag in the Classroom	**Grant Agreement No.:** SCB11011	**Date Submitted:** December 2014
Recipient Contact: Mindy Sotelo	**Telephone:** (831) 637-7643	**Email:** sbcfb@garlic.com

Project Summary

Agriculture makes up much of the history and culture of San Benito County. There is a great need in San Benito County for people, young and old, to know which foods are available and the growing process of these foods, particularly focusing on California specialty crops. With a population of 55,058, more than half are of Hispanic or Latin origin, which compromise the majority of the farming organization in the San Benito County. One important need that this project addressed is the education of community with focus on the importance of eating fresh fruits and vegetables that are part of specialty crops, and informing the public about the seasonal availability of these crops.

San Benito County has an obesity rate of 22.9% and an adult diabetes rate of 6.6%. By promoting specialty crops through exposure and awareness, positive effects have been noted in the people that consume these foods. Thousands of people will continue to see the crop signs that are posted monthly for the public to view, and be educated as to what specialty crops are growing in the County.

This project does not build on a previously funded SCBGP project.

Project Approach

San Benito Ag in the Classroom worked with educators and growers to offer a monthly “Harvest of the Month” program in local schools. Each month during the school year, a different crop that was in season was featured. Some of the crops featured were: Radishes, asparagus, peppers, Fuji apples, pomegranates, butternut squash, carrots, walnuts, kale and raspberries. The classes were provided with a teacher informational packet, take-home color sheet for each child that included: Nutritional facts, recipe ideas, how the crop is grown, a specialty crop farmer biography and harvesting information. Classrooms were supplied with enough produce for every child to have a taste test of the featured specialty crop. For many children, this was their first time being exposed to a particular specialty crop. For example, the month that walnuts were featured, a teacher in one of the classes asked, “How many have never tried a walnut before?” Six children raised their hands. Out of a class of 28 children, that is 21% of children that were newly exposed to walnuts. It was also observed that although some children and adults were previously exposed to a particular specialty crop, they were still able to learn more. Children and adults were able to better understand the harvest process of specialty crops: Amount of time it takes to grow, how it grows, how it is cared for, and why there is a price variance for different crops. There was a newfound appreciation for the care and work that goes into growing and harvesting California’s specialty crops. Once the consumers become more educated on the different specialty crops, it would lead to a better understanding of price variance and encourage consumers to try different seasonal specialty crops. This program was extremely popular and continued to grow throughout the duration of the grant. In the beginning of the project, there were 60 classes, and towards the end of the project time, there were 109 classes, reaching 3,422 children every month with an additional 10,000 family members being reached monthly through the take-home materials given in classrooms. The students that were impacted were ranging from preschool to high school, and also included migrant students and special needs students. One rural school featured the program in their lunch program, which resulted in reaching 550-750 students monthly. (See Attachment 1)

Another accomplishment was building three school gardens. The initial goal was to build two school gardens, but with the growing popularity of the program, three gardens were successfully established. Project team went through a garden application process to ensure that every school was given the opportunity to apply. One of the criteria was having someone available for future maintenance of the garden once the grant term expired, this would ensure sustainability of the gardens once the grant term expires. With the change to school common core state standards, there is a lot more ways to incorporate hands-on work in the garden. The first school chosen was RO Hardin Elementary School, which is a Pre-K through 5th grade school with 805 students. Approximately 75% of the school population is on free or reduced lunch assistance program. The lead teacher has reported that 200 children will continue to use the garden weekly at this school. The extra crops produced from this school garden are used by the kids and families. The second school that received a garden was a rural school called Tres Pinos Elementary School which is an 8th grade school consisting of 133 students. The third school was Rancho San Justo middle school which is a 6th to 8th grade school consisting of 854 students. (See Attachment 2)

The final task completed during this grant period was the development and installation of 10 crop signs around the County. Local artist and growers created custom specialty crop signs; each sign featured a different crop and the farmer that grew that crop. Several of the signs were interchangeable, depending on what was growing in the field at the time. For example, when spinach was being featured during the month, the same sign was utilized later on for cilantro and tomatoes. (See Attachment 3)
The idea of this project was to create awareness within the local community about what is grown here, what it looks like, what seasonality means, and creating an appreciation for agriculture. The signs are placed on major roadways in the County and are seen by approximately 25,000 people daily. During the 4th of July weekend, the community had a motorcycle rally, and an additional 100,000 people had seen the crop signs.

This project solely focused on specialty crops, eliminating the potential to benefit non-specialty crops.

The major significant contributor to this grant was the San Benito County Farm Bureau. Also, the staff helped with logistics, hosted meetings with growers, and offered support of resources including office equipment, office supplies and administrative support. The other project partners were the growers that supported the program and supplied this project with additional knowledge on specialty crops, as well as supported the "Harvest of the Month" program and were willing to feature the crop signs on their properties. The relationships and collaboration with the growers and teachers exceeded the initial expectations. Both were incredibly supportive of the project and the future success of agriculture in San Benito County.

Goals and Outcomes Achieved

Ten crop signs were designed, painted and installed. People around the community were spreading the word and talking about the specialty crop signs and agriculture. It was also observed that commuters pulled over to the side of the road to take pictures of the specialty crop signs. The initial measurable outcome for the "Harvest of the Month" program was to take place in 60 classrooms. The goal was exceeded by almost double; "Harvest of the Month" was in 109 classrooms throughout the County. The "Harvest of the Month" event featured different specialty crops every month during the school year. There was also a take-home

packet about the featured crop of the month that included the farmer and nutritional value of the crop. At the end of the project program, a survey was given to all of the children and the teachers. Many children reported that they were more open to trying new fruits and vegetables and were asking their parents to buy more of the featured crops at the stores. This showed that the more comfortable and knowledgeable children were with the crop, the more likely they would ask their parents to buy and prepare it at home. One of the children reported that every time he went to Subway for a sandwich, he asked for extra spinach on his sandwich. The teachers reported that they liked the program and would love to continue with it in the future.
The last measurable outcome identified and completed was building the three school gardens; there has not been a chance to fully evaluate this outcome because it was done towards the end of the grant cycle. All three schools that were chosen to receive the gardens were overjoyed, and reported that they could not wait to utilize the gardens in the 2014/2015 school year.

The long term outcome measures are the crop signs that were designed and installed featuring a monthly specialty crop and the farmer that grew those crops. The goal was community exposure, which will lead to more consumption of specialty crops. Furthermore, providing the children an opportunity to grow food in school gardens, taste the specialty crops, and identify what is being grown in the County increases awareness of specialty crops and empowers children to make healthy nutritional choices.

There was no baseline data at the beginning of this grant. “Harvest of the Month” program grew from 60 classrooms to over 109 classrooms by the end of the grant term. The number of children that were impacted by this program grew from about 1000 to over 3000, on average each month. All of the schools that participated in the program expressed desire to participate again with increased number of participants at each school. Over 1800 children now have a school garden where they will be able to maintain and grow specialty crops. Furthermore, with the addition of 10 crop signs in the community, over 25,000 people are reminded daily of the various specialty crops being grown around their community.

Three major successful outcomes of this project are: 85% of the schools in San Benito County were participating in the “Harvest of the Month” program. Over 3500 children every month were given the opportunity to taste a fresh specialty crop grown locally, and learn about the farmers growing it. The entire County benefited from the crop signs around the County; it has contributed to increased awareness and appreciation for the specialty crops grown in the area.

Beneficiaries

300 specialty crop growers in the county benefited from this project. Through crop identification, seeing the monthly featured signs of what is growing locally, and providing a taste in the classroom has led to increased exposure and awareness to specialty crops purchased locally. The information that was sent home monthly helped provide awareness and a better understanding of how the crops grow and the value of the crops. Children enjoyed the tasting sessions and obtained a better understanding of the nutritional value of these foods. In the future, the chances that more specialty crops will be purchased are higher because children were exposed to locally grown specialty crops through this program.

Number of beneficiaries affected: Over 3500 children monthly, 10,000 family members through take home information sheets, 25,000 daily drivers and passengers around the county that see the crop signs, and over 1800 children utilizing the 3 new school gardens.

Lessons Learned

The relationship between Ag in the Classroom, growers and teachers was a very important part of the success of this project. Making contact with local educators for “Harvest of the Month” opened the door for an ongoing relationship associated with local agriculture. Schools and educators are now requesting information about Agriculture and having presenters in their classrooms to talk about Agriculture. They are also seeking help and ideas for future lesson plans. Farmers are doing presentations at schools and have commented that people came up to them in the community and thanked them for their work. Agriculture information is being disseminated and utilized more frequently. There is an increased visibility in the community that has broadened the outreach beyond the schools. San Benito County Ag in the Classroom was asked to partner with the County library and participate with many other venues, like our County Fair featuring a “Wheel Barrow” garden contest. This grant has opened up huge opportunities to bring Ag education to a diverse group of populations within San Benito County.

A lesson learned through this project was finding ways to network and build relationships for a more effective program outcome. One of the issues encountered was communication with teachers, which was a challenge in the beginning. The most challenging part was building a relationship with teachers on the level of being able to easily relay required information. The Director of Curriculum at the County Office of Education helped improve some of the communication issues with the teachers, but the more effective method proved to be finding one teacher in each school who embraced the project and became the “Lead Harvest of the Month Coordinator” for his/her particular school. The daily contact and personal relationship with the Lead Coordinators proved to be the most effective and efficient way to develop the program.

This project has allowed San Benito County Ag in the Classroom opportunities to educate the community about specialty crops far beyond initial expectations. The consumer response to Ag education has been amazingly supportive. Groups and organizations that previously have not shown interest to Ag Education are now fostering understanding and openness to this program, and this was an unexpected outcome.

One goal that was not achieved was signage in local grocery stores. Although the produce managers were supportive of the program and featuring a local grower and specialty crop that coincided with the featured crop at schools, there were corporate regulations that prevented the signage at grocery stores to take effect. Determining the requirements ahead of time would have provided more time to make necessary changes.

Additional Information

Attachment 1: Flyer providing the “Harvest of the Month” event information
Attcahment 2: Photo of a school garden
Attachment 3: Example of a specialty crop sign posted for public to view in San Benito County

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 12	Project Title: Ag In Motion	
Grant Recipient: National Ag Science Center	**Grant Agreement No.:** SCB11012	**Date Submitted:** December 2014
Recipient Contact: Michele Laverty	**Telephone:** (209) 521-2902	**Email:** michele@agsciencecenter.org

Project Summary

As the population becomes more urbanized and removed from life on the farm, students do not understand the connection between farming and the food they eat. Simultaneously, schools are decreasing the number of science minutes taught, making it harder to understand the science that helps put food on their tables. Ag In Motion brought agriculture-related science to every seventh grader in Stanislaus County and beyond. Students performed agriculture-related science experiments, explored how specialty crops are grown, and learned how light and bugs affect production. At the end of the visit from Ag In Motion, students understood where specialty crops came from and how pests and other factors impact food production in the specialty crop industry.

The decrease of science minutes, elimination of field trips and constant discussion regarding the importance and value of water and farmland make agricultural education an important topic for school age youth. As middle school students are beginning to make food and career choices, it is crucial that they understand how specialty crops are produced, the importance of this valley as an agricultural leader in specialty crops production, and how fresh, locally grown specialty crops can play key roles in their healthy diet.

This project does not build upon a previously funded Specialty Crop Block Grant Program (SCBGP) project.

Project Approach

School Visits- 44 schools were visited each school year, and the total students reached exceeded 45,000. The first year only seventh graders were reached, but the scope of the project was expanded in the second year to include eighth graders as well due to excess capacity. The expansion to include both grades meant that students received two opportunities to visit the mobile classroom and explore specialty crop science.
Public Outreach Visits – A small number of public outreach visits were completed. The design of the mobile lab, as a science classroom, does not lend itself well to public outreach at large venues. Ag In Motion did, however, attend Ag Day at the Capitol and staff made many pubic presentations featuring Ag In Motion content outside of the mobile classroom.
Development of student and teacher evaluation – An online teacher survey was prepared and sent to each teacher after the site visit. Results were analyzed and adjustments made as needed. A variety of methods were tested for student evaluations. This past school year, hard-copy pre- and post-evaluations were used to measure results and this proved to be effective. A good return rate was received from a variety of rural and urban schools. The results indicated that the visit to the lab and the content did increase student knowledge and understanding of specialty crop

agriculture. This sampling method will continue in the future.
Review and summary of student and teacher evaluations – Teacher evaluations consistently indicated that learning goals were reached in the visits to the mobile classroom. Student surveys indicated the understanding of science in agriculture increased. Students developed a connection between their food and the science lesson and understood how specialty crops are grown. The missing link for the students was the connection between classroom, food, and career. The reason for this connection is to support future farmers and scientists exploring specialty crop science. Future revisions of the content will be made to ensure this connection is made for students.
Presentation of student and teacher evaluation results – Results were presented to the Natural Ag Science Center's Board of Directors at a public board meeting and shared at science center industry meetings and in grant proposals. Of the 120 students surveyed, 50% more students gained the knowledge that agriculture is the science of food and fiber. A total of 20% wanted to learn more about the science of agriculture and those who grow their food. As a result, videos are being researched to bring a specialty crop grower's face to the corresponding lab in two minute career videos.
Content review – Each year a complete review of the content for both grade level lesson plans was completed. Additionally, lessons were reviewed based on teacher input and recommendations. Adjustments were made to suit the learning needs of specific classes (special education or gifted). Some lesson materials were changed to increase ease of facilitation and learning results. Changes included the addition of a career and industry web to each student notebook and adjustments to the language in the books to make the activities clearer.
Research content revision and development of new specialty crop content – Research is underway for new lesson plans to develop additional content, which align with the Next Generation Science Standards. At the end of the first year eighth grade lessons featuring soil chemistry to tie the grade level content with the importance of specialty crop science were added. These lessons specifically addressed soil pH and nitrogen levels discussing nursery crops and tree crops. Students explored how certain specialty crops will grow or not grow in specific soil conditions.
Scheduling of schools for AIM visits – The scheduling of schools has been a learning process. The process began by calling the schools to set visits and evolved to an email scheduling with the schools going on-line to provide additional information. Last year the schedule was set based on geography to decrease miles driven. Ag in Motion has been able to schedule all of the school sites in Stanislaus county and one in an adjoining county. Scheduling has been relatively streamlined and is becoming a simple project beginning in the spring for the following year. The organization has experienced great support from district administrators who support the scheduling.

SCBGP funds were used to directly, solely, and exclusively enhance the competitiveness of California specialty crops.

Through this project and the launch of the mobile classroom very strong partnerships have been developed with both the Stanislaus County Office of Education and local school districts. These organizations have become partners in developing summer camps and teacher training to spread agricultural science education information. All groups have worked together to add gardens to schools and increase awareness of specialty crops on many levels. Working relationships with the University of California Cooperative Extension have been strengthened and partnerships continue on various education ventures.

The Stanislaus County Office of Education assisted with scheduling of the mobile classroom at school sites enabling a 100% participation of all schools located in the county. Visiting all 44 schools allowed the students to experience agricultural-related and specialty crop specific labs twice in middle school. Modesto City Schools provided Future Farmers of America (FFA) members to support summer science camps which, although not directly funded by this grant, support and enhance the Mobile Classroom and specialty crop education for students at grades 3-8. Finally, the University of California Cooperative Extension partnership has included garden planting at school sites which again extends the learning about specialty crops from the classroom and the Mobile Classroom to the school garden.

Goals and Outcomes Achieved

Ag in Motion's goals and measurable outcomes were as follows:

- Introduce 2,000 new students to bug anatomy and their function in specialty crop agriculture. This goal was met as over 4,000 students learned about bugs and their function through labs in Ag In Motion over the period of the grant.
- Teach 1,000 students that strawberries are specialty crops and how researchers use DNA to impact production. This goal was met as more than 6,000 students explored the science of specialty crop DNA learning about strawberries and nursery crops including pluots. There can be no more direct tie from the classroom to specialty crops than for students to identify the food that they eat as a specialty crop. This lesson was taught 6,000 times in Ag In Motion.
- The content was expanded to include eighth grade soil science which allowed students to be taught twice in their middle school career about the importance of specialty crops through chemistry of soil and help the students directly connect their classroom to the area's agriculture. An exercise was added for students to directly connect the pH of the soil studied to the specialty crops grown in this area. Expanding the content allowed a deeper connection with the students and increased the number of students served, therefore helping reach the measurable outcomes.

The National Ag Science Center met all of the goals for the project. This school year 44 schools were served and over 14,000 students reached.

The students surveyed in the reporting period increased their understanding that specialty crop agriculture is the science of food and the environment from 60% to 80%. The knowledge that science is used all of the time in specialty crop agriculture increased from 45% to 60%.

The most successful outcomes of the project are:

- *45,000 students reached since launch of Ag In Motion in 2011.*
- *44 schools each year in 2012 and 2013 received visits from Ag In Motion.*
- *There was a measured increase in the awareness of students that science is an integral part of agriculture.*
- *45,000 students were exposed to specialty crop science.*

Beneficiaries

Students at middle schools in Stanislaus County have the opportunity to explore hands-on agricultural science lessons at their school sites. Results and accomplishments were regularly shared with the Natural Ag Science Center's Board of Directors and with community organizations, which include specialty crop farmers, consumers and the general public. As the majority of the crops grown in Stanislaus County are specialty crops, any outreach to the general public includes consumers of specialty crops. Each day in the mobile classroom Ag in Motion discusses the specialty crops grown in the county and the State of California.

44 schools were served with the Ag In Motion mobile classroom. A total of 14,000 students were reached each year. Over the course of the grant Ag in Motion estimated over 45,000 students in five counties learned about specialty crop science. Ag in Motion was also able to reach students in Sacramento, Fresno and Merced counties on special visits to those areas.

Lessons Learned

The lessons learned from the project are that Ag in Motion is a very efficient organization which works hard to maximize the dollars it has; however, to successfully work with federal and state granting agencies the organization would need additional staff or other personnel resources to simply manage the process. The management of the grant reporting requirements was simply too taxing on program staff to make getting this type of funding a second time a viable option. Overall, there are no real changes Ag in Motion would make to the project to be more efficient. Ag in Motion is well supported by the community and donors and that allows for flexibility to spend funds where needed at the time. One change Ag in Motion made from the beginning of the project to the end was to schedule schools with a geographic focus to reduce fuel costs. Ag In Motion has been a successful project and will continue and perhaps expand to other regions of the state. The lessons learned in the first three years have been positive and will allow Ag in Motion to make small refinements of program and scheduling to enable success in both future years and new regions.

The unexpected outcome of implementing this project was the relationship the organization developed with certain schools and students. As a result of this relationship Ag in Motion developed additional programs to further engage students like Jr. Scientists and summer camp. These programs both expanded the grade levels of students and school sites served and provided an opportunity to teach agricultural science through the students. Ag in Motion learned that providing opportunities for deeper understanding of agricultural science topics can make huge impacts in the educational lives of students.

The biggest lesson learned for the organization is the limitations of this type of funding. Ag in Motion is so small, and therefore, has to be very responsive to both program needs and funder needs, and this type of funding did not allow for that flexibility.

Additional Information

Reference material attached.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 13	**Project Title:** Evaluation of Winter Cover Crops to Reduce Nitrate Leaching and Increase Yields in Drip-irrigated Tomato Rotations	
Grant Recipient: The Regents of the University of California Davis	**Grant Agreement No.:** SCB11013	**Date Submitted:** December 2014
Recipient Contact: Martin Burger	**Telephone:** 530-754-6497	**Email:** mburger@ucdavis.edu

Project Summary

Groundwater contamination by nitrate (NO_3^-) is an acute problem in some parts of California where more than 30% of wells exceed safe nitrate levels. The project was undertaken to study and quantify the effects of cover crops on nitrate leaching, tomato crop performance, and soil properties affecting irrigation and nutrient use efficiency.

Adoption of subsurface drip irrigation (SDI) for processing tomato production is almost complete in California with >80% of tomato fields under this type of irrigation. Although the potential for nitrate (NO_3^-) leaching is assumed to be lower under SDI than furrow irrigation, nitrate leaching in SDI tomato has to date not been measured.

Cover crops are not widely used in California's annual cropping systems with <5% of the acreage planted to cover crops each year. Therefore, in this project, in addition to quantifying nitrate leaching, information on cover crop root systems, canopy development, and nitrogen (N) uptake was collected to enable growers to make informed decisions and beneficially use cover crops in annual specialty crop rotations.

According to recent findings of UC Davis researchers, on average >80 lbs. of N per acre per year leach into groundwater beneath irrigated lands, usually as NO_3^-. Therefore, growers must be given tools to better control NO_3^- leaching, and management practices reducing NO_3^- leaching must be evaluated to test their efficacy and to make sure that such practices do not negatively affect crop performance.

Previous 2009 SCBGP Project 2 assessed the practice of cover cropping in terms of soil infiltration properties, and drainage of irrigation and precipitation water was estimated by using a water balance approach. However, NO_3^- leaching could not be measured by that approach. The previous project seemed to suggest that cover crops might enhance percolation of soil solution. To resolve these lingering questions, a systematic approach requiring measurements of soil moisture and NO_3^- in three dimensions within the soil profile and state-of-the-art modeling to assess the movement of water and NO_3^- was necessary. The present project was designed to accomplish as main goal to measure NO_3^- leaching and calibrate a model that could be used to explore the effects of specific management practices on NO_3^- leaching.

Project Approach

Field site, methodology, laboratory experiments, and outreach activities

In fall 2011, two cover crop and one winter-fallow treatments were established at the University of California, Davis (UCD) Sustainable Agriculture site Russell Ranch to monitor winter cover crop growth, soil moisture conditions and nitrate movement in the soil profile. The two cover crops were Triticale cv. forerunner, a wheat relative with a fibrous root system, and bell bean, Vicia faba L., a legume with a taproot. The cover crop treatments were in replicated (n=3) 1-acre plots where cover crops have been grown every winter since 1993, whereas the plots of the winter-fallow treatment (n=3) had never had a cover crop during this time.

At one location per treatment, three-dimensional grids of instruments were installed to measure soil water content and water potential (the driving force for water movement) and to collect soil solution samples (suction lysimeters) that were analyzed for NO_3^- and ammonium (NH_4^+) concentration in the laboratory (Fig. A1). The instruments were connected to dataloggers continuously recording hourly measurements during 2.5 years. Furthermore, equilibrium tension lysimeters to collect soil solution at 1.3 m depth were put into operation in fall 2012 at the three monitoring locations to provide another detection method for nitrate leaching (Fig. A2).

The above measurements at the heavily instrumented sites were complemented with periodic soil moisture measurements via neutron probe, soil sampling, as well as root and canopy harvests (root length density, aboveground biomass and N content) in all the 9 treatment plots. Triticale and bell bean root systems were characterized through a combination of field measurements and climate controlled growth chamber studies. Roots were washed from the soil cores taken in the field and total root length was measured using a scanner-based imaging system (WinRhizo). Root abundance was expressed as length of root per volume of soil. In the bell bean treatment, the results represent a combination of bell bean and weed roots because the latter could not be distinguished from bell bean roots. Furthermore, a set of individual plants was monitored for leaf production rates and N content in the field. Time- lapse movies of root growth were made in the laboratory.

In the fall 2012 and 2013, the NO_3^- of the surface layer (0-15 cm depth) was isotopically labeled with ^{15}N to track the fate of NO_3^- into the cover crops and in the soil profile.

During the tomato growing seasons (2012, 2014), water and N fertilizer inputs, canopy cover to calculate evapotranspiration based on reference values available from the California Irrigation Management Information System (CIMIS) and biomass were monitored, and tomato yields, and N content in fruit and vines were measured at harvest. In the rotation year (2013), when corn was grown in the instrumented plots, water inputs were measured and evapotranspiration was estimated via Aquacrop model (http://www.fao.org/nr/water/aquacrop.html). Tomatoes have to be grown in rotation with other crops to reduce disease pressure. Tomatoes could not be grown in the same plots for three years in a row, and the instruments buried at various depths in the soil profile could not be moved, thus it was decided that corn will be grown, which is increasingly used as rotation crop in drip-irrigated tomato rotations.

To investigate soil N mineralization rates which potentially affect N availability to the tomato crop, a soil incubation study was conducted in the laboratory: Cover crop residues were added to soil in microcosms from the two cover crop and winter-fallow treatments, and N mineralization was assessed through periodic measurement of nitrate over a period of 105 days.

Nitrate leaching was calculated by three independent methods: a) Calculating water fluxes across soil layers using measured soil water potential and water content (i.e. in-situ soil water retention values) and the average unsaturated hydraulic conductivity derived from empirical soil moisture and computed best-fit soil hydraulic parameters, and then combining water flux and measured NO_3^- values obtained from suction lysimeters (Fig. A3); b) water balance approach using water storage, inputs and outputs, and measured soil solution NO_3^- values; c) measurement of leached NO_3^- collected by the equilibrium tension lysimeters.

The model HYDRUS-1D was calibrated to simulate water movement and NO_3^- flux below the root zone under different management and weather scenarios. The scenarios explored were different NO_3^- concentrations in the soil profile, varied precipitation regimes, and presence or absence of winter cover crops.

In 2013, pre-plant NO_3^- levels were assessed in 16 subsurface drip-irrigated commercial tomato fields in Yolo, San Joaquin, and Fresno counties as part of a study funded by the California Tomato Research Institute. Additionally, fertilizer N inputs, tomato yields, crop N content, and post-harvest NO_3^- levels were measured in those fields. Nitrate data from those commercial fields were used to simulate NO_3^- movement in the soil with and without cover crops under varied precipitation scenarios.

During the project period, three Field Days each with about 150 attendees were held at the Russell Ranch where the results of the project were presented to growers, state agency and university personnel, students, and the general public. Two workshops with growers (about 20 attendees) were held on campus where the results were discussed in greater detail. Several articles were written about this project in the Trade journal ‘AgAlert’ and in the journal ‘Discover’ (circulation 1 million). Results were also presented at professional meetings [Soil Science Society of America (SSSA) Annual Meeting, Western Soil Science Society Meeting, California Plant and Soil Conference, SSSA Ecosystem Services Conference].

Results

Cover crop evaluation

Overall, Triticale root systems grew deeper and denser than the plants in the bell bean treatment (i.e. bell bean and weeds) (Fig. A4). Measurements taken during late-November showed that the root systems of both cover crop treatments were similar in size; however, by mid- to late-January triticale root systems were deeper and total root length density (RLD) was 2.7-4.4 times the root length density for the bell bean treatment. By the end of the cover crop season (late-February or mid-March), total RLD of Triticale was 3.5-4.5 fold higher than the that in the bell bean treatment. Furthermore, 95% of all triticale roots were in the 0-150 cm soil layer, while 95% of bell bean and weed roots were located in the 0-90 cm layer. The study in the controlled environment growth chambers with time-lapse photography demonstrated a classic fibrous root system of Triticale: 3-5 seminal roots grew rapidly through the soil and a wave of branch roots followed behind (Fig. A5). Bell bean, on the other hand, produced a single taproot with a dense network of mainly horizontal branch roots. Most of the bell bean branch roots were found near the surface, while triticale branch roots were distributed more evenly throughout the root system.

The combination of field and growth chamber studies, demonstrate that triticale more effectively explored the soil volume, potentially enabling it to extract more nitrate from the soil. When trying to minimize nitrate leaching, rooting depth is very important, and the deeper root system created by triticale is consistent with the nearly complete depletion of nitrate from the soil down to approximately 150 cm. In contrast, the shallower root system produced by bell bean and weeds was associated with less extensive depletion of soil nitrate.

The results of the ^{15}N study in the field corroborated the data on root distribution of the two cover crops. Triticale took up 15 times more soil NO_3^- than bell beans (Fig. A6). The weeds in the bell bean plots took up a similar amount of the labeled NO_3^- as Triticale, but the NO_3^- uptake by weeds occurred later during the cover crop season whereas Triticale had taken up 50% of the NO_3^- in the 0-15 cm layer within <2 months of sowing. In the bell bean and winter-fallow plots, small amounts of ^{15}N-labeled NO_3^- were found at depths down to 2.1 m, whereas NO_3^- levels in the Triticale plots were too low to be analyzed for ^{15}N. Results from the 2013-14 season are pending.

Since Triticale performed better than bell beans as a NO_3^- scavenger, growth and N uptake of this cover crop species under varied environmental conditions were studied in greater detail. Triticale N uptake can be predicted by using the consistent relationship between growing degree days (GDD) and plant growth (Fig. A7). An early planting date would result in faster cover crop establishment, ideally before the heaviest winter rains come, and greater NO_3^- uptake than later planting dates (Fig. A8). During the 2012-2013 and 2013-2014 rainy seasons, the cover crops were initially irrigated in late October in order to study their function under optimal conditions. However, it is unlikely that growers would irrigate cover crops to get them established. Based on precipitation data of the last 31 years, we were able to predict that in 56% of the years, Triticale would have taken up at least 45 kg N ha^{-1} by the end of February, had this cover crop been planted each year before the first significant rainfall (>30 mm) (Fig. A9). Such rainfall events occurred between Nov. 1 –15 in 31% of the years, between Oct. 15-31 in 25% of the years, and 19% of the time rain fell between Nov. 15-30; and rain occasionally started in early October (9%) or in December (16%).

During the time of this project, evidence that bell beans can be a bridge host for tomato spotted wilt virus and thrips has surfaced, as reported independently by UC Davis researchers. Therefore, in the future, the role of bell beans in tomato rotations may be diminished on account of this risk.

Water and NO_3^- fluxes

The cumulative NO_3^- leached during the rainy season of 2012-13, based on the measurements by equilibrium tension lysimeters was 3.9, 0.7, and 2.1 kg NO_3^-—N in bell bean, Triticale, and winter-fallow, respectively. This compares with 1.8, 0.5, and 0.8 kg N ha^{-1} as calculated based on water potential differences for the same period. During the 2013-14 rainy season, when rainfall only occurred in spring, NO_3^- leaching measured by the equilibrium tensions were 0.8, 0, and 10.4 kg NO_3^-—N in bell bean, Triticale, and winter-fallow, respectively.

The tracking of soil moisture during the irrigation season at three lateral positions in relation to the drip tape by the multi-dimensional grid of instruments revealed that in the two cover cropped soils there was hardly any lateral movement of water towards the furrows, but rapid drainage in the center, especially in the top 60 cm (Fig. A10). In contrast, in the winter-fallow soil, the water content was similar in the center underneath the drip tape and the furrows at that depth. These observations can be explained by two hypotheses: 1. Long-term cover cropping improved soil structure and increased porosity in those soils and this increased drainage underneath the drip tape and tomato root development; 2. The slightly higher clay content in the winter-fallow than cover-cropped soils and the lack of cover crop root channels in this soil increased lateral movement of water near the surface and decreased tomato root development. Characterization of tomato root distribution supported these hypotheses. Across all treatments, root length density was highest near the surface and decreased with depth (Fig. A11). In each treatment, nearly two-thirds (61-65%) of tomato roots were concentrated in the top 60 cm of soil, and nearly one-third (26-31%) of roots were found between 60 and 120 cm. Tomato roots in the winter fallow treatment were more tightly concentrated near the drip tape than either of the cover crop treatments. Tomato roots in the bell bean treatment were more uniformly distributed across the bed. In the triticale treatment, the edge and furrow locations showed similar root distributions with depth.

Although this study was conducted during drought years, some important conclusions could be drawn from the calculated water and NO_3^- fluxes over the 2.5 years. Two periods with high leaching potential were identified, one in fall/early winter with the onset of the first rainfall, the other in spring at the beginning of the irrigation season (Fig. A12). During both these distinct periods, downward flux of water and NO_3^- leaching readily occurred because soil moisture was relatively high (in the fall due to the tomato irrigation season, and in spring after moisture accumulation during winter). The absolute amounts of NO_3^- leaching were modest during these two low-rainfall winters. However, the modeling results illustrated potential NO_3^- leaching with higher precipitation and/or greater residual soil NO_3^- levels in the fall.

Tomato yields

Tomato yields in 2012 ranged from 100.2 – 103.9 Mg ha^{-1} and did not differ among the three treatments. However, crop N uptake (fruits and vines) and the apparent N use efficiency (defined as the fraction of fertilizer N in harvested fruit) were significantly higher in the winter-fallow than in the cover cropped soils (N uptake 250 ±26 vs. 177 ±7 and 180 ±3 kg N ha^{-1}; NUE 84 ±3 vs. 65 ±3 and 67±2 %), which suggests that in the cover cropped soils less N may have been available for crop uptake because some NO_3^- may have been leached below the root zone although an alternative explanation would be that inorganic N levels were initially higher in the winter-fallow soil. These hypotheses cannot be further evaluated as the equilibrium tension lysimeters and instruments to measure water and nitrate fluxes were not installed yet at the time. The results of the 2014 cropping season are pending.

Modeling

The simulation modeling showed that among precipitation, initial soil NO_3^- concentration, hydraulic properties, and the presence of cover crops, the amount of precipitation has the strongest effect on NO_3^- leaching. The project team simulated NO_3^- leaching in all treatments under varied conditions: high/low soil NO_3^- concentrations, wet and dry years (2005-06 with 589 mm precipitation and 2013-14 with 235 mm precipitation). The models indicate that NO_3^- leaching increased by two orders of magnitude with increased precipitation. The different hydraulic parameters and associated initial soil moisture conditions also strongly affected NO_3^- leaching, which varied by approximately one order of magnitude among the soils of the experimental plots. Increasing total NO_3^- in the soil profile in the wet year to 360 kg NO_3^-–N tripled NO_3^- leaching. The simulation modeling did not capture the effect of presence or absence of a cover crop well because the present model neglects active NO_3^- uptake, N-fixation by legumes, and also plant exudation of organic N. Further improvements of the model are in progress to take account of the plant processes.

The overall scope of the project benefits all subsurface drip-irrigated specialty crops. Subsurface drip irrigation is sometimes used to grow commodities other than specialty crops, as was the case during the period of the present project. However, rotation with non-specialty crops is solely done to alleviate disease pressure for the more valuable specialty crops. Rotating specialty crops with other non-specialty crops is standard management practice to reduce disease pressure.

Principal investigator (PI) chaired the weekly meetings, supervised crop sampling and growth analysis, and coordinated the integration of the field, laboratory, and soil physics aspects of the project. The Project manager (PM) coordinated field operations, such as instrument installation, soil and plant management and sampling, data collection, storage, and interpretation, and communication with the funding agency. Project Scientist and Junior Specialist, under the supervision of Co-investigator, constructed some and installed most of the field instruments to monitor soil moisture and water potential, and soil solution, computed water and nitrate fluxes using three independent methods and performed modeling. Graduate student conducted crop sampling and root growth analysis under the PI's supervision, and under the PM's supervision collected soil solution weekly (and more frequently during storm events) for nitrogen analysis. Visiting scholars conducted the ^{15}N stable isotope experiments in the field and laboratory. Co-investigators provided valuable advice and feedback during meetings.

Goals and Outcomes Achieved

The main goal of the project was to quantify NO_3^- leaching in tomato rotations in winter-fallow and cover cropped tomato rotations. Water and nitrate fluxes were quantified using field instrumentation and three different methods. Furthermore, two cover crops were evaluated in terms of their efficacy of immobilizing NO_3^- during the rainy season. This was done by characterizing root growth, biomass accumulation, and N uptake by taking measurements during three cover crop seasons, and by deriving relationships between growth, N uptake, and weather patterns. Additionally, field experiments employing ^{15}N stable isotopes to track the fate into plants and within the soil provided excellent information on NO_3^- uptake by cover crops. The effects of cover crops on soil physical and hydraulic properties and on crop performance were assessed by analyzing soil moisture dynamics, and by measuring tomato N uptake and yields in the different treatments, as well as by modeling. Farmer recommendations were developed based on the overall water and nitrate fluxes, the cover crop evaluation, modeling, and crop performance.

Several recommendations arise from results of this project.

1) Grain cover crops such as Triticale are indeed very useful in taking up NO_3^- during the rainy season (when NO_3^- readily leaches out of the root zone with sufficient water inputs) and in returning N to the upper soil layer after incorporation to be useful for tomatoes and other cash crops.
2) To avoid NO_3^- leaching during the tomato growing (i.e. irrigation) season, growers should take great care to minimize water applications, in particular during the early part of the growing season when some drainage may occur, and especially in well-structured soils that have developed as a result of organic matter additions and year-round plant cover.
3) Routine pre-plant soil sampling and adjustment of fertilizer N rates according to residual inorganic N availability is of paramount importance to avoid excessive inorganic N levels in specialty crops rotations year-round.

The main objective of measuring NO_3^- leaching under different management practices was achieved as the measurements of NO_3^- fluxes by the three independent methods were in approximate agreement. As a consequence of the drought during two project years the actual amount leached NO_3^- was modest.
The expectation was that calibration of the model HYDRUS would enable the project team to quantitatively model NO_3^- leaching under different management and weather scenarios. However, the simulation modeling mainly showed the relative importance of the different parameters. For example, the NO_3^- leaching depends to a large degree on a soil's hydraulic properties, so the modeling showed large differences (by about one order of magnitude) in NO_3^- leaching among the three soils under the same precipitation and identical initial NO_3^- concentrations.
The project team was able quantify root distribution and NO_3^- uptake by the different cover crops and develop simple models of biomass accumulation and N uptake based on growing degree days for one of the cover crops, Triticale. The other cover crop, bell beans, is less suitable as a nitrate scavenger.
The effect of cover cropping on soil properties could not unequivocally be determined. During the irrigation season, it was observed that distinct differences in soil moisture distribution in the main root zone between the cover cropped and winter-fallow soils. There were indications that preferential vertical flow was occurring in the cover cropped soils which may have caused some drainage and loss of NO_3^- below the root zone. However, it was not possible to corroborate these observations with the NO_3^- flux measurements because at greater depth (2.1 m), lateral variability of water and nitrate flux was less evident than in the root zone.

The project team implemented several methods of estimating NO_3^- flux in the field and demonstrated that these measurements were in reasonable agreement. Predictably, we also encountered large variability in soil hydraulic properties that confound attempts to precisely quantify the cover crop impacts. Rooting depth and root length density of cover crop species over time were determined, and relationships between planting date, weather conditions, biomass and N accumulation by one of the two cover crops were explored and presented in a simple model. Hydraulic parameters were determined in-situ and through modeling and measurements of saturated hydraulic conductivity in soil cores. The calibration of the HYDRUS model, and development of additional modules, such as root growth in 2D, and inclusion of active root N uptake independent of transpiration, have been identified as requirements for successful simulation of water and nitrate dynamics under varied management practices. Two critical periods with high leaching potential, late fall and the beginning of the irrigation season have been identified and recommendations for best management practices to reduce the risk of NO_3^- leaching during these times have been developed.

Triticale was identified as a cover crop suitable to take up residual NO_3^- during the rainy season. Triticale had 3-4 times greater root length density than bell beans, and Triticale roots reached down to almost 2 m depth whereas bell beans had roots to a depth of less than 1 m depth. Triticale immobilized 15 times more NO_3^- than bell beans, or 50% of all the NO_3^- in the 0-15 cm layer. Although Triticale can take up to 70 kg NO_3^- ha^{-1}, which makes growing this cover crop an attractive strategy to reduce NO_3^- leaching, this project also clearly proved that water and nitrate fluxes are highly dependent on precipitation and site specific hydraulic properties of a soil, and therefore, judicious N fertilizer management is of paramount importance. The project team conducted a survey of commercial tomato fields which showed that pre-plant NO_3^- concentrations in 2013 ranged from 50-490 kg NO_3—N ha^{-1} with a mean of 158 kg NO_3—N ha^{-1} suggesting that regular pre-plant NO_3^- sampling and adjustment of fertilizer N rates accordingly could decrease excessive NO_3^- levels in fields of specialty crops. The measurements of NO_3^- fluxes during 2.5 years showed that NO_3^- leaching potential during the early growing season is high, which, in conjunction with the observations of pre-plant NO_3^- levels in grower fields, calls for irrigation guidelines emphasizing accurate irrigation amounts at the beginning of the irrigation season. Graduate student Dumlao won the first prize of the student poster competition at the 2014 California Plant and Soil Conference in Fresno, CA. The presentation of the project in a magazine with 1 million circulation and repeated write-ups in one of California's leading trade-journals, AgAlert, will be followed with posting of project results on the UC Davis Agricultural Sustainability Institute's website Solution Centre for Nutrient Management.

Beneficiaries

The beneficiaries are California's tomato growers. More than 80% of tomato acreage is drip-irrigated. Additionally, growers of other specialty crops, such as vegetable and orchard crops, will benefit from the information generated in this project. The data on the cover crop growth and development is a contribution to promote the use of cover crops in annual crop rotations. Finally, the successful measurement of NO_3^- leaching by three methods of which two of them can be considered novel, and the forthcoming publications on these methods contribute to improving methodology needed for monitoring NO_3^- levels and the potential for groundwater pollution.

Currently there are about 490 enterprises growing processing tomatoes with a crop value of about $900 million. The economic value of improved groundwater supplies is difficult to calculate. In the long term, the people living in the Central Valley, projected at about 20 million by the year 2040, would benefit from improved groundwater supplies as a result of implemented best management practices developed in this project.

Lessons Learned

It was not possible to quantitatively assess the effects of cover cropping on soil physical and hydraulic properties over time because the changes that take place with cover cropping have already occurred over the last 20 years, and the duration of the project was too short for any additional changes to be detected. Some differences between cover cropped and winter-fallow soils are pre-existing (e.g. soil texture among the different soil layers varies to some degree from plot to plot), whereas other differences (e.g. soil structure, soil water retention or saturated hydraulic conductivity) may have been influenced by regular cover cropping, but cover crop effects and inherent differences could not be separated. The project team did measure bulk density and soil strength as indices of compaction in all the plots but did not find differences among treatments.

A drawback for the modeling was that the team had to use HYDRUS-1D (i.e. one-dimensional modeling only) because the module of root development has not been developed yet for HYDRUS-2D. For example, modeling in 1D showed that the presence or absence of plants in each of the soils did not change NO_3^- leaching or water movement by much although there was evidence that substantial differences in root activity and drainage exists among the soils. The wetting patterns between cover cropped and winter-fallow soils were distinctly different to a depth of about one meter, with cover cropped soils draining rapidly in the center and furrows staying dry while moisture distribution across beds and furrows of winter-fallow soils was more uniform during the irrigation season. Such differences could be better explored with a 2D model, and hopefully this experience will spur the development of a root growth module in HYDRUS-2D. The team had hoped to use HYDRUS 2-D to model the nitrate fluxes and conduct a sensitivity analysis to understand the relative importance of particular plant and soil properties. However, it was found that the HYDRUS packages, while they deal well with soil properties, are not yet developed for accurate depiction of plant uptake and efflux processes. Extending HYDRUS software and implementation is a good direction for future work.
The project team was surprised that the plots thought to be well matched in soil texture, turned out to vary so much in soil hydraulic conductivity.

One of the work plan activities was to measure N fixation by bell beans using the ^{15}N natural abundance method, which requires measurement of baseline ^{15}N values in tissue of plants grown in a N-free medium in addition to field measurements. However, the project team did not succeed in growing N-fixing plants in such a medium. Using a value of N fixation (75% of aboveground biomass N) from the literature indicated that bell bean plants fixed 12, 83, and 14 kg N ha^{-1} in 2011-12, 2012-13, and 2013-14, respectively.

The complexity of quantifying NO_3^- leaching was challenging, and processing the massive amount of data collected proved to be very time-consuming. If the project duration was longer, as well as more flexibility of starting and ending dates, that would have enabled this team to complete the project more conclusively. The hard work to instrument plots at Russell Ranch provided a rich dataset that can be mined to understand many aspects of water and nitrogen movement in soils. The efforts of this project will continue to provide information on impact of cultivation practices on water use and nitrogen chemistry in agriculture.

Additional Information

Illustrations, tables, figures, and outreach material are included in the Appendix. More information about the project site can be found at http://asi.ucdavis.edu/rr.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 14	**Project Title:** Reducing the Environmental Regulatory Burden on Specialty Crop Producers	
Grant Recipient: Ag Innovations Network	**Grant Agreement No.:** SCB11014	**Date Submitted:** December 2014
Recipient Contact: Serena Coltrane-Briscoe	**Telephone:** 707-823-6111 x 220	**Email:** serena@aginnovations.org

Project Summary

California specialty crop farmers face a complex regulatory environment. The already challenging proposition of growing food has been further complicated by increases in the number of activities subject to regulation as well as the number of agencies with authority over on-farm actions. Meanwhile, there is concern within the conservation community that existing regulations are not achieving a sufficient level of environmental protection. In response to this paradox, regulators explain that the static nature of current laws and regulations does not provide the flexibility or adaptability needed to address the dynamic problems society faces today. They also report a lack of sufficient resources to carry out their role effectively.

The result is a regulatory scheme that frustrates farmers, does not always deliver environmental outcomes, and can leave those charged with implementing regulations without the flexibility or resources to do their jobs well.

In response to this complex set of issues, Ag Innovations Network (AIN) set out to achieve the following objectives:

- Foster communication and collaboration toward minimizing regulatory challenges
  - Build a common understanding of key regulatory issues across stakeholder groups
  - Establish connections between stakeholders concerned with and already working on key regulatory issues
- Identify and advance both short- and long-term solutions that:
  - Produce environmentally beneficial outcomes
  - Minimize the challenges associated with regulatory compliance for California specialty crop farmers
  - Complement and expand upon existing local and statewide efforts to decrease regulatory burdens

Over the course of dozens of meetings that AIN has held with food system stakeholders during the past several years, the complexity of California's regulatory setting has been consistently identified as one of the top three issues facing specialty crop agriculture, along with a lack of reliable supply of both labor and water. In 2010, members of the multi-stakeholder group, the California Roundtable on Agriculture and the Environment, addressed aspects of the issue in *Permitting Restoration: Helping Agricultural Land Stewards Succeed in Meeting California Regulatory Requirements for*

Environmental Restoration Projects.[1] Food System Alliances,[2] now active in eight counties throughout California, have similarly prioritized regulatory challenges.

Reducing the Environmental Regulatory Burden on Specialty Crop Producers was launched in response to the need identified by agricultural, conservation, and regulatory partners, and was designed to seek solutions that simultaneously reduce the business challenges associated with regulatory compliance for specialty crop farmers and meet the underlying public goals of regulation.

Project Approach

Through research on the current regulatory structure and existing efforts to address challenges, interviews with key stakeholders, and focused listening sessions with agricultural, conservation, and regulatory representatives, AIN documented a range of perspectives on regulatory issues. The process allowed stakeholders to share their experiences, describe specific challenges, and propose solutions to those challenges.

A Technical Advisory Committee reviewed and vetted early findings, helping to prioritize top recommendations for further consideration. A Summit on Regulations Affecting Agriculture was an opportunity for all stakeholders to come together to learn, share, and collaborate on further developing the key recommendations, which were presented in the project's final report, *Regulating for Agricultural and Public Outcomes: Perspectives and Recommendations*.[3]

Specifically, the project included the following activities:

- Conducted extensive interviews with sixteen key stakeholders representing governmental agencies, agriculture, and civic and environmental interests to inform a more effective project design and provide insight on current efforts, challenges and solutions related to regulatory burden for specialty crop growers.
- Formed a Technical Advisory Committee[4] (TAC) with 36 members representing specialty crop growers, commodity groups, community and environmental organizations, and regulatory agencies.
- Engaged members of the California Roundtable on Agriculture and the Environment (CRAE) – 36 members strong - to advise on the project via interviews, forums, and TAC involvement.
- Presented the project to 10 members of the Ag Vision Advisory Committee and discussed collaboration.
- Developed a regularly updated website[5] including project information, reports from stakeholder engagement efforts, news, and a comprehensive set of 150 resources.
- Worked with Food System Alliances in Fresno, Ventura, and Yolo Counties to engage growers in identifying local challenges and proposed solutions. More than 25 grower perspectives were

[1] http://aginnovations.org/images/uploads/Permitting_Restoration.pdf
[2] http://aginnovations.org/alliances/
[3] http://aginnovations.org/articles/view/regulations_affecting_agriculture/
[4] http://aginnovations.org/regulations/tac/
[5] http://aginnovations.org/regulations/

captured and posted at http://aginnovations.org/regulations/progress/, as well as being presented to other stakeholders.

- Engaged ten state-level agencies in identifying current efforts, challenges, and solutions; worked to find areas of alignment, getting a commitment to participate in the process and to cooperate in exploring options for improving the efficiency and performance of the regulatory system. No lobbying activities took place.
- Engaged environmental stakeholders from 12 organizations in sharing their perspectives on regulatory challenges and recommended solutions.
- Engaged 11 representatives from 9 county-level agencies in identifying challenges, recommended solutions, and current efforts to address regulatory issues.
- Produced *Draft Summary: Stakeholder Perspectives on Moving Toward a New Regulatory Compact for Agricultural and Environmental Health* based on the stakeholder input collected (attached).
- Engaged the TAC in identifying top priority recommendations from among the solutions proposed during the stakeholder input process.
- Presented the project to the State Board of Food and Agriculture and the attendant public (about 70 people total).
- Organized a solutions forum, entitled the *Summit on Regulations Affecting Agriculture*,[6] at which more than 50 representatives of agriculture, conservation, and regulatory agencies (including members of the California Roundtable on Agriculture and the Environment) came together to: a) build a common understanding of the key regulatory challenges; and b) agree on high priority improvements to the regulatory system, in both the short and long term, that address the needs of all affected stakeholder groups.
- Drafted the final project report, based largely on the results of the solutions forum, and engaged both the project team and project participants in a review process.
- Published and disseminated the final project report, *Regulating for Agricultural and Public Outcomes: Perspectives and Recommendations*[7] via email, U.S. mail, and in person to more than 700 agricultural, conservation, and government stakeholders as well as media contacts and other interested parties. Recommendations are paired with potential implementation leads, as identified by stakeholders.

Project Findings and Recommendations

Perspectives

- Specialty crop farmers are much more concerned about the cumulative impact of navigating, comprehending, and complying with myriad regulatory requirements than they are with specific legislative statutes, regulations, or agencies. They report frustration with the lack of transparency in the regulatory system, which is also thought to be unreasonably costly and time-consuming, as well as deterring implementation of innovative projects.
- Conservation representatives report concern that existing regulations do not achieve a sufficient level of environmental protection and express that the current system does not adequately distinguish projects of public benefit, inadvertently impeding or even preventing their completion.

[6] http://aginnovations.org/regulations/summit/
[7] http://aginnovations.org/articles/view/regulations_affecting_agriculture/

- Regulators acknowledge many of the problems conveyed by the agricultural and conservation communities. However, the static nature of current laws and regulations does not provide the flexibility or adaptability needed to address the dynamic problems society faces today. Regulators explain that the statutory or traditional agency structure and culture, limited funding and staff, and competing mandates compromise their ability to proactively address many of the challenges. They also report the need for greater cooperation and collaboration with those they regulate.

The Recommendations

Near-term adjustments to the current regulatory system

Reduce conflict and increase innovation by building understanding among stakeholder groups

- Increase productive interaction between stakeholders dealing with regulatory issues
- Increase the flow of critical information between regulators and the regulated
- Better accommodate innovative on-farm practices through research and outreach
- Engage stakeholders early and effectively in rule making and implementation planning

Reduce regulatory "friction" by improving interagency coordination

- Create effective coordination programs that include both state and local government
- Encourage a team approach to align regulatory goals and actions

Reduce the cost of complying with regulations by creating vehicles to easily discover and navigate regulatory requirements

- Improve efficiency and coordination of permitting processes
- Provide a regulatory roadmap for common agricultural business activities to easily learn the requirements for project implementation
- Establish one-stop-shops for permit assistance
- Improve the technical support capacity of agencies and others to assist growers in meeting regulatory requirements
- Develop a web portal for consolidation of crucial information

Envisioning a "modern" regulatory system

While significant relief can be achieved through information exchange, reducing regulatory friction, and easing navigation of the regulatory process, stakeholders also identified the need to begin considering what a modern regulatory system for agriculture would look like. The stakeholders identified several key characteristics of an ideal regulatory system:

- It responds to society's multiple public and private interest goals
- It takes an integrated approach that moves away from a focus on media, such as air or water, and toward whole farm management
- It considers the net benefits of on-farm innovations over time
- It explicitly focuses on incentivizing beneficial behavior
- It is outcome- and risk-based, moving beyond practice-focused regulations
- It encourages shared understanding and learning, and has the capacity to adapt to new information and innovation
- It provides good customer service to the regulated community and good results for the public

AIN's President and Director of Programs supervised the project, with the President taking a lead process design and facilitation role throughout the project. The Project Coordinator carried out day-to-day implementation of the project. The Alliance Program Director and Senior Facilitator acted as facilitators during several stakeholder input processes. The project's Consultant advised on the project, and assisted with stakeholder interviews, research, document review and outreach. AIN's Intern provided project support.

Goals and Outcomes Achieved

The activities listed under "Project Approach" meet or exceed the performance goals and measureable outcomes initially set for the project.

Initial Goal	**Activity Completed**
Convene advisory committee for the project comprised of specialty crop growers, commodity groups, community and environmental organizations, and regulatory agencies.	Convened Technical Advisory Committee (TAC).
Compile and summarize the studies and data on regulatory burden collected by Farm Bureau, Western Growers, Sustainable Conservation, RCDs, and others and add to it additional data from Ag Innovations Network's seven county Alliances.	Compiled studies and data into a comprehensive web resource.
Compile a set of best practices/approaches to reducing regulatory burdens, taking into account local, state and federal-level regulations.	Compiled best practices/approaches into a comprehensive web resource.
Create a website to showcase case studies, resources, solutions and a toolkit for producers to access to help them overcome regulatory barriers.	Created a project website with a comprehensive web resource.
Issue report on the above.	*Draft Summary: Stakeholder Perspectives on Moving Toward a New Regulatory Compact for Agricultural and Environmental Health* included the results of research as well as stakeholder perspectives.
Engage CRAE in a review and analysis of options for reducing burdens and improving environmental performance.	Engaged CRAE via interviews and TAC involvement.
Work with Food System Alliances to host 3+ county-level convenings to identify local challenges and proposed solutions to be presented at statewide forum.	A total of 6 forums were held with 48 agricultural, conservation, and local government representatives. Individual interviews were held with an additional 16 state government representatives.

Document county-level recommendations.	Posted on the website and incorporated into the *Draft Summary* mentioned above.
Convene solution forum of stakeholders to give the issue more visibility in the eyes of the public and to forge new bonds of agreement and action by stakeholders and agencies on supported approaches.	The *Summit on Regulations Affecting Agriculture* was held on June 12, 2013.
Issue report on the forum with proceedings, solutions and tools for making local change including a guide to implementing a county permit-streamlining program.	Produced final report, *Regulating for Agricultural and Public Outcomes: Perspectives and Recommendations*.
Disseminate report to the Governor, the legislature, state agencies, County Boards of Supervisors and Ag Commissioners, SC growers through their commodity and trade associations, and all participants in the process.	Disseminated report to more than 700 key stakeholders.
Work with state agency partners to develop implementation plan for adopted recommendations.	Worked with stakeholders to form commonly agreed upon recommendations and identify potential implementation leads for each recommendation, which were included in the final report and disseminated to potential implementation leads for further action. Via AIN's county-based Food System Alliance Network, a call for coordinated action at the county level has been sent out, highlighting county-based recommendations from the report. Staff will work with Alliances in an on-going way to support implementation efforts.

Beneficiaries

California's 85,000 specialty crop farmers, conservation representatives, and government agencies are the primary beneficiaries of this project. More than 150 stakeholders participated in the project, and many more will benefit from the findings and recommendations. Implementation of the recommendations is expected to result in reduced cost of regulatory compliance for specialty crop producers as well as more cost effective operations for regulatory agencies.

Lessons Learned

- Due to the complexity of the issue, and the number of relevant studies, programs, legislation, and perspectives on the matter, the research phase of the project took far longer than expected, and stretched throughout the project as additional information was gathered or presented to the project team. Having a strong foundation in existing efforts and thinking on the issue of regulations affecting agriculture was necessary to ensure a project concept and design that would lead to the best possible results.

- As the project team built a collection of resources and information, it was recognized that this constantly growing body of work was best reflected in an easily updateable website, rather than in report form, as initially anticipated.
- In gathering input from farmers and state-level agencies, it became apparent that important stakeholder voices were missing. The project addressed that gap by engaging conservation organizations and county-level regulatory agencies.
- As the project progressed, AIN recognized the importance of working closely with governmental agency partners in advance of the Summit on Regulations Affecting Agriculture (a.k.a. solutions forum) to secure buy-in. This allowed the project team to accomplish some of what was intended for the forum beforehand, and effectively shortened the foreseen implementation phase afterwards.
- The production of the final report took longer than anticipated, due largely to the need for both internal and stakeholder review, which ultimately strengthened the final product.

Additional Information

Attachments

- Regulating for Agricultural and Public Outcomes: Perspectives and Recommendations (Attachment 1)
- Draft Summary: Stakeholder Perspectives on Moving Toward a New Regulatory Compact for Agricultural and Environmental Health (Attachment 2)
- Summit Packet (Attachment 3)

USDA Project No.: 15	**Project Title:** An assessment of springtime temperature inversion conditions and the usefulness of wind machines for frost protection in California coastal winegrape regions	
Grant Recipient: The Regents of the University of California, Cooperative Extension (UCCE)	**Grant Agreement No.:** SCB11015	**Date Submitted:** December 2014
Recipient Contact: Mark Battany	**Telephone:** 805-781-5948	**Email:** mcbattany@ucanr.edu

Project Summary

Wine grapes are prone to damage from spring frosts which can cause significant reductions in crop production and thereby lead to large economic losses to the area wine grape industry. Sprinkler frost protection has been the main protective method in many coastal regions, but increasing limitations on water supplies are making this method less available to growers. Alternative frost protection methods that use less water are needed if the economic viability of coastal wine grape production is to be maintained.

Wind machines are one potential replacement for sprinkler frost protection. A warming effect is achieved with a wind machine if there is warmer air above the ground surface that can be mixed with the colder air that typically occurs near the ground surface at the vine level. These temperature inversions are often expected to occur on typical radiation frost nights. The warmer the high-elevation air is relative to the vine-level air, the 'stronger' the inversion is. The stronger the inversion, the greater warming effect that can be expected from the operation of a wind machine.

The purpose of this project was to measure and characterize the temperature inversion conditions that occurred on spring frost nights throughout the vineyard regions of San Luis Obispo, Santa Barbara, and Sonoma Counties over three seasons. The ultimate purpose is to provide area growers with information on inversion conditions such that they can make the most informed decision possible with respect to their investments in frost protection methods. If the conditions indicate that wind machines can provide reliable protection from frost, then growers can make the shift to that method and ultimately use less water.

The current severe drought has placed agricultural water use in the forefront; any practices which can reduce the overall water use are now receiving large amounts of attention. The timing for this project could not have been better from this standpoint; water supply issues are at the forefront in all three of the counties where project staff conducted measurements. San Luis Obispo and Santa Barbara Counties are facing increased pressure on limited groundwater supplies, while Sonoma County is facing conflicts between agricultural pumping and ecosystem needs in the Russian River system. In no part of California or the Western US are water supplies for agriculture increasing; thus growers will need tools to protect their crops from frost damage that use as little water as is possible.

This project was not built upon a previously funded SCBGP project.

Project Approach

Project staff fulfilled the tasks as outlined in the work plan. Project staff installed and operated the novel meteorological towers that were previously developed by the Project Investigator (PI) at over 60 locations in the vineyard areas of the three study counties. The towers measured the air temperature at heights of five and 35 feet above the ground surface throughout the spring of 2012, 2013 and 2014. Overall there was a very high success rate in the operation of these towers, with very little data loss due to weather damage. No towers were stolen or vandalized.

Project staff originally planned to organize two frost protection themed conferences in early 2014 as part of this project. However, the large number of university and industry conferences at which staff was invited to present this project information in 2014 obviated the need to hold separate meetings.

Given the extraordinary drought conditions in the past winter, interest in non-sprinkler frost protection methods increased hugely. This resulted in numerous invitations to present the project results and methodology at conferences and seminars. The PI presented at a Sonoma County Viticulture conference on Dec. 6, 2013, at the UC Davis Current Issues in Wine and Grape Research Conference on Feb. 12, 2014, at the UC Davis Water Management Seminar on Feb. 20, 2014, at a Sonoma County Water Management seminar on Feb. 21, 2014, and at the UCCE Viticulture Seminar in Templeton, CA on Feb. 28, 2014. The total attendance at these meetings was 630 people.

Project staff is currently processing the large amount of data collected over the three years. Staff processed the data for the 2012 and 2013 seasons in the spreadsheets developed for this purpose, and that summary data was shown in presentations to industry in status updates of the project. Staff is now working on the overall summary of the three years of measurements.

This project was conducted in wine grape regions, thus the data collected is primarily of benefit to these industries. Other frost-prone specialty crops exist in some of these areas, primarily high-value berries; these industries may also benefit from the information that is developing from this project. No frost-sensitive, non-specialty crops exist in the measurement areas that would have benefitted from the project.

Non-official partners included the 60 cooperating commercial vineyard locations that allowed access to measure temperature inversion conditions on their properties. This project could not have been conducted without their generous cooperation.

Goals and Outcomes Achieved

The primary activity in this project was to assess the temperature inversion conditions throughout vineyard areas in Sonoma, San Luis Obispo and Santa Barbara Counties. Staff accomplished this by operating 60+ meteorological towers that sampled air temperature at 5 ft. and 35 ft. heights during the spring of 2012, 2013 and 2014.

The long-term goal of this project has been to provide growers with accurate data to make informed decisions on frost protection methods. If the data demonstrates that wind machines will provide useful and reliable protection in the regions studied, then this provides growers with the confidence to make the shift from sprinklers to wind machines. The UCCE doesn’t expect this to be a rapid process; it may take many years, as large investments have already been made in sprinkler systems. However, as was observed in Sonoma County in 2014, the lack of water supplies due to drought can spur the rapid adoption of wind machines when growers have no access to water for their sprinklers.

Project staff achieved precisely what was proposed to be accomplished in this project. The method to measure inversion conditions proved to be convenient and reliable, and enabled staff to gather data at a scale which has never been attempted in any previous research in this field. The success rate with the measurements was much higher than anticipated, as the methodology proved to be very robust and reliable over the three years.

Project staff successfully collected the proposed three years of springtime temperature inversion data for the three target counties. Staff is now working to process this very extensive data set into comprehensive scientific publications and targeted extension material directed at the wine grape industry in the three target counties. Staff intends to have this information available by late 2014 such that the grape industry will be able to utilize the results in their 2015 season decision making.

The ongoing extension updates on this project to the wine grape industry over the past three years have convinced many growers that this type of detailed information measured *in their own vineyards* would have great value in their decision making processes. Thus staff witnessed a steady growth in the number of private towers (constructed and operated following the instructions) being used by growers. In the spring of 2014, the number of these private towers exceeded the 60 towers that staff operated in the study. This very rapid adoption of the method by the private sector is a clear demonstration of the value that the temperature inversion measurements have for growers to make the most informed decisions. Instructions for building and operating the temperature inversion towers are available at this website:

http://cesanluisobispo.ucanr.edu/Viticulture/Frost_Protection/

Beneficiaries

The beneficiaries of this project are primarily the growers of wine grapes in the target counties. The methods used in this project will also serve as an example to growers of other frost-prone specialty crops in other parts of California and throughout the USA. If the long-term benefits of this project are a reduction in water use for sprinkler frost protection in vineyards, this will reduce pressures on water supply resources to the benefit of other users including environmental uses.

The value of the wine grape crops in the three target counties is nearly one billion dollars; the value added by associated wine production and tourism industries multiplies this many fold. Crop losses due to severe frosts can be substantial; for example the 2011 frosts in San Luis Obispo County reduced the overall crop by approximately 25% as compared to the previous year. Thus the overall economic impact of ensuring that appropriate and adequate vineyard frost protection methods are utilized can far exceed the investment made in conducting this study.

Lessons Learned

Project staff was able to carry out the proposed project as planned. One of the primary challenges was to find suitable sites to locate the temperature inversion measurement towers; this was made more challenging by the very large number of sites involved in this project. Luckily collaboration from the grower community was very positive to help this project succeed. The nature of the measurements made in this project means that an enormous amount of data needs to be processed to produce summary results; specialized spreadsheet programs were developed to help make this more efficient. However the current phase of final data analysis will take a considerable amount of work hours to accomplish. The grant proposal did not include any funding for salary support to conduct any of the work; if UCCE were to do this project over again, project staff would probably choose to make it a thesis project for a UC Davis graduate student including salary support for their time processing the collected data.

The focus on the importance of measuring the temperature inversion conditions and how this information can be used to make the most informed decisions on frost protection strategies has caught the interest of NOAA in their extensive work on the Russian River system in Sonoma and Mendocino Counties. NOAA has recognized the value that the types of measurements project staff are taking can have for improving frost forecasting as part of their overall efforts to maintain the health of the Russian River ecosystem. In 2013 NOAA provided additional monitoring equipment (value approximately $20k) that allowed the UCCE team to install eight live-reporting temperature inversion towers throughout vineyard areas of Sonoma and Mendocino counties. The data from these stations is uploaded automatically to the internet and can be viewed by the public. The success of this initial NOAA-funded project led to a NOAA grant awarded in 2014 for an additional $100k to fund 13 more live-reporting inversion towers in the same areas, and to upgrade the current eight towers to make them more permanent installations. This generous support by NOAA for the project will enable it to continue operating for many more years into the future, providing real-time temperature inversion data of use to vineyard managers as well as meteorologists and water resource managers in the Russian River watershed.

The NOAA website with the current data from the eight UCCE-NOAA inversion towers is available here:
http://www.esrl.noaa.gov/psd/data/obs/datadisplay/index.php?ProjectID=9
(Set the ‘Project’ to ‘Russian River Habitat Blueprint’ and click the ‘Update’ button to see just the eight towers)

Additional Information

Article: Online temperature inversion data for sites in the Russian River:
http://cesonoma.ucanr.edu/viticulture717/Viticulture_Newsletter/April_2014/Online_temperature_inversion_data_for_sites_in_the_Russian_River/

UCCE’s plan is to submit articles to the following journals:

An in-depth scientific article in the journal "Agricultural and Forest Meteorology":
http://www.journals.elsevier.com/agricultural-and-forest-meteorology/
This is a difficult journal to publish in; may have to submit elsewhere if they do not want to publish.

A general article in UC's "California Agriculture" Journal:
http://californiaagriculture.ucanr.edu/

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 16	**Project Title:** Improved Tracking of Water Use in Specialty Crops	
Grant Recipient: University Corporation at Monterey Bay	**Grant Agreement No.:** SCB11016	**Date Submitted:** December 2104
Recipient Contact: Lee Johnson	**Telephone:** 650-604-3331	**Email:** Lee.F.Johnson@nasa.gov

Project Summary

California's central coast is the leading region of cool-season vegetable production in the U.S., with Monterey County alone supplying about half of U.S. lettuce and broccoli production, valued in excess of $1.5 billion (Monterey County Crop Report, 2012). These specialty crops are typically well-watered to assure economic yields and market quality. Producers of vegetables and other specialty crops on the central coast of California are under regulatory pressure to reduce nitrate loading to groundwater supplies, which has been partly caused by long term over-irrigation and consequent drainage of crop nutrients through the soil profile. In addition, over-pumping of groundwater supplies for agriculture has contributed to seawater intrusion to coastal aquifers. These problems are aggravated by statewide water supply availability issues as impacted by episodic drought events. In Salinas Valley, for instance, water supply comes from groundwater, which is recharged by the Salinas River and ultimately by two large reservoirs - Nacimiento and San Antonio, both of which are at minimum release levels in 2014. With the lowered water table, some wells are at threat of going dry.

To address the challenge, there is a need for low-cost mitigation and adaptation strategies. One such approach is the employment of technologies that incorporate information on weather conditions and crop growth stage for evapotranspiration (ET) based irrigation scheduling. Support in this regard is provided by the California Irrigation Management and Information System (CIMIS), operated by the California Department of Water Resources (CDWR). CIMIS comprises a statewide network of weather stations that provide weather data and daily estimates of grass reference evapotranspiration (ETo) in agricultural regions. Users may elect to access data from the nearest station or from Spatial CIMIS, which provides daily gridded ETo at 2 km resolution statewide. ETo inherently accounts for the major meteorological factors affecting crop ET: solar radiation, air temperature, air humidity, and wind speed. Though ETo can help determine crop water requirements, USDA surveys indicate that only about 12% of California farms make routine use of such data to inform irrigation scheduling. Effective use of ETo requires additional calculations to account for effects of crop type, development stage and site-specific factors, and can be challenging for users to integrate with operational irrigation scheduling. Pre-tabulated crop coefficients can be used to perform an approximate correction to ETo. While useful, these simplified guideline values are not available for all crops or crop varieties, nor are they applicable to all management practices and site-specific conditions. Development of convenient, user-friendly tools that provide customized field information may therefore serve to increase adoption of ET-based practices for on-farm irrigation scheduling.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

Project Approach

This project called for the performance of a series of replicated irrigation trials in cool-season vegetables, to include planning, performance and data analysis. Four trials, two each on iceberg lettuce and broccoli, were performed at the USDA Agricultural Research Station in Salinas, California. The main goal was to compare ET-based irrigation scheduling with current industry standard-practice. Uniform sprinkler irrigation was used during crop establishment in all cases, followed by surface drip during the treatment period. Each experiment involved three treatments with five replications in a randomized block design. Two decision-support models were evaluated as follows: 1. an FAO56-based algorithm embedded in NASA's prototype Satellite Information Management System based on observed Fc (fractional cover, which is the proportion of the field that is covered by green vegetation), and 2. a U.C. Cooperative Extension on-line database driven irrigation scheduling tool, CropManage, based on modeled Fc. Both methods used daily reference ETo data from the CIMIS to translate crop coefficients to crop ET. The third treatment was irrigated according to grower standard-practice, estimated at 150-175% of ET replacement. All crops were grown to commercial standards, with cored-trimmed iceberg lettuce yields at ~20 tons/ac, and broccoli yields ~8 tons/ac, across treatments, in all cases approximately in line with industry averages. The key project conclusion was that use of these publicly available decision-support models for ET-based irrigation scheduling resulted in 23-34% reductions in applied water as compared to standard practice.

UC Cooperative Extension (UCCE) and USDA cooperated to successfully grow each crop to commercial standards. UCCE was responsible for overall guidance and oversight of cultivation practice, including fertility management and specification of irrigation amounts on the CropManage treatment. USDA provided daily monitoring of field condition, performed most upkeep tasks, and advised the project on third party crop management needs (such as herbicide/pesticide spray applications). UCCE and USDA assisted with harvest and equipment setup/removal, and advised on statistical analysis of yield and quality evaluation data. UCCE contributed significantly to the outreach effort, to include hosting an Irrigation/Nutrient Management Workshop that attracted over 100 specialty-crop growers and crop consultants in both 2013 and 2014. The workshops were held at the Ag Conference Auditorium of UCCE (1432 Abbott St., Salinas). Commercial cooperators (Fresh Express, Tanimura & Antle) advised on harvest timing, deployed harvest crews & equipment at their own expense, and provided guidance on crop quality evaluation.

Goals and Outcomes Achieved

The activities supported the planning, maintenance, data collection and data analysis associated with the irrigation trials. A key activity was using the decision models to prescribe irrigation amounts per treatment for each irrigation event. Uniform amounts of sprinkler irrigation were used for crop establishment. A surface drip system was then used to water the field plots in a randomized block design (3 treatments, 5 replications), managed through a three way irrigation manifold. Supporting cultivation practices included soil preparation, planting, crop thinning, weeding, spray treatments (pesticide, herbicide, and fungicide), fertilizer management, and harvest. Primary data collection included applied water, crop fractional cover, crop yield, and crop quality per treatment. Established statistical procedures were used to analyze the data for treatment effects.

The specific outcome measures, concerning the potential to improve specialty-crop irrigation efficiency, were achieved and demonstrated during the project term. Broader adaptation of decision-support tools by the grower community remains a longer-term objective. Toward this end, continued improvements are being made regarding the performance and accessibility of CropManage and SIMS. In particular, UCCE continues to hold grower workshops dedicated to CropManage operation, which has a growing subscribership and has gained additional programmer support at the institutional level. A beta version of SIMS continues to be developed in cooperation with specialty-crop growers statewide, in combination with ground-based ET monitoring. Utilities are being added to facilitate data extraction for end-users and to support the operation of other support models. Conduct of additional demonstration trials will be of continued importance in terms of grower outreach for both software tools.

Four side-by-side irrigation trials provided a quantitative basis for comparing standard irrigation practice with ET-based practice as guided by decision-support models operated in conjunction with CIMIS data. As compared to standard practice, reductions of 21-29% for lettuce and 28-34% for broccoli were observed for the ET-based methods. Several hands-on CropManage training sessions were held throughout the project, the most recent of which was at the Ag Conference Auditorium of UCCE/Salinas on May 1, 2014. The target audience for these workshops included specialty crop growers, farm managers, agency personnel, consultants, and specialty crop industry representatives. A total of 25 persons attended the most recent session. Project results were disseminated to the specialty crop and scientific communities in the form of several publications and presentations as listed below under Additional Information.

Several types of baseline data were successfully collected and archived on a per-treatment basis during each experiment. Irrigation amounts were monitored by flow meters during each irrigation event. Crop fractional cover was monitored every 3-4 days by a combination of direct dimensional measurements and by use of an Agricultural Digital Camera. Soil moisture was monitored every 3-4 days by tensiometers and capacitance probes. Vertical drainage was monitored per irrigation event by capillary lysimeters. Daily reference evapotranspiration was monitored by the CDWR and extracted from the CIMIS archive. Crop yield and crop quality data were gathered by cooperation with industry collaborators. Most datasets are archived as part of the CropManage website and database.

Two independently developed models (CropManage, SIMS) were used in conjunction with CDWR/CIMIS grass-reference ETo data to guide irrigation scheduling of cool-season vegetable crops at ET replacement levels. Both models are designed for ease-of-use, require no on-site sensor installation, and thus offer a convenient and cost-effective way to gain information on crop water requirements for large numbers of fields. The four experiments performed in this study attained commercial yields under an ET-based irrigation regime that represented substantial applied water reductions of 21-29% for iceberg lettuce and 28-34% for broccoli as compared with grower standard practice and baseline data compiled by University of California, Division of Agriculture & Natural Resources (UCANR).

Beneficiaries

The main project beneficiaries are growers and shippers of cool-season vegetables based in the coastal valleys of California, which is the leading production region in the U.S.

Cool-season vegetables are produced on 331,633 acres on the California coast, with valuation of $2.13 billion annually. The specific crops addressed in this study (broccoli, head lettuce) rank in the top-ten Monterey County crops in terms of acreage and revenues.

Lessons Learned

The industry outreach effort has reinforced the need for decision-support tools to be designed with strong emphasis on human factors, accessible user interface, and implementation on a variety of mobile platforms. Software upgrades were performed with respect to these factors throughout the project, based on user feedback, with additional revisions planned under funding from additional sources.

Hardware costs for fabrication of the irrigation manifold, a hardware assemblage of filters, meters, and pumps that delivered water to the three treatments, were mistakenly underestimated initially. This matter was overcome by budget reallocation, and was discovered early enough in the project (during planning sessions) such that it had no impact on schedule or workplan.

Due to rapid growth rate and corresponding high nutrient demand typical of broccoli, water above the ET replacement level was applied during two fertigation events in year 1 in order to sufficiently flush nitrogen from the driplines. This added increment amounted to a total of about 0.3 inches, for the 100% ET replacement treatments. This situation was addressed the following year by applying nitrogen during longer irrigation runs (ie, those that operated on a somewhat longer time interval), though this solution must ultimately be balanced against crop condition.

Additional Information

Papers and conference presentations:

Johnson, L., M. Cahn, F. Martin, F. Melton, S. Benzen, B. Farrara, and K. Post. Evapotranspiration-based irrigation scheduling of iceberg lettuce and broccoli in Salinas Valley, California. *Hortscience* (in final prep).

Johnson, L., M. Cahn, F. Martin, F. Melton, C. Lund, B. Farrara, and S. Benzen, 2014. Results from 2012-2013 irrigation trials in cool-season vegetables. Proceedings, USCID Water Management Conference, pp 27-34, U.S. Committee on Irrigation & Drainage, 4-7 March, Sacramento.

Cahn, M., R. Smith, T. Hartz, B. Farrara, L. Johnson, and F. Melton, 2014. Irrigation and nitrogen management decision support tool for cool season vegetables and berries. Proceedings, USCID Water Management Conference, pp 53-64, U.S. Committee on Irrigation & Drainage, 4-7 March, Sacramento.

Johnson, L., M. Cahn, F. Martin, F. Melton, C. Lund, B. Farrara, and S. Benzen, 2013. New tools for ET estimation and irrigation management in specialty crops. Paper #131595001, Proceedings Amer. Soc. Agric. & Bio. Engrs., Annual Int'l Mtg. (ASABE Technical Library), 21-24 July, Kansas City.

Cahn, M., R. Smith, T. Hartz, and B. Noel, 2013. Irrigation and nitrogen management web-based software for lettuce production. Amer. Soc. Hort. Sci., 22-25 July, Palm Desert. (abstract)

Johnson, L., M. Cahn, F. Martin, C. Lund and F. Melton, 2012. Irrigation trials for ET estimation and water management in California specialty crops. Amer. Geophysical Union, 3-7 Dec., San Francisco. (abstract)

Articles, newsletters:

New Tools Provide Precise Vegetable Irrigation, AgAlert (Calif. Farm Bureau Federation), 16-Apr-2014.

Cahn, M., L. Johnson, F. Martin, and F. Melton. UCCE Crop Notes newsletter (in prep).

Annual workshops:

ET-based irrigation scheduling of lettuce, broccoli, and other cool season vegetables, Irrigation and Nutrient Management Meeting, UC Cooperative Extension, 12-Feb-2014, Salinas.

ET-based irrigation scheduling of cool season vegetables, Irrigation and Nutrient Management Meeting, UC Cooperative Extension, 26-Feb-2013, Salinas.

Cropmanage model presentations/workshops:

UCCE/Sustainable Agriculture Research Education, Farm Bureau Santa Clara Co., Green Valley Farm Supply, UC-ANR, Univ. Arizona, Driscoll's, Central Coast Ag Water Coalition, Ventura Resource Conservation District, Central Coast Agricultural Water Quality Alliance, CDFA/FREP, Reiter Affiliated Companies, UCCE Santa Cruz Co., UCCE Santa Barbara Co., Ventura Co. Farm Bureau, Calif. Crop Advisors, AgKnowledge, Taylor Farms, Hartnell College, Chiquita Fresh Express.

SIMS model presentations:

Western Growers Assn., Calif. Irrigation Institute, Central Coast Agricultural Water Quality Alliance, Calif. Dept. Water Resources, US Committee on Irrigation & Drainage, CSUMB Agricultural Outreach Event, CSU Stanislaus GIS Day, Amer. Soc. Agronomy, Amer. Soc. Photogrammetry & Remote Sensing, Amer. Soc. Enology & Viticulture, Amer. Geophys. Union, Amer. Soc. Civil Engineers, Assoc. Amer. Geographers, CalGIS Ag/Natural Resource Symposium, Calif. Water Law Symposium.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 17	**Project Title:** California Berry Crops: Improving Water-use Efficiency While Maintaining Crop Quality	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB11017	**Date Submitted:** December 2014
Recipient Contact: Shermain Hardesty	**Telephone:** (530) 752-0467	**Email:** shermain@primal.ucdavis.edu

Project Summary

Due to California's long-term drought and escalating water prices in some regions of the state, specialty crop growers need to determine if they can reduce their water use in the production of specialty crops, specifically blueberries, blackberries, and strawberries--without sacrificing yields and quality. Currently, there is no known baseline irrigation requirement for blueberry, strawberry, or blackberry production in California. Current research indicates that strawberry growers routinely overwater their crops, often by as much as 15-20%. The near and long-term effects of decreased water availability will alter the way berry crops are grown; farming practices will need to be modified to use water more efficiently with concomitant adjustments for salinity and nitrogen management. The project's purpose is to quantify the effects of reduced irrigation on yield and normal growth parameters on strawberries, blueberries, and blackberries. The project findings will be very valuable because of the state's water shortages and the resulting economic importance of berry crops to the state's overall horticultural sector, and agricultural economy.

Currently, California is enduring its third driest year (2014) on record as agricultural, urban, and environmental demands for water are at an all-time high. The recently submitted report by UC Davis Center for Watershed Sciences concluded that the 2014 drought will result in a 6.6 million acre-foot reduction in surface water available to agriculture, with partial replacement by increasing groundwater pumping by 5 million acre-feet. The direct costs of the drought to California agriculture were projected to total $1.5 billion, with the statewide economic cost of the 2014 drought projected to total $2.2 billion, and a total loss of 17,100 seasonal and part-time jobs.

This project did not build on a previously funded SCBGP project.

Project Approach

The project involved five major research activities and objectives: 1. Conduct irrigation trials of strawberries, blueberries, and blackberries using varying levels of irrigation. 2. Analyze postharvest crop quality effects of the irrigation treatments. 3. Analyze effects of the irrigation treatments on crop nutritional content. 4. Determine effects of the irrigation treatments on consumer sensory quality and 5. Assess the impact of irrigation treatments on crop yields and profitability. Various outreach activities were conducted to disseminate the research findings to specialty crop growers, farm and resource management specialists, and the broader agricultural and scientific community. Analysis of variance testing was conducted for various measures mentioned, such as crop quality and yield to determine if the differences in measures across irrigation treatments were due to the irrigation treatments or attributable to random fluctuations. Test results were considered to be statistically significant if they were different at the 95% level of probability. The tasks, results, and conclusions are summarized below for each objective.

Objective #1. Irrigation trials:
The co-PIs and University of California (UC) irrigation specialist collaborators developed an irrigation protocol, designed the irrigation systems for each berry crop, and identified specific equipment needed. It was determined that it would be more effective to use 4, rather than 5, irrigation regimes: 50%, 75%, 100%, and 125% of crop Evapotranspiration (ET). One Co-PI added a 5th irrigation regime of 150% of crop ET in years two and three. Four or five replications were included for each irrigation treatment. Thus, there were 16 or 20 plots for the specific berry. The farm advisor Co-PIs reviewed various irrigation trial articles, and calculated the ET coefficients for each crop and location. Also, planted Ouachita blackberries, Snowchaser blueberries and Albion strawberries (Benicia variety was substituted in Orange County because of Albion's poor production there). In addition to that, maintained and monitored the planted plots, harvested the crops, and recorded crop yields. Once during the production season (usually during the peak harvest period), the farm advisor co-PIs arranged with staff for transportation of the harvested crop to UC Davis for postharvest quality and nutritional analysis; and, sometimes sensory testing.
During the two year and nine month project period, 8 crops of blackberries from three locations, 4 crops of blueberries from two locations, and 6 crops of strawberries from three locations, were harvested. However, the grant ended before the 2014 blackberry harvests can be completed in two of the locations; therefore, complete yield data were available for only 6 blackberry harvests. The yield data analysis is reported under Objective #5.

Objective #2. Postharvest quality effects of irrigation treatments:
When the berries arrived at UC Davis, Co-PIs measured the visual quality of the berries at arrival, and again after storage. The visual quality rating scale ranged from 1 (excellent) to 4 (unmarketable/poor). Co-PIs also measured the number of diseased berries in a clamshell at arrival, and again after storage.

Samples from 5 blackberry harvests were analyzed for visual appearance; 2 were from Fresno County, 2 were from Santa Clara County, and 1 was from Santa Barbara County (Attachment 1). There were no statistically significant differences in appearance across the irrigation treatments at harvest for the blackberries. After 5 days of storage, only 1 harvest had statistically significant differences; visual appearance worsened as the irrigation levels decreased. There were no statistically significant differences in the number of diseased blackberries across the irrigation treatments, neither at harvest nor after 6 days of storage.

Samples from 4 blueberry harvests were analyzed for visual appearance; 3 were from Fresno County, and 1 was from Orange County. There were no statistically significant differences in appearance across the irrigation treatments at harvest for the blueberries. After 14 days of storage, only one harvest had statistically significant results; the appearance of the blueberries grown with the highest irrigation level was significantly lower than that of blueberries grown with lower irrigation levels. Significant results were also obtained for the number of diseased blueberries.

Five harvests of strawberries were analyzed; two were from Orange County, two were from Santa Clara County, and one was from Fresno County. There were no statistically significant differences in visual appearance across the irrigation treatments for the strawberries; neither at harvest, nor after 6 days of storage. Similarly, there were no statistically significant differences in the number of diseased strawberries across the irrigation treatments, neither at harvest nor after 6 days of storage. Thus, Co-PI concluded that there was no consistent evidence that reducing irrigation adversely affected the visual appearance and shelf-life of blackberries, blueberries, or strawberries.

Objective #3. Nutritional effects of the irrigation treatments:
Co-PI analyzed the effects of the irrigation treatments on the nutritional content of samples for five blackberry harvests. The tests included berry weights, percent dry weight, total sugars (As well as the individual sugars fructose, glucose, and sucrose), total acids (as well as the individual acids citric, malic and shikimic), sugar/acid ratio, anthocyanins, phenolics and vitamin C. For the sake of brevity, only the results for total sugars, total acids, sugar/acid ratio, anthocyanins, phenolics and vitamin C are reviewed below. Only one blackberry harvested from Fresno County in 2012 had statistically significant differences; total sugar levels were significantly higher for blackberries grown with the lowest irrigation level. For this harvest, another significant finding was that the blackberries irrigated with 100% of ET had significantly lower total acid levels than did the blackberries grown with lower irrigation levels. None of the differences in sugar to acid ratios for blackberries were statistically significant.

Co-PI also analyzed samples from three blackberry harvests for their levels of anthocyanins, phenolics and Vitamin C, which are all phytonutrients considered to have possible health benefits as dietary antioxidants. Only one harvest from Fresno County in 2012 had statistically significant differences; the anthocyanins were significantly lower for blackberries grown with the lowest irrigation level (50% of ET).

Co-PI analyzed the nutritional effects of the irrigation treatments for samples from four blueberry harvests. Total sugar levels were significantly lower for blueberries grown in Fresno County in 2013, with the highest irrigation level (125% of ET). These blueberries also had significantly lower total acid levels than did the blueberries grown with 50% of ET irrigation. The blueberries grown in Orange County in 2014 with the lowest irrigation level (50% of ET), had significantly higher acid levels than did blueberries grown with more irrigation. The Fresno County blueberries (2003) grown with 50% of ET irrigation, had significantly lower sugar to acid ratios than did the blueberries grown with higher irrigation levels. The decreases in Vitamin C levels for blueberries grown with increasing irrigation levels were statistically significant.

Co-PI analyzed the nutritional effects of the irrigation treatments for samples from 4 strawberry harvests. For the 2012 crop grown in Santa Clara County, total sugars and sugar to acid ratios were significantly higher for strawberries grown with lower ET% irrigation levels. For the 2013 crop grown in Orange County, total sugars were significantly higher for strawberries grown with the 100% irrigation level than with the other irrigation treatments. Anthocyanins were significantly higher for the 2013 Santa Clara strawberries grown with 100% ET irrigation and lowest for the 50% ET irrigation. Conversely, phenolics were significantly higher for the 2012 Santa Clara strawberries grown with 50% ET irrigation than those grown with more irrigation.

Overall, the results of these nutrient content tests were mixed. There was some tendency for berries grown with the lower irrigation treatment, to have the higher total sugars and total acids. This would be considered a beneficial result of reducing irrigation.

Objective #4. Sensory effects:
The PI and Co-PI's staff conducted sensory testing with consumers of blackberries, blueberries, and strawberries from nine harvest samples. Consumers at farmers markets and grocery stores were provided with a small cup containing two to three whole berries (of only one type of berry) grown using the 4 irrigation treatments and asked to assess the appearance, flavor, and texture on a one to seven scale (1 being "dislike extremely" and 7 being "like extremely"). They were then asked to identify the cup which they preferred the

most. The tasting order of the berries was rotated to prevent order bias. Consumers were not aware that the berries they were evaluating were grown with different irrigation treatments.

Nine consumer sensory tests were conducted: 2 blackberries (1 in 2012, 1 in 2014); 3 blueberries (1 in 2013, 2 in 2014) and 4 strawberries (3 in 2013, 1 in 2014). Six of the tests were done in Davis California, 2 in Irvine, California and 1 in Fresno, California. The goal was to get 100 respondents at each testing; however, the number of respondents ranged from 52 to 100, depending on the amount of harvested berries available. There was no irrigation treatment that was consistently preferred in this sensory testing. There were no consistent results among tests for a specific berry regarding average ratings for appearance, flavor, or texture by irrigation treatment. The differences in preferences among the 4 irrigation treatments were statistically significant in only 2 of the 9 tests; they were both for blueberries. In 2013, the blueberries grown in Fresno County with the 50% ET irrigation treatment were most preferred—by 35% of the consumers. In 2014, the blueberries grown in Fresno County with the 100% ET irrigation treatment were the most preferred—by 39% of the consumers. During the 2014 sensory test, consumers also rated the blueberries grown with 100% ET irrigation treatment the highest (with statistically significant results) regarding all three characteristics—appearance, flavor and texture. Such unanimity did not occur in any of the other 8 sensory tests. In the 4 strawberry sensory tests, berries grown with the 125% ET irrigation treatment were always the least preferred. Another consistent result was that the berries grown with the 125% ET irrigation treatment were never the most preferred in any of the 9 tests. The strongest conclusion that can be made from these results is that the 125% ET irrigation treatment adversely affects the sensory quality of the berries.

Objective #5. Impact of irrigation treatments on crop yields and profitability:
The Co-PI Farm Advisors harvested mature berries at least once a week. For each plot, their field assistants recorded the number of berries picked and the weight of both, the total harvest and of the marketable fruit. Total marketable yields for a growing season were calculated on a pounds per acre basis. Among the 8 blackberry crops harvested, the differences in yields across the irrigation treatments were statistically significant only for the 2013 and 2014 harvests in Fresno County. For both years, yields were highest for the berries grown with the 150% ET irrigation, followed by the 125% ET irrigation.

Among the 4 blueberry crops harvested, the differences in yields across the irrigation treatments were statistically significant for all 3 harvests in Fresno County. Curiously, yields were highest in 2012 for the blueberries grown with the least irrigation; this irrigation trial may have been compromised by rain that occurred in the late spring and which limited the number of times that controlled irrigation treatments were applied before the crops were harvested. In 2013 and 2014, the coPIs added a 5th irrigation treatment of 150% ET; during both years, total yields for the season peaked with the 125% ET irrigation treatment and declined for the 150% ET irrigation treatment. Among the 6 strawberry crops harvested, the differences in yields were statistically significant only for 2013 crop grown in Fresno County. Yields increased as irrigation levels rose.

Overall, these yield data provides evidence that yields tend to increase with irrigation levels. There can be a limit to this positive trend, as evidenced by the 2013 and 2014 blueberry harvests that had decreased yields for the 150% ET irrigation treatment. This finding merits further investigation for all 3 berry crops. If these results were to be replicated, it would be very important for growers to know that irrigating at 150% ET can reduce their yields and increase their costs; thereby, decreasing their profitability.

To quantify the effect of different irrigation treatments on profitability, a University of California Cost Study for a particular region close to one of this project's research plots was adapted for each berry crop (these costs studies are available at http://coststudies.ucdavis.edu/current.php). Yield data from this project were incorporated into the cost study. Since the cost studies were for previous years, costs were adjusted to 2013 values using USDA's Prices Paid by Farmers Index for all production items. Average crop prices for the production region in 2013 were calculated using shipping point prices in 2013 from custom reports run on USDA Agricultural Marketing Service's Fruit and Vegetable Market News Portal. Using the cost studies, costs, revenues, and net returns were projected for each irrigation treatment and its related yield (rounded-off). Note that this model includes a significant increase in blackberry yields when increasing irrigation from 100% of ET to 125% of ET, while yield increases for blueberries and strawberries are much more moderate.

The impacts of different irrigation treatments on net returns per acre of production of blackberries, blueberries, and strawberries are displayed in the attachment 2. The highest return irrigation treatment for each berry crop and irrigation cost scenario is shaded in the attachment. The inflation-adjusted irrigation costs from the Cost Studies ranged from .5% to 4.1% of total costs--clearly a relatively small proportion of total costs for these high value crops. At these irrigation cost levels, profitability is directly correlated to yields. With the exception of the 150% of ET irrigation treatment for blueberries (with the reduced yield), net returns increase as irrigation levels rise. To estimate the impact of potential irrigation cost increases, net returns were projected for irrigation costs doubling, tripling and quadrupling; such cost increases are no longer sounding very unrealistic as drought conditions worsen. For blackberries, the additional revenue generated from the increased yields gained from applying additional water, exceeds the marginal cost of the increased irrigation, even when irrigation costs are quadrupled. This result is attributable to the significant yield increase from 100% of ET to 125% of ET. For blueberries, the results are different; when irrigation water prices triple, the most profitable irrigation option for blueberries changes from 125% of ET to 50% of ET. Similarly, the most profitable irrigation option for strawberries changes from 125% of ET to 100% of ET when irrigation costs quadruple. These results are determined by the crop's yield response to increased irrigation and the price of the berry crop, relative to the irrigation water cost increase.

Objective #6. Various outreach activities:
The PIs and coPIs shared the project results with growers and industry through workshops and two field days attended by over 200 individuals. Several CoPIs presented the project's preliminary research results from the consumer taste tests, and the quality and nutrient tests at the field days. One of the coPIs also demonstrated moisture sensing equipment. Since none of the analysis for any of the 3 crops was completed until spring, 2014, no peer-reviewed articles were published before the grant expired.

This research was limited to 3 specialty crops: Blackberries, blueberries and strawberries; thus eliminating the potential of enhancing non-specialty crops.

The PI managed the project's research and outreach activities, conducted the profitability analysis, led the consumer sensory testing, and participated in the outreach. The PI and UC Davis administrative staff also compiled the required administrative reports and invoices. The Farm Advisor Co-PI and UC irrigation specialist collaborators developed an irrigation protocol, designed the irrigation systems for each berry crop, and identified the specific equipment needed. The Farm Advisor Co-PI planted the research plots, maintained them, and monitored soil moisture levels; harvested the berries and recorded the harvest data. They organized and participated in outreach workshops and Field Days events.

Co-PI directed the assessment of the impacts of the irrigation treatments on postharvest quality (visual appearance ratings, diseased berry counts, shrivel, antioxidants, firmness, total soluble solids, total acids, chroma, and hue). Co-PI's staff collected the harvested berries from the Farm Advisor's Co-PI to conduct the sensory tests and the tests for postharvest quality and nutritional content. Co-PI also presented preliminary findings at outreach events. Junior Specialist Call, who works for Co-PI, conducted all of the statistical testing of the data for the 9 sensory tests, yield data for 18 crop harvests, and postharvest quality data from 14 harvests. Another Co-PI directed the assessment of the effects of the irrigation treatments on the nutritional content of 13 harvests of berries. The tests included measuring berry weights, dry weights, total sugars (as well as fructose, glucose, and sucrose), total acids (as well as citric, malic and shikimic acids), sugar/acid ratio, anthocyanins, phenolics and vitamin C. Collaborators helped design each location's irrigation trials. One of the collaborators provided berry production expertise. Farm collaborators provided land and irrigation water for the research plots, respectively, in Santa Clara and Santa Barbara counties. The University of California's Research and Extension Centers in Fresno County and Orange County also provided land and irrigation water for three sets of research plots.

Goals and Outcomes Achieved

The performance indicators for this project were specific activities, such as planting research plots, measuring crop yields, and conducting postharvest quality and sensory tests. The performance indicators did not include achieving specific results for these various research activities.

The Farm Advisor Co-PI started the project by designing five sets of research plots, installing soil moisture monitors, irrigation systems, and planting berry plants. They monitored soil moisture levels, maintained plantings, harvested the crops, and recorded yields and fruit counts. They arranged with other Co-PI and staff for transportation of the harvested crop to UC Davis for postharvest quality, nutritional analysis, and sensory testing. Co-PI's staff conducted the postharvest quality tests (Visual appearance and presence of diseases) for 14 harvest samples, 9 sensory tests, analyzed the data regarding postharvest quality, compiled yield data from eighteen crop harvests and analyzed it; and ran the statistical tests regarding the sensory data. Another Co-PI and staff measured dry weights, sugars, acids, Vitamin C, anthocyanin pigments, and phenolics for fourteen crop harvest samples.

The PI and Co-PI staff conducted nine sensory tests with consumers to assess the impact of the irrigation treatments on the appearance, flavor, and texture of the blackberries, blueberries and strawberries to identify the preferred irrigation treatment. The sensory data was then analyzed. The PI quantified the impact of different irrigation treatments on the profitability for each of the 3 berry crops in a different growing region. All of the Co-PI and the PI participated in outreach activities through workshops and Field Days. The team participated in 3 outreach events. Co-PI conducted the Blueberry/Blackberry Field Day and tour at the UC Kearney Field Station on May 21-22, 2013. Approximately 100 growers and researchers attended. Effects of irrigation regimes were highlighted during the tour of the blackberry and blueberry test plots. In January, 2014 Co-PI presented some of the project's preliminary results at the Central Coast Annual Caneberry Meeting in San Luis Obispo, California; there were 63 attendees. Co-PI organized a Berry Field Day for growers at the UC South Coast Research Station on April 2, 2014 in Irvine, California; there were 45 attendees. Several Co-PI presented the project's preliminary research results from the consumer taste tests and the quality and nutrient tests; and demonstrate moisture sensing equipment.

The project's long term goal was to reduce water used by growers for irrigation of their strawberry, blueberry, and blackberry crops while maintaining or enhancing product quality. Yields on the test plots increased with irrigation levels (except when irrigation was 150% of ET for blueberries); therefore, the production research results did not support the project's long-term goal. However, if irrigation water prices continue to increase and/or irrigation water availability becomes even more constrained, the results of the nutritional, sensory, quality tests and profitability analysis will support reductions in irrigation.

The team achieved its goals to test the impact of the different irrigation levels on season total yields, postharvest quality, and nutritional content for 4 blueberry harvests (1 each year in Fresno County, and 1 in 2014 for plots planted in Orange County in 2012). There were no statistically significant differences in yields in 2012, but they were statistically significant in 2013 and 2014. Regarding postharvest quality, there were statistically significant differences only in 2013. There were no statistically significant differences in the nutritional content tests for the blueberries in 2012, indicating potential compromise of the testing by the late spring rains. In 2013, there were some statistically significant differences in the nutritional content tests for the blueberries at the one of the locations. In 2014, there were some statistically significant differences in the nutritional content tests for the blueberries at one of the locations.

The team planned to test the impact of the different irrigation levels on season total yields, postharvest quality and nutritional content for 9 strawberry harvests (1 each year in each of three locations). Due to administrative delays with subcontract approvals for the Farm Advisor Co-PI, no plants were purchased in two locations to be harvested in 2012. One Farm Advisor Co-PI retired in June, 2013; therefore, only 6 crops of strawberries were harvested. Only 1 harvest had statistically significant differences in yields for the different irrigation treatments, Fresno County in 2013. There were no statistically significant differences in postharvest quality for the different irrigation treatments.

The team planned to test the impact of the different irrigation levels on season total yields, postharvest quality and nutritional content for 9 blackberry harvests (a harvest each year in each of 3 locations). In 2012, rain during the spring in two of the three regions allowed for only minimal control over irrigation levels. Yield data were collected in two of the three locations in 2012; there were no statistically significant differences. In both 2013 and 2014, there were statistically significant differences in blackberry yields in Fresno County. During 2014, the grant ended before the blackberry harvests in Santa Clara and there were statistically significant differences in total sugars, sugar/acid ratio and phenolics in 2012 in one region, just anthocyanins in 2013 in the same region, and just total sugars for another region in 2013 in different locations.

The team planned to conduct eight sensory tests; 9 sensory tests were conducted with 807 consumers. There was no consistency in the sensory test results, except that the berries grown with the 125% of ET irrigation treatment were consistently not the most preferred choice.

The PI had planned to conduct the profitability analysis during Winter-early Spring 2014, after most of the harvested crops had been analyzed. Since there were very few significant differences observed in the test for the 2012 and 2013 crops, the profitability analysis was delayed until June 2014, after some additional yield data, postharvest quality data, and nutritional content data were available. The analysis indicated that, except for the 150% of ET irrigation treatment for blueberries (with reduced yield), net returns increased as irrigation levels rose. Net returns were projected for irrigation costs doubling, tripling, and quadrupling. For blackberries, the large increase in yields attributable to the 125% of ET irrigation, kept this highest level of irrigation as the most profitable irrigation option. For blueberries, the results are different; when irrigation water prices tripled, the most profitable irrigation option for blueberries changed from 125% of ET to 50% of ET. Similarly, the most profitable irrigation option for strawberries changed from 125% of ET to 100% of ET when irrigation costs quadrupled. These results are determined by the crop's yield response to increased irrigation and the price of the berry crop, relative to the irrigation water cost increase. These findings of the profitability analysis have not been disseminated yet.

The team did not plan to have a specific number of outreach activities. Instead, the outreach target was to determine optimal irrigation levels for each crop and region, and then disseminate the findings at regional Field Days in 2013 and 2014 with; 25 strawberry growers and 20 blackberry growers in Santa Clara county and the surrounding area; 20 strawberry growers and 10 blueberry growers in San Diego county; 50 strawberry growers, 20 blueberry growers; and 15 blackberry growers in Fresno and Tulare counties. There were 208 attendees at the 3 workshops and Field Days; this number is greater than the initial 160 planned total.. The PI and Co-PI will continue to share results from this project at future workshops and the Field Days events.

Currently, there is no known baseline irrigation requirement for blueberry or blackberry production in California; research indicates that strawberry growers routinely overwater their crops, often by as much as 15-20%. There were no conclusive results from research to share with growers that would convince them to reduce irrigation levels on their berry crops and not impact crop quality. Growers were not asked if, and how much, they have been reducing their irrigation levels on their berry crops. It could not be concluded if the lack of significant impacts of reduced irrigation on postharvest quality and nutritional content mean that growers of blackberries, blueberries and strawberries can reduce their irrigation levels without compromising the postharvest quality and should consider reducing their irrigation levels. But, there were some complications in conducting the research that could have compromised the results. More research is needed over a longer period of time to support reduced irrigation levels. However, increased irrigation costs could eventually cause growers to reduce their irrigation level; the projection in the profitability analysis supports the shift to lower irrigation levels with berry crops, particularly if the yield increases, it is not disproportionately large for the 125% of ET irrigation level.

There were no consistent findings on the impacts of the varying irrigation levels on postharvest quality, composition, yields, and sensory quality. The strongest results were: 1. The reduction in blueberry yields with 150% of ET irrigation; 2. The tendency for total sugar levels to be the highest for the berries grown with 50% of ET irrigation; 3. The fact that the 125% irrigation level was never the preferred irrigation treatment for any berry in the nine sensory tests involving 807 consumers; and 4. The profitability analysis indicated that, as irrigation costs increase, growers will be likely to reduce their irrigation levels, particularly if crop yields are not highly sensitive to lower irrigation levels.

Beneficiaries

Growers of blackberry, blueberry, and strawberry crops have better understanding of interplay of irrigation practices, salinity management, and rainfall. Blackberry growers and technical service representatives are more cognizant of the role of red berry mite infestation, salinity management, and "reversion" phenomenon in blackberry fruit quality and yield. Agriculture industry professionals (Project team, University of California researchers and personnel from USDA agencies) have a better understanding of irrigation practices and salinity management for berry crops. The state of California also benefits by learning more about water requirements and possible reductions in water usage.

Thus far, 208 individuals who are mainly farmers and agriculture industry professionals have formally heard about some of the findings from this project. This number will increase when the news and articles are released about the findings, as well as the presentation of results at more workshops regarding the strongest findings which are: 1. The reduction in blueberry yields with 150% of ET irrigation; 2. The tendency for total sugar levels to be the highest for the berries grown with 50% of ET irrigation; 3. The fact that the 125% irrigation level was never the preferred irrigation treatment for any berry in the nine sensory tests involving eight-hundred seven consumers; and 4. The profitability analysis indicated that, as irrigation costs increase, growers will be likely to reduce their irrigation levels, particularly if crop yields are not highly sensitive to higher irrigation levels.

The potential economic impact for each crop is difficult to assess since irrigation requirements vary by location and weather. Additionally, irrigation water costs per acre foot vary considerably across the state. Potential cost savings from reduced irrigation can be estimated using California acreage data from USDA-NASS report for the 3 berry crops, assuming irrigation costs of $400 acre foot and current irrigation requirements of 1.8 acre feet per season for blackberries; 3.0 acre feet per season for blueberries; and 2.91 acre feet per season for strawberries. 5%, 10% and 25% reductions in irrigation for these three crops will generate, respectively, annual statewide costs reductions of $2.7 million, $5.5 million and $13.7 million. If the current drought persists, irrigation water costs will rise and the cost savings from water conservations will increase. Another economic benefit of reducing irrigation for berry crops is the value of other crops that could be grown with the conserved water.

Lessons Learned

This irrigation research is important from the standpoint that growers and the public need to be aware of the watering frequencies; it has an effect on amounts and impacts on yields, quality, and flavor of the berry fruit.

Irrigating berry crops at the 125% of ET levels adversely impacted their sensory quality. Irrigating blueberries at the 150% of ET level adversely impacted profitability; it reduced yields and increased cost. Fruit size diminished with water stress, and so did fruit marketable quality. Also, blackberry and blueberry plants withstood water stress better than strawberries because of their perennial nature, deeper root system, and woody structure.

The good news, from a grower's perspective, is that irrigation levels appeared to not be so critical in maintaining a consistent nutritional composition for a berry crop. From a scientific standpoint, a broader range of treatments was needed to know where irrigation actually affected nutritional composition; that was not achieved in this project. More frequent salinity sampling in the research field enabled growers and consultants of diverse perennial crops to appreciate accumulating salinity in absence of leaching winter rains.

Unfortunately, the year the strawberries were grown in Fresno County, coincided with an extreme hot weather that lasted for multiple weeks. This had a negative impact on the total yields. However, there were consistent trends in the plot replications that were still valuable in making some of the conclusions.

There was large variation in the fruit nutritional composition from trial to trial (location to location) although the same cultivar was used. Some of the location difference was due to climate (coastal versus inland); however, year to year results from the same trial were generally similar.

The trial plots and surrounding commercial planting had high amounts of culled blackberry fruit due to non-uniform ripening. Also, both red berry mite infestation and “color reversion,” where some individual drupelets turned from black to red after cooling, left the fruit looking unevenly ripe. Both, red berry mite infestation and color reversion are poorly understood; they are difficult to quantify and evaluate, which often results in difficulty managing it.

Furthermore, there were negative variables beyond control at the University field research station: Coyotes chewed the drip tape, birds ate the plants/fruits, and the weather heat wave. During the harvest period starting April 1, 2013 to June 15, 2013, there were 21 days with temperatures over 90 degrees, and nine days over 95 degrees, according to the weather station in Parlier. This affected flower pollination, set, and yield results. Strawberries typically prefer temperatures ranging under 85 degrees. The spikes in temperature affected the fruits ready to harvest, as well as future crops since the plant has fruits and flowers in varying stages. Due to the wet spring in 2012, the farm advisor Co-PI in Santa Clara and Fresno counties had only minimal opportunities to apply the irrigation treatments to strawberry and blackberry plots before the crops were harvested. It was difficult to sort out the impact of drought conditions, low winter rainfall, and accumulating salinity on irrigation management.

Often, the quantity of fruit that were ripe at a given time was limited. This was not a problem for the nutrition compositional analyses (fewer clamshells required), but was problematic for the postharvest studies. Many times there was not enough fruit to conduct all shelf life evaluations, or to do quality and sensory evaluations on the same samples. The missing data made it difficult to compare and identify trends.

There are often limitations with on-farm trial management due to farm conditions and grower management of resources and people. No matter how isolated the experimental area is from the main irrigation system, the investigator still relies on the overall ranch/farm system. Cooperating growers and managers have a problem seeing parts of the field stressed and may want to apply more water. Co-PI had difficulty convincing irrigators to maintain different irrigation schedules; it may be beneficial in the future to inform cooperators before proceeding. There may be research benefits from establishment of trials on sites where there are no limitations on irrigation water quality for salinity management, but application to on-farm conditions may not be typical or representative.

Timing of the grant award was critical in two ways: First, this award was received late in October, 2011, and the University administration was slow in processing the initial award, which resulted in Farm Advisor’s Co-PI sub-award to be delayed; and secondly, there were no funds to purchase strawberry start-ups to plant and harvest for the following crop year. Once the planting window for a crop has passed during the year, the planting must be delayed until the next year. Commercial nurseries do not carry the plants during the “off season” and crops that are planted late are often lost since the plants are not well-established and are unable to withstand the colder, wetter weather.

When working with such small fruit, it is near impossible to directly compare consumer preferences with the fruit's actual quality and composition. Perhaps there is a better way to overcome this limitation, such as using a trained panel or a different setup for the consumer survey.

Additional Information

Attachments are included.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 18	**Project Title:** Development of Sustainable Infrared Dry-Peeling Technology for Fruits and Vegetables	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB11018	**Date Submitted:** December 2014
Recipient Contact: Dr. Zhongli Pan	**Telephone:** (530) 752-4367	**Email:** zlpan@ucdavis.edu

Project Summary

The conventional lye and steam peeling of fruits and vegetables are very water- and energy-intensive methods. These methods generate large amount of wastewater that results in severe environmental impact. The hot lye peeling uses sodium/potassium hydroxide which produces high saline wastewater that is also costly to treat. The severe drought occurring in California and other states, and the strict environmental regulations for the disposal of food processing wastewater, exhibit the urgent need in sustainable processing technologies for specialty crops. Therefore, the food processing industry is under pressure to replace the traditional methods for vegetable and fruit peeling. The development of non-chemical, dry-peeling technology has recently been identified as a top priority in California. Infrared (IR) radiation is energy in the form of electromagnetic waves or electromagnetic radiation. IR heating uses IR radiation energy of a specific wavelength to heat it effectively. The IR heating of agricultural and food products has a high rate of heat transfer and reduced NOx emissions. Developing the IR dry-peeling technology is important to realizing the benefits of the sustainable peeling process because it does not need water or chemicals. Based on the University of California, Davis' previous research, IR peeling has a great potential to replace current methods to address challenges faced by food processors. The main objective of this project was to develop a new IR dry-peeling system to produce products with superior quality, and reduce peeling loss compared to lye and steam peeling. The specific objectives of this project were to:

1. Develop a pilot-scale IR dry-peeling system with flexible processing parameters including selective IR intensity, product to emitter gap size, IR residence time, conveying systems, and peeling eliminator to peel a variety of fruits and vegetables;
2. Evaluate peeling performance and product quality including peeling easiness, peel removal percentage, peeling yield and recovery and product color and texture;
3. Optimize operational and design parameters of pilot-scale system; and
4. Demonstrate an IR dry-peeling system to food processors to highlight merits, disseminate the technology and promote commercialization.

In California, more stringent requirements have been imposed by the Regional Water Quality Control Boards to reduce the level of salinity in wastewater. Ever-tightening environmental regulations have arisen in the recent years regarding lye usage and its disposal. This calls for developing alternative chemical free peeling methods that can effectively peel fruits and vegetables while minimizing peeling losses and improving product quality. The California Energy Efficiency Roadmap (2006) identified development of non-chemical peeling technology as a top priority in the California's food industry. The industry processes 16-18 million tons of food yearly, mainly canned fruits and vegetables; therefore, food processing is under pressure to replace the current peeling methods to solve environmental pollution and long-term water supply problems, and increase the competition of peeled products. The IR dry-peeling technology developed through this project will significantly benefit the food industry and society due to savings in water and water-related energy use, higher quality products, value-added by-product recovery, and reduced environmental pollution.

This project does not build upon a previously Specialty Crop Block Grant Program funded project.

Project Approach

1. **Design and built prototype IR peeler**

A prototype IR peeler was designed and built as shown in Figures 1, 2 and 3. The prototype was vital to clarify the designing parameters including emitter configuration, conveying roller, and peeling eliminator profiles. The constructed prototype had a conveyor and IR heating section. The conveying system was equipped with rollers on which collars were installed. The collars were used to rotate fruit with unique shapes (e.g. pears) under the IR emitters so that uniform heat could be provided over the fruit surface.

(a) (b)

Fig 1 Prototype conveyor and IR heating section designed for testing fruit and vegetable peeling using infrared: (a) front and (b) side views

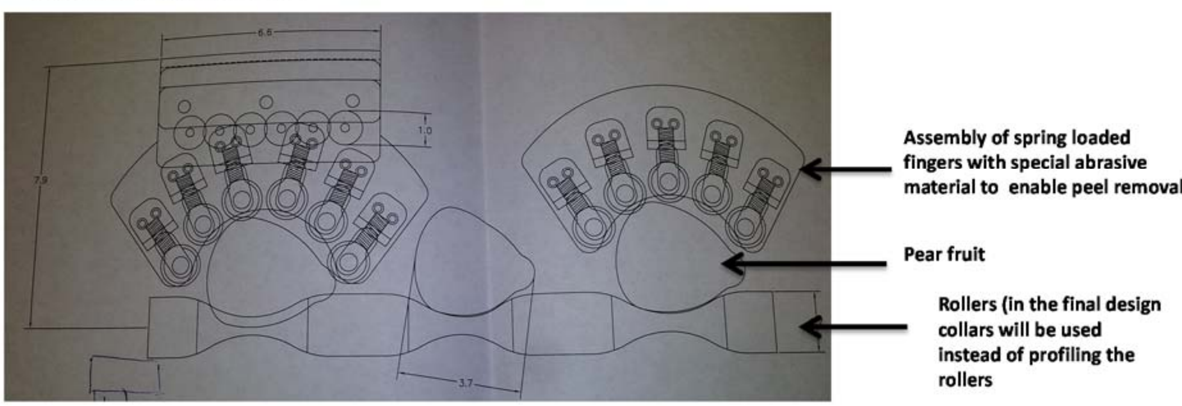


Figure 2 Peel removal section with and assembly of spring loaded fingers with special abrasive material to enable peel removal.

Figure 3 Elements of the fabricated prototype peel remover. The spring loaded fingers are equipped with special abrasive material to enable peel removal.

2. Test the processing parameters of the prototype devices

The prototype equipment was tested to determine specific considerations incorporated in the final design of the peeling system. Based on the test results, two heating sections were specified to achieve uniform heating and ensure complete peel removal of pears. The residence time was found in a range from 90-135 s under the first double sided heating zone, and 30-60 s for heating the bottom part of fruits at the second heating zone. In the final equipment design of three rows were determined to be optimum for delivering the pear to the IR heating zone. To avoid an edge effect, the pears should be placed at a horizontal location of at least 2.5 inches away from the edge of IR emitters (emitter dimensions of 12”×24”), while at the same time the gap between pears and emitters should be maintained as close as possible. Also, the prototyping steps were critical to determine the appropriate diameter of the roller and collars and delineate the location and curvature of the collar on the rollers to accommodate different fruits and vegetables.

3. Design pilot scale IR dry-peeling system

A pilot scale IR dry-peeling system was designed to effectively peel the different fruits and vegetables. Because the system is designed to peel multiple fruits, the following considerations were taken: (1) the design layout was adjusted to achieve harmonious operation of the different sections of the system; (2) heating the selected fruits and vegetables uniformly to achieve effective peeling with a short time; (3) optimal roller profiles for effective fruit rotation and conveyance; (4) the roller profile which provides uniform rotation of pears during conveyance under infrared emitters to achieve appropriate heating approach; and (5) assemble a peel removal/elimination section facilitated with proper rubbery fingers to achieve effective peel removal. A schematic diagram of the heating units of IR dry-peeling system is shown in Figs.4 and 5. A schematic diagram of peeling elimination unit is shown in Fig. 6.

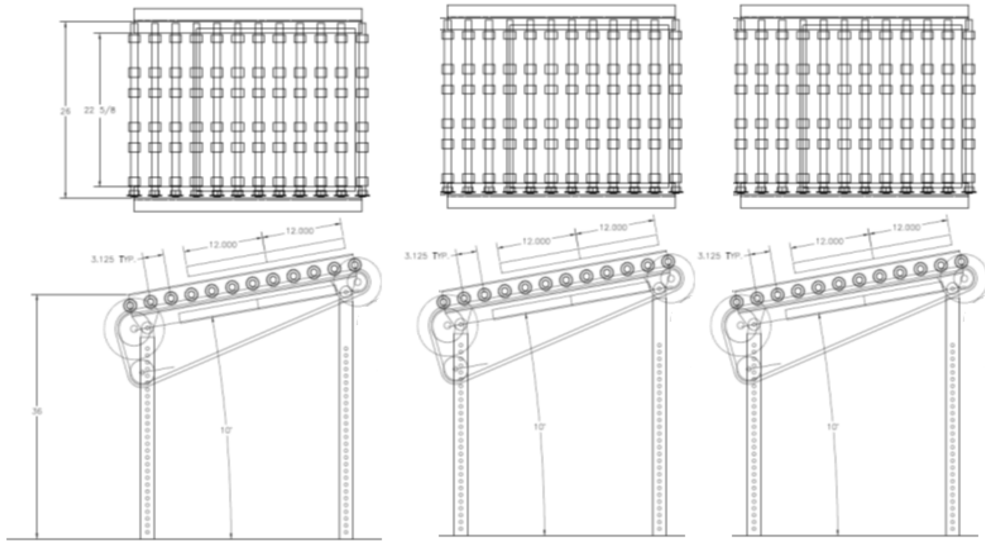


Figure 4 Schematic diagram representing heating units of IR dry-peeling system.

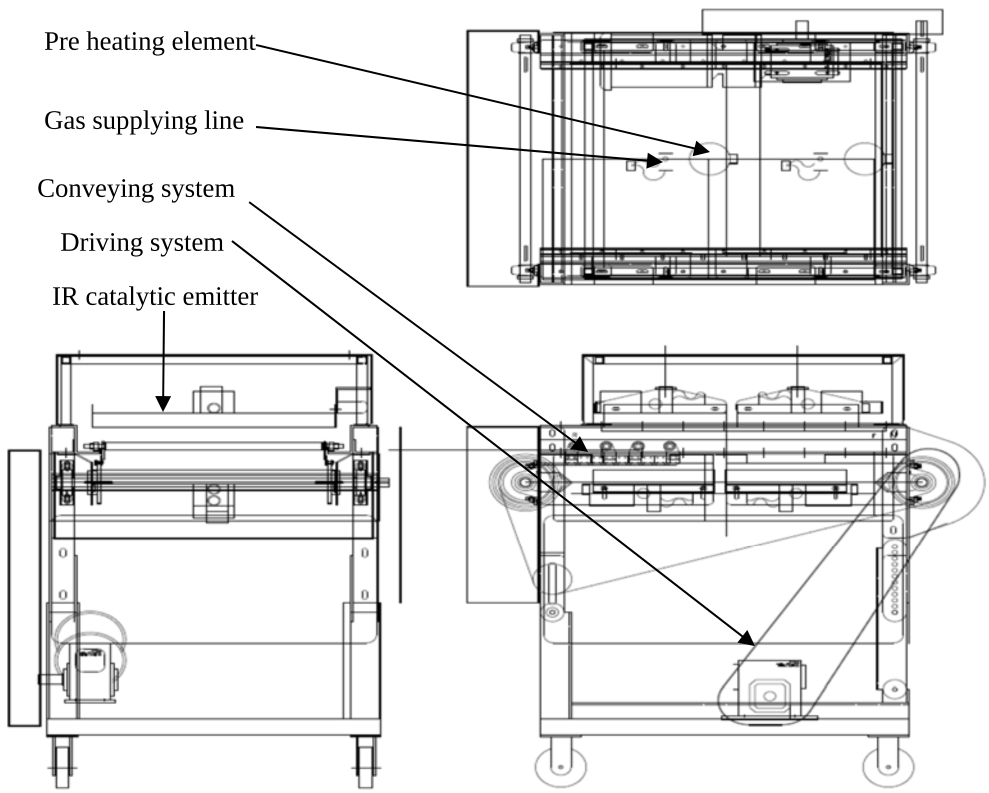


Figure 5 Schematic diagram of heating unit components.

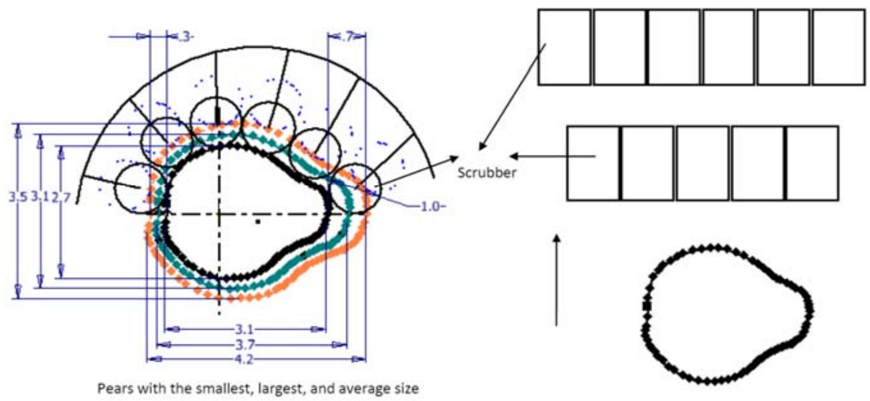


Figure 6 Schematic diagram of peeling elimination unit.

4. Fabricate and assemble the pilot scale IR dry-peeling system

A pilot-scale IR dry-peeling system with flexible operating conditions and design parameters to peel fruits and vegetables was successfully fabricated (Figure 7). The system consists of three heating units, which are operated automatically and continuously to insure peeling of selected fruits and vegetables. Each heating unit consists of four catalytic IR emitters, conveying system, gap size controller, four gas lines facilitated with gas controllers and pressure gauges, digital electric motor to control conveying speed and resident time of products. The catalytic IR emitters are powered with natural gas. Two heating units matched with the peeling eliminator unit are used for pear peeling. The first heating unit loosens pear skin from flesh through rapid IR heating. The second heating unit ensures uniform heating of the bottom part of pear. After passing through the second heating unit, the pears are transferred to the peel elimination section to remove loosened skin. The third heating unit was fabricated with specific conveying roller distance and collar holder position suitable to peel tomatoes. The necessary safety guards, to fulfil the safety issues required by the UC Davis safety services department, were also installed in heating units and the peeler eliminator. The heating units were tested for the emissions of CO_2 and NOx. The emission tests were carried out by the UC Davis industrial hygienist. The CO_2 and NOx concentrations were measured directly over the emitters and around the machine. The emission tests showed that there were no emissions of NOx from the four emitters. The measured CO_2 in the air was slightly higher than the normal concentration in the laboratory atmosphere. The heating units are allowed to operate in the laboratory without any additional safety requirement.

(A)

(B)

Figure 7. Fabricated units: (A) heating units (B) peel removal unit.

5. **Test the IR dry-peeling system's processing parameters**

5.1 Test conditions

The IR dry-peeling system was tested using pears and tomatoes to optimize the system processing parameters. Pears, variety (Bartlett) and tomatoes variety (HZ5608) were obtained from commercial growers in Californian. Pears from early and mid-season with a diameter ranging from 77 to 87 mm and a height ranging from 75 to 100 mm were used in the tests. The pears were ripened in the pomology lab in the University of California Davis (Fig. 8 A and B). They were placed in a cold storage (0 °C) for 12 days then transferred to a ripening room set at a temperature of 20 °C and with a relative humidity of 95% for five days. Tomatoes with sizes ranging from 50 to 56 mm were used. Tomatoes were sorted using a sorter with different size slots (Fig. 8 C). The peeling testers were carried out under a single row and full load (3 rows for pears and 4 rows for tomatoes). Ten replicates for single row and three replicates for full loads were conducted. Different residence times ranging from 55 to 121 sec for pears and from 43 to 93 sec for tomatoes were tested. A minimum emitter gap (distance between the emitters and fruit surface in the peeling equipment) was set to be 5 mm.

(A) **(B)** **(C)** **(D)**

Figure 8. Pear and tomato samples used for conducting peeling tests: A, and B pears during the ripening; C, tomatoes sorter; and D, sorted tomatoes.

5.2 Measured parameters

Several parameters were measured during the peeling tests to investigate the peeling performance of the IR peeling system. These parameters included temperature of fruit surface, peeling easiness, peeling removal percentage, peeling yield, peeling recovery, cooking ring, firmness and color of peeled products, and peeled skin thickness.

(A) Surface temperature: Thermal imaging, FLIR

(B) Pear firmness: Texture analyzer with 8 mm probe

(D) Color: Chroma meter, CR-400

Figure 9. Measurements of surface temperature (A); pear firmness (B); tomatoes firmness (C); and color (D).

5.3 Results of peeling performance

High peeling performance was achieved for pears and tomatoes (Tables 1 and 2). Under single raw loading, 100% of peel was removed with perfect peeling easiness at a temperature of 111°C and a residence time of 85 sec for pears with firmness of 5-7 lb. For full loading (three rows), 100% of peel was removed with perfect peeling easiness at a temperature of 103°C and a residence time of 108 sec for pears with firmness ranged from 4-6 lb., which is the typical firmness of peers used in the peeling industry. High peeling yield (90.2%) and peeling recovery (86.2%) were achieved for pears under the full loading. For tomatoes under full load, 100% of tomato peels were removed with perfect peeling easiness at a temperature of 112°C. Peeling yield and recovery were 90.71% and 87.20%, respectively. The small heating ring in pears and high quality peeled pears and tomatoes are shown in Fig. (9). The performance of the IR peeling was compared with lye peeling (Table 2). IR peeled tomatoes had significantly firmer texture than the lye peeled ones. Tomatoes peeled with IR and lye had similar color. Based on the test results, the second heating section for pear peeling is not necessary.

Table 1. Peeling performance for pears under single raw and full loadings.

Loading	Temp. (°C)	Resident time (sec)	Peeling performance				
			Peel removal percentage (%)	Peeling yield (%)	Peeling recovery (%)	Cooking ring (mm)	Skin thickness (mm)
Single	111	85	100±0.00	89.59±2.16	84.52±2.29	0.54±0.05	0.93±0.23
Full	103	108	100±0.00	90.21±0.82	86.20±1.81	0.61±0.10	1.21±0.24

Table 2. Peeling performance for tomatoes peeled with IR and lye methods.

Peeling	Peeling removal (%)	Peeling yield (%)	Peeling recovery (%)	Firmness (N)	Color		
					L	a	b
IR-Full load (112 °C)	100.0±0.00	90.71±3.31	87.20±2.64	2.65±0.21	32.42±2.59	26.05±3.15	20.72±2.86
Lye (96 °C)	99.00±1.00	82.10±2.60	76.00±2.20	0.84±0.20	30.658±3.64	28.37±2.95	24.51±3.49

Figure 9. Peeled pears and tomatoes at temperatures of 105 and 112°C using IR peeling system.

5.4 Energy consumption

The energy consumed by the pilot scale IR drying peeling system for heating was determined for a single raw and full loading. The energy consumption for a single raw loading for tomatoes and pears was 1906 and 835 megajoules (MJ)/ton, respectively. However, under full loading, the energy consumption significantly decreased to 562 and 394 MJ/ton for tomatoes under full load of 5 and 6 rows. The energy consumption was determined to be 395 and 326 MJ/ton for pears under full load of 3 and 4 rows (Table 3). It should be mentioned that the energy consumption in industrial scale systems should be much lower than the determined energy consumption for the pilot scale unit since there is no insulation of the pilot system.

Table 3. Energy consumption in tomatoes and pears with newly built IR dry-peeling system

Fruit	Capacity	Energy (MJ/ton)	Resident time (s)
Tomatoes	Single row	1906	61
	4 Rows	562	72
	6 Rows	394	76
Pears	Single row	835	76
	3 rows	395	108
	4 rows	326	119

5.5 Demonstrate the performance of the newly built IR dry-peeling system

Demonstration tests were successfully conducted to disseminate the technology to the food industry. Eleven representatives from the California League of Food Processors, fruits and vegetables processors (i.e., Pacific Coast Producers, JBT FoodTech, and Del Monte), and a food processing equipment manufacturer (Precision Canning Equipment) attended the demonstration and technology review event. The tests were carried out using pears and tomatoes. The performance of the IR system was tested and demonstrated under the optimum operating parameters using single and full load approaches of pears and tomatoes. The representatives from industry were pleased with the design and performance of the IR peeling system and quality of the peeled pears and tomatoes. They were also impressed with the absenteeism of the lye and water consumption during the peeling tests and would like to move the technology to next level for commercialization.

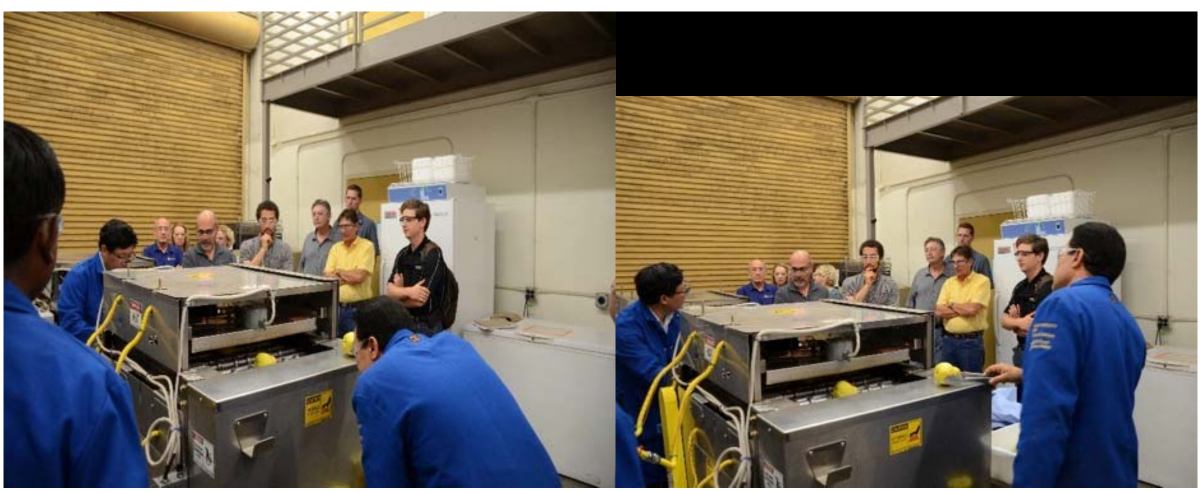


Figure 10. Demonstration tests of the IR dry peeling system.

All the funds were used to solely enhance the competitiveness of specialty crops. No products other than specialty crops were benefitted from this project.

The principal investigators, Professor Zhang, Dr. Atungulu, and Co-Principal Investigators, Dr. Pan and Dr. McHugh administrated the project and maintained communications with all research team members. The research team included postdoc and graduate students, development engineers and scientists. The principal investigators provided technical and supervisory support to the research team to conduct the tasks of the research. The research engineer, postdocs, scientists and graduate students conducted research experiments, and also analyzed the data obtained from the experiments.

Goals and Outcomes Achieved

The goals and specific objectives were fully achieved for this project. A pilot-scale IR dry-peeling system with flexible operating conditions and design parameters to peel pears and tomatoes was designed and constructed. The optimal operating conditions and design parameters such as IR intensity, product-to-emitter gap size, conveying system, and IR residence time and collar shape profile were determined to achieve high peelability and low peeling loss that were better than those for lye peeling. Peeling performance and product quality were studied based on peeling easiness, peeling removal percentage, peeling yield, peeling recovery, cooking ring, firmness and color of peeled products and skin thickness. Operational and design parameters of a larger scale unit for pear and tomatoes were optimized and specified. Industry and research guided recommendations of optimized operational and design parameters for a larger scale unit have been documented. The results of this project were disseminated through demonstrations, meeting handouts, conference presentations, and the project final report. More peer-reviewed articles are being produced and will be published in prestigious journals such as Food Engineering and Transactions of ASABE (American Society of Agricultural and Biological Engineers). The research results and technology has been publicized on the web: http://research.engineering.ucdavis.edu/panlab/research/.

The long-term outcome of this project is to commercialize the developed sustainable infrared dry-peeling technology for fruits and vegetables. The IR dry-peeling showed promising results as an alternative peeling technology to replace the conventional lye and steam peeling. This will help to address the immediate needs that the processors have in meeting long-term goals of water supply, salinity management, energy efficiency, and quality assurance in the processing industry of fruits and vegetables. The project has significantly popularized and created awareness on the developed IR dry-peeling technology to the industry, processors, and general public. Food processors are aware of the results of this project. During the demonstration tests, several attendees showed interests to further discuss with their management teams the commercial scaling up of the developed system.

The gathered data have led to optimizing the operating parameters of the IR dry-peeling system. High peeling performance and high quality products were obtained. Based on the obtained data, the peeling performance was characterized by peeling easiness, peeling removal percentage, peeling yield, peeling recovery, cooking ring, firmness and color of peeled products and skin thickness were evaluated. Accordingly, the optimal operational and design parameters for a larger scale unit were determined. The high peeling performance can be achieved at temperature of 103°C and resident time of 108 sec for pears, and temperature of 112°C and resident time of 72 sec for tomatoes. The sustainable technology produced much better quality products compared to the current lye and steam peeling. The outcome of this project will impact the canning industry by avoiding the utilization of water and chemicals with the production of high quality product.

The project successfully developed a pilot-scale IR dry-peeling system for fruits and vegetables. The developed IR dry-peeling technology will significantly benefit the food industry and society due to saving in water and chemicals during the peeling of fruits and vegetable with producing high quality products. Compared with lye peeling, using the dry peeling technology could save about 10.3 kg of lye and 2,600 gal/ton of water per ton of raw fruit. The texture of the IR peeled fruits was better than that peeled using steam or lye peeling methods. For example, the peeled tomatoes with IR had a firmness of 2.65 N as compared with 0.84 N that measured for the tomatoes peeling with hot lye. Moreover, the average peeling yield and recovery were 89.6% and 84.5% % could be obtained for pears and 90.7% and 87.20% for tomatoes, respectively. For a larger scale IR peeling unit, it is recommended to apply IR to heat pears to a temperature of 103 °C and tomatoes to a temperature of 112°C, the gap between the emitters and fruits of 5 mm, and a residence time of 108 sec and 72 for pears and tomatoes, respectively.

Beneficiaries

The fruit and vegetable processors in California and the U.S. will directly benefit from the outcome of this project. These processors in California process 16-18 million tons of food yearly. These processors can benefit from the project results by scaling up the sustainable peeling technology. The elimination of water and chemical uses also benefits the entire society.

The developed IR-dry peeling technology would benefit many of the 230 fruit and vegetable processors in California. Since IR dry-peeling does not need water during peeling, the development and implantation of the new technology will bring significant water savings (up to 90% of water use) in this industry. Moreover, because no lye and other chemical are needed for IR peeling, wastewater treatment and the associated environmental concerns will be eliminated. By applying the new peeling technology, the processors will be able to meet new standards of wastewater discharge limitations. Additionally, the by-products from the dry-peeling process contains less water and no chemicals; consequently these products including peel and seeds can be easily and efficiently used for producing value-added products. This will make the fruit and vegetable processing industry in California more economically competitive. Moreover, the IR peeling method is safe for workers due to elimination of chemicals.

Lessons Learned

The research team gained extensive knowledge that will be applied to design a commercial scale IR peeling system. The research team realized that to build the new infrared dry peeling system, prototyping was a critical step to clarify proper design parameters of conveying and heating sections. Conveying roller profiles which achieved effective fruit rotation and conveyance were prerequisites for a scale-up of the IR peeling system. The peels elimination unit was designed using a mechanical mechanism to adjust the gap between its fingers and the fruits. This led to a less peel removal effectiveness than expected due to the inconsistency of pear fruit size and shape. In a future design, an electronic system should be designed using sensors to adjust the gap between the fingers to have the needed gap that achieves a high peel removal rate of fruits. Other designs (pinch rollers suitable for pears) for peel removals should also be considered in future design.

It was very difficult to arrange onsite demonstration during the processing season. To disseminate the technology, a technology review and demonstration event was conducted at UC Davis. This worked well to disseminate the technology since more people from different companies and organizations attended the event.

Additional Information

Publications:

1- Pan, Z. 2013. New infrared based technologies and equipment for agricultural and food processing. Presented at SARTA Showcase. October 16. Sacramento, CA.
2- Li, X., Pan, Z., G.G. Atungulu, M. Delwiche, T.H. McHugh. 2013. Using infrared radiation heating for tomato peeling: Process characterization and mechanism. The IFT Annual Meeting. July 13-16. Chicago, IL.
3- Pan, Z. 2012. Novel infrared food processing technologies. Presented at Grimmway Farms. December 3. Bakersfield, CA.
4- Wang Y., X. Li, G. Sun, D. Li, and Z. Pan. 2014. A comparison of dynamic mechanical properties of processing-tomato peel as affected by hot lye and infrared radiation heating for peeling. Journal of Food Engineering. 126:27-34.

Website:

The information about this research is available at http://research.engineering.ucdavis.edu/panlab/research/.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 19	**Project Title:** Drought-tolerant Lettuce and Spinach Varieties for Adaption to Climate Change	
Grant Recipient: USDA-ARS, Salinas, CA	**Grant Agreement No.:** SCB11019	**Date Submitted:** December 2014
Recipient Contact: Beiquan Mou	**Telephone:** 831-755-2893	**Email:** Beiquan.mou@ars.usda.gov

Project Summary

Global warming may affect agriculture more through water availability than temperature. Water is a precious resource and has become increasingly scarce due to population growth, environmental needs, and frequent drought. Climate change has resulted in reduced precipitation, less snow pack, and earlier snowmelt, leading to a three-year-long drought in California. Court orders limit the pumping of Northern California water to farms in San Joaquin Valley, severely restricting the leafy vegetable production. Coastal Monterey County faces water shortage and seawater intrusion, and has planned the construction of several desalination plants for residential uses. Warmer weather accelerates the rates of plant transpiration and water evaporation from soil, and every 10-degree increase in temperature translates into a 50% increase in the amount of water required by a crop. Conversely, ever-tighter regulations on farm runoffs call for crop varieties with reduced irrigation requirements and better water use efficiency.

Forecasts show that global warming over the next several decades will take place irrespective of any action taken today. Thus the development of crops that can cope with heat, drought and other climate extremes may well be the single most important step to adapt to the warming planet. However, breeding a new variety takes time, often about 10 years. The ability to breed new varieties is undermined by the rapid loss of the genetic diversity of plants, which is in turn accelerated by climate changes. Therefore, there is a pressing need to mitigate the abiotic stresses through improvement of leafy vegetables for present needs and future conditions.

The purpose of this project was to screen lettuce and spinach collections to find drought-tolerant varieties with higher water use efficiency in order to enhance water conservation, reduce production costs, and improve the competitiveness and sustainability of lettuce and spinach crops in California.

California is, as of 2014, in an official drought emergency. Significantly reduced precipitation along with reductions in fresh water availability due to legislative and judicial action make water usage currently the number one issue facing vegetable production in California. This project was designed to begin addressing water use in leafy vegetable production in a time when not only is current production threatened, but growers must be able to increase yields into the future to keep up with increasing demand for fresh produce or risk losing market share to imports. Developing lettuce and spinach that can match current yields with reduced irrigation inputs will ensure that California growers improve the profitability and sustainability of lettuce and spinach production while also reducing the down-stream impacts of irrigation runoff which will help to meet newly implemented compliance rules for water quality.

This project did not build upon a previous SCBGP project.

Project Approach

During this project initial screens were conducted on both lettuce and spinach germplasm collections. This involved the development and adaptation of drought-stress methodologies to crop systems that had no preexisting data from which to work. A significant portion of the lettuce germplasm collection was initially screened in the greenhouse with replicated screens being performed for select germplasm. The same was completed for the spinach collection. The lettuce collection was narrowed from nearly 4,000 varieties to 200 initial varieties for field trials and further narrowed after the first replicated field trials to a small pool of only 50 varieties which include both highly tolerant and highly drought-susceptible controls. A final small field trial was performed with the 50 varieties subset to identify the most tolerant varieties for immediate incorporation into a drought-tolerance breeding program. Along with the initial greenhouse screens notes where taken on potential physiological characteristics of drought-tolerant lettuce to assist in guiding future breeding efforts.

Project staff completed the replicated field trials of the lettuce candidates in the Salinas Valley. Staff was unable to complete replicated field trials in multiple locations throughout the state with the initial candidate pool when collaborators withdrew from the project. Overall, the field trials were able to provide staff with invaluable information that will directly benefit breeding efforts in drought-tolerance. Also, the first manuscript derived from this project is currently in peer review, with one more expected before the end of this calendar year and another scheduled for submission in 2015; this would exceed the original goal in publishing the amount of novel information developed during the course of this project.

The spinach pool was narrowed in initial greenhouse screens to a manageable 40 cultivars including both likely tolerant and highly susceptible germplasm for use in field trials. At the completion of this grant period Due to delays, the spinach field trials were not performed, but will be completed within the next growing season.

This project did not benefit commodities other than specialty crops.

The Project Director (PD) provided oversight of the project, hired a Postdoctoral Research Associate (PR) to complete the bulk of the research, met with the PR at regular intervals to provide direction, and provided budget oversight throughout the grant period.

The PR performed the bulk of the research involved in this project including developing the drought-stress screening methodologies used for both initial greenhouse screens along with field trials. While the PR performed the field trials the PD assisted in the design of field layouts that were critical to this project. Also, PD and PR have authored a protocol manuscript describing the methodologies used for initial greenhouse screening that is currently in peer-review.

Goals and Outcomes Achieved

Both the lettuce and spinach germplasm collections were initially screened in the greenhouse with select varieties undergoing further replicated screening for drought-tolerance. Drought-tolerant candidate pools were established and replicated field trials were performed in the Salinas Valley. Through these replicated field trials, and in conjunction with the initial greenhouse drought screens, varieties of lettuce likely containing drought-tolerance traits have been identified and are now awaiting incorporation into a breeding program for drought-tolerance. This work contributes directly to the expected measurable outcome of the identification of drought-tolerant varieties.

Contributing to the measurable outcome to disseminate/publish the new knowledge, are several activities:

- Presentation of both lettuce and spinach drought-tolerance data at the American Society of Horticultural Sciences annual meetings in 2013 and 2014; approximately 1,000 scientists, educators, students, landscape and turf managers, extension agents and industry professionals attend the annual meetings each year (http://www.ashs.org/?page=GeneralConference).
- Presentation of results at the California Leafy greens research program meeting in 2014; 250 growers, shippers, processors, researchers, breeders, extension agents, students, media, and leafy green industry officials.
- Presentation of results at the USDA-ARS and Korean RDA Workshop in 2013
- Submission of a manuscript outlining the efficient method of drought-tolerance screening in leafy vegetables developed during the course of this project which is currently in peer review.
- Manuscripts outlining the lettuce results and addressing the identification of drought-tolerance in spinach are expected to be submitted in December 2014 and/or early 2015.

The long term success of this project will be monitored after the completion of this project to identify the acceptance of drought-tolerance traits into the market. The long term success of the project will be judged by the percentage of lettuce and spinach acreage planted with drought-tolerant cultivars in California. This will be measured by mail and telephone surveys of seed companies for the percentage of lettuce and spinach seeds sold with the drought-tolerant trait three years after the completion of the project.

The screening of the lettuce and spinach collections leading to the identification of drought-tolerant varieties was completed as planned. Replicated field trials were completed for the lettuce portion of the project as planned, but only for the Salinas Valley location as previously stated. Drought-tolerant germplasm was identified. Replicated field trials with the narrowed candidate pool of spinach germplasm were not completed during the project period, but are scheduled to be completed within the next year. Project staff fully anticipates completion of spinach goals in relation to the use of replicated field trials in order to confirm greenhouse results within the next year.

In summary, staff narrowed an enormous germplasm pool of approximately 4,000 lettuce germplasm down to only 200 varieties that went to field trials. Further replicated field trials conducted allowed further narrowing of this small drought-tolerant candidate pool to a subset of 50 varieties representing the most likely tolerant as well as susceptible germplasm. The approximately 25 varieties that showed a strong probability of possessing drought-tolerance traits represent a huge step toward the development of drought-tolerant lettuce cultivars for commercial production and a step toward water conservation in lettuce production, which aligns with the stated goals of this project. In regards to the spinach portion of this project, an initial candidate pool of around 1,000 germplasm was narrowed through greenhouse screens to a small candidate pool of 40 varieties of which about 20 are thought to contain drought tolerance traits. This represents significant progress toward achieving the initial goals of this project, and staff suspects that upon the completion of the replicated spinach field trials in 2015, the results will confirm the initial findings and allow for the incorporation of this newly identified drought-tolerant germplasm into a directed breeding program.

Beneficiaries

The results of this project will benefit many stakeholders in the leafy greens industry of California including; growers, packers, shippers, seeds companies and their associated personnel who will be better prepared to respond to water shortages both in the near and long term along with lettuce and spinach consumers nationwide who will be better insulated from deleterious climate conditions into the future.

This project benefited 107 lettuce, 67 spinach, and 25 spring mix producing companies and more than 30 seed companies with thousands of personnel involved in growing, processing, and distribution of lettuce and spinach products and seeds in California. With the limited water supply, a 15% decrease in crop's water requirement could potentially increase lettuce/spinach acreage by 15%, worth $292 million a year. New drought-tolerant lettuce and spinach cultivars could increase sales of seed companies in global markets.

Lessons Learned

One of the biggest lessons learned during the completion of this project involved the development of a semi-high throughput screening method for drought tolerance in leafy vegetables. This protocol was developed from the ground up to directly benefit this project, but proved to be so effective and efficient that it led to a protocol manuscript being submitted for peer review. This proved to be a pleasant surprise and will hopefully be utilized by the wider research community and in that way can allow this project to continue and assist in drought-tolerance development for many years after the completion of the funding period.

The development and implementation of the drought screening protocols proved to be much more time consuming than originally thought. Much of this can be traced directly to the lack of established research in the area of drought-tolerance in vegetable production which meant nearly every step of the way required developing new methods. In addition, the enormous scope of the initial lettuce screen took more time than originally planned. These delays, combined with the delayed hiring of the post doctoral associate, resulted in delaying the spinach field trials until after the grant period. The spinach trials will be completed, but it will require one more growing season to finish the field work.

An unexpected outcome was the attention the project received from the media due to the historical drought in California this year (please see Additional Information for details).

Additional Information

If a manuscript is published, interested readers can find more information about the research by contacting the corresponding author whose email is provided above.

One thing that arose as a byproduct of this project was several opportunities for public outreach and education on drought-tolerance in California vegetable crops. The PR did a series of interviews in 2014 after an official drought emergency was declared for the state. The PR was interviewed by a local Salinas television station for a segment on developing drought tolerance in lettuce, was included in an interview in the Salinas Californian newspaper on the effects of climate change to the Central Valley, and was featured in an interview with the newspaper the Clay Center Dispatch (Clay Center, KS) about former local residents working to address global problems.

USDA Project No.: 20	Project Title: Sustainable Methods for Extracting High Quality Oil from Fruit and Vegetable Seeds	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB11020	**Date Submitted:** December 2014
Recipient Contact: Dr. Zhongli Pan	**Telephone:** 530-752-4367	**Email:** zlpan@ucdavis.edu

Project Summary

California produces approximately 2.3 million tons of seeds yearly from byproduct streams of tomato, grape and pomegranate processing alone. The food industries pay a considerable amount to get rid of byproducts (e.g., pomace/seeds) from their premises. The byproduct stream contains a high percentage of seeds that contain a high oil content (12-25%, wet base), and nutritional value. A large volume of these byproducts end up in landfills or is used as animal feed with no or low value. Optimum utilization of these oil rich resources will increase the net income from these crops and reduce environmental footprints. Utilization of oils produced from these resources in human diets could improve human health due to the presence of high content of antioxidants, unsaturated fatty acids, nutraceutical and antimicrobial compounds.

Several methods are being applied for oil recovery from crop seeds, and among them are chemical extraction and mechanical press. The widely existing chemical extraction method uses hexane as solvent. This method has severe negative environmental effects; a health hazard to workers, low product value and discourages oil consumption due to safety concerns for residues of solvent in the oil. A stringent requirement imposed by environment regulatory bodies and the cost of waste management restricts processors from fully utilizing the oil rich seeds. Therefore, this project was proposed with a goal to develop sustainable processing methods for seed separation and oil extraction using the mechanical press method.

This project does not build upon a previously Specialty Crop Block Grant Program funded project.

Project Approach

1. Procure, assemble and install an oil seed press, seed separation shaker and infrared dryer.

   The KOMET CA 59 G oil press (IBG Monforts Oekotec GmbH & Co. Germany) with a capacity of input material of 5–8 kg/h was purchased and installed. The oil press was used for seed oil extraction experiments at different screw speeds, die diameters and preheated die temperatures. A screen separator (Royson Engineering Company Hatboro, PA) was procured and installed for separating seeds from the pomace. An infrared dryer was designed and fabricated to study the effect of infrared heating on seed oil extraction.

2. Pomace sample collection.

   Tomato pomace samples were collected from a Campbell tomato processing plant under both hot and cold break processes (Dixon, CA), Morningstar Company (Williams, CA) and Pacific Coast Producers (Woodland, CA). The grape pomace/seeds of Cabernet Sauvignon (Vitis vinifera L.) variety harvested during 2011 obtained from Sonomaceutical Inc. (Santa Rosa, CA) and pomegranate pomace/seeds were collected from the SunnyGem Juice Company (Buttonwillow, CA).

3. Establish methods and procedures for best separation of seeds from byproduct stream.

   In the wet separation method, tomato pomace was mixed with 5 times water (w/v), then stirred with a glass bar and left to stand for 0.5 min. The upper layer of peel and lower layer of seed were separated by sieving several times through a1 mm sieve. The peel and seed portions were separately dried at 45℃ and the product was used for analysis. In the dry separation method, the pomace was first dried at 45℃, and then shattered with a blender to collapse the particles of peel and seed which adhered together in the process of dehydration. The blended pomace was passed through a 1 mm sieve to separate the peel and seed.

   For tomato pomace produced from hot break, purities of peel and seed obtained by dry separation were 93.09%, and 84.26%, and the corresponding yields were 37.49% and 62.51%, respectively. For wet separation, the corresponding purities were 89.65% and 96.6%, and the yields were 48.01% and 51.99% respectively. For cold break pomace, purities of seed and peel from dry separation were 90.63% and 52.01% and purities from wet separation were 95.05% and 95.71% respectively. Compared to dry separation, wet separation caused loss of protein, soluble dietary fiber, and ash content for both peel and seed. In addition to the observed micronutrient loss, the wet separation method is also expected to be water intensive and could pose wastewater disposal problems. Therefore, dry separation is recommended as a promising method for tomato pomace.

   The pomegranate seeds from the juice extraction had only pieces of arils and were used for oil extraction without separation. However, cleaning of surface of the seeds to remove the sticky outer layer by grinding in a mill for 10 seconds was found to be effective in improving the purity of seeds and oil recovery.

   The grape seeds from the red wine making winery were used for oil extraction without further separation.

4. Optimization of operating conditions and design parameters of the mechanical oil seed press processing.

   4. a. Grape seed oil.

   The effect of processing parameters on oil yield from grapes of Cabernet Sauvignon (Vitis vinifera L.) was studied using a KOMET Screw Oil Expeller. Results showed that reducing the particle size by grinding of seeds did not significantly influence the oil yield, but hindered the extraction by clogging. Preheating the screw press with a ring heater to 60°C eliminated the initial time lag to extract oil. For seeds with moisture content (MC) of 5.2%, increasing screw speed from 140 to 500 rpm increased the filtered oil production rate from 0.2-0.57 kg/h at 10 mm die diameter without significantly affecting the oil extraction percentage. Increasing the die diameter from 6 to 10 mm increased the oil production rate from 0.15 to 0.43 kg/h at 380 rpm and decreased the filtered oil extraction percentage from 9.2 % to 7.3%. There was no effect of the MC of seeds, in the range of 3.1 to 8.7% on oil yield. Oil yield decreased significantly at MC exceeding 8.7%. At a MC of 3.1%, the maximum oil recovery was 69% using 6 mm die diameter at 380 rpm screw speed. The optimum conditions for oil extraction from whole grape seeds were 5.2% MC, 500 rpm and 10 mm die. At the optimum conditions, the die temperature was 90.8 °C, residence time was 8.6 seconds and the oil yield was 7.6 % at the oil production rate of 0.57 kg/h.

4. b. Pomegranate seed oil.

Pomegranate seeds collected after extracting the juice were free from peel and arils. The seeds were dried in hot air oven at <55°C to a MC of < 8% that is required for oil extraction. Pomegranate seeds required multiple passes through the press to expel the oil due to the fine particle size and low oil content. The multiple passes increased the residence time of seeds in the machine. At a MC of 8%, oil yields of 3.75% and 4.02% were obtained respectively after 6 and 8 passes. The screw speed was 140 rpm screw and die size was 6 mm. The oil yield increased to 4.4% when the MC was brought down to very low of 0.5%. The pomegranate oil recovery by the expeller process was 37.5% for seeds with 8% MC seeds and 41.1 % for seeds with 0.5%.

Cleaning of the pomegranate seeds by grinding in a mill for 10 seconds and removing the fine particles improved the purity of seeds. The cleaned pomegranate seeds produced an oil yield of 6.5% in 3 passes using 6 mm die diameter at a screw speed of 140 rpm speed. The oil recovery increased to 60.8% which was 23.3% higher than the un-cleaned seeds. Therefore, cleaning of seeds before oil extraction is recommended because of the improved oil recovery and reduced number of passes through the expeller. To extract oil in a single pass, it is suggested to have a screw expeller with a long screw of 30 inches or longer.

4. c. Tomato seed oil.

The pressing of tomato seeds through the screw press produced soft and flaxy cake even at the smallest die diameter of 4 mm instead of hard and dry cake. Due to the tiny size of tomato particles, seeds and solid particles entered the oil passage holes of the press and clogged the holes. Hence the tomato seed oil was extracted using the expeller press at French Oils LLC, French Camp, California for oil quality analysis. For tomato seeds with a MC of 8%, an oil yield of 8% was obtained with an oil recovery of 53.3%.

4. d. Effect of infrared (IR) drying/preheating on grape seed oil.

To investigate the effect of IR drying/preheating treatment on the grape seeds oil yield, the grape seeds were heated to 60-75°C. Grape seeds were placed at 15 to 20 cm distance from the IR heat source for 10, 20 and 60 minutes. The IR preheated grape seeds produced 10.39% of oil yield compared to 9.2% of unheated grape seeds. The increase in oil recovery was about 8% compared to the unheated samples. Therefore, IR treatment is recommended for improving the oil recovery from grape seed oil.

5. Quality of mechanically pressed and solvent extracted seed oil.

5. a. Chemical characteristics of pressed and hexane extracted seed oil.

Acid, iodine and peroxide values of grape, pomegranate and tomato seed oils extracted by screw press and hexane at are shown in Table 1. Though the acid, iodine and peroxide values of the mechanically pressed seed oils were higher than hexane extracted grape seed oil, the values were within the recommended limits for commercially produced unrefined oils: acid value < 4.0 mg

KOH/g, iodine value 124-143 and peroxide value < 15 miliequivalents of oxygen/kg oil. The acid, iodine and peroxide values of expeller pressed tomato and pomegranate seed oils were found to be higher than that of hexane extracted oils.

Table 1. Chemical quality of fruit seed oils extracted with hexane and mechanically pressed at various conditions

Oil type	Acid Value	Iodine Value	Peroxide Value
Grape, hexane extracted	1.18 ± 0.06	126.77 ± 2.60	2.42 ± 0.14
Grape, pressed	1.46 ± 0.06	136.81 ± 6.67	15.50 ± 0.25
Tomato, hexane extracted	0.57 ± 0.00	115.74±1.36	1.59±0.14
Tomato, pressed	0.85 ± 0.01	111.90 ± 10.98	5.40±0.55
Pomegranate, hexane extracted	1.10 ± 0.00	158.62 ± 1.20	3.19 ± 0.24
Pomegranate, pressed	1.30 ± 0.31	168.33 ± 3.19	3.14 ± 0.12

Fatty acid compositions of grape and tomato seed oil samples were quantified using a gas chromatograph equipped with a Flame Ionization Detector. Grape seeds oil was composed of approximately 69% linoleic acid, 15% oleic acid, 9%, palmitic acid, and 6% stearic acid. Tomato seeds oil consisted of 55% linoleic acid, 21% oleic acid, 14% palmitic acid, and 6% stearic acid. There were no significant differences in the compositions of the oils produced by hexane extraction and mechanical pressed oil. The fatty acid compositions grape and tomato seeds oil was not significantly changed after 24-month storage period.

5. b. Shelf life of seed oils.

Shelf life of mechanically pressed, hexane extracted, and store bought grape seeds oils were determined by performing an accelerated oxidation test called Schaal oven test. In the test, oils were stored at 63°C in forced air (in the lab air does not move much, when air is moved by fan it is called forced air, meaning air moves with certain speed) for 24 days. Samples were taken on day 3, 6, 9, 12, and 24, which were equivalent to 3, 6, 9, 12, and 24 months of storage. Peroxide value and p-anisidine values of samples were measured to estimate the formation of primary and secondary oxidation products in oils. The peroxide value increased steadily with storage time and at the end of 24 months the peroxide value was increased from 15.5 to 120.9, 2.42 to 128.8, 12.7 to 132.7 miliequivalents of oxygen/kg oil respectively for mechanically pressed, hexane extracted and store bought grape seed oil samples. This might be due to the presence of a high level of unsaturated fatty acids in the oil. The peroxide values of mechanically pressed grape seed oil were lower than that of crude hexane-extracted oil and store-bought oil.

At the end of 12 months of storage, the p-anisidine values of mechanically pressed, hexane extracted and store bought oils increased from 0 to 2.49, 1.28 to 2.93, and 1.9 to 5.43, respectively. After 12 months, the p-anisidine values increased exponentially to 11.26, 12.37 and 16.18 respectively for mechanically pressed, hexane extracted and store bought grape seed oil. The rapid increase indicates the formation of large quantities of secondary oxidation products. The p-anisidine values of mechanically pressed oil were lower than the store bought and hexane extracted oil, which was consistent with the peroxide value.

The peroxide value of expeller-pressed and hexane extracted tomato oils increased from 5.40 to 71.77 and 1.59 to 81.17 miliequivalents of oxygen/kg oil, respectively. The initial peroxide values of mechanically pressed tomato oil were higher than those of hexane extracted oil. However, once the oxidation process initiated, the peroxide value of hexane extracted oil increased faster than that of the mechanically pressed oil. The unrefined pressed and hexane extracted oil maintained peroxide values at <15 miliequivalents for up to 6 months. This indicates that the oils can be stored for 6 months without the need for the addition of antioxidants or refinery.

5. c. Sensory study.

To evaluate the differences between hexane extracted and mechanically pressed grape seed oil, a sensory study was performed with 103 panelists. The results showed that there were significant differences in odor and color between the two oil samples. However, the panelists did not show a significant preference to either hexane extracted or mechanically pressed grape seed oil samples.

6. Demonstration of seed oil and Screw oil press.

The results of the project were discussed with three processors in California. The first processor was motivated to produce grape seed oil using the optimum conditions for maximizing oil yield. Project staff demonstrated the extraction of tomato seed oil using a mechanical expeller in the premises of an oil producing company located in French Camp, California. The results of pomegranate seed oil extraction was shared with a leading pomegranate juice producer in Buttonwillow, California who was motivated to utilize the large amount of seeds obtained after juice extraction. The processors showed interest in adapting the project results.

Moreover, on April 20, 2013 display of seed oils and the press used for oil extraction was done during the UC Davis Picnic Day to create awareness about the seed oils and on the mechanical oil extraction technology to several hundreds of visitors. Among the visitors, 103 persons participated in the sensory study and about 20 people observed the demonstration of the grape seed oil extraction process using the hexane extracted method and the mechanically pressed expeller method. The composition and health benefits of the seed oils were explained to the visitors. The project team also worked closely with French Oils LLC, French Camp, CA, to transfer the knowledge learned from the project to food industry.

No other commodities other than specialty crops were benefitted from this project and all the funds were used only for specialty crops.

The Principal Investigators administered the project, supervised and communicated research progress and findings. They also provided technical and supervisory support to the research team to conduct proposed research experiments. The research engineer and graduate students conducted all the experiments for this project, and analyzed experimental data.

Goals and Outcomes Achieved

The proposed goal and objectives were achieved by performing the activities listed in the previous section. Dry and wet methods for separating pomace from cold and hot break processes into seeds and peels were developed. The dry method of separation was recommended because it was the most effective for producing high seed purity, less micronutrient, and material losses. The method has a potential of water savings compared to wet method. The mechanical press was used to extract the oil from grape and pomegranate seeds. The effect of moisture content of seeds, particle size of seeds, screw speed, die diameter and preheat temperature on oil yields were studied. The modifications required to use the mechanical press to extract oil from tomato seeds were recommended. The quality of grape, pomegranate and tomato seed oils extracted by mechanical press and hexane extraction methods were determined and compared. The storage life of screw pressed oil was studied and quality changes were determined. The dissemination of the technology was carried out by demonstrating the technology and conducting sensory tests. Technology transfer to the food industry was conducted through direct cooperation, conference presentations and publications. The developed sustainable technology is popularizing by creating awareness on the nutritional and health benefits of the seed oils.

The long term outcome of this project is to adopt the developed sustainable technology for oil extraction from food processing byproducts. The project results have shown that high quality seed oils can be extracted using the mechanical expeller. The oils are rich in free fatty acids and could be stored for six months without affecting its quality at ambient conditions. The project has popularized and created awareness on the extraction methods and health benefits to the industries and general public. It is expected that the project results could help in adopting the developed technology by food processors.

All the established goals were achieved during the grant term.

This project developed methods and optimized the expeller operating conditions for extraction of grape and pomegranate and tomato seed oils. The quality of oils was within the set values for unrefined crude oils for edible use. The outcome from this project will directly impact the food processing industries and growers by increasing the profits to the processors and net income from tomato, grape and pomegranate crops

There were no significant differences in the compositions of the oils produced by hexane extraction and mechanical pressed oil. This project developed methods and optimized the expeller operating conditions for extraction of grape and pomegranate and tomato seed oils with oil yields of 9.3%, 6.5% and 8.0% at oil recovery rates of 69%, 61% and 53.3%, respectively. The quality of oils was within the set values for unrefined crude oils for edible use. The oils are rich in free fatty acids and could be stored for six months without affecting its quality at ambient conditions.

Beneficiaries

The tomato, pomegranate and grape (wine) processing industries in California and the U.S. are the beneficiaries of the project outcome. The fruit and vegetable processors in California produce 16-18 million tons of commodities yearly with a huge volume of seeds as byproducts. These industries can also benefit from the findings as they can use the findings with slight modification to suit the nature of their byproducts.

The developed method for oil extraction directly benefits fruit and vegetable processors to produce high yields with high quality and healthy oils as value-added products from the seeds. The developed method does not use chemicals, and reduces or eliminates environmental pollution resulted from using solvents and landfilling of seeds. Moreover, the method is safe for workers due to elimination of solvents. The new oil pressing methods eliminate the burden of waste management and help processors to meet regulations imposed by the State and Federal governments for environmental protection.

Lessons Learned

Screw pressing did not require size reduction of the seed, as well as elaborate filtration and refining as required for the chemical method. The defatted seed cake obtained as a byproduct of seed oil extraction is rich in nutrients and edible fibers. Therefore, the produced cake could be a good source for cattle feed or raw material for edible protein extraction. It was realized that the screw diameter, length and the size of oil passage holes in the barrel are important design parameters. The screw should have adequate length to allow enough retention time for maximum oil recovery from the seeds. Cooling the oil immediately after extraction by using dry ice or other cooling mediums will protect the oil from oxidation.

It was not possible to use the laboratory KOMET Screw Oil Expeller to extract oils from tomato seeds. Recommendations were given to design a proper press to extract oils from tomato seeds and similar small seeds. Using IR to heat seeds prior oil extraction improved oil recovery.

Additional Information

Publications:

1. Shao, D., Atungulu, G.G., Pan, Z., Yue, T., Zhang, A., Chen, X. 2012. Separation methods and chemical and nutritional characteristics of tomato pomace. Transactions of the ASABE. 56(1):264-268.
2. Chandrasekar Venkitasamy, Hui Ean Teh, Griffiths G. Atungulu, Tara H. McHugh, Zhongli Pan. 2013. Optimization of Mechanical Extraction Conditions for Producing Grape Seed Oil. Poster presented at IFT annual meeting, 13-16, July, 2013, Chicago.
3. Hui Ean Teh, Chandrasekar Venkitasamy, Griffiths G. Atungulu, J. Bruce German, Zhongli Pan. 2013. Physiochemical Characteristics of Seed Oil Extracted from Fruit Processing Waste Streams. Poster presented at IFT annual meeting, 13-16, July, 2013, Chicago.
4. Chandrasekar Venkitasamy, Hui Ean Teh, Griffiths G. Atungulu, Tara H. McHugh, Zhongli Pan. 2013. Optimization of Mechanical Extraction Conditions for Producing Grape Seed Oil. Manuscript under review by Transactions of ASABE.

Website:

The information about this research is available at
http://research.engineering.ucdavis.edu/panlab/research/

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 21	Project Title: Torrefaction of Specialty Crops Pomace to Produce High-Energy Density Fuels	
Grant Recipient: U.S. Department of Agriculture, Western Regional Research Center	**Grant Agreement No.:** SCB11021	**Date Submitted:** December 2014
Recipient Contact: Charles Myers	**Telephone:** 510-559-5769	**Email:** chuck.myers@ars.usda.gov

Project Summary

Producers of apple juice, wine, olive oil, tomato paste and juice, almonds, and walnuts in California generate thousands of tons of byproducts each year. These byproducts are mostly converted to low-value compost or animal feed and have to be used quickly because they can be highly perishable. Consequently, growers have to find ways to transport or stabilize the byproducts and this can be costly. Torrefaction of the byproducts can provide added value by converting them to stable, high-energy density fuels. Torrefaction involves heating biomass under inert atmosphere between 200°C to 300°C. This removes most moisture and volatile components to produce a fuel comparable to low-rank coal. The torrefied biomass is hydrophobic and stable to microbial attack and moisture. Torrefaction also decreases mass of the material, resulting in reduced shipping costs. This provides specialty crop growers with a value-added alternative for their byproducts.

In the next decades, some specialty crop industries are expected to grow at a rapid pace, leading to generation of even more byproducts. For instance, the olive oil industry is expected to produce ten times more oil within the next decade. Consequently, torrefied byproducts provide a value-added alternative to the specialty crop growers.

This project did not build on a previously funded SCBGP project.

Project Approach

The WRRC (Western Regional Research Center) first characterized the raw agricultural byproducts, which included apple, grape, olive, and tomato pomaces as well as almond and walnut shells. Raw grape and tomato pomaces had the highest energy values due to their high lignin and lipid contents. The WRRC then used experimental design to determine mass and energy yields from torrefaction of the byproducts. The torrefaction temperatures ranged from 200°C to 290°C and torrefaction times ranged from 20 to 100 minutes. Apple pomace had lower thermal stability than the other byproducts and had to be torrefied at lower temperatures. The torrefaction results indicated that grape pomace had the highest energy and mass yields over the experimental temperature and time ranges. Also, torrefaction temperature had a larger effect on mass and energy yields than torrefaction time. A reactor was designed and built to capture condensable gases generated during torrefaction. The WRRC found that the condensable gases had higher energy values and mass yields at higher torrefaction temperatures and longer times. In addition, the WRRC used microwave heating to torrefy the byproducts. The WRRC designed and built a Teflon reactor that can be used in a microwave oven. The WRRC found that microwave torrefaction required much less time (3 to 9 minutes) than a conventional furnace to produce torrefied byproduct with high energy values. The WRRC also used COMSOL software to simulate material property changes during torrefaction of byproducts. Unfortunately, the simulation results didn't compare to the experimental data. Actual torrefaction is more complex than the simulation. In addition, the collaborator, Renewable Fuel Technologies (RFT), torrefied the byproducts in their large scale torrefaction reactor. RFT determined that almond shells represented the most promising feedstock in their process. The WRRC presented the results of this project at two national American Chemical Society meetings, one in New Orleans (April of 2013) and the other in Dallas (March of 2014). Approximately 30 research scientists attended these presentations. Also, the WRRC presented these results in a seminar held at the Albany location. This seminar was attended by approximately 40 scientists and WRRC industrial partners. The WRRC is currently preparing manuscripts for publication in peer reviewed journals, such as Energy and Bioresource Technology.

The WRRC's Pacific West Area Budget Office set up an account specifically for this project and administered funds through this account. All funds were solely used on this project to examine torrefaction of specialty crop byproducts.

The collaborator, RFT, designed and built a large scale torrefaction reactor. They torrefied the agricultural byproducts and the WRRC helped characterize the torrefied biomass material properties. RFT determined that almond shells showed the most promise as a feedstock in their torrefaction process because the shells have good energy and mass yields and the raw shells currently have little commercial value. Also, RFT showed interest in the microwave torrefaction technology developed by the WRRC.

Goals and Outcomes Achieved

The WRRC used experimental design to examine effects of torrefaction temperature and time on material properties of torrefied agricultural byproducts. The WRRC designed and built two reactors for the torrefaction experiments. One reactor was used in a conventional furnace and was able to capture condensable gases generated during torrefaction. The other reactor was used in a microwave oven to examine microwave torrefaction of the byproducts. The WRRC carried out the torrefaction experiments in the experimental design and developed response surface models for mass and energy yields in both the conventional furnace and microwave oven. The collaborator, RFT, used their larger scale torrefaction reactor to examine torrefaction of the agricultural byproducts. The WRRC helped characterize the material properties of the torrefied byproducts. From these experiments, RFT determined that almond shells showed the most promise as a feedstock in their torrefaction process.

The WRRC designed and built a Teflon reactor for microwave torrefaction of agricultural byproducts. The WRRC used experimental design to examine the effects of microwave torrefaction temperature and time on material properties of the torrefied byproducts. The torrefaction temperatures varied from 200°C to 240°C and the torrefaction times varied from 3 to 9 minutes. The WRRC determined that microwave torrefaction required lower temperatures and shorter times to produce torrefied byproducts with comparable energy values to those from a conventional furnace. Also, the WRRC is preparing manuscripts for publication in peer reviewed journals.

Beneficiaries

The groups that benefitted from the completion of this project's accomplishments included producers of apple juice, wine, olive oil, tomato paste and juice, almonds, and walnuts in California. The mass and energy yields of the torrefied byproducts will enable these specialty crop industries to determine the economic value of producing torrefied biomass.

The beneficiaries included the 6474 almond, 5712 walnut, 2074 apple, and 490 tomato farms in California as well as the 2972 registered wineries and approximately 500 olive farms that produce olive oil. Together, these industries generate over 18 million tons of produce that are valued at over $5.45 billion. The torrefied byproducts provide these specialty crop growers a value-added alternative for their byproducts.

Lessons Learned

The learning process in this project involved designing and developing the two reactors for the conventional furnace and microwave oven. The WRRC initially tried to use a screw top design for the furnace reactor. However, the screw top became easily stuck after each torrefaction experiment. Eventually, the WRRC had to abandon this design and eventually used a clamp top design that performed much better. Also, it was a challenge for the WRRC to find Teflon connectors for the reactor used in the microwave oven. However, the WRRC was able to build a reactor that operated successfully in the microwave oven.

One unexpected outcome involved the agreement between UC Davis and WRRC that allowed the WRRC to use elemental analysis equipment at Davis. The WRRC wanted to use the equipment, but it was unavailable as it required repair. Consequently, the WRRC had to send their samples to an outside laboratory to perform the elemental analysis.

Additional Information

The WRRC is preparing manuscripts based on torrefaction of agricultural byproducts in the conventional furnace and microwave oven. These manuscripts should be completed by late 2014 or early 2015 and will be sent to peer reviewed journals, such as Energy and Bioresource Technology, for publication. Copies of these manuscripts will also be sent to the specialty crop growers that provided the byproducts for this project. Also, the WRRC will provide copies to any interested parties upon request.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 22	**Project Title:** Best Management Practices (BMPs) for California Native Blue Orchard Bees (BOBs) and BMPs for Wildflower Seed Production in Orchards and Vineyards	
Grant Recipient: San Luis Obispo Bee Company	**Grant Agreement No.:** SCB11022	**Date Submitted:** December 2014
Recipient Contact: Stephen Pryor	**Telephone:** 805-594-1778	**Email:** sjpryor@hotmail.com

Project Summary

Colony collapse disorder (CCD) among honeybees has greatly reduced the number of hives available for early pollination and greatly increased the cost per hive for orchardists. As an alternative, much research has been devoted to the use of blue orchard bees (BOB) from northern climates as pollinators in California. However due to significant climatic differences within California, the synchronization of imported blue orchard bee emergence with early California crop bloom requires intensive management involving prolonged artificial cold storage and rapid spring heating. California BOB require no artificial cold storage and very little manipulation to emerge in synchrony with California almonds or cherries. Unfortunately, little work has been done with California BOB in orchards or on native bee forage planted as orchard and vineyard cover crops.

The lack of a reliable supply of BOB has also been a problem in its use as a commercial pollinator. California BOB can be raised on cover crops in both orchard and vineyards allowing the production of additional BOB for extend periods during warmer weather. The high cost of wildflower seed makes seed production in orchards and vineyards a logical approach to bringing the costs much lower. Crop residues from early wildflower seed production are far less than residues from later season grasses and no nutrients leave the orchard/vineyard with the seed crop, so no additional inputs are required.

CCD shows no signs of abating in the near future. Using BOBs as an alternative commercial pollinator for almonds and cherries will lessen the demand for honeybees and place a downward pressure on honeybee hive rental prices for compatible orchard and cane berry crops.

Project Approach

Cover crops

This has been an informative project for cover crop research. The four orchards used in this cover crop research were two organic and two conventional almond orchards. All orchards were seed drilled or broadcast seeded. In each orchard, six species of native wildflowers, *Phacelia ciliata*, *P. tanacetifolia*, *P. cicutaria*, *Collinsia heterophyla*, *Nemophila menziesii* and *Eschscholzia californica* were sown in orchard middles.

The best cover crop performance was in orchards with North-South row alignment. This probably allowed for better light penetration during low sun angle months. The lack of rain was the main limiting factor throughout this project and weed competition was the second greatest limiting factor. Between the four orchards, orchard A had the best wildflower cover crop growth due to access to water, low weed competition and North-South row alignment. Even though the well went dry, orchard C had the second best growth due to the canal system allowing post harvest irrigation and the North-South row alignment. Weeds were the significant limiting factor in this orchard. Orchard B had the third best wildflower cover crop growth. Even though orchard B had excellent water access, it was held back by high weed competition and the East-West row alignment. Orchard D had the poorest wildflower growth due to very low rainfall and a surface broadcast seeding technique that is inferior to being sown with a seed drill. Easily, the three most important cover crops throughout this research were *Phacelia ciliata*, *Phacelia tanacetifolia* and *Nemophila menziesii*.

In orchard seed production

The success of wildflower seed production within commercial orchards was dependant on the orchard floor management technique utilized by the grower. The best technique for seed production and cover crop management is to drill a five feet wide strip of a single species of wildflower in the middle of the cover crop.

The best advice for wildflowers as cover crops:
1. Start with as bare ground as possible.
2. If not a bare plot then at least remove the annual grasses.
3. Control unwanted broadleaves especially, *Malva parviflora*, *Erodium cicutarium* and *Chenopodium album*.
4. Plant a single wildflowers species per row to allow for different maturation and seed shatter timing.
5. Only plant a 4-5ft wide strip down the middle of the 'middles'.
6. Use a seed drill over simply broadcasting seed.
7. Sow seed as soon as possible after almond pickup and irrigate.
8. Make sure incoming equipment is free of undesirable weed seed.

Bee Populations

Bee population returns during this research were between 58% and 65% in orchards and 150% and 185% in wildlands. In wildland and vineyard areas, the last three years of drought have caused a large vegetation shift from broadleaf dominance to annual grass dominance. Unfortunately, this has resulted in far fewer floral resources being available to bee populations. Native Blue orchard bee populations are not as large as those found in Washington, Oregon, Idaho and Utah. This is probably due to the lower rainfall levels in California. In addition there is also very high competition from honeybees for natural forage especially during the early spring season when native BOBs are nesting and commercial migratory honeybee colonies are stacked here in California.

Observations in all locations during the final years confirmed that female BOB easily accept molded nesting substrate. By viewing plugged nests at shelters in the wild and in orchards it is anticipated that the total population will at least have a 100% return.

Nest Design

The nest designs developed during this research are superior to what is used in standard BOB culture. (Attachment 1) Throughout this research nesting shelters, molded nests, wood/paper nests and bees were placed in Central Valley almonds and coastal wildlands. In the final year of research, thick willow dominated riparian corridor habitat was the only wildland habitat that would support BOB populations. Molded nests were well accepted, however, the drought and the inability to irrigate the orchard during the winter negatively impacted the settlement of blue orchard bees.
In the final year molded nests were placed into bee nest preference trials in 5 and 10 acre flight cages, over almonds and *Phacelia* at Paramount Farms in Lost Hills, California. The closed trials were to compare female nest preference and nest characteristics, such as male/female offspring ratios, between the newly molded nests

and the industry standard of paper straw nesting material. Observations have indicated that the injection molded nest design appears to be much more attractive to female BOBs than were simple paper tubes with guard tubes around them.

Nests blocks were removed from riparian corridors, orchards and flight cages in late May after the bee larvae had spun cocoons. Nests will be opened and cleaned in November after the bee larvae have become adults and begin diapause.

A new injection molded, cleanable, nest design has been finalized. In previous work done it was the most accepted nest design, but was difficult to manage during necessary nest cleaning. This injection molded nest design will be available for next years nesting season and will be deployed next year in orchards and wildlands.

Almond Production

The observed nut set in the project orchards will result in a smaller crop than last year. This lower crop yield is probably due to the warm winter resulting in a lack of sufficient chill hours to establish synchronization between primary cultivars and cross pollination cultivars.

During the 2.5 years of this research there was no significant difference between the production of those 'treatment' trees close to nesting BOBs and control trees distant from nesting BOBs. This may be due to optimum pollination weather for honeybees during bloom all the years of this research project.

Information dissemination

Cover crop field days were held on March 7 and March 14, 2014 in Wilton, CA with 70-80 in attendance. The field days were mostly attended by orchard growers, certified crop advisors and pest control advisors. The field days were also attended by US Department of Agriculture and University of California representatives as well as nonprofit organizations and seed producers interested in incorporating sustainability practices into commercial agriculture.

The overall scope of the project did not benefit commodities other than specialty crops; however the results of this project has benefitted research into the utilization of other bee species, for the use in production of specialty crops other than almonds and cherries. Blueberries and other early fruit crops may benefit greatly due by the use of early blooming cover crops to enhance crop productivity and bee health.

The project partners in this research are central valley almond and non irrigated central coast grape growers. Their role in this research has been to provide acceptable management practices and modify unacceptable management practices to present a real world workable scenario to allow the use of native wildflower cover crops and BOB production within the production area. Almond and cherry, with irrigation available, were easily able to modify their orchard floor management practices sufficiently to allow the growth of native wildflower cover crops. Due to the drought some orchard growers had to keep cover crop growth mowed down to conserve water. Other growers with deeper wells still had irrigation water and were able to sustain regulated cover crop growth until seed shatter. Cover crop growth in central coast vineyards with no active irrigation was very low in growth and dominated by annual grass growth.

All cooperators did as much as they could to make the project successful, but the drought caused such stress on the water infrastructure that in many cases it was impossible or economically unfeasible for growers to add irrigation to their cultural program.

Goals and Outcomes Achieved

The activities listed below were completed to achieve the goals and outcomes:

1. Coordinated the cooperation of commercial orchard growers for use of orchards during research.
2. Coordinated access to wild lands where starting populations of BOBs can be nest trapped.
3. Located and nest trapped wild populations of California native BOBs. Wild bees were cleaned of pests and pathogens for future release into commercial orchards during bloom. Trapping was conducted by deploying various nest designs within wild areas that contain flowering plant species on which BOB are known to forage. Multiple nest materials and structures were used at the initiation of trapping in an effort to identify the most acceptable types. As trap nesting continued only the most desirable materials and designs were continued in use.
4. Designed and constructed highly acceptable and easily managed nesting materials to allow the production of BOBs in such numbers that they can be effectively used to pollinate commercial orchards.
5. Located and collected populations of native wildflowers that can be manipulated to bloom early enough in the almond orchards that they are utilizable by BOB females nesting in the orchards. Selected wildflowers were repotted from the wild and grown out in a small scale to obtain the first seed. These first seeds were used to grow larger quantities of seed in successive years.
6. Grew out the seed of the wildflower species selected for use in sufficient quantities to be sown into the floors of commercial size orchards.
7. Deployed BOBs in commercial orchards to determine the effect on pollination of the target crop and the change in population of the BOBs after foraging in the orchards.
8. Conducted night counts and establishment estimates for female BOBs released in orchards.
9. Quantified population changes in BOBs released in orchards and those trap nested in wild lands.
10. Established treatment and control trees and recorded production from these trees to establish any significant differences in production between those trees pollinated within the BOBs foraging radius and those trees outside the BOBs foraging radius.

Outcome measures were not long term. However the overall goal of this project was to establish BMPs for management of BOBs as a commercial pollinator. When looking at that as the goal the results of this project will be applied to future research by SLO Bee Company and to long term projects by other researchers conducting studies towards similar goals.

All of the goals established for this reporting period were accomplished.

Based on almond orchard yield data in this project, it was not clear that BOBs provide superior pollination to honeybees. The combined pre-hulling yield of four trees from control and treatment was not significantly different. The combined yield of four control and treatment trees in a conventional orchard was (2012 C=292.32lbs, T=285.49lbs) (2013 C=304.48lbs, T=310.81lbs) and in the organic almond orchard (2012 C=184.63, T=186.09) (2013 C=175.97, T=173.18). Even though there was no significant difference in yields it does not means that BOBs were not effective pollinators. The significantly greater production in conventionally farmed orchards is normal due to the use of synthetic fertilizers resulting in increased yield.

Both years had ideal pollination weather and honeybees had excellent flight conditions and honeybee colonies in both years were very healthy.

Night counts conducted at the beginning of 'Non-pareil' bloom were used to determine female BOB establishment. In both 2012 and 2013 nest establishment was less than the set target. In 2012 the establishment rate was observed at 41% at the beginning of 'Non-pareil' bloom that occurred on February 22nd. In 2013 the establishment rate was observed at 54% at the beginning of 'Non-pareil' bloom that occurred on February 19th.

Since this project did not show a significant difference in yield or a significant difference in orchard pollination between BOB and honeybees, it is not possible to say that the costs of maintaining a BOB population would be significantly lower then honeybee rental on a required pollination per acre basis. From the results of this project it appears that the ability to produce sufficient BOB populations for consecutive year's pollination will depend on increasing in-orchard retention and establishment of nesting female BOBs. Until that goal is achieved it will be necessary to include the addition of wild caught BOBs to augment those produced in the orchard.

Cover crop results were excellent during this research. Seed was first planted immediately after almond pick-up and irrigated. Seed was planted at the same time in coastal vineyards and cherry orchards that receive only rainfall as a water source. Seed sown in irrigated almond orchards germinated quickly. Seed sown in vineyards and cherries did not occur until after the first rains. On Oct. 24th 2012 the growth of *Phacelia ciliata, P. tanacetifolia* and *Nemophila menziesii* allowed to set seed the previous year was under way in almonds. These plants originated from seed allowed to be set seed and simply mowed after seed set, followed by standard conventional almond operations.

Wildflower seed production is feasible in all orchards depending on water availability, weed competition, early orchard planning and ongoing management program. During the last two years of this cover crop trial, establishment of wildflower species in orchards occurred naturally when given the chance to set and mature seed. The importance of water and weed competition was especially clear when comparing the two conventional orchards.

The conventional orchard with nipple type drip irrigation in the tree rows had very little cover crop growth by either weeds or wildflowers. During years of normal rainfall, much more wildflower cover crop growth would occur in the middles, producing a relatively weed free surplus of seed that would be produced for the following years cover crop within that orchard. The ground in the tree rows of standard conventional almonds is sprayed with a pre-emergent herbicide. This orchard management method is fairly standard in Madera, Fresno and Kern county almond orchards.

The conventional orchard with micro sprinkler irrigation had lush, vigorous wildflower cover crop growth. However, growth from other weedy plant species was also vigorous and competitive. In orchards with high competition it's difficult for wildflowers to compete with better adapted annual grasses and after several years the grasses will choke out the wildflowers. This is why it's always best to start a blooming cover crop program in a clean orchard.

In the two organic orchards wildflower cover crop growth was good due to deep post harvest irrigation the previous year. In the organic orchard with the working well, irrigation allowed the wildflower cover crop to mature and set seed for this coming year. The well in the other organic orchard had dried out and all cover crops had to be mowed down to conserve water. Very little wild flower seed was set so little or no seed will be produced. In those orchards that practice bare orchard floor management or plant with the intent of later becoming organic, it is easily conceivable that a grower would be able to supply their own needs as well as the seed requirements of several other orchard growers given adequate rain or slight irrigation adjustment. It may be especially feasible in young, non-producing orchards with plenty of sunlight penetration.

It appears that the time from set and the disturbance cause by almond raking and pick-up was enough to allow for germination after a deep post-harvest irrigation. *P. ciliata* had the first true leaves and was approximately 1 inch tall. *P. tanacetifolia* and *Nemophila menziesii* was in the late cotyledon stage and was also about 1 inch tall. On Oct. 24th, 2012 *Phacelia ciliata*, *P. tanacetifolia* and *P. cicutaria* seed was sown into plots adjacent to the already established plots in Winton. On Dec. 10th 2012 the naturalized *P. ciliata* that was allowed to set seed the previous season was six inches tall and had the first few flowers open. The *P. tanacetifolia* that was allowed to set seed the previous season was 12 inches tall, but had not yet opened any flowers. *Nemophila menziesii* was 2 inches tall in the lower section with no flowers. There was no visible sign of any re-growth from the previous years *Collinsia heterophylla or Pholistoma auritum*.

On Feb. 2nd 2013 the second year *Phacelia ciliata* was in full bloom. Second year *P. tanacetifolia* was in early bloom. This was significant in that this high quality bloom was now available as forage for BOBs before almond bloom. On February 2nd 2013 the newly planted *P. ciliata* was in early bloom, *P. tanacetifolia* had formed distinct whorls, but had not yet bloomed and *P. cicutaria* was in the early stage of flower whorl formation. On February 2nd 2013 the second year *Nemophila menziesi* had also made a rapid, unexpected reappearance and co-dominated the shadier areas of the project orchard with chickweed, *Stellaria media*. This occurred after being allowed to set seed the previous year followed by standard conventional almond practices. On Apr. 6th 2013 both first and second year *Phacelia ciliata* was finished blooming. The bloom on both first and second year *P. tanacetifolia* was roughly 80% complete and *P. cicutaria* was in full bloom and covered with honeybees. Therefore, high quality BOB and honeybee forage can be maintained before, during and after almond bloom. Also, on Apr. 6th 2013 *Nemophila* menziesi was still in full bloom in the lower orchard section. On October 7th 2013 *Phacelia ciliata*, *P. tanacetifolia*, *P. cicutaria*, *Nemophila menziesi*, *Collinsia heterophylla* and *Eschscholzia californica* were planted.

Single species were planted per row. Phacelia *ciliata* began to bloom in mid December 2013 and *Nemophila menziesi* was blooming by February 12th 2014. By March 7th 2014 both of these species were in full bloom. *Phacelia tanacetifolia*, *Collinsia heterophylla* and *Eschscholzia californica* were just beginning to bloom. In both trial years grass overwhelmed the cover crops in both the dry farmed cherry orchard and the central coast vineyard.

Two major successful outcomes were achieved during this research. The first major outcome is the successful design of a cover crop management program for utilizing BOB or other alternative pollinators in orchard environments. This cover crop design allows the maintainence of high quality forage starting in late December or early January, depending on weather, through early to late April. This extended bloom period allows early emergence of BOBs before almond bloom, as well as continued BOB reproduction after almond bloom has ceased. Additionally, this extended bloom period benefits honeybee keepers by allowing them to bring in honeybees earlier than usual and also allows them to leave honeybees in the orchard longer after almond bloom has ceased.

The second major outcome was the design of two forms of highly acceptable, easily managed and predator/pathogen limiting BOB nests for commercial scale use. These nests are highly acceptable because of their incorporation of wood in the design and the exterior three-dimensional layout of the nest which allows easier orientation of nesting females to their nest entrance. The ease of management of these nest designs allows the quick processing of cocoons during the winter following the pollination period as well as the washing and reuse of BOB nests. These nest designs are of dense enough material to keep out predators while still having ventilation which allows oxygen and moisture exchange with the exterior environment helping greatly reduce the development of fungal growth in the nest interior.

The groups that benefited from the completion of this project are:
1. Over 6,000 orchard growers that may want to use alternative pollinators in their future operation.
2. Researchers that may want to use some of the results of this research to add to the success of their research projects in the use of alternative pollinators.
3. Individuals that may want to become producers of alternative pollinators to serve the pollination market.
4. Seed producers that may want to produce seed for sale, for the blooming cover crop market.

The first potential economic impact of this project, if BMPs can be developed to increase the establishment of nesting females, is to save growers money and allow them to produce their own pollinators and not rent honeybee colonies. The second impact would be to place downward pressure on the cost of honeybee colony rental for those growers who continue to use honeybees for pollination.

Lessons Learned

Lessons learned that will benefit users or trappers of BOBs:
1. Use nesting materials that are easy to open and inspect after BOB females have finished nesting.
2. Use nesting materials that cannot be penetrated by parasitic wasp ovipositors.
3. Use nesting materials that allow gas and moisture exchange with the nest exterior.
4. Use nesting materials that have some wood component and wood smell incorporated into them.
5. Release some females at each nest location within the orchard to act as an attractant to other females.
6. Release some females at each nest trapping location in riparian corridors to allow wild females to follow the released females back to their nest location.

Lessons learned for the use of wildflowers as cover crops:
1. Start with as bare ground as possible.
2. If not a bare plot, remove the annual grasses.
3. Control unwanted broadleaves especially *Malva parviflora*, *Erodium cicutarium* and *Chenopodium album*.
4. Plant a single wildflowers species per row to allow for different maturation and seed shatter timing.
5. Only plant a 4-5ft wide strip down the middle of the ‘middles’.
6. Use a seed drill over simply broadcasting seed.
7. Sow seed as soon as possible after almond pickup and irrigate.
8. Make sure incoming equipment is free of undesirable weed seed.

The one unexpected outcome that was an effect of this project was how early *Phacelia ciliata* came into bloom when planted and pre-irrigated shortly after almond pickup and how long its bloom period lasted.

The goal of 70% female BOB nesting establishment was not achieved. The lesson learned was that it will be more difficult and take more time than anticipated to develop BMPs for BOBs in orchards. It is possible that the new nest designs will help in coming years, combined with the use of newly developed nesting attractants, will help resolve this situation, especially now that a successful cover crop program has been developed. Increasing the early establishment and decreasing dispersal of females in an open orchard environment is the key success in using BOBs as orchard pollinators.

Additional Information

Attachment 2 – Early Cover Crop Management in Almond

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 23	**Project Title:** Calculating Scope Three Greenhouse Gas Emissions to Mitigate Climate Change, Reduce Costs, and Address International Market Demand	
Grant Recipient: Wine Institute	**Grant Agreement No.:** SCB11023	**Date Submitted:** December 2014
Recipient Contact: Allison Jordan	**Telephone:** 415-356-7535	**Email:** ajordan@wineinstitute.org

Project Summary

The purpose of the project was to develop a Life Cycle Analysis (LCA) for the California wine industry. Through the LCA, the industry would increase its understanding of the processes within the winegrape growing and winemaking cycle that have the greatest relative contribution of greenhouse gas (GHG) emissions. By taking into account the life cycle of the product (i.e., cradle to grave), the LCA is a useful way to identify opportunities to reduce the overall carbon footprint. This project fits within the California wine industry's long-term commitment to sustainable winegrowing and continuous improvement.

The project also addressed the need to develop emission factors for all significant inputs to the production, use, and disposal phases of winegrapes growing and wine production. The LCA findings and emission factors could then be incorporated into the web-based wine industry GHG calculator in the Sustainable Winegrowing Program's (SWP) on-line performance metrics system, which to date had only included Scope 1 and 2 emissions for wineries and vineyards.

The proposed project addressed the need for the California wine industry as a whole, and for individual wineries and vineyards, to better understand and measure Carbon footprints. By calculating the footprint and identifying those processes that contribute the most GHG emissions, the industry is better positioned to help mitigate climate change, improve resource conservation, reduce costs, and meet global market and regulatory requirements.

In 2011, several European and Southern hemisphere countries and many retailers were indicating that carbon labeling would be required. Although labeling is not yet required, many retailer supply chain initiatives and questionnaires – such as The Sustainability Consortium's Key Performance Indicators for the wine and grapes category being used by Walmart and Sam's Club – do address GHG emissions. In 2007, Wine Institute joined together with wine associations from Australia, New Zealand and South Africa to develop the International GHG Protocol and calculator, and in 2012 the California Sustainable Winegrowing Alliance (CSWA) released an online performance metrics tool that includes GHG emissions. However, these efforts did not address Scope 3 emissions such as packaging and distribution.

While the dozens of wineries that participated in the data collection and workshops as part of this project benefited immediately, the project will benefit thousands of vintners and growers in all California winegrowing regions (covering more than 500,000 acres). With the goal of continuous improvement, California growers and vintners can use the results of this study as a guide when considering opportunities to reduce their carbon footprint. Many opportunities for carbon footprint reduction will also lead to efficiencies in operations and reduced costs associated with raw material and energy purchases. Further, reduction of GHG emissions can help address regulatory and market pressures, mitigate business risk, and improve resource conservation. Through the SWP's online tools, vintners and growers will be able to benchmark their GHG-related practices to their peers. Finally, once sufficient data is collected and aggregated, the CSWA can set improvement targets and allocate resources on targeted education to achieve those goals by focusing on processes and materials with the most significant GHG impact.

The LCA complements the last decade of work by Wine Institute and CSWA and supports the idea of continuous improvement. In 2002, Wine Institute and the CSWA published a comprehensive California Code of Sustainable Winegrowing Self-Assessment Workbook, now in its third edition, and in 2003 created the CSWA, a nonprofit organization devoted to providing vintners and growers with tools, resources, and workshops to promote the adoption of sustainable vineyard and winery practices. In 2010, CSWA launched a third party certification option, Certified California Sustainable Winegrowing.

In 2011, this LCA project was initiated and, in addition to building off these previous 10-years of work, the project team incorporated "lessons learned" and data from the following projects into the LCA project and Scope 3 calculations:

- "CA Vineyards Climate Protection Initiative" (a CSWA project funded by 2007 SCBGP Project 4) – CSWA worked with scientists from UC Davis, Wine Institute, CAWG and other partner organizations to conduct a literature review to better understand the vineyard-specific GHG emissions and offsets, including carbon sequestration of vineyards. A full report and grower-friendly educational handout were created and, given the research gaps, the DeNitrification DeComposition (DNDC) carbon and GHG emissions model was calibrated for winegrapes as a tool for calculating GHG fluxes in vineyards.
- "Field Testing a Carbon Offset and GHG Emissions Model for CA Wine Grape Growers to Drive Climate Protection and Innovation" (a CSWA project funded by 2010 SCBGP Project 50) – CSWA worked with scientists to better understand the carbon and nitrogen fluxes occurring in the vineyard soil by calibrating and field testing the internationally used DeNitrification and DeComposition (DNDC) tool, which was then integrated into the Performance Metrics online tool. Emissions data from this project was used to "ground truth" the vineyard phase of the LCA.
- "Performance Benchmarking, Tools and Resources for the California Wine Industry" (a CSWA project funded by a USDA Conservation Innovation Grant) – In 2012, CSWA added Performance Metrics to its online self-assessment and reporting system for energy, water, and nitrogen use, as well as for energy-related GHGs to assist growers and vintners in measuring and tracking their resource use and related emissions. Data entered into the system was used to develop the LCA; and data from the LCA, including scope 3 emissions, was subsequently incorporated into the on-line performance metric system.
- "Reducing Our Footprint: Minimizing GHG Emissions and Nitrogen Leaching in Vineyards, and Enhancing Landscape Carbon Stocks" (a USDA Agricultural Resources Service project funded through 2009 SCBGP Project 7) – Scientists from this project served as advisors to the LCA project.

While the above projects helped Wine Institute and CSWA to better understand Scope 1 and 2 emissions for wineries and vineyards, Scope 3 emission factors had not yet been defined with a high degree of confidence. Adding Scope 3 elements to the existing GHG calculator provides a means for California wineries – with diverse winemaking and distribution processes – to better understand their carbon footprint from a full LCA perspective; and for the industry as a whole to eventually be able to set improvement targets.

Project Approach

Work Plan – Project activity	*Results, accomplishments, conclusions*
• Perform LCA, focusing on Scope 3, to identify and develop emission factors for all material and energy inputs into the production, use, and disposal of winegrapes and wine using international protocols	PE International, Inc. (PE) conducted a literature review and developed a LCA baseline model. Using international protocols and data provided by California vintners and growers as well as the related projects described above, PE modified the baseline LCA model to reflect the California wine industry. Hot spots, variables that have the greatest impact on results, were identified. PE conducted sensitivity analyses on those hotspots.
• Develop tables of emission factors for significant Scope 3 GHG emissions; • Adapt the existing SWP GHG Calculator to include Scope 3 emissions; • Incorporate the LCA and GHG calculator into the SWP on-line self-assessment and reporting system; • Incorporate the GHG LCA into CSWA's performance metrics project	Emission factors were developed and incorporated into the online SWP GHG calculator and metrics project to include scope 3 emissions for packaging and distribution. These activities were completed in advance of workshops held in June 2014.
• Educate 2000 vintners and growers about California wine's carbon intensity at the industry-level and the availability of the calculator for them to better understand their own footprint. • Conduct 5 workshops for a minimum of 200 vintners and growers to demonstrate how to use the web-based tool	• An executive summary of the project entitled, "California Wine's Carbon Footprint: Study objectives, results and recommendations for continuous improvement," was published and 500 copies were printed for distribution at workshops and upon request. • A pdf of the report was posted online for access by the 1,800 SWP participants and thousands of other California winegrowers (See http://www.sustainablewinegrowing.org/docs/California_Wine_Executive_Summary.pdf). CSWA's website receives nearly 18,000 unique visitors annually. (See Attachment A.) • The release of the report was distributed to Wine Institute membership and regional associations (approximately 1400 individuals on distribution list) via News Briefs. • Two webinars were conducted with Wine Institute's Environmental Working Group and CSWA board members during the Life Cycle Assessment phase (10/16/12 and 12/5/12) with

	30 vintner and grower participants. • Four in-person workshops and one webinar workshop were coordinated and facilitated in April 2013 and June 2013. The workshops were held in San Francisco and in different growing regions of California – Paso Robles, Livingston, and Sonoma for 105 vintner and grower participants. • Since 2011, CSWA held an additional eleven targeted education workshops that covered GHG-related topics in wine regions across California and via webinars throughout the year, reaching an additional 187 vintner and grower participants. CSWA staff also presented on the performance metrics, DNDC tool, and LCA project at the 2012 Sonoma County Winegrape Commission Field Day at Shone Farm, reaching approximately 100 other winegrowers. The LCA project was mentioned at these workshops, and will continue to include information about the LCA project, outcomes, and resulting web-based tools.
Conduct media outreach through a press release to trade publications and dailies in winegrowing regions throughout California to encourage articles about the project in order to reach a broader audience.	• Information about the project, with a link to the California Wine's Carbon Footprint summary, was distributed to approximately 150 media. • The summary and a separate memorandum, entitled the "Green Line Response Memo," prepared by PE International will be used to respond to media inquiries about GHG emissions and climate change issues related to the California wine community (See Attachment B.)
Collect and analyze data to evaluate the effectiveness of the project through surveys on emission factors and usability of the GHG calculator and LCA data collected via the SWP system.	• CSWA collected evaluations following workshops, and solicited input on the usability of the GHG calculator via the online system during the development phase from the Environmental Working Group and CSWA board members. • Many of these vintners and growers were also using the performance metrics site to input data that was used to conduct the LCA.

Use data collected to help set industry-wide targets.	• This activity was not achievable within project time frame. Data collection (required to convert the baseline LCA to a California-specific LCA) efforts took significantly longer than anticipated. In addition, when the proposal was submitted, CSWA had not yet released the SWP online performance metrics tool and the challenge of collecting data was not yet apparent. • Although CSWA has collected GHG data from vintner and growers, the organization wants to have sufficient data to ensure the data is a meaningful baseline and representative of an industry average. Once sufficient data is submitted into the online system, CSWA intends to work with vintners and growers to set industry targets.
Share project process and results with CDFA, National Grape and Wine Initiative, and other specialty crop industry associations to promote transferability to other specialty crop sectors.	• Laura Morrison of PE International and Allison Jordan of Wine Institute co-presented at an August 2012 LCA conference in Tahoma, Washington; • A delegation of Wine Institute member wineries and associations recently traveled to Bentonville, Arkansas to meet with The Sustainability Consortium, Walmart and Sam's Club, all of which are interested in carbon footprints, among other key performance indicators, of wine and other categories. • The California wine industry's climate-related activities have also been shared with the multi-stakeholder Stewardship Index for Specialty Crops, National Grape & Wine Initiative and other organizations to promote transferability of information and lessons learned to other specialty crop sectors.

The project did not benefit commodities other than specialty crops.

Key contributors to the project included:

- Wine Institute Director of Environmental Affairs and Executive Director of the California Sustainable Winegrowing Alliance, served as Project Director and oversaw project implementation. Wine Institute's Environmental Affairs Coordinators, provided coordination and administrative assistance.

- PE INTERNATIONAL, an LCA/sustainability consulting firm, led the development of the LCA model, conducted the literature review, identified hotspots, ran sensitivity analysis, and ran various scenarios (e.g., light weighting glass, shipping distances, etc.) and integrated information received for project participants. She also conducted industry outreach and presented at the California Carbon Footprint workshops.
- The Environmental Working Group (EWG) of Wine Institute's Technical Advisory Committee (comprised of facility and vineyard managers and other wine industry professionals with a broad range of educational and technical backgrounds) provided technical input, oversight and evaluation, and acted as a Technical Advisory Committee. The EWG members also provided much of the data which allowed PE to modify the baseline LCA into a CA specific LCA.
- The CSWA Board of Directors also provided input, particularly regarding the executive summary document and integration of Scope 3 elements into SWP's online performance metrics system. CSWA staff coordinated and facilitated the California Carbon Footprint workshops.
- SureHarvest developed the online Performance Metrics tool and was responsible for integrating the LCA project outcomes into the SWP on-line software and reporting system. SureHarvest also helped in the collection of data through the online tool, and presented at the Carbon Footprint workshops.
- Kennedy/Jenks provided project management support. In addition, they coordinated with PE to answer questions specific to how wineries and vineyards operate and to help gather data from wineries.

Goals and Outcomes Achieved

The goal of the project was for the California wine industry and individual wineries and vineyards to calculate Carbon footprints to help mitigate climate change, improve resource conservation, reduce costs, and meet global market and regulatory requirements.

Performance Indicators	Activities completed to achieve the performance goals and measurable outcomes
• Completion of LCA	With data provided by vintners and growers and technical review by the EWG, PE developed an LCA model that reflects the California wine industry.
• Table of emission factors for Scope 3 elements	Once the LCA model of the California wine industry was completed and approved by the EWG, PE developed an appropriate table of emissions.
• Completion of web-based GHG calculator that includes Scope 3 emissions • Integration of LCA into the SWP online self-assessment and reporting system • Incorporation into CSWA's performance metrics projects	Working together, PE and Sureharvest integrated the LCA and scope 3 emissions into the existing online tools. These activities were completed in advance of several educational workshops and webinars held in the summer of 2014.
• # of winegrowers reached	Through workshops and webinars, 422 vintners and growers were reached; through websites, educational material, electronic newsletters, and other communications, an estimated 2000 vintners and growers were reached.
• # of workshops	In April and June 2014, one webinar and four in-

Performance Indicators	Activities completed to achieve the performance goals and measurable outcomes
	person and workshops were held throughout California. In addition, prior to the workshops, multiple webinars were held with vintners and growers to define the project and to receive their input.
• Press release and # of trade publications covering the LCA project	Approximately 150 media received a link to the Carbon Footprint pdf via Wine Institute News Briefs.
• Completion of survey and # of participants submitting data	Approximately 50 wineries and vineyards submitted data and/or completed an evaluation.
• Establishment of baseline and targets for improvement	This was not achieved. As described elsewhere in the report, data collection required significantly more time than anticipated and there was not adequate time to collect sufficient data that is representative of an industry average.
• # of specialty crop organizations and growers reached through outreach	Approximately 20 specialty crop organizations and over 2000 growers were reached through News Briefs, workshops, industry events, and other outreach activities.
• Quarterly invoices and bi-annual reports to CDFA; maintain communications and project coordination with all collaborators through monthly conference calls and meetings	Wine Institute submitted all project administration documents (contract, progress reports, invoices, etc.) in a timely manner. In addition, the project was facilitated through monthly (and often more frequent) communication among the project participants, collaborators, and influencers.

Wine Institute and CSWA are committed to providing vintners and growers with tools for continuous improvement, maintaining California wine's leadership in sustainability, and to address market and regulatory pressures. Thus, outreach to growers and vintners through the Sustainable Winegrowing Program will continue beyond the project period. This outreach will focus on educating the industry on the LCA project findings as well as encouraging the industry to utilize the online system, including the self-assessment and performance metrics tools. The LCA and scope 3 emissions are now incorporated into these tools. As growers and vintners continue to increase use of the SWP system, Wine Institute and CSWA will be able to collect better data and with sufficient data, establish an industry average baseline and targets for improvement.

The project goals were accomplished. PE initially developed a LCA baseline model based on a literature search of existing published LCA of packaged wine. This baseline model was modified to reflect the California wine industry by collecting data from California vintners and growers and from the Performance Metrics tool. The data collected represents 4-5% of total vineyard acreage in California and 85% of cases produced in California. Additional vineyard information was derived from the DNDC tool, which models the carbon and nitrogen bio-geochemistry in a vineyard. The DNDC model was used to simulate field emissions in all the wine growing regions throughout California and was shown to be an accurate representation of statewide vineyard field emissions.

The LCA for the California Wine Industry was completed, and the areas with the most opportunity for improvement to reduce a vineyard or winery's carbon footprint (also known as "hot spots") were identified. With a focus on continuous improvement, the project also identified opportunities to reduce a facility's carbon footprint in four areas: These include: (1) packaging, particularly the use of glass bottles; (2) vineyard field emissions, particularly nitrous oxide (N2O) associated with bio-geochemical processes and nitrogen application; (3) vineyard and winery electricity usage for operations; and (4) distribution of packaged wine throughout the U.S. using truck and rail transport.

Further, Sureharvest has updated the CSWA Performance Metrics tools to reflect the findings of the LCA study and now includes packaging materials and distribution impacts. This update enables companies to understand hot spots in their individual operations. By understanding the carbon footprint, individual growers, vintners, and distributors can consider how to best use their resources and target specific greenhouse gas reduction activities. Small changes at the facility level can have a large impact on the overall industry footprint if adopted across the industry

This information is now accessible to thousands of growers and vintners through workshops, webinars, newsletters, and incorporated into the online tools. The results have also been shared with a wider audience through participation in conferences, such as the 2012 LCA conference and in Wine Institute/CSWA discussions with other specialty crops groups and industry associations. This information will continue to be distributed throughout the industry and growers and vintners will be encouraged to use the online tools.

As more growers and vintners enter their information in the performance metrics systems, Wine Institute and CSWA will be able to collect baseline data. Further refinement of the data collection process will enable a deeper understanding of variation by product, operation, and scale of facilities. Understanding and inclusion of the use phase (e.g., storage and refrigeration) through a consumer use habit survey will add another level of detail to LCA results.

Below is the status of all baselines and targets that were outlined in Wine Institute's proposal.

The GOAL of the project is for the California wine industry and individual wineries and vineyards to be able to calculate Carbon (C) footprints to help mitigate climate change, improve resource conservation, reduce costs, and meet global market and regulatory requirements. Completion of an LCA that includes credible emission factors for significant Scope 3 elements, and a web-based tool that enables wineries and vineyards to calculate their GHG footprints are key PERFORMANCE MEASURES (PM). Currently, Scope 3 elements are missing (BENCHMARKS), and the development of the LCA and addition of Scope 3 to the calculator are key TARGETS. Another key PM is incorporation of the LCA project into the SWP, on-line self-assessment and reporting system that is used by wineries and vineyards that produce 65% of California wine case production and 70% of CA vineyard acreage (BASELINE=0; TARGET=1). A third key PM is establishing a baseline and setting targets for improvement by incorporating the LCA and Scope 3 elements into the California wine industry's existing performance metrics project (BASELINE=0; TARGET=1). *All targets were met.*

Other PERFORMANCE MEASURES include:

a) Educating at least 2,000 winegrowers and other specialty crop producers (TARGET) about project outcomes and LCA tool availability through 5 workshops or trade events (TARGET) for approximately 200 participants (TARGET), 5 trade publications (TARGET), websites, newsletters and other communication tools. (BASELINE FOR ALL WAS 0). *Targets met or exceeded.*

b) Increasing the number of users of the web-based GHG LCA calculator, with a goal of approximately 10% of SWP participants by the end of the grant period (TARGET=200; BASELINE=0.) *Approximately one-quarter of way towards meeting target of individual SWP participants; however, wineries that produce 85% of California's wine cases participated in the project.*

c) Evaluating project effectiveness through surveys, data analysis and progress reports (TARGET=1; BASELINE=0). *Target Met.*

d) Sharing project process and results with a minimum of 20 regional and state specialty crop producer organizations (TARGET), helping to expand the audience to thousands of specialty crop growers (BASELINE=0). *Target Met.*

As detailed in other report sections, the project successfully achieved all goals and objectives in a timely manner. Completion of the LCA and California Wine's Carbon Footprint document, and integrating Scope 3 elements into the SWP performance metrics tool helps further establish the California wine industry as a leader in sustainability, while helping vintners and growers continuously improve and address market and regulatory pressures. Educating 422 vintners and growers via workshops and webinars, and an additional 2,000 winegrowers via other communication tools demonstrates the effectiveness of the Specialty Crop Block Grant as a means to leverage other organization's resources and capacities to help ensure the competitiveness of specialty crops in California.

Beneficiaries

<u>Vintners and Growers:</u> will benefit by having tools and information to help them respond to regulatory and market requests about the carbon intensity of the industry and of their operations. This project and the resulting online tools are intended to help vineyards and wineries understand their carbon footprint so they can adjust management practices to improve resource conservation, reduce cost, and help mitigate climate change. They can also use the media material, such as the Executive Summary and Green Line Response memo (Attachments A and B) to respond to retailers and other interested parties.

<u>Other Specialty Crops</u>**:** Project process and results will be shared with table, raisin and winegrape sectors, in California and other U.S. regions, and other specialty crops will also benefit from the project, expanding the potential reach of the program by thousands of producers and acres. The SWP is already being used as a model program in other winegrowing regions and agricultural sectors, including raisins, table grapes, almonds, avocadoes, and pears.

<u>Partner Organizations:</u>

- Through National Grape & Wine Initiative there will be an opportunity to leverage this project with other wine regions and the raisin and table grape sectors

- Stewardship Index for Specialty Crops (SISC), a collaborative initiative to develop a system for measuring sustainable performance-based metrics throughout the specialty crop supply chain (see www.stewardshipindex.org for more information).

Wine Institute and the CSWA have disseminated information via the SWP's outreach and education tools, workshops, newsletters and website. Results will be shared with table, raisin and wine grape sectors in CA and other U.S. regions, as well as other specialty crop producers, expanding the potential reach by thousands of producers and acres.

Beneficiaries from the project include 422 participants in workshops, webinars and industry events where the LCA project was discussed, and opportunities for continuous improvement to reduce carbon footprints were addressed. The project deliverables also reached approximately 2000 vintners and growers, further expanding the beneficiaries of the project. Given California wine's economic impact of $61.5 million on the state, the project provides specialty crop producers with tools and resources to address the growing interest in carbon footprints in the market and regulatory arenas.

Lessons Learned

Overall, the project went well and most objectives/goals were accomplished. A key reason for the success was the project team. Selecting an LCA consultant, PE, with appropriate experience, technical acumen, and ability to translate technical terms into vernacular encouraged a greater participation by industry members. It was also helpful to have Kennedy/Jenks assist with project management and facilitation. Since PE had no previous winery experience, having someone available to immediately respond to questions about wine-making and viticulture processes helped the project move along without further burdening industry participants.

Other areas identified as improvement opportunities – such as vineyard field emissions and vineyard and winery electricity usage – are already being addressed by the industry through sustainable practices identified in the Code of Sustainable Winegrowing and through targeted education and partnerships with entities such as the USDA Natural Resources Conservation Service and Pacific Gas & Electric Company.

One of the unexpected outcomes from the LCA study was further appreciation for the size and diversity of the California wine industry. Another is the relative small impact of wine closures in the overall wine cycle, with impacts ranging from 1-3%, when the environmental attributes of various types of closures is a common topic. Packaging, however, is a significant contributor to the overall California wine footprint, and the industry's major trend of light weighting of glass bottles (also called dematerialization) can significantly reduce a bottle of wine's environmental burden. Using less glass also has the benefit of shipping less mass, thereby reducing the burden of distribution. As with all consumer products, quality and consumer preference are important considerations that were not included in the scope of this study.

As mentioned previously, collecting data from growers and vintners took longer than anticipated. Initially, participants were asked to provide the requested data by August 2012 to keep with the LCA schedule and as not to interfere with harvest activities. However, few wineries met this deadline given harvest preparation, legal review, and other constraints. Data that was ultimately collected represented 4-5% of total vineyard acreage in California and 85% of cases produced in California. Additional vineyard information was derived from the DNDC tool, which models the carbon and nitrogen bio-geochemistry in the vineyard during the life cycle of the vine based on conditions such as weather, soil type, and management practice. The DNDC model was used to simulate field emissions in all winegrowing regions throughout California and, through calibration and testing, was shown to be an accurate representation of statewide vineyard field emissions.

The data was analyzed and used to convert the baseline LCA model to a model that reflected the California industry. For the inputs and outputs of the wine life cycle, a weighted average was calculated using the known production totals for each vineyard and winery that provided data. Outliers were identified and individually assessed as to their inclusion or exclusion within the study. The work was further vetted through literature and conversations with industry experts. The collected information was then translated into quantitative environmental impacts using PE INTERNATIONAL's GaBi Software for Product Cycle Assessments. Although these steps took additional time, they were needed to ensure the accuracy of the model, and did not disrupt Wine Institute's ability to complete the project in a timely manner.

Partly as a result of these delays and difficulties and partly due to other complexities of data collection, the project did not have enough time to gather sufficient data to set targets relative to the industry-wide carbon footprint. Wine Institute's recommendation to others undertaking carbon footprint studies is to not underestimate the time it will take to collect data from participants.

Additional Information

Below are links to the California Wine's Carbon Footprint, to the CSWA Sustainable Winegrowing Program Overview, and to the SWP Performance Metrics portal.

- http://www.sustainablewinegrowing.org/docs/California_Wine_Executive_Summary.pdf
- http://www.sustainablewinegrowing.org/sustainable_winegrowing_program.php
- http://www.sustainablewinegrowing.org/performance-metrics.php

Also attached, please find the following documents:

- Attachment A – California Wine's Carbon Footprint
- Attachment B – Green Line Response Memo
- Attachment C – Sample Agenda from LCA workshop
- Attachment D, E, and F – Presentations from LCA workshops

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 24	Project Title: Lake County Rising Promotional Campaign	
Grant Recipient: Lake County Winegrape Commission	**Grant Agreement No.:** SCB11024	**Date Submitted:** December 2014
Recipient Contact: Debra Sommerfield	**Telephone:** 707-279-2633, x302	**Email:** debras@lakecountywinegrape.org

Project Summary

This project started in 2011, a time when a weak economy and competition from the global marketplace had significantly impacted Lake County winegrape growers and wineries. Focused on improving quality in their fruit, many Lake County winegrape growers also were experiencing a loss of the traditional multi-year contracts due to the market downturn and difficulty in finding buyers for their fruit. Lake County wineries, although growing in number in the region and receiving awards for their wines, were experiencing a challenge in terms of a general lack of awareness and recognition as a wine region in the marketplace. This project – entitled the "Lake County Rising Promotional Campaign" – was designed to benefit Lake County growers and wineries with a multi-pronged approach, which included baseline and periodic surveys on the state of the industry, a multi-faceted media and promotional campaign, training for growers and wineries on regional messaging, as well as a showcase of the region through a range of trade and consumer events.

The project timing and its duration has been extremely influential in bringing the local industry members together to speak with the same voice, to carry the message of the region forward to a range of audiences by providing the tools, resources, and vehicles necessary to deliver the message in the most impactful and cost-effective way. The growth in the local industry is apparent – and the pride with which the industry speaks about the wine region has grown tremendously over the course of the project.

Project Approach

Activities and events included:

- Exhibit at several national trade shows in 2012, including: Unified Wine & Grape Symposium, Sacramento, CA, January 24-26, 2012 (12,400 attendees); Texas Wine & Grape Growers Annual Conference & Trade Show, San Marcos, TX, February 16-18, 2012 (500 attendees); Midwest Wine & Grape Conference and Trade Show, St. Charles, MO, February 9-12, 2012 (third largest show in North America); Eastern Winery Exposition, Lancaster, PA, March 7-8, 2012 (850 attendees and exhibitors); Wineries Unlimited, Richmond, VA, March 29-April 1, 2012 (2,300 attendees). Lake County wine region exposure through campaign messaging at national industry trade shows reached over 42,000 attendees. Surveys responses received of 1063 from consumers, 114 from growers, 39 from wineries, 50 from wine and winegrape buyers, and 137 from workshop and seminar attendees.
- Over the course of the grant, 1,063 consumer surveys, 114 grower surveys, 39 winery surveys, 50 wine and winegrape buyer surveys, and 137 workshop and seminar attendee surveys were collected and analyzed.
- Participation in Lake County Winery Association sponsored "Wines with Altitude" consumer wine tasting event (September 2012) at Treasure Island to build on consumer marketing efforts in the San Francisco Bay area. More than 20 Lake County wineries participated in this event, which was attended by more than 200 Bay Area consumers.

- Presentation on the Lake County wine region by a Lake County sommelier at the American Wine Society trade show, Portland, OR, (November 2012), which had 500 attendees. The presentation included Lake County appellations and the combined impact of soil, elevation, sunlight and climate on the region's wine flavors; this was followed by a tasting of wines representing the region's different growing areas.
- A Lake County wine tasting event, titled "Wine, Tunes, & Classics," was presented at the California Automobile Museum in Sacramento (May 2013) as a way to reach Sacramento area wine consumers. Nineteen Lake County wineries participated and presenting award-winning Lake County wines that included a special wine-and-food pairing designed to showcase the distinct flavor profiles of Lake County wines.
- A hospitality training session was presented (June 2013) for hospitality professionals employed by local restaurants, lodging establishments, and catering businesses. The session included a presentation of key messages on the Lake County wine region, how to sell/up-sell Lake County wines, and how to recommend Lake County wines to complement menu items with a hands-on wine-and-food pairing.
- A Lake County Rising Presentation was made (June 2013) to a panel of 10 professional wine judges and industry members in conjunction with the Lake County Wine Competition. The presentation highlighted the Lake County wine region, its climate, soils, elevation and other characteristics.
- A seminar for the trade and media, titled "The Mountains of the North Coast," was presented (June 2013) at MacMurray Ranch in Healdsburg, with 80 attendees and presenters. The technical presentation identified specific climate characteristics of the Lake County viticultural area and included a technical tasting led by North Coast winemakers experienced with Lake County grapes/wine.
- Display of the Lake County Rising trade show booth at the Lake County Fair (September 2013) provided a visual representation of the vibrant Lake County wine region to the general public (annual fair attendance is 38,000).
- Participation in a consumer event in the San Francisco Bay Area at the Pleasant Hill Art and Wine Art (October 2013) featured the Lake County trade show booth and pouring by Lake County wineries.
- A series of three industry seminars – titled "Momentum" – was presented in Lake County (November 2013, January 2014, March 2014 – with a combined attendance of more than 240) to educate local grape growers, wine and hospitality professionals, and others in the trade on the Lake County Rising story. Expert speakers and panelists presented a number of key topics, including: the wine region's key messages, the climate of the Lake County wine region, the current state of the wine industry and Lake County's position in the marketplace, consumer perceptions about Lake County wine and winegrapes, legal considerations in grape/wine purchase agreements, and use of the information to sell wine and winegrapes now and in the future. When asked to rate the overall effectiveness of these seminars in a post-event evaluation, 97 percent of participants rated the sessions as excellent or very good.
- Participation at Unified Wine & Grape Symposium in the Regional Wine Pouring (January 2013, January 2014). Attendance at the 2013 event was 13,400. A post-event debrief discussion of the 2012 event which included an exhibit on the trade show floor (see January 2012, above) revealed that although several contacts were made, it did not result in reaching the target audience of grape buyers. Thus, a change was made to adjust the region's presence from the trade show portion during

the whole event to a more cost-effective presence during the event's regional wine tasting. Direct contact with wine writers was made and media and industry/trade were able to taste and discuss the quality of Lake County wines and fruit – furthering the message of the winegrowing region. This was done in 2013 and 2014 and proved to be a success.

- A technical seminar and tasting for sommeliers in San Francisco (February 2014) was led by Master Sommelier Tim Gaiser with a Lake County Rising presentation introducing the Lake County wine region and a presentation on the climate of the Lake County winegrowing region by Professor Greg Jones of Southern Oregon University. An intimate discussion among the participants revealed overwhelmingly positive comments on the quality and variety of wines presented.
- Participation in a consumer event in the San Francisco Bay Area at the 2014 Spring San Francisco Vintners Market (April 2014) at Fort Mason. Fourteen Lake County wineries participated and the Lake County trade show booth was displayed, providing a visual showcase of the Lake County wine region.

Deliverables included:

- Creation of a professional trade show booth highlighting the Lake County wine region that is used at almost all seminars, events, and trade shows where Lake County has a presence.
- Initial benchmarking and continued measuring of the industry and the perception/recognition of the industry through multiple phases of in-depth surveys to three audiences – Lake County growers, Lake County wineries, and consumers – with a total of 1,217 surveys received. Multiple surveys were conducted throughout the duration of the project. An in-depth focus group of growers also was conducted to tease out more perspectives and insights on the challenges and success of growers, the status of the industry, and the role the Lake County Rising promotional campaign has had. Analysis of the survey results throughout the grant period helped to shape planned activities and events.
- Production of a professional video titled "Lake County Rising" that tells the story of the Lake County wine region – its history, its climate/elevation/topography, professionalism of the growers, and future of the region – in a compelling visual format in multiple segments. The video was delivered online, on DVDs and thumb drives, given to all growers, and shown at events, presentations, and seminars, both within and outside of Lake County.
- Development of a climate research report on Lake County's wine region by Professor Greg Jones, research climatologist from Southern Oregon University. The report supports existing marketing materials and provided in-depth information and key messages for use by all involved in Lake County's wine industry. Key findings were presented during several events, and the full report was distributed during the "Momentum" series and is available for download online (http://www.lakecountywinegrape.org/lcwc/wp-content/uploads/2013/11/Greg-Jones-Momentum-2013.pdf)
- Improvements to the navigation of the Lake County Winegrape Commission web site (ongoing) to enable the ease of access to the many tools and resources funded by the grant, including reports, survey results, videos, and event presentations.
- Inclusion of the Lake County Rising campaign messaging on the Lake County Winery Association web site.
- Inclusion of Lake County-specific survey questions in the annual nationwide Omnibus Consumer Opinion Survey (January 2014), results of which revealed both an increase in awareness of the

region over the prior five years as well as the need for continued marketing efforts to generate demand for Lake County wine.
- Promotion of the range of activities and events was done on an on-going basis through monthly electronic newsletters, just-in-time e-mail blasts, press releases, as well as a Facebook campaign to growers, wineries, prospects and a range of interested individuals.

The Lake County Winegrape Commission provided overall grant leadership and day-to-day execution of all grant-funded activities, events, and programs; managed all grant expenditures; and handled monthly grant billing with assistance from a consultant/project manager.

The Lake County Winery Association provided in-kind support at several events with hands-on assistance and communications including pouring at events and disseminating information about events and activities to association members and consumers via e-mail, web, and social media. LCWA integrated the Lake County Rising key messages into the organization's online presence and encouraged member wineries to do the same.

The County of Lake provided in-kind support including substantial staff time in the creation and development of the trade show booth, as well as participation in trade shows, consumer events, and training events.

Goals and Outcomes Achieved

Goal 1 – Increase Consumer & Industry Brand Awareness
Activities that were completed to achieve this performance goal included participation in consumer events to educate consumers on the quality and desirability of Lake County wines, participation in national and California industry trade shows to educate industry members about Lake County wine and winegrapes and build demand, industry education events, and electronic and print campaign messaging. Success was measured using multi-phased audience surveys, increases in media articles on the Lake County wine industry, increased web site traffic, growth in LCWC Facebook likes, and inclusion of Lake County in the national Consumer Omnibus survey.

Goal 2 – Increase Sales of Wine and Winegrapes
Activities that were completed to achieve this performance goal included participation in consumer events to build demand, participation in national and California industry trade shows to educate the industry about the quality of and build demand for Lake County grapes and wine, industry education events, and electronic and print campaign messaging. Achievement of goals was measured by survey results, and a comparison of year-over-year crush reports.

Goal 3 – Train Local Growers and Vintners on Marketing Campaign Tools
Activities that were completed to achieve this performance goal included the Momentum series of seminars, distribution of campaign marketing tools in print and electronic media to local growers and vintners, e-newsletters to growers and vintners, a hospitality training workshop, partnered efforts with the Lake County Winery Association and individual wineries to incorporate campaign messaging into web sites and local training, and surveys of grant workshop attendees to measure training effectiveness. The hospitality session attracted the maximum attendance with 16 key members of the local food/beverage service industry. As a result, several attendees and others in the hospitality industry have requested additional copies of session materials for use in staff training.

Increasing brand awareness in the marketplace was a long-term goal for this project. The discussion that follows in the next section conveys progress towards achievement of that goal. However, as a result of grant activities and to further the understanding of Lake County's position in the marketplace, LCWC identified the need for additional information and insight from experienced buyers to further guide the region's strategic marketing. In an effort that will expand and enhance the impact of the grant-funded work, LCWC initiated a supply and demand analysis study (not subsidized by grant funds) that is currently underway.

Goal 1 – Increase Consumer & Industry Brand Awareness
A number of indicators and data points were used to measure progress with targets for increase in brand awareness for the Lake County wine region overall, by the wine industry, and by consumers. Grant activities were multi-pronged to reach both the industry and consumer audiences and impact the industry as a whole.

<u>Consumer Awareness</u> – The question "How would you describe your familiarity with Lake County as a wine region?" was asked in all phases of the consumer survey to gauge brand awareness and recognition. The percentage that characterized their familiarity with Lake County as a wine region as "very much" increased from 33.24% of respondents in Phase 1 to 48.81% of respondents in Phase 3, which represents a 46.8% increase. While the increase in awareness was not as high, the response to the 2014 Wine Opinions National Consumer Panel Survey further supported the increase in consumer awareness about Lake County. Responses to the question Regional Awareness demonstrated a decrease of 13% in respondents who reported that they have never heard of the Lake County wine region.

<u>Industry Awareness</u> – The brand awareness and perception of Lake County as a wine region was gauged early in the grant through surveys from respondents outside of Lake County. Three sets of surveys were secured from tradeshow participants during Phase 1 of the grant. Responses demonstrated familiarity with the Lake County wine region and the perception of quality of the winegrapes from the region. The percentage of respondents who rated their familiarity with Lake County as a wine region as "very much" or "fairly well" varied between a low of 22.58% of responses and a high of 85.71% for these audiences.
When asked to rate their understanding of the quality of winegrapes from Lake County, these same respondents rated the quality as "above average" or "very good" in over 50% of responses.

Industry awareness of the Lake County brand was further assessed by looking at comparisons of the price per ton for leading varietals grown in Lake County. The table below demonstrates the premium prices paid for Lake County grapes when compared with California as a whole and the Lodi growing region. Lake County winegrapes have long been recognized by Napa and Sonoma wineries as high quality fruit for their wine programs. Increases in average price per ton in the Lake County annual crop reports from 2012 to 2014 reflect a series of activities to expand awareness and enhance demand for Lake County winegrapes and wine.

Price Comparison for Leading Varieties

	Price per Ton 2012			Lake Cty "Premium"	
Variety	**Lake Cty**	**California**	**Lodi**	**vs CA**	**vs Lodi**
Chardonnay	1210	849	559	43%	116%
Sauv Blanc	1005	862	511	17%	97%
Cab Sauv	1616	1385	727	17%	122%
Merlot	1201	802	588	50%	104%
Petite Sirah	1551	854	807	82%	92%
Syrah	1317	761	565	73%	133%
Zinfandel	1518	715	817	112%	86%

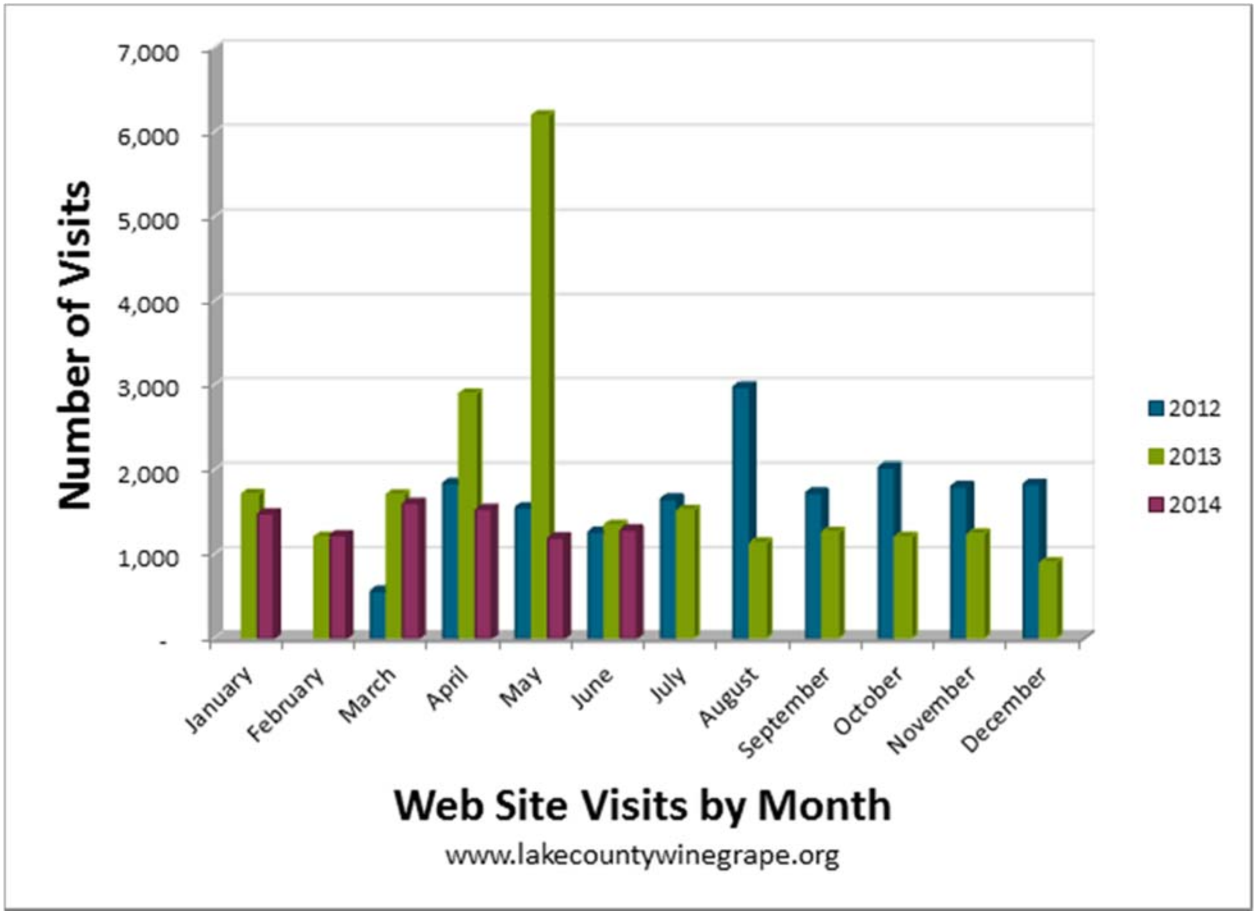
Source: CASS, Full Glass Research 2014

18

Other Sources & Activities Impacting Brand Awareness

Social Media and Website Activities – Social media and website visits give a less definitive picture of increased brand awareness. Facebook likes for the LCWC Facebook page increased from 84 page likes in November 2011, to 256 page likes in June 2014, which represents an increase of 146%.

LCWC web site visits were tracked using Google Analytics. The chart below shows web site traffic by month beginning in March 2012 when the current version of the LCWC web site was launched. The spike in visits in April and May of 2012 were largely due to an information page on the site for Wine, Tunes & Classics consumer wine tasting.



Media Attention – Another indicator was the number of media articles in national or regional press on the Lake County wine region and impressions generated by partner-sponsored advertising for grant consumer activities. Specific advertising for the "Wine, Tunes, & Classics" consumer event resulted in an estimated 1,000,000 impressions for the Lake County wine region.
Over the course of the grant, Lake County wines enjoyed press coverage in a range of national, regional, and local publications. Articles about the region appeared in publications such as *Food + Wine Magazine*, *Wine Spectator*, *Touring & Tasting Magazine*, and *Sunset Magazine* – all of which point to the increasing recognition of the region in the media, and in turn, consumers and trade.

Goal 2 – Increase Sales of Wine and Winegrapes

Survey data was gathered to estimate increase in gross sales of wine from 2011 to 2013. Based on interpolation of the responses, gross wine sales for Lake County wineries increased an average of 15% to 20% from 2011 to 2013 exceeding the grant goal of a 10% increase. Both tasting room traffic and wine club membership continued to rise an average of 10% or more each year, further supporting the interpretation of the data on gross wine sales.

The Lake County annual crop reports were used to determine progress towards achieving an increase in the price per ton for winegrapes. Based on these reports, the average price per ton paid for Lake County winegrapes increased from $1,176 per ton in 2011 to $1,407 per ton in 2013, an increase of 19.6% over the three growing seasons, exceeding the goal of a 10% increase in average price per ton for Lake County winegrapes.

Goal 3 – Train Local Growers and Vintners on Marketing Campaign Tools

Training on the marketing campaign was a key driver for the successful implementation of this grant. Information sharing as well as workshop training was used to educate the local growers and vintners on the Lake County Rising campaign messages and tools.

Plans for delivery of the training were revised from the original grant plan based on many factors. The time demands of both national trade show participation and the consumer event combined with the annual cycle of grower and vintner availability pushed the training timeline back. Additional factors including a dramatic positive turn in the marketplace and survey responses from both growers and vintners on training needs resulted in the decision to present a more robust “Momentum” series of seminars.

Total attendance at Momentum was 240. Surveys were received from 122 attendees. The seminars were well attended by both grower and vintner audiences with effectiveness ratings of “excellent” or “very good” by 93% of the participants. This training was augmented by a video presentation and distribution of marketing materials to 169 attendees at “Elevate!” – a Lake County wine industry networking event held in June 2013.

Key messages were further reinforced over the course of the grant in LCWC e-newsletters and on its web site, reaching the broad grower/vintner population.

The target for this goal area was 66% attendance by eligible industry members and 80% rating the training as useful and applicable. Based on a total grower and vintner population of 190, the target of training 66% of the audience (125) was met. Based on the seminar survey effectiveness ratings of “excellent” or “very good” by 93% of the participants, the target of an 80% rating was exceeded.

Further evidence of the success of this series was revealed in an email from one of the winery participants following the second Momentum seminar. Based on survey results from industry market research firm WineOpinions on Lake County’s position in the marketplace, the vintner went back to his staff to share the information and discuss the question of whether Lake County should promote itself with a specific varietal.

Winery survey results demonstrated that several of the Lake County wineries were incorporating key points of the Lake County Rising marketing messaging into their marketing campaigns as well as staff training. Grower surveys as well as the focus group discussion reinforced the relationship basis of winegrape sales in the Lake County grower segment. While Lake County growers have grown significantly more professional over the past decade in their viticultural practices, many today lack the tools and/or experience when it comes to strategic marketing, communications, brand-building, and sales. Lake County Rising training efforts helped to educate and assist the grower segment and enhanced their understanding of Lake County’s position in the marketplace and provided messages, tools, and networking with others in the trade for future sales negotiations.

Goal 1 – Increase Consumer & Industry Brand Awareness

The table below includes baseline data for consumer brand awareness and progress toward the goal of increasing brand awareness by 15% for this segment.

Regional Awareness & Trial, 2008 vs. 2014

“Wine Opinions”

Percent by awareness and trial (past 3 months)	Have NOT heard of		Heard of NOT tried		HAVE Tried	
	2008	2014	2008	2014	2008	2014
LODI	27%	11%	44%	42%	29%	47%
LIVERMORE	52%	34%	40%	50%	8%	16%
LAKE COUNTY	39%	26%	47%	51%	14%	23%
SANTA BARBARA	7%	6%	53%	47%	39%	47%
AMADOR	49%	30%	32%	44%	19%	26%
PASO ROBLES	19%	8%	31%	31%	51%	61%
SONOMA	2%	1%	19%	16%	79%	83%
MONTEREY	7%	7%	55%	48%	50%	45%
NAPA VALLEY	1%	1%	17%	13%	83%	86%
MENDOCINO	12%	7%	47%	49%	41%	44%

Source: Wine Opinions Jan 2014

Goal 2 – Increase Sales of Wine and Winegrapes

The table below shows baseline data for price per ton and achievement of the goal of increasing price per ton of winegrapes by 10%.

Average Returns on Winegrapes		
Year	**Average Price Per Ton**	
2011	$1,176	**baseline*
2012	$1,375	
2013	$1,407	

Source: Crop Reports, County of Lake, CA
www.co.lake.ca.us/Government/Directory/Ag/Agprograms/Crop.htm

Goal 3 – Train Local Growers and Vintners on Marketing Campaign Tools

While a benchmark was not applicable for this goal, the target for this goal area was 66% attendance by eligible industry members and 80% rating the training as useful and applicable. Based on a total grower and vintner population of 190, the target of training 66% of the audience (125) was met. Based on the seminar survey effectiveness ratings of “excellent” or “very good” by 93% of the participants, the target of an 80% rating was exceeded.

The Lake County Rising campaign produced a number of successful outcomes including:

- Increase in average price per ton of Lake County winegrapes by 19.6% over a three-year period, making Lake County the third-highest paid region for red winegrapes in California.
- Increase in consumer brand awareness by at least 13% as evidenced by the national 2014 Wine Opinion Omnibus Consumer survey results, with an even greater increase reflected in the three phases of consumer survey results.
- Increased Lake County winery tasting room traffic and wine club membership by an average of 10% per year based on winery survey responses.
- Lake County Rising information and marketing message distribution to a wide audience through grant activities that produced more than 1 million impressions from sponsor advertising as well as exposure through articles in publications with combined readership of more than 7 million.

Beneficiaries

The direct beneficiaries of this grant were the wineries and growers in Lake County that make up the Lake County wine industry. Entities that provide support services to the Lake County wine industry such as farm labor contractors, material suppliers, and wine/winegrape brokers indirectly benefited from grant activities due to the improvement in the demand for Lake County winegrapes and wine.

An estimated 32 Lake County wineries and 158 Lake County growers were the beneficiaries of the activities under this grant.

Lessons Learned

The Lake County Rising project provided key messages for a unified voice as well as many avenues to market the Lake County wine industry. Survey results for individuals who are familiar with Lake County wine and winegrapes were positive. That said, the project reinforced the notion that continued marketing is a critical need for future growth and financial success in the region. Grant activities focused on both industry and consumer segments. While the consumer is the ultimate end of the line for Lake County wine, marketing to consumers one at a time is expensive and has limited overall impact.

The realization that success as a region is dependent on success of both the winegrape growers and wineries was a key lesson learned from this project. Although the audiences for each segment are different, the synergy from sharing key messages and working together cannot be overstated. Members of both segments of the industry have much to gain in working together in the future.

The measurements for this grant spanned three key areas. Surveys played a key role in the measurement process. The survey process was set up to repeat the same questions over each phase of the process, not considering that this might create confusion for those participants who answered the questions several months apart. This resulted in some less than perfect data from which to draw conclusions, especially in terms of gathering data on income. With the benefit of hindsight, it became apparent that this issue may have been eliminated by using an expert source in creating and administering the survey process. The Lake County Winegrape Commission (LCWC) has since brought in a professional survey organization for additional market research work. Specifically and as a result of grant activities, LCWC identified the need for additional information and insight from experienced buyers to further the understanding of Lake County's position in the marketplace and, in turn, guide the region's strategic marketing efforts. In an effort that will expand and enhance the impact of the grant-funded work, LCWC has commissioned a supply/demand analysis, one component of which is a survey of buyers, which is currently underway.

The successful implementation of this project was dependent on the working relationships between the three partner organizations. Over the course of the grant, the working relationship among the three key partners was strengthened and refocused.

A second, more unexpected, outcome was the deeper understanding and appreciation of the importance and synergy between the winegrape grower segment of the industry and the winery segment, reinforcing the power of collaboration and consistency in marketing messages. These two outcomes bode well for the future, setting the stage for continued partnering and growth in the Lake County wine industry.

A third similar example came out of the hospitality training session that was held in June 2013. Attendees were appreciative of the training session and directly requested assistance in strengthening connections between local wineries and hospitality staff; an opportunity to taste additional Lake County wines; and requests for materials to use in staff training. Based on these requests, the "Momentum" series of seminars, which initially was to be exclusively grower training, was expanded to engage all levels of the Lake County wine and hospitality industries.

Finally, due to significant changes in the marketplace for wine and winegrapes, participation in two of the national (East Coast) industry trade shows that had been outlined in the work plan were reviewed. After consideration of the potential impact of these activities and the benefits of instead focusing on the North Coast and California region, plans to attend the final trade show were canceled, with efforts instead focused on events and outreach in areas closer to the region.

While various experiences over the course of the grant period helped define subsequent programming, three key experiences provided lessons learned that have helped to shape ongoing promotional programming:

- Having the opportunity to exhibit at national trade shows with a professional trade show presence was extremely valuable. The collaboration with the County included having economic development personnel present in the booth alongside representatives from local winegrape industry – this proved to be successful as it made a positive impression on attendees who were interested in discussing a potential location/re-location of their wine business to the area. Overall, it was determined that exhibiting at national shows is particularly valuable during down economic cycles while attending and pouring at these shows (when that opportunity is available) may be the most cost-effective approach during up cycles.

- The presentation of the "Wine, Tunes, & Classics" consumer event enabled both the Lake County Winegrape Commission and Lake County Winery Association to work together to put on a successful event outside of Lake County in a key target market, something that hadn't been done before by either organization. The experience brought together 19 local wineries that traveled and set up in a key target market (Sacramento). While attendance was solid, it was determined that partnering is critical for success and sponsors are absolutely necessary to put together the needed funds for this type of an event. It also was determined that piggybacking on an already-established event to reach out-of-county markets is a good way to have a presence in multiple markets while keeping costs down.

- The importance of continually reassessing the plans and activities for the grant was a key lesson learned from this project. Changes in the marketplace drove decisions to eliminate some activities and allowed for the addition of others, increasing the overall impact and ensuring the most effective use of grant funding.

Additional Information

To view the Lake County Rising video, go to: https://www.youtube.com/watch?v=xZSQdt8H7ek

To view Lake County Rising information on a partner web site, visit the Lake County Winery Association site at: http://www.lakecountywineries.org/region

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 26	**Project Title:** Enhance the Competiveness of Placer County Mandarin Oranges	
Grant Recipient: Placer County Resource Conservation District	**Grant Agreement No.:** SCB11026	**Date Submitted:** December 2014
Recipient Contact: Elisa Noble	**Telephone:** 530-885-3046 ext 118	**Email:** elisa@placercountyrcd.org

Project Summary
The Placer County foothills provide the ideal microclimate for growing the high quality Mountain Mandarin. While the area is known locally for its mandarin production from November through January, it is largely unheard of anywhere else. Cities such as Rocklin, Roseville, and the greater Sacramento region are ripe for an expanded consumer base.

There are about 65 Mountain Mandarin growers in Placer County, the vast majority who depend on direct marketing in some form. In 2005 the Mountain Mandarin Growers Association (MMGA) was formed to "increase production, quality, and distribution" of mountain mandarins. MMGA recognized the need to work together in developing a strategic marketing plan that would provide a consistent brand and increase their consumer base.

MMGA was astute to recognize the potential for an expanded local and regional market. Consumers in the greater Sacramento region are increasingly interested in buying local and knowing where their food comes from. Sacramento has a burgeoning "Farm to Fork" campaign, farmers markets are popping up everywhere, and foodie/culinary tourist attractions are increasingly popular.

The project did not build on a previously funded SCBGP project.

Project Approach
Activities and Tasks

The project started by MMGA establishing a steering committee and soliciting proposals from marketing contractors. Right Angle Productions (RAP) was selected as the marketing contractor, and has proved to be an invaluable partner to MMGA and the individual growers.

RAP began their work by investigating market trends, identifying key audiences, developing and testing key marketing messages for identified target markets, and evaluating economic factors related to serving identified target markets. From there, RAP developed a very comprehensive strategic marketing plan. After RAP's analysis and feedback from MMGA members, the two groups collectively determined the best way to promote mandarin sales was to get more people to actually come to the orchards. With this in mind, Orchard Days was created and instituted. The original concept called for two weekends in December and one day in January. The January date was added in response to growers' concerns that mandarins tend to be hard to sell after Christmas. The growers also wanted to include promotion of the Mountain Mandarin Festival in November, and use it as the kickoff to the season.

At this point, the 2012 Mandarin season was right around the corner, so MMGA and RAP chose elements of the plan to implement that could be completed quickly and were most likely to have an impact.

Following the 2012 season, RAP and MMGA reviewed what went well and what needed improvement. The first season was very successful, with a lot of media attention and dozens of new people coming to the orchards despite the driving rain. Therefore, the growers decided to continue with and expand the Orchard Days concept, adding additional activities for people to do and purchase at the groves. The growers also chose to eliminate the January date as several growers were out of fruit or unable to participate that late in the season. The strategic marketing plan was adjusted according to this input.

RAP and MMGA now had a full year to implement the many other elements of the plan, and completed the following tasks as related to the strategic marketing plan:

- Built brand identification with identified target markets.
- Evaluated event-based marketing efforts.
  - The results of this evaluation led to MMGA's strategic decision to participate in the events listed in "Outcome #2" below, under "Goals and Outcomes Achieved."
- Evaluated collaborative marketing models.
  - The results of this evaluation led to MMGA's and RAP's decision to produce the materials and place advertisements listed in "Outcome #3" and "Outcome #4" below, under "Goals and Outcomes Achieved."
- Built brand and further marketing efforts through collateral materials.
- Built brand through printed and online marketing materials.
- Further branded events in each subsequent year.
- Identified and built strategic partnerships.
- Promoted MMGA's brand.
- Developed tools for measuring quantitative benefits.
- Improved individual growers' marketing strategies and techniques.
  - The improved marketing strategies and techniques of individual growers are listed under Outcome #5 below, under "Goals and Outcomes Achieved."

After the 2013 Mandarin season, RAP and MMGA again reviewed the successes and challenges of the season. This second season garnered even more media attention, brought hundreds of visitors to the orchards, and the Mountain Mandarin Festival had record numbers of visitors–over double the previous year. Challenges continued to include the additional time it takes for growers to perform marketing on an individual basis.

The Placer County Resource Conservation District (Placer RCD) was asked to take over administration of the grant in December of 2013. The marketing portion of the project received more emphasis with the change of the project administration.

Throughout 2014, in particular, RAP and MMGA worked to identify future marketing priorities, and to develop the capacity to continue and grow the marketing ability of MMGA and individual growers. Discussions were held with other Placer agricultural organizations about working together on collaborative marketing strategies. These efforts will likely eventually lead to more collaborative marketing opportunities.

Results and Accomplishments

The vast majority of the results and accomplishments of this project are discussed below under "Measurable Outcomes." One area not covered there are the strategic partnerships that were identified and built:

- Mountain Mandarin Festival – events, ads, press releases, TV/radio spots, social media
- PlacerGROWN – eBlast, Style magazine column, distributed maps at events
- Placer County Vintners Association (PCVA) – distributed maps, ads, giveaway packages, participated in Orchard Days
- Placer Visitors Bureau – Tastings at Northern California stores, lobby display, potted mandarin tree outside, distributed maps at events
- Placer County Resource Conservation District (PCRCD) – distributed maps at events, assisting in new grant possibilities
- Placer Theatre Ballet – ad in program and distribution of maps at the door
- Rocklin Chamber – free ad in newsletter, distribution of maps at events and in the Chamber office, mandarins featured on tables at November and December breakfasts, ribbon cutting at Mandarin Festival, online event calendar and eBlasts
- Apple Hill – displays at two orchards
- Joanne Neft – distributed maps at events
- County Supervisors, other officials – proclamation, social media and events
- MMGA members

The project did not benefit commodities other than specialty crops.

Many partners contributed to the success of this project. The roles of RAP, MMGA, and Placer RCD are described in detail above in "Activities and Tasks." Additionally, the Mountain Mandarin Festival was a key partner as that event highlighted the mandarin season in Placer County. PlacerGROWN and the Placer County Vinters' Association (PCVA) were also partners for various marketing efforts, as described below in "Goals and Outcomes."

The original goal of the project was to increase mandarin growers' sales and farm visits through the development and implementation of a strategic marketing plan. The strategic marketing plan was to include at least the following:

- an approach for successful participation in the Mountain Mandarin Festival;
- selection/development of additional events for growers to participate in;
- increased branding of the Mountain Mandarin;
- development and printing of promotional materials; and
- marketing assistance to individual growers.

The strategic marketing plan was successfully implemented. RAP accomplished a great amount of work in achieving the Expected Measurable Outcomes identified in the Scope of Work, as detailed below.

Outcome #1: An approach for successful participation in the Mountain Mandarin Festival.

- Created an easy-to-use and easy-to-store booth that better conveys the MMGA's message and Orchard Days information.
- Created booth staffing, set-up and take-down procedures to streamline member involvement.
- 16 MMGA members had booths for their businesses represented.

- Advertisement on the back of the Festival program listing all of the MMGA growers.
- Capitalized on the 20th year anniversary of the Festival in 2013.

Outcome #2: Selection/development of additional events for growers to participate in.

- Development of "Orchard Days," which are two weekends in December when at least 18 growers had their farms open to the public. Growers provided activities for visitors such as food, live music, animals, face painting, kids' activities, etc. The Orchard Days were specifically advertised as agri-tourism events to increase awareness of mountain mandarins.
  - Created Facebook Event for each weekend, and "boosted" the posts by paying for advertisements. The first Orchard Days reached 13,256 targeted people and the second reached 20,121 targeted people. 28 people visited as a result of the Facebook ads.
- Identified local, successful, well-attended events where MMGA could have a booth, including: Old Town Auburn's Country Christmas, Old Town Auburn's Festival of Lights, California State Fair in Sacramento, Farm to Fork in Sacramento, Gold Country Fair in Auburn, Hot Chili & Cool Cars in Rocklin, Lincoln Showcase in Lincoln, Farm and Barn Tour in Placer County, Eggplant Festival in Loomis, PlacerGrown Harvest Festival in Rocklin, Mandarin Festival in Auburn, and farmers' markets in Roseville, Rocklin, and Auburn.

Outcome #3: Increased branding of the Mountain Mandarin.

- Completed redesign and update of MountainMandarins.com website.
- Created new promotional booth, including printed tablecloth, tabletop display and artwork, and 10-foot banner.
- Updated artwork on 5 and 10-pound mandarin bags that are used by many growers throughout the season.
- Worked with Placer County Department of Economic Development, Placer County Ag Department, Placer County Supervisors, Placer Visitor's Center, Placer Valley Tourism, PlacerGrown, UC Davis Ag Extension, the Placer County Vintners' Association, PCRCD, local chambers of commerce, and local businesses to spread the word about Orchard Days, mandarin season and the many benefits of Placer County Mountain Mandarins®.
- Coordinated with TV, radio, magazines, newspapers, bloggers, Placer County Department of Economic Development, PlacerGROWN and local chambers of commerce to run spots and articles about Placer County Mountain Mandarins.
- Created a new Mandarins & Wine Getaway Weekend event to help promote the Mandarin Trail (and Mountain Mandarins), especially during Orchard Days, as an agri-tourism destination.
- Partnered with PCVA and cross-marketed products. This resulted in more first-time visitors to ranches. As part of that partnership, "Mandarins & Wine Getaway Weekends" was created with the PCVA, Auburn Holiday Inn and Mandarin Festival. Holiday Inn sold at least six overnight stays as a result of that advertising. Also as a result of a promotion for the Getaways with PlacerGrown, two more packages were given away as prizes, and both went to people who had never visited the farms.
- Several TV stations visited mandarin farms during Orchard Days.
- Placed Advertisements in:
  - Edible Reno Tahoe with Placer County Vintners Association, Auburn
  - Holiday Inn & Mandarin Festival
  - Sacramento Magazine Special Placer Wine Section – September

  - Placer Theater Ballet Nutcracker Program – December
  - Rocklin Chamber Newsletter – November & December
  - Sun City Roseville Community Magazine – December
  - Gold Country Media Papers – Auburn Journal, Placer Herald, Roseville/
  - Granite Bay Press Tribune, Loomis News, Lincoln News Messenger
  - Bench at Gold Country Fairgrounds with Mandarin Festival
  - 2014 Apple Hill Cider Press
  - A-Frame Signs at Farmer's Markets

- Articles, News Coverage, TV & Radio Spots include:

- ABC/News10
- Agritourismworld.com
- Auburn Journal
- Auburn Sentinel
- Blog – The Tori Story
- Business Journal
- CBS/Good Day
- Edible Reno/Tahoe
- Entercom Sacramento Perks
- Fox 40
- Gold River Messenger
- Holiday Inn Website
- KFBK "Friday Food Segment" with Kitty O'Neal
- KAHI
- Loomis News
- NBC/KCRA 3/58
- Nugget Market
- Placer County Online
- Placer County Vintners Association Website
- PlacerGROWN Facebook
- Placer Mercury
- Placer Sentinel
- Placer Valley Tourism eBlast
- Rocklin Chamber Online Community Calendar and eBlast
- RocklinToday.com
- Sac & Co.
- SacBee.com calendar
- Sacramento Bee Calendar
- Sacramento Bee Food And Wine
- Sacramento Bee, Cathie Anderson
- Sacramento Bee, Debbie Arrington
- Sacramento Business Journal, Mark Anderson
- Sacramento Magazine
- SFGate.com
- Style Magazine
- Style Magazine Blog
- Style magazine calendar
- VisitPlacer.com
- Whole Foods
- Zoom Roseville

Outcome #4: Development and printing of promotional materials.

- 2012 season
  - 10,000 full color, two-sided rack cards
  - 10,000 full color, two-sided maps
  - Full-page, back cover ad in Mountain Mandarin Festival program

- 2013 season
  - 20,000 two-sided postcards advertising Orchard Days and Mountain Mandarin Festival
  - 20,000 updated maps/brochures
  - Created and printed 2,800 flyers for insertion in Sun City Courier
  - Created and printed two double-sided A-frame signacades and purchased stands to display at events and Foothills Farmers' Markets
  - Created, printed and laminated posters and photos for Apple Hill displays
  - Placed ads in 6 Gold Country Media papers the week prior to each Orchard Days weekend

- Placed full page ad in the Mountain Mandarin Festival
- Placed ½ page ad in the Placer Theater Ballet programs
- Placed ¼ page ad in Rocklin ChamberNews
- Placed full page ad in Apple Hill's Cider Press
- Placed two Facebook event ads
- Organized professional photography of seven member orchards during Orchard Days
- Organized maps and posters for booth and other displays
- Created, updated and reviewed articles for distribution to a variety of media outlets
- Created grower cards for media baskets
- Finalized new website and kept website updated throughout season
- Purchased OrchardDays.com domain
- Created 5-page mobile website
- Created Facebook events for Orchard Days to boost target audience

<u>Outcome #5:</u> Marketing assistance to individual growers.

- Worked with MMGA members to plan and coordinate events and activities for the Mountain Mandarin Festival and Orchard Days.
- Assisted members participating in Orchard Days with all necessary County permits.
- Worked with new members to familiarize them with MMGA marketing plans.
- Assisted with planning and promoting individual member activities during mandarin season.
- Outreached to members interested in participating in photographs and videos of their ranches
- Coordinated with MMGA members to secure value added products for promotional uses.
- Created Facebook how-to procedures for members interested in social media.
- Held workshops to assist growers with social media and other marketing strategies.
- Created a sign in/tracking sheet for orchards to use during Orchard Days and the season to identify visitors and determine the information source used to learn about the member orchard, to gauge effectiveness of advertising and to create contact lists for orchards.

Workshops and marketing consultations were only offered to MMGA members. Workshops and individual consultations were given on marketing strategies and best practices, best places and ways to advertise, things individual growers could do to bring people to their particular ranch, ways to differentiate their products from others, and the use of social and online media. Individual sessions were held at grower ranches with between 2-4 people, and larger workshops drew 20-30 members.

Outcome measures were not considered long term; however, the success of this project will likely have positive impacts for MMGA growers into the future.

The goals established for this project were: 1) increase MMGA member sales, and 2) increase traffic to MMGA member orchards. Actual accomplishments did not include specific data from each grower to indicate if sales and/or traffic increased. Growers are reluctant to share sales information, and it was difficult to get growers to record farm visitor numbers. Growers are focused on serving customers during the two month season, and these growers already have a lot of record keeping to maintain.

That said, the examples cited below along with many anecdotal reports, strongly indicate that both project goals were met: MMGA member sales increased, as did traffic to MMGA member orchards.

All growers reported seeing an increase in farm visitors, many of whom had no idea the mandarin orchards existed until seeing the advertisements in papers, on TV, or at events. Many visitors reported following the map to travel to the farms for Orchard Days or other visits.

At least six growers sold out by the end of December 2013, which is 4-6 weeks earlier than normal. One grower increased his profit this year by $10,000.

Beneficiaries

The 65 mandarin growers in Placer County were the primary beneficiaries of this project. Even those who did not actively participate in the project undoubtedly benefited from the increased consumer awareness. Each acre of mandarins produces about four tons of mandarins, and a ton is valued at $2,200. There are approximately 240 acres of bearing mandarin trees in the County, which equals a potential of over $2.1 million in sales.

With the implementation of the strategic marketing plan, most, if not all, growers sold out. Even more importantly, many growers sold out much earlier than usual, which reduces the expenses associated with continued travel and marketing.

There are a total of 1,355 farms in Placer County. Many of these operations, particularly those selling other specialty crops during the mandarin season, likely benefited from increased consumer awareness of local food available in the foothills. Since many of the mandarin sales were on the farm or at agri-tourism events, one can surmise that the local economy also benefited as visitors traveled to the area.

Lessons Learned

This project highlighted the success that can be realized by hiring a knowledgeable and qualified contractor. RAP did a great job utilizing their contacts and skills to expose Mountain Mandarins and the MMGA growers to many potential new markets and buyers. The project would not have been nearly as successful without their efforts.

More demand in the local area was anticipated, but it was overwhelming the number of visitors who lived in the area and weren't aware of the mandarin farms.

The goals and outcome measures were achieved with great success. This was due largely to the combination of: 1) hiring a highly-skilled marketing professional who was also familiar with agriculture and built relationships with the growers, and 2) a core group of MMGA members who committed to making the project a success.

It is a challenge to collect quantifiable data from growers. The Mandarin season is fast and furious, as growers try to pay off their year of hard work in two months. As a result of implementing the strategic marketing plan, growers were already performing many new tasks associated with marketing. This is in addition to the normal record keeping associated with the season. While the need for some quantifiable data is understandable in these kinds of projects, it will likely always be challenging to collect.

There are various approaches one could take to address the challenge of collecting grower data. One option would be to ask each grower how they manage record keeping, and determine if there are relatively simple ways to work from each grower's existing process. It would likely require quite a bit more time and funding, to collect detailed grower data. Respect of growers' privacy should also be considered by not requiring them to report exact sales or profit numbers. One possibility is to collect data on increased percentage of sales. This could demonstrate the marketing benefit while protecting grower privacy, and without requiring arduous amounts of detailed accounting. A suggestion is to remain flexible on how the marketing benefit can be demonstrated.

Additional Information

The website can be accessed at *www.mountainmandarins.com* and *www.orcharddays.com*.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 27	**Project Title:** Improving Water Efficiency in High Elevation (HE) Vineyards	
Grant Recipient: Calaveras Winegrape Alliance	**Grant Agreement No.:** SCB11027	**Date Submitted:** December 2013
Recipient Contact: Nanette Tanner	**Telephone:** 209-728-9467	**Email:** cwamembership@goldrush.com

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

The purpose of this project was to evaluate the effect of irrigation on a vineyard when water is applied based solely upon an increasing temperature forecast. The premise is that irrigation before a high temperature episode enables water to filtrate into the ground and to the roots. This makes more water available to reduce plant stress when forecasted peak temperatures occur and requires less total water for optimum plant growth and crop quality and quantity.

Agriculture accounts for 70% of water use in California. As agriculture's use of water in California is scrutinized, it is important to adopt water saving practices that are economical & sustainable whenever possible.

Water saving practices are especially important for growers in High Elevation (HE) regions because of their arid climate conditions experienced during the growing season versus that which exists in valley or coastal regions. Using standard irrigation practices in HE vineyards, plant water loss during high temperature episodes can be +30% with fruit yield reductions estimated to reach 50%.

It is estimated there are more than 20,000 acres of vineyards at 1,000+ feet elevation in California. Lake, Mendocino, Calaveras, Amador, Tuolumne, El Dorado, Napa, Monterey & San Luis Obispo counties' water resources would be impacted by reducing water use, thus preserving county and state water resources.

Also, efficient vineyard productivity could potentially increase a county's tax revenues, as meeting vines optimal moisture needs will improve vine health, grape composition & phenolic attributes; thus enhancing the competitiveness of HE grapes. Strong healthy vines mean less invasive vineyard practices can be exercised, reducing the need to enter a vineyard to deliver pesticides, fumigants & chemicals; decreasing dust abatement & soil compaction. Better wine grapes = better grape sales = jobs, taxes, dollars.

Water demand in California continues to increase. With global warming, winter rainfall and Sierra snowpack are very much in question every year. As such, it is timely and important to research and develop irrigation practices which will reduce the negative impact of extreme temperatures and dry conditions.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

Prior to the grape growing season, activities included: evaluation of available weather forecast websites, setup of test and control vineyard blocks, and research of existing literature relative to the concept, collection of area historical temperature data, and an initial irrigation Model Procedure was formulated. After bud break and through harvest tasks performed included measuring and recording: daily temperatures and forecasts, evapotranspiration, leaf water potential (plant moisture stress (PMS)), soil moisture measurements, photo visual documentation, plant nutrient petiole sample tests, crop production response, and juice and wine quality. Prior to the growing season (October 2011 through April 2012) project irrigation models and data collection catalog systems were developed. The irrigation model's concept and procedure guidelines specified watering schedules & water quantities based on forecasted temperatures (see Attachment 1). Spread sheets were created to collect and analyze all data for continuous Model evaluation and adjustment during the growing season.

The irrigation system in the test vineyard was modified per the study requirements in the five study blocks. Test blocks were established with approximately 1500 Marsanne plants (TB1), 1300 Grenache plants (TB2) and 150 Cabernet Sauvignon plants (TB3). Control blocks were established in approximately 1300 Roussanne plants (CB1) and 1300 Grenache plants (CB2).

Four internet weather websites including the Weather Channel, National Oceanic Atmospheric Administration, Intellicast, and University of California Pardee were evaluated. To determine which weather website was best, all weather sites were recorded and the average temperature differences, standard deviations and ranges were calculated for each forecast day, from November 2011 through March 2012. The variations for all parameters on all of the weather websites trended upwards with increasing forecast days, with the average temperature forecasted varying just a few degrees from the actual average temperature. Standard deviations showed that most of the forecasted temperatures will fall within an acceptable range. Although any of the sites could be used, the Weather Channel site worked best for the vineyard site used in the study because it had the smallest average difference from actual vineyard temperature in the 10 day forecast.

At the onset of bud break (mid-April 2012), the two test blocks (TB1 and TB2) were irrigated per the Project Model output. During the season there were a total of 13 irrigations done in response to forecasted temperature increases. There were 2 irrigation events when irrigation was applied because the temperature increase was less than 5^0 for 9 days or more per the parameters of the model. The two control blocks (CB1 and CB2) were irrigated per previous years "normal" irrigation schedules. In the third test block (TB3), irrigation durations were based on PMS levels to determine vine response time effects of water quantity. Results showed that small amounts of water (as little as 2 gallons) reduced PMS and leaf recovery response time was within hours.

The UC Cooperative Extension Sierra Farm Advisor evaluated the model and suggested evapotranspiration (ET_0) be monitored as historically it had not been measured in the past. For the entire 2011/2012 growing season, it is estimated that 542 gallons of water were lost due to evapotranspiration (ET_0). This estimate was determined by using an average ET_0 loss of .22 inches per day for the season. It is interesting to note that the water applied per the Model was only 15% of that value (83 gallons applied vs 542 gallons lost).

Ten-day temperature forecasts were taken from April 1 through harvest and post-harvest. Data values were recorded and used in the Model to determine the number of gallons to irrigate. These values will be tested in Phase II in two separate vineyard sites.

Initial PMS levels were measured in Test Block 3 (TB3) in October 2011 on fully mature leaves at the end of the 2011 season. Testing was started in all other blocks between April 30 and May 5, 2012 as new leaves matured. This testing continued through 2012 harvest and until leaf die-back in October 2012.

To establish a baseline for setting the "Normal" irrigation parameter for the control blocks, a summary of historical high temperature data was used. This data included high temperature recordings for the months of June through October for the years 2006 through 2011. Noting the history of the highest five day temperatures and the time of day the high temperatures occurred, the Model's parameters to irrigate were set at forecasted increases greater than 5^0, 10^0 and 14^0 and when temperatures forecasted exceeded values of 100^0 F. Any one of these changes in temperature is a 'high temperature event'.

The performance measurements used in the project test blocks were a) total gallons of water applied to the vines for the year, b) crop tonnage, c) grape/wine phenolics, anthrocyanins, brix and total anthrocyanins produced, and were compared to the same performance measures used in the control blocks.

Per Model specifications, initial irrigation began on May 5th because the forecast indicated a 16^0 increase (which is a 'high temperature event'). Per Model guidelines, when temperature averages were above 82^0, 4 to 8 gals of water were applied when a 'high temperature event' occurred.

Control sites were irrigated per previous year schedules. The normal amount used was 4 gal/week or 8 gallons if temperature rose to over 100^0F.

PMS was tested throughout the growing season. It was found that early in the season (before veraison – which is when grapes begin to color), PMS values only fluctuated with the day's high temperature, not with watering. But, at the start of veraison (end of July), irrigation began to more dramatically influence PMS values and plant moisture stress levels decreased. The vines continued to respond as such throughout harvest and post-harvest.

Per the work plan, data was inputted, the model was adjusted accordingly per temperature increase range parameters and temperature limits, and the number of days in advance/gallons of water to apply was adjusted. If the forecast was flat or decreasing, the number of days and gallons applied was also adjusted. PMS, ET_0 , soil moisture data and degree days were collected and photos taken to evaluate and validate the effects of the irrigation model procedure.

The foundation for an operational model procedure for Best Methods Practices (BMP) was written. Model Guidelines were documented and will be tested in Phase II & III. An Excel spreadsheet was designed and will be updated in Phase II & III for easy input to determine vine irrigation needs.

In summary, all test data collected: vine growth, visual responses (using photos), PMS, soil moisture, temperature, ET_0 and moisture events (rain and irrigation) were documented. A presentation of project status was presented at the Calaveras Winegrape Alliance (CWA) Vineyard Tour (July 27, 2012); attendees included UC Davis representatives, the Calaveras County farm advisor and Agricultural commissioner, and area growers. Updates were given at CWA growers meetings and CWA Board Meetings.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

A Microsoft Excel Model Spreadsheet (Attachment 1) provides a sample schedule and procedure to irrigate a vineyard dependent upon the forecasted day high temperature. The Model Spreadsheet can be utilized with any weather websites that provide a 10 day local temperature forecasts. Phases II and III may dictate adjustments in degree values and/or irrigation scheduling.

Project accomplishments include: a) A 26% reduction in water usage in the test blocks were achieved as compared to the "normal" water usage applied in the control blocks. This is 6% above the stated 20% project target goal. b) The harvest in the study's vineyard was the best ever obtained. Implementation of the irrigation model did not reduce the crop size. c) To determine grape juice and wine quality, juice and wine from each 2012 block was tested. Wine samples from 2011 TB2 and CB2 were tested and compared. Post-harvest 2012 petiole analysis was also performed. Overall, there were no significant differences that could be attributed to irrigation, in grape juice or wine quality between test and control blocks. Therefore grape quality and grape production did not suffer as a result of less water being applied.

To evaluate outcomes, the data collected for the project included vineyard day high temperatures, PMS levels, gallons of water applied, soil moisture values, vine visual condition (photographs and microscope pictures), evapotranspiration, season's degree days, plant and juice nutrients, and crop quantity.

The 2011/2012 winter provided 25" of rain which is about 70% of normal rain fall. This means less water was in the ground for the growing season and the plants were more dependent on irrigation water. In addition there were 26 days of high temperatures of 100^0 or more, compared to 5 days in the previous year. Potentially, when years deliver fewer high temperature days even less water will be used. Therefore, the success of the Irrigation Model to reduce water usage was demonstrated.

It is also important to note, laboratory phenolic testing for anthrocyanins, brix and total anthocyanins (TAs) have been performed on the 2011 wine made from the Grenache and Cabernet Sauvignon. Comparisons with the 2012 wine showed no significance differences.

Results disseminated are ongoing to the CWA growers at their meetings and to the Ag commissioner. Staff presented the study and guidelines used in the study at the UCCE Vineyard Tour Field Day and CWA Dinner.

A website page draft has been completed and will be published in 2014. The guidelines were provided to approximately 30 growers. The CWA's presentation at the Calaveras Grape Growers meeting was attended by 20 growers. The Field Day presentation had approximately 10 growers present. The number of growers attending other CWA grower meetings fluctuated depending on the month, generally 12 to 25, as there was very low attendance during harvest months.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

The UC Extension Farm Advisor (Lake County) states that all vineyards above 1000 feet elevation are high elevation vineyards. Per the results of this study it is demonstrated that these vineyards could potentially save 17% in irrigation water usage. As a result, other agricultural entities could benefit by having more water available statewide.

There are an estimated 20,000 acres of high elevation vineyards in California. Assuming an average 1,000 vines per acre, there are approximately 20 million vines that could utilize this savings. In the study the control blocks received 112 gallons of water and the test blocks received 83 gallons of water. This is a 26% reduction. All told this would mean a savings of 380 million gallons of water statewide.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

The Phase I Model, formulated before the 2012 growing season resulted in a 26% reduction in water usage. However, it was learned from PMS levels in August and September that some plants had higher than desired stress levels during high and constantly high temperature periods. To prevent this high stress, the Model was adjusted to ensure irrigation needs during these periods. If this was done during the entire Phase I season, the percent reduction would have been 17%. From what was learned and the changes made to the model in Phase I; seventeen percent (17%) water savings is potentially expected for phases II and III.

Using less water more often, as was done in test block TB3, demonstrated that when additional water is applied at the right time, improved plant vitality is achieved. Doing this, a significant amount of water will be saved in Phase II and III (17% estimated). Crop tonnage was 3.2 lbs per vine in TB1 verses 4.45 lbs per vine in CB1. Farming challenges (mildew) unrelated to irrigation caused a reduction in the TB1 crop.

It was found that Plant Moisture Stress (PMS) testing before veraison was not productive. PMS testing did not show plant stress increases or decreases relative to irrigation water applied until the plants started going through veraison. The plants did show PMS variances relative to day high temperatures throughout the season.

Prior to veraison, visual inspection was a best indication of plant stress in this study. However, after veraison, PMS did decrease relative to the amount of irrigation water applied and was a better measure than visual inspection. PMS data will be recorded in Phase II and III to see if PMS data remains flat before veraison.

Soil sensors were used to measure soil moisture. Readings from sensors at the 36" level did not change relative to water applied. Soil moisture readings had acceptable values at the onset of the growing season as a result of winter rains which were 25" in the 2011/2012 season. As the season progressed, there was a steady decrease in soil moisture. The soil moisture sensors at the 16" level did respond to irrigation but they did experience a gradual decrease in soil moisture readings as the season progressed.

The season water loss due to ET_0 was much greater than the irrigation water applied. In the model's Test Blocks, gallons needed were 15% of the water lost due to ET_0. In the Control Blocks, gallons needed were 19%. As demonstrated by the deep soil moisture data, water gained in the water tables during the winter, continued to be available to plants throughout the growing season.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

Attachment 1 is a sample of the models procedure guidelines specifying watering schedules and water quantities based on the forecasted temperature. Attachment 2 is a Power Point Presentation which has been presented at a Calaveras Grape Growers meeting and some additional slides illustrating more of the study's technical data, plots generated, and photographs for a more detailed snapshot of the study's data and information gathered.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.:	Project Title:	
28	Reducing Spoilage and Expanding Growth in California Specialty Olives through Improved Fermentation Management	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB11028	**Date Submitted:** December 2014
Recipient Contact: Maria L Marco	**Telephone:** 530-752-1516	**Email:** mmarco@ucdavis.edu

Project Summary

The purpose of this project was to provide knowledge-based microbial management tools and information for California fermented table olive processors. This information was needed because market expansion of California fermented table olives has been hindered by a lack of knowledge on the microorganisms essential for the production of this product. A mechanistic understanding of table olive fermentations has been urgently needed because California processors have recently experienced massive losses of fermented olives due to spoilage and lack the necessary tools to maintain, improve, or modify production conditions.

California produces all table olives for the entire USA. This industry lost 29 percent of its bearing acreage, declining from 35,000 acres to 25,000 acres since 2000, due to substandard imported product taking the market share among food-service providers. Because each 1,000 acres retained in the table olive sector is equivalent to $4 million annually in farm gate income based on $1000/ton at four tons per acre, these losses have significant economic impacts. The project directly benefited the major California specialty table olive companies which currently process between 8 to 10% of the state's table olive crop into the Sicilian-style product (approximately 90% of the crop is processed in the canned "black-ripe" style). Specialty table olive spoilage has caused significant economic losses in amounts exceeding $100,000 in one year alone. These companies will benefit from a better understanding of the microbial quality of their fermentations by enabling manipulations of the fermentations to prevent spoilage events and produce a consistently superior product.

Project Approach

Project staff was able to complete the activities discussed below within the two year scope of this project.

<u>Project Activity: Quantify the amounts of bacteria and yeasts associated with commercial Sicilian-style olive fermentations.</u> Project staff examined the bacterial and yeast quantities in commercial Sicilian-style olives and brines for fermentations initiated early, mid, and late in the harvesting season of 2012 starting weekly and then monthly for 6 months. Quantities of yeast and lactic acid bacteria (LAB) in the olive fermentations are consistent between commercial processors and also for olives harvested on different collection dates. At approx. 10^7 cells/g olive (ml brine) LAB are more abundant than yeasts in the olives and olive brines. Yeast was more abundant in the brine than the olives. These results are remarkable because they show that California fermented olives have very similar microbial profiles and succession characteristics, even though they are fermented by different companies using different processing conditions. This finding is important because it shows that modifications to processing conditions made at one processor are also likely going to be applicable by other fermented olive processors in California.

Project Activity: Perform pilot olive fermentations to address dose-dependency and control of an inoculated spoilage yeast. A total of 18 pilot-scale fermentations were performed. The olives and supplies were provided by a commercial processor and the containers were either used as controls or inoculated with (pectinolytic) yeast and LAB. The amounts of bacteria and yeasts associated with the olive fermentations were quantified. Pectinolytic yeast caused spoilage when added to the fermentation in high (10^7) and lower (10^5) amounts. The addition of a non-pectinolytic yeast strain to the fermentation resulted in some protection against pectinolytic yeast-induced olive softening and spoilage. LAB added to the fermentations did not cause any noticeable defects in the fermentations and appear to have inhibited the growth of pectinolytic yeast. These findings were notable because they showed that even low quantities of pectinolytic yeast can cause olive spoilage and, secondly, that, with optimization, the addition of starter cultures should be useful in preventing olive spoilage.

Project Activity: Determine texture and chemical parameters of olives in pilot scale Sicilian-style olive fermentations The chemical characteristics (pH, titratable acidity, salinity, redox), and olive texture were measured weekly and then monthly for 6 months for pilot fermentations described above. A pectinase assay was applied using olive brine and confirmed that fermentations containing pectinolytic yeast also have higher amounts of pectinase enzymes in the brine. Importantly, it was found that there is a narrow window of time when abnormally high pectinase activity is found but the olive fruits are not yet highly damaged. This knowledge shows that the pectinase assay will be a useful diagnostic tool for olive processors as an "early warning" system for problem fermentations.

Project Activity: Identify the most abundant microbes in olive fermentations In this task, over 120 olive and brine samples were selected from commercial and pilot fermentation for microbial identification. Through opportunities based in part on a UC Davis Undergraduate Fellowship program, high-throughput (HTP) DNA sequence-based identification methods were applied. This was a particularly exciting advancement for this project because of the comprehensive aspect of the approach. Specifically, entire fungal and bacterial communities associated with those olives/brines were targeted for identification. Because HTP DNA sequencing is a culture-independent, project staff was able to view the total fungal and bacterial populations present. The resulted showed that the microbial communities change significantly over time during table olive fermentations and are distinct between olives and brines. These results are completely novel and will be very useful for understanding the progression of olive fermentations and the design of methods for improved control and stability over the final product.

Project Activity: Prepare a manual on proper microbial management of olive fermentations. A manual was prepared (Attachment 1) and distributed to the three largest fermented olive processors on April 23, 2014. This meeting also resulted in the development of a "best practices" document (Attachment 2).

Project Activity: Prepare a manuscript for publication in a food microbiology journal on the microbial/chemical characteristics of fermented olives and control of spoilage. This activity will actually result in two publications rather than only the single publication scheduled for this grant. Because of the complicated aspects of the project's results, those manuscripts are still in preparation and will be published in peer-reviewed journals early 2015.

Project Activity: Hold work progress meetings with olive processors. A total of four project meetings were held: December 17, 2012, June 27, 2013, August 26, 2013, and April 23, 2014. Work progress meetings were attended by the project team members and the heads of California Sicilian-style processor companies. Also in attendance at some meetings were the technical heads for the companies. At the meetings, the project team presented the results of the experiments and described the next steps in the project.

There were both academic and industry partners on this project. The Primary Investigator (PI) supervised and organized the work performed in this project. The PI also supervised the graduate student, technician, and undergraduate students who performed the majority of work on the project activities. The PI also coordinated the project team and served as the primary contact to the CDFA and the California olive processor industry. The co-PIs contributed expertise on yeast (fungal) biology and taxonomy to the project. They also supervised undergraduate students who were responsible for identifying yeasts isolated from olive fermentations and characterizing their pectinolytic capacities. The Director of the University of California Davis, Olive Center, contributed expertise on the commercial olive industry in California and served as a liaison between the research performed on this project and the California olive processors. He also formatted and edited the guideline manual for the California olive processors within this project. Both co-PIs participated in project meetings with the research team as well as with the industrial partners. A major strength of this project has been the collaboration between the PI and co-PIs. This collaboration has resulted in the major output of acceptance and application of this work by California olive processors.

The industrial partners consisting of the three largest fermented olive processors in California were crucial to the success of this project. The partners and specifically the West Coast Olives, Musco, and Delallo companies provided timely shipments of their commercial olives on a regular weekly and monthly basis for approximately six months and then subsequently as requested. These olives were the basis for approximately half of the work performed in this project, and hence the research would not have been possible without their support. The processors also contributed to the project development and data analysis during work progress meetings. This is significant in light of competing interests and differences in olive processing methods between their companies.

Goals and Outcomes Achieved

The goal and expected measureable outcome of this project was to disseminate and explain microbial management recommendations for Sicilian-style fermented olives to specialty table olive companies located in California. Because expectations for the quantity and composition of fermentative microorganisms in California fermented olives currently did not exist, this project focused on providing those baseline data. These expectations were met and even exceeded by providing in-depth microbial and chemical analysis of commercial olives from the three largest California fermented olive processors. The olives were examined from three harvests from each of the three processors and for no less than 20 time points during the nine months required for fermentation. Project staff also was able to monitor pilot fermentations to obtain baseline data on “defective” olives. This knowledge and experience was communicated to California olive processors in a printed manual and explained in a scheduled project meeting with the companies in April 2014. Also during the course of that meeting and in collaboration with the California olive processors in attendance, a “best practices” document was prepared that summarizes the needs and agreed upon actions for olive fermentations (Attachment 2). Project success was measured by meeting attendance of technical and business representatives of the companies and their written evaluations of the microbial analysis recommendations

(Attachment 3). Interest was achieved by one olive processing company to implement one of the recommended best practices on the pectinase assay at their olive processing facilities.

The "survey results" (Attachment 3) from the three largest California processor companies shows that the three processors were satisfied with this work and are either in the process of adopting the recommendations or have already started to use them at their facilities. The "best practices" document (Attachment 2) formulated together with the California processors shows that there are significant commonalities between different California companies and a shared interest towards achieving reductions in spoilage in their products.

Baseline data on olive fermentations acquired in this project resulted in the production of a guideline manual (Attachment 1) in which key steps for monitoring olive fermentations are shared. Best practices to prevent losses due to spoilage were agreed upon by the project participants and the California processors and written into a best practices document (Attachment 2). Although olive spoilage continues to be a problem for the California fermented olive processors, this project successfully identified the major causative agent of olive spoilage (pectinolytic yeast) and provided steps to prevent or mitigate losses. Outside the scope of this project, yet urgently needed, are ways to determine the likelihood of any fermentation to spoil and alter/modify fermentations to either better control/prevent spoilage yeast growth.

Beneficiaries

Approximately 25 California olive farmers benefited from the completion of the project's accomplishments, as well as the olive processing industry. This project resulted in the training of undergraduate and Master of Science students as well as a technician that are now equipped to join the California olive and fermentation industries. The dissemination of project results is through the publications to peer reviewed journals and visits with food industry representatives interested in olives, fermentation, and novel foods.

There are five primary commercial olive companies in California. Although this project worked with the three largest of those companies, all five companies can benefit from this project.

Lessons Learned

A major lesson in this project is the finding that the microbial profiles of California Sicilian-style olive processors are very similar, even though they use different fermentation conditions. This is a positive finding because it shows the universality of the methods project staff developed and that they are going to be generally applicable to all California fermented olive processors. Another insight is that the California olive industry is very willing and eager to prevent spoilage and losses of their products.

USDA Project No.: 29	Project Title: Implementing the California Standard to Increase Navel Orange Consumption	
Grant Recipient: California Citrus Mutual	**Grant Agreement No.:** SCB11029	**Date Submitted:** December 2013
Recipient Contact: Bob Blakely	**Telephone:** (559) 592-3790	**Email:** bob@cacitrusmutual.com

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

Over six years of consumer research by the citrus industry funded in part by the Specialty Crop Block Grant Program (SCBGP), resulted in the new minimum maturity standard for navel oranges. The "California Standard" was proven to be a much more reliable indicator of flavor and favorable consumer response, as indicated by expressed intent to purchase more, and more often, established through consumer research studies. In 2012 the minimum maturity ratio standard that had been the regulatory standard since 1914 was abandoned and the California Standard was adopted as the new legal minimum maturity standard for navel oranges. This was embraced by the citrus industry as a very progressive change, but presented the challenge of educating both marketers and consumers to the change and the significant positive impact the California Standard would have the quality of navel oranges reaching the market place.

Timing was important to achieving the maximum benefit from this project. The purpose of this project was to increase consumption/purchases of navel oranges by educating shippers, marketers and consumers on the California Standard and to combine that effort with a public relations campaign promoting the improved eating quality and consistency of California navels derived from implementing the higher more reliable maturity standard. The regulation enforcing the California Standard was effective April 1, 2012 (Attachment 1). This project was timed to coincide with the start of the 2012-2013 navel season, which was the first navel crop harvested to the new standard. The project used multiple media avenues and combined educational and promotional messages to create heightened awareness, generate enthusiasm among markets and increase consumer demand and purchasing akin to rolling out a new product.

A 2008 SCBGP, Project 15 entitled "Development of an orange maturity standard that assures better flavor and promotes increased consumption", helped fund the consumer research, which led to the adoption of the California Standard. This project built on that success to achieve the maximum benefit from the adoption of the new standard.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

It was the desire of the project team to initially influence marketers by creating curiosity and a desire to learn more about the California Standard well in advance of the season. This was done through a technical fact sheet for industry professionals, print media, and a California Standard website, http://thecaliforniastandard.com/ that was created to serve as an educational tool and as a media resource. California Citrus Mutual staff as well as growers and shippers made themselves available for media interviews. There were approximately 32 print, 6 radio, 2 television and 1 web video interviews that were produced. Several news organizations initiated interviews from there, and several also used their own industry sources. There was somewhat of snowball effect once the interest was created. The project team saw this as a very positive indication of successfully generating interest.

In September 2012, leading up to the beginning of the navel orange harvest and continuing through November 2012, the project conducted an advertising campaign introducing the California Standard and promoting “a tastier California navel orange”. Ads were run in printed trade publications and on produce news websites. Seven of the most widely circulated produce and supermarket publications were utilized. An eye catching ad featuring a little girl eating a navel orange was often run next to news articles on the California Standard (Attachment 2).

The campaign to promote California citrus and the California Standard acknowledged that there are two primary audiences: the industry professional and the consumer. In light of this, the campaign components utilized mediums and language appropriate to each. The industry professionals received a technical fact sheet, and had access to backup technical documents on *thecaliforniastandard.com* web site. A more technical news release was provided to trade journals and international online news resources.

The mainstream media received a consumer-oriented news release along with a photo of field-testing to accompany the news story. The web site offers media resources such as The California Standard logo in various file formats, print-quality photos, and names and contact information for sources of additional information.

To create a brand and a positive image for what could otherwise be seen as too technical and scientific, a tagline was created for each audience (“Taste the Sweet Difference” for consumers and “The Sweet Appeal of Consistency” for industry) along with a bright and colorful logo.

News releases were sent to trade journals and mainstream media, as well as magazines, web sites and blogs that focus on topics such as health and nutrition, cooking and parenting. The official news release was followed up with a more personal email and phone calls, encouraging use of the information, with a message that targeted the recipient’s specific area of interest. The California Standard enjoyed print, radio, television and online coverage locally, nationally and internationally in trade and mainstream media.

The navel season began two weeks earlier than the past two seasons. The fruit matured early and by the time the navels were passing the minimum color standard, they were also passing the California Standard, minimum maturity standard. The interest in the promise of a better tasting navel orange, generated through the media effort, equated to renewed early season excitement on the part of buyers. This had been waning in recent years past. The excitement resulted in higher demand and increased sales early in the season. Sales through January 2013 were up 6% over the previous year.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

The goal of the project was to increase sales of navel oranges through customer and consumer awareness of better tasting navel oranges resulting from adoption of the new maturity standard. The ultimate long term goal is to stabilize and then eventually increase per capita consumption by consistently delivering a good tasting navel orange to the market at the beginning of the season.

The new minimum maturity standard, "The California Standard"™, was developed and adopted into California regulation after six years of industry and SCBGP funded scientific development and consumer research. The California Standard is based on new science that measures maturity based on the relationship between the total sugar and total acid in the orange, rather than on the direct ratio of the two. This was proven through research to be a much better predictor of flavor and consumer satisfaction.

The project contracted with a public relations firm to work with the Project Director to create educational and informational pieces, media releases, and a website to serve as an informational resource for the media, customers, and consumers. The project also included promoting "A Tastier Navel Orange" in an advertising campaign that ran in the major produce and retail supermarket publications, both print and web based.

During the spring and summer of 2012 the project team developed ideas and created the materials, including press releases and developed the website. The project team met with the sales and marketing directors of several major navel orange marketers, including Sunkist and Paramount citrus, for input on messaging and to determine the most effective way to reach the target audience. The input from Sunkist and from Paramount Citrus was very helpful and contributed to the success of the project. One recommendation that came from the marketers was especially beneficial to the project: the recommendation to disseminate the marketer pieces electronically, rather than as hard copies sent through regular mail. Marketers told California Citrus Mutual they preferred high quality electronic media of printed material, because it was easier for them to utilize and redistribute to their customers, both domestically and internationally. California Citrus Mutual believes this modification contributed to the success of the project.

The project issued press releases in early April 2012 to coincide with the announcement that the California Standard would go into effect at the beginning of the 2012-2013 navel season. From April through

December 2012 media coverage of The California Standard helped inform packers, buyers and marketers, and was timed to impact buying decisions. The industry news release utilized *thecaliforniastandard.com* web address. Media coverage targeting consumers was timed with shipping of fruit and intended to encourage them to try the new, better tasting California navel orange. The consumer news release utilized *thesweetdifference.org* to more directly capture the message.

Full-color ads featuring The California Standard were placed in print trade journals as well as websites and e-newsletters chosen based on circulation and reputation within the industry. For a campaign to have national reach, the budget was limited. To maximize the available budget, ads were strategically placed in publications with the highest circulation, timed with the decision-making process for buyers, and designed to be bright and eye-catching. Ad placements were also timed to coincide with the Produce Marketing Association (PMA) trade show, where feasible. Online ads featured the same design elements as the print ad, to build the brand and create consistency. In addition, online ads were hyperlinked to the website. The ads ran from September to December 2012. The total combined circulation and monthly traffic total 310,185 views.

Magazine/Site	**Run dates (2012)**	**Circulation/Traffic**
Produce News	Sept. 10, 24 Oct. 29 Nov. 5	11,926 subscribers
Producenews.com	Sept. 2012 Oct. Nov.	33,967 unique visits per month 54,392 visits to web site, monthly 81,000 page views, monthly
The Packer	Sept. 17, 24 Oct. 8, 15	13,000 subscribers (Pre-PMA special section)
Thepacker.com	Sept.	30,000 impressions
Supermarket News	Sept. 3, 10, 24 Oct. 29	29,000 subscribers (PMA special edition distribution)
Freshplaza.com	Sept.	30,000 unique visitors per month
Freshplaza.com daily E-newsletter	Nov.	26,900 subscribers

The web hits tool used for the project was Google Analytics. Unfortunately, Google Analytics seemed not be reliable as it failed to accurately capture the data. For example, the report showed only two returning visits. California Citrus Mutual realized it was flawed because project team members visited the site regularly to access the information and monitor updates. Therefore, this portion of the project was not successful in capturing accurate web hit data.

Current and prior year weekly sales data was collected from shippers representing 76% of the industry's total volume. The information collected was consolidated into weekly comparisons from the beginning of the season through the end of January 2013, and totaled for the period. The results showed a marked increase in sales the first five weeks of the season, during which sales were up 1,464,113 cartons over the previous season. Sales were up 1,166,250 cartons through week four of 2013. (See Attachment 3)

The success is attributed to:

1. Customer awareness of the new maturity standard as a result of the media campaign
2. An early maturing good quality crop
3. The higher percentage of good tasting fruit reaching the market place, because of the higher standard, resulting in consumer satisfaction and repeat purchases.

Week	2011-12	2012-13	Difference
43		162,105	162,105
44	224,968	653,026	428,058
45	763,807	1,290,639	526,833
46	1,025,220	1,255,833	230,613
47	990,314	1,106,818	116,504
48	1,498,046	1,434,025	-64,021
49	1,794,628	1,536,328	-258,300
50	1,646,918	1,553,347	-93,571

The expected outcomes of this project were achieved. Customer and consumer awareness were increased through the media releases and advertising campaign. The informational pieces and media releases sent out by the project expanded the coverage exponentially by generating dozens of follow up news stories and interviews that were carried in newspapers, and trade publications. Broadcast news also picked up the story, running feature news stories on television and radio. Online e-news websites ran video features on the California Standard. One such video story produced by The Packer and featuring the President of Paramount Citrus was embedded on The California Standard website. The press coverage increased awareness and helped achieve the primary objective of the project, which was to generate addition navel orange consumption early in the navel season. The far reaching impact of the electronic media was demonstrated during the middle of the media campaign during a tour that California Citrus Mutual was conducting for a group of retail supermarket produce managers from Taiwan. During a visit at a packinghouse one of the members who had seen a story online began asking questions about the California Standard.

A primary objective of the project was to influence early season navel orange sales. Navel orange shipments from the beginning of the season through the end of January 2013 were up 6%, which equated to an additional 1.2 million cartons compared to the same period in 2012.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

There are two groups who benefited from this project. The California navel orange industry, comprised of approximately 2,000 growers and 130 shippers, benefited from increased sales. Establishing a higher minimum maturity standard primarily impacts sales early in the season by ensuring a consistently better tasting orange at the beginning of the season. Demand generated by the media exposure, reinforced by a better eating orange in the market resulted in an additional 1.2 million cartons of navel oranges being sold from the beginning of the season through January 2013. These additional cartons generated an additional $13.9 to $14.3 million in revenue. Consumers of navel oranges benefited from receiving and eating better tasting navel oranges. It was demonstrated in early projects that consumers who have a positive eating experience are likely to repeat their purchase and consume more.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

The project went very much as planned, without any major disruptions or setbacks. When developing future projects the team concluded that it would be important to consult more with stakeholders during the development of the project. If this had been done during the development of this project, California Citrus Mutual would have learned that electronic media and electronic dissemination of information was preferable to print media and mailing campaigns. Fortunately, this was learned during the development of materials for the project and adjustments were made, which contributed to the success of the project.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

For examples of articles and media coverage see Attachments 1- 5.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 30	**Project Title:** Improving Analytical Methods and US Standards to Increase Competitiveness of California Table Olives and Olive Oil	
Grant Recipient: The Regents of the University of California, Davis, Olive Center	**Grant Agreement No.:** SCB11030	**Date Submitted:** December 2014
Recipient Contact: Dan Flynn	**Telephone:** (530) 752-5170	**Email:** jdflynn@ucdavis.edu

Project Summary

The purpose of this project was to develop innovative methods to assess the quality of olives and olive oil, and facilitate the adoption of improved quality standards for the United States. The project addresses a top industry priority identified through a strategic planning process in 2010 led by the UC Davis Olive Center, a process that included olive growers and processors, university faculty, farm advisors and culinary experts. The concern identified by industry leaders was that inadequate standards and analytical methods are hindering the long-term sales and competitiveness of olives grown and processed in California. The project's tasks were to determine the chemical values of a variety of olives grown in California, identify chemical markers for sensory defects, develop standards based on the chemical markers, and lead a stakeholder effort to develop and adopt improved standards and methods based on this research.

Improving the competitiveness and long-term sales of olives grown and processed in California is a project objective that can be achieved by facilitating the adoption of adequate quality standards in the United States. Therefore, developing scientific methods for assessing the quality of table olives and olive oil is crucial.

Also, the importance and timeliness of this project is apparent because the University of California Davis has documented the poor quality of imported black-ripe table olives and olive oil that have large market share in the United States. In 2009 the University of California Davis Olive Center issued a study that found sensory defects (such as metallic and soapy flavors) in imported 'California-style' black-ripe olives that are used in the food-service industry, (primarily on pizza). There is widespread concern in the California industry that when consumers taste the inferior imported product sold in retail cans the consumer decides never to purchase 'California-style' olives again. In 2010 University of California Davis released a study showing that 69 percent of the imported 'extra virgin' olive oils failed international sensory and chemical standards for extra virgin. Subsequent studies in 2011 and 2012 found similar rates of substandard imported olive oil. The inferior imported oil, generally sold at a low price, undercuts California producers who are producing high-quality extra virgin olive oil.

This project was not built upon a previously funded SCBGP project.

Project Approach

Identify and collect samples to be tested.

The research chemist and project director worked with the USDA laboratory and industry cooperators to identify samples to be collected. For table olives, the criteria for collection was based on imported samples that had been pulled as substandard by USDA inspectors, domestic samples of varying qualities pulled by domestic producers and samples from the market. For olive oil the sampling was based on the most popular cultivars in California, along with cultivars that were identified as often outside international standards in an Australian government study. Olives were collected from multiple sites in California and the United States, delivered to the UC Davis laboratory on the same day or overnight delivery, and either refrigerated at 43 °F overnight or processed to oil on the same day of delivery. A total of 11 table olive samples and 38 olive oil samples were analyzed.

Analyze table olive and olive oil samples at USDA Western Regional laboratory and at UC Davis.
Table olive samples were analyzed by laboratory assistants at the USDA and at the UC Davis Olive Center, and olive oil samples were analyzed at the UC Davis Olive Center. The table olive samples were analyzed for volatile constituents using gas chromatography/flame ionization detector (GC/FID) and gas chromatography/mass-spectrometry (GC/MS). Olive oil samples were analyzed for fatty acid and sterol profiles by GC/MS.

Evaluate chemical peaks and select the most reliable for further study.
The research chemists at the USDA and UC Davis analyzed the chemical markers for the table olive samples and identified two, styrene and ethanol, for further study. The table olive industry provided funding to examine styrene and ethanol in more detail. The UC Davis research chemist and laboratory assistant analyzed the fatty acid and sterol profiles of the olive oil samples and noted that results. The research chemist and laboratory assistant identified volatile compounds associated with the defects in olive oil.

Develop chemical method for use by regulators.
The UC Davis research chemist developed a rapid method for determining styrene in the table olive samples. The results showed that styrene was present in imported samples at an average of three times the concentration in domestic samples. The UC Davis research chemist also developed a method for analyzing ethanol in the table olive samples.

Meet with oversight task force on three occasions.
The project director determined early in the project that it was difficult to bring the task force together, but did meet with individual members and subgroups of the task force at least once per year to discuss the project's scope and progress.

Write scientific article describing the project findings and results.
The research chemist at USDA published a paper based on the findings of the table olives in the peer-reviewed Journal of Food Chemistry in April 2014: "Volatile constituents of commercial imported and domestic black-ripe table olives (Olea europaea)." The research chemist at UC Davis published a paper based on the findings of the olive oils in the peer-reviewed Journal of Agricultural and Food Chemistry in November 2013: "Ultrahigh Performance Liquid Chromatography Analysis of Volatile Carbonyl Compounds in Virgin Olive Oils." The project director and research chemist wrote two additional reports on project results that were released in May and June 2014: "Correlating Olive Oil Sensory and Chemistry Results" and "Fatty Acid and Sterol Profiles of Olive Oils Produced in the United States." In addition, the research chemist at UC Davis has submitted two more papers entitled, "Determination of Significant Volatile Compounds for Sensory Defects Found in Virgin Olive Oils" (still in peer-review) and "Characterization of Volatile Compounds of Virgin Olive Oil Originated in the United States" to the peer-reviewed Journal of Food Chemistry and Agricultural and Food Chemistry (published November 27, 2014).

Present results at the American Chemical Society annual meeting.
The UC Davis research chemist presented results before 250 people at the annual American Chemical Society (ACS) meeting on August 10, 2014. The title of her talk was "Olive Oil Authenticity: Pursuing Innovation in the Chemical Analysis". In addition, a graduate student who worked with the research chemist presented a poster entitled "Characterization of volatile of virgin olive oil originated in the United States" and gave an oral presentation "Determination of Significant Volatile Compounds for Sensory Defects Found in Virgin Olive Oils" before 150 people at the annual American Oil Chemists' Society (AOCS) meeting on April 29, 2014.

Meet with regulators to discuss study measurable outcomes and recommendatioins related to existing U.S. standards.
The project director met with USDA officials on June 27, 2014 to discuss the project research. The project director has established an ongoing dialogue with USDA on the potential for modifications in quality standards.

The overall scope of the project did not benefit commodities other than specialty crops.

The California table olive industry provided $25,530 and $33,000 to examine ethanol and styrene, respectively, in table olives. California olive growers provided in-kind assistance by harvesting and shipping olive samples for oil processing at UC Davis.

Goals and Outcomes Achieved

The research team has accomplished the three measurable outcomes identified in the approved project:

1. **Increase chemical confirmation rate of sensory rancidity defects in olive oil from the benchmark rate of 30 percent to a target rate of greater than 90 percent.**
   The research chemist and a laboratory assistant conducted an analysis of carbonyl compounds in virgin olive oil samples using an ultra-high-performance liquid chromatography (UHPLC) instrument and have identified the chemical compounds that are associated with rancidity defect in sensory. The project director, laboratory assistant and research chemist also evaluated data collected on 260 virgin olive oil samples to determine the relationship between sensory and chemistry methods.
2. **Identify at least one chemical marker of table olive sensory defects that would assist regulators in enforcing quality standards.**
   The research chemist and laboratory assistants evaluated table olive samples using gas chromatography/flame ionization detector (GC/FID) and gas chromatography/mass spectrometry (GC/MS).
3. **Prove that California campesterol levels naturally exceed 4.0 percent.**
   The project director collected 28 olive samples over two seasons from various locations in California. The project director and laboratory assistants produced olive oil from the samples using an Abencor processing system. The research chemist and laboratory assistants evaluated campesterol in 38 samples (with 10 additional samples sourced outside of California) using GC/MS.

The performance on the project goals are as follows:

- **Continue the study of ethanol as a chemical marker of table olive sensory defects.**
  The research chemist has analyzed ethanol content in table olive samples that were flagged as substandard by USDA inspectors. The team found that the instrument cannot detect ethanol at a

sensitivity that would provide a practical method for enforcement of a quality standard. Although, other marker compounds such as 2-methylbutanol and 3-methlbutanol may be useful.

- **Draft additional papers for scientific journals based on the study results.**
  The research chemist has drafted two additional papers that are being considered by a scientific journal as mentioned earlier. In addition, the research chemist is working on two additional papers based on the findings of fatty acid and sterol profiles of the oils from the Abencor processing system and on the faster, better, cheaper method for determining pyropheophytin (PPP) using UHPLC with a fluorescence detector.
- **The project director will prepare a report and meet with USDA.**
  The project director prepared a report and met with USDA officials on June 27, 2014 to discuss the study results.
- **The project director will describe project results at the American Oil Chemists' Society (AOCS) meeting in May 2014 and will disseminate results via electronic means to industry stakeholders.**
  The project director described the project results at the AOCS meeting in May 2014.

Increase chemical confirmation rate of sensory rancidity defects in olive oil from the benchmark rate of 30 percent to a target rate of greater than 90 percent.
The project's analysis of 260 olive oil samples (domestic and imported) indicates that changing the free fatty acidity standard for extra virgin olive oil from 0.8 percent to 0.4 percent could increase chemical confirmation of sensory defects to 90 percent. The UC Davis Olive Center study team also developed a 90+ percent chemical confirmation rate for peroxide value, ultraviolet absorbance, pyropheophytins (PPP) and diacylglycerols (DAGs). The study team also developed a more rapid and less expensive method for PPP analysis that may assist USDA regulators if this chemical test is added to USDA standards in the future. Among other assets, PPP has a reasonably strong relationship with the oxidation of olive oil. The study team also identified chemical markers that are responsible for sensory defect. A series of unsaturated aldehydes with 7 carbons - 12 carbons, such as 2, 4-heptadienal, *E*-2-nonenal and *E*-2-octenal are chemical markers that are responsible for rancidity, *Z*-3-hexenyl acetate and nonanoic acid contributed significantly to fusty defects, acetic acid and butyric acid were responsible for winey-vinegary defects. The study team is worked on optimizing the threshold level of each marker to correlate with the sensory results.

Identify at least one chemical marker of table olive sensory defects that would assist regulators in enforcing quality standards.
The study team has found that ethanol, 2-methylbutanol and 3-methlbutanol are promising chemical markers for fermentation-related sensory defects in California ripe table olives. These fermentation defects include descriptors such as alcohol, oak barrel, artificial fruity/floral, metallic, medicinal/soapy and rancid.

Prove that California campesterol levels naturally exceed 4.0 percent.
The study team's analysis of the sterol profile from 28 California 2012 and 2013 olive oil samples that were produced in the laboratory found that the campesterol levels exceeded 4.5 percent in 25 percent (7 of 28) of the samples.   In addition, they found that samples also exceeded USDA standards for other sterols, including brassicasterol, apparent B-sitosterol, delta-7-stigmastenol, cholesterol, uvaol+erythrodiol, and total sterols. Samples also failed USDA standards for several fatty acids, including palmitic acid, palmitoleic acid, heptadecenoic acid, oleic acid, and linoleic acid.

A stronger scientific foundation for improvement in quality standards.
The project showed how existing chemical standards could be modified to provide a stronger relationship to the sensory standard for extra virgin olive oil. The analysis of 260 olive oil samples (domestic and imported) indicates that changing the free fatty acidity standard for extra virgin olive oil from 0.8 percent to 0.4 percent could increase chemical confirmation of sensory defects to 90+ percent. The study team also developed a 90+ percent chemical confirmation rate for peroxide value, ultraviolet absorbance, pyropheophytins and diacylglycerols. A faster, better and cheaper method for pyropheophytins was developed. Chemical markers such as 2, 4-heptadienal, *E*-2-nonenal and *E*-2-octenal for rancidity defects, *Z*-3-hexenyl acetate and nonanoic acid for fusty defects, acetic acid and butyric acid for winey-vinegary defects have been identified and will be study further to be used for chemistry and sensory correlation. In addition, this project, with the additional funding support provided by the California Olive Committee, establishes a scientific foundation for the chemical quality of ripe olives for the first time.

Stronger evidence that existing US standards should be modified to accommodate domestic olive oil.
The fatty acid and sterol analysis conducted through this study on 28 California olive oil samples (as well as 10 additional samples sourced outside of California) provide the most compelling evidence to date that U.S. standards should be modified to accommodate the natural chemistry of U.S.-produced olive oil.

Beneficiaries

The following groups benefitted from the completion of this project's accomplishments:

- Olive growers, large and small, hand-harvest and mechanical harvest.
- Olive processors, including the four largest in table olives and olive oil, as well as dozens of smaller olive oil processors.
- USDA inspectors who evaluate quality.

The following beneficiaries were directly affected by the project's accomplishments:

- Up to 1,500 olive grower and processor beneficiaries, who now have access to Best Practices information and digitized olive publications, providing valuable information to improve quality and production efficiency.
- At least 20 USDA inspector beneficiaries, who received expert training on olive oil sensory analysis through this project and who will be receiving similar training in the future from table olive industry funding.

Lessons Learned

LESSON #1: Look for alternatives to buying new equipment at full price. The project director was able to obtain without a charge a $40,000 Abencor processing system through a professor who donated the equipment. The research chemist was able to use the savings to get a UHPLC instrument for a steep discount that allowed the project team to explore innovative methods of identifying chemical markers for sensory defects.

LESSON #2: Look for synergies with other funding opportunities. The California ripe olive industry was interested in supplementing the work conducted through this study by funding investigation of how ethanol could be used as a potential marker for sensory defects. The industry interest allows this project to increase its impact.

The Olive Oil Commission of California referenced this project's results when proposing an olive oil standard to the California Department of Food and Agriculture.

Additional Information

None.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 31	**Project Title:** Increasing Market Vitality and Enforcement through Marketing Manager Training and Certification at California Certified Farmers' Markets	
Grant Recipient: California Department of Food & Agriculture	**Grant Agreement No.:** SCB11031	**Date Submitted:** December 2013
Recipient Contact: Steve Patton Susan Shelton	**Telephone:** (916) 900-5030 (916) 900-5030	**Email:** Steve.patton@cdfa.ca.gov Susan.shelton@cdfa.ca.gov

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

The Certified Farmers' Market (CFM) Program provides opportunities for California farmers to market their products directly to consumers with exemptions for minimum size, labeling, standard pack and container requirements.

In 2010, news reports highlighted instances of deception at CFMs, including vendors selling fraudulently labeled products and reselling fruits and vegetables from wholesale markets. These actions are detrimental to the CFM industry. Input solicited from the industry, consumers, and county stakeholders resulted in a recommendation that CFM Managers participate in a training and certification program.

CFM Managers are the first line of enforcement to ensure certified producers follow many of the rules, regulations and statutes governing the CFM Program. While many CFM Managers are industry professionals, a substantial number are volunteers and unaware of the rules and regulations governing CFMs.

The project purpose was to enhance compliance at CFMs to ensure an equitable marketplace resulting in increased consumer confidence in the product offered at CFMs and increased sales of California specialty crops.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

A subcommittee consisting of stakeholders, including County Agricultural Commissioners and Market Managers, was created in late fall/early winter 2011. The subcommittee met multiple times to determine specific topics, issues and information to be encompassed within the training manual and educational sessions.

Notices of non-compliance were reviewed to ensure workshop curriculum highlighted the most prevalent noncompliance issues, such as failure of certified producers to display certificates, producers not having proper organic registrations when selling produce as organic, and producers not separating product that was being sold for and produced by another farmer. All information gathered by the subcommittee was given to the contracted technical writer for inclusion into the market manager curriculum.

The subcommittee met with the technical writer to fine tune the draft, and ultimately approved the final training materials and market manager manual.

The completed market manager manual and training materials were printed in March 2013. The manual was organized into chapters, which include Direct Marketing for California Farmers, Essentials of a Successful Market, Doing Business, Marketing Integrity and Informational Tools and Tips. A training guide was also developed and completed for the workshop trainer to use as an outline; this included a PowerPoint presentation and outline of the information found in the manual.

Meeting locations for the Market Manager Training classes were selected, and a flyer was created and sent out via direct mail to 353 known CFM Managers in March 2013. This flyer was also posted on the CDFA website during this time.

The CFM Manager courses were held from April 16 through May 9, 2013 in 11 locations throughout California - San Francisco, Marysville, Eureka, San Diego, Irvine, Pasadena, Sacramento, Santa Clara, Santa Monica, Ventura, and Fresno. An average of 23 people attended each class, and a copy of the Certified Farmers' Market Program Manager's Manual was provided to each attendee.

An exam created to measure the market managers' knowledge of direct marketing was given at the beginning and end of each class. Tests given at the beginning of each class averaged a score of 72 %, while the average score after taking the class was 89 %, showing an increase in knowledge gleaned from the course.

Matching funds were used in the form of expertise from the subject matter experts in many of the Divisions at the California Department of Food and Agriculture (CDFA). None of the time spent from personnel in the Animal Health, Market Enforcement and Division of Plant that worked on the non-specialty crop sections were charged to the grant award. Their expertise was used in gleaning information for the training materials. Additionally, time spent by CDFA for project activities related to all aspects of writing, tracking expenses and all paperwork associated with the grant process was not charged to the award. This time more than covers the $2,200 of grant monies that make up one percent of the total grant amount, which corresponds to the one percent of non-specialty crops that make up a CFM.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Although the Market Manager training was originally planned as a mandatory training with an online refresher component for annual certification, the regulatory authority to make the training mandatory did not transpire due to lack of industry support. Without the need for a mandatory program, there was no need for a refresher program to be written, and therefore, this component of the grant was not undertaken.

As this Market Manager Training will not be ongoing, it is difficult to determine the effect it will have on the industry. However, even a voluntary one-time event provided benefits. It was expected that the number of non-compliance notices issued would decrease to less than 60 per month, a 25% decrease, by the close of the second year. Although a second year of training was not conducted, in the months following the 11 training sessions (May 2013 – October 2013) the average number of non-compliance notices issued was 59 per month. This indicated the expected measureable outcome of a 25% decrease would likely have been achieved, and possibly exceeded, if the training continued for a second year.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

Those benefiting from this project are the approximately 253 CFM managers who received the training and the necessary tools to administer a compliant CFM and maintain an equitable marketplace. Furthermore, the specialty crop producers selling their produce at CFMs benefit by competing in an equitable marketing place rather than against non-compliant individuals. In addition, an equitable marketplace results in increased consumer confidence in the product offered at CFMs and, therefore, increased sales of California specialty crops for producers in the CFMs.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

The CFM Manager Training sessions were well regarded and received. As the regulatory authority to make the training mandatory and ongoing did not transpire, the scope of the project was slightly affected. In the end, comprehensive training documents were created and useful in the 11 training sessions, thus fulfilling and the meeting the initial objectives of the grant. The training documents continue to be available on CDFA's website to help new market managers as they navigate the world of the CFM.

Some of the training materials were used when CDFA created a training class and resource binder for the local County Agricultural Commissioners' representatives. These county personnel ensure that CFMs are operated consistent with California laws and regulations, issue the non-compliance notices, and are ultimately the backbone of the compliance side of CFMs. This resource is an additional benefit that was not anticipated when the grant was written.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

None.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 32	Project Title: Domestic and International Market Potential of the California Olive Industry	
Grant Recipient: The Regents of the University of California, Davis, Agricultural Issues Center	**Grant Agreement No:** SCB11032	**Date Submitted:** December 2013
Recipient Contact: Daniel A. Sumner	**Telephone:** (530) 752-1668	**Email:** dasumner@ucdavis.edu

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

In the United States, more than 300,000 metric tons of olive oil was marketed in 2012 at a value of close to $1 billion, tripling 1990 levels (USDA-FAS) and making it one of the larger specialty crop markets in the U.S. While U.S. production of olive oil is dominated by California producers, it accounts for less than 3 percent of the olive oil products sold in the United States. The largest supplier of olive oil to the U.S., accounting for about 60 percent of olive oil consumed, is the European Union (EU). The economic success of the California olive industry depends on growers, processors and marketers making effective strategic decisions. Evolving markets and policies drive competitive conditions, which may allow the California olive industry to capture a much larger part of the lucrative market; yet California the olive industry lacks the required specifics, objectives and accurate information about the U.S. and global olive markets and drivers of change in those markets for informed assessments. In addition, these decision makers lack economic projections and framework to evaluate impacts of coming changes in markets and policy.

The purpose of this project is to document the impact of EU trade and support policies for olives in order to improve the competitiveness of the California olive industry. The Regents of the University of California, Davis (UCD) partnered with The University of California, Ag Issues Center (UC AIC) in order to assemble data from many relatively inaccessible sources, including classified market and policy data spanning the past 20 years, and develop an economic analysis to project the effects of strategic and policy alternatives. An immediate objective of the project was to provide California olive industry stakeholders with unique olive market information and analysis needed to assess EU trade barriers and subsidies, as well as U.S. quality standards.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

During the early stages of this project the UC AIC staff engaged California olive industry stakeholders to discuss the goals and objectives of this project. UC AIC staff were active participants in California olive oil industry events, and attended policy hearings conducted by the California Senate. From these interactions and discussions, the research team acquired a better understanding of the complexities of the California olive industry and further defined the data required to achieve project goals.

UC AIC staff collected and assembled data from multiple sources including the United States Department of Agriculture National Agricultural Statistics Service (USDA NASS), the U.S. International Trade Commission and other relevant sources. UC AIC collected U.S. import and export data for olive products dating back to 1996, and staff searched and collected European Union (EU) policy and production data dating to the same period.

Using this data, UC AIC staff developed an econometric model to estimate the United States demand for olive oil. This model allows for testing the significance and magnitude of drivers of demand, such as income, price of olive oil, price of alternative cooking oils and publicity of olive oil health factors and trendiness. Furthermore the UC AIC model is able to determine demand differences for olive oil of different quality levels and countries of origin. The elasticities of demand for olive oil estimated by the UC AIC models are a unique body of information and are the first indications of how sensitive the demand for olive oil in the U.S. is to changes in specific variables. This information can be used by industry participants in determining how to most effectively market their products. A policy brief based on this work was printed in the *Agriculture and Resource Economics Update* (*ARE Update*), a bimonthly magazine published by the University of California Giannini Foundation of Agricultural Economics for the purpose of providing wide dissemination of research results and expert opinion from faculty and graduate students in agricultural and resources economics at UC Davis and UC Berkeley; the *ARE Update* targets a lay audience of policy makers, advisors, agribusiness managers, and other professionals interested in agricultural, resources environmental and development economics. A full report has been submitted for publication in an academic journal.

Using the findings from the econometric model of U.S. demand for olive oil, the AIC researchers have developed an economic simulation model that examines market implications of changes in EU support policies for olive growers and processors. In addition, data relative to the production and processing of olives in the EU was collected, as well as data relative to olive production and processing from countries in North Africa. The simulation model takes into account the market effects of regulated standards and labeling requirements and their enforcement. The results from the simulation model, as with the demand estimation, is a unique set of information that can inform California olive oil producers how different future scenarios might affect their competitive position.

All information produced from this project is available to industry stakeholders via written reports and through personal consultation with UC AIC staff.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

UC AIC's first specific goal was to develop and provide information to describe the unique economics of the U.S. olive oil market and assess the competitive position of the California olive oil industry. UC AIC's second specific goal was to statistically assess the relationships between unique olive market characteristics and simulate how changes in these characteristics influence the competitive position of the California olive oil industry in the U.S. market. The ultimate goal of this project was to improve the long-term strategic decision making of all California olive oil industry stakeholders.

For each of the two specific goals, UC AIC measured performance by providing detailed information and analysis to decision makers of the California olive oil industry. This information was not available prior to the start of this project. Therefore, the baseline for these specific goals was zero. UC AIC's development of the econometric model of U.S. domestic demand for olive oil and the designation of those factors that drive this demand was a significant achievement toward accomplishing these goals. The results from this analysis were published and released via multiple outlets. First, "New Demand for Old Food: The US Demand for Olive Oil" was published in the *ARE Update*. The article was published in the March/April 2013. Since its publication the specific issue of the *ARE Update* has been downloaded approximately 680 times. The article has been downloaded approximately 2,300 times. Results were also made available via the UC AIC website. The specific olive oil reference on the front page of the UC AIC website has been downloaded 130 times since its publication in May 2013.

Results from this work have been presented in one seminar on the University of California, Davis campus to approximately 30 agricultural economists and industry stakeholders. Two presentations are scheduled to be made at the International Agricultural Trade Research Consortium conference in Clearwater, Florida to approximately 200 U.S. agricultural policy stakeholders. These presentations will include analysis on U.S. olive oil demand, as well as trade policy related to EU imports of olive oil. Results are scheduled to be published in academic journals in the coming months. The journals have yet to be determined.

Achievement of UC AIC's ultimate goal will be a long term process that will carry on well past the completion of this grant period. The use of these tools by industry stakeholders and the continuing outreach of UC AIC staff will continue to provide a return on the efforts put forth in this project.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

The direct beneficiaries of this project are the 1,700 California olive farms and their 17,000 employees along with other farms considering olive production. Processors and distributors and their employees will also benefit from this project. Indirect beneficiaries from this project are the California economy as a whole and consumers of olive products.

In 2012 the U.S. consumed over 300,000 tons of olive oil and the trend is for continued growth in consumption. California is the largest commercial producer of olive oil in the U.S. but only for 3 percent of the domestic market supply. An expanding and more competitive U.S. olive oil market will provide a lucrative specialty crop alternative for growers in several regions of California and could improve rural economic prospects. The results from this project will increase the competitiveness of the California olive industry, which has the potential to generate $1 billion in additional revenues annually and more in terms of broader impacts on the rural economy.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

The work conducted with this project resulted in a better understanding of the enormity and complexity of the global olive oil market. During the course of UC AIC's interactions with various stakeholder groups, staff learned that olive oil had been a source of mystery in the EU for a long time. Although it is certain that olive oil producers within the EU are receiving government support it is not uniform across the member states. It was extremely difficult to get an accurate measure of how much support growers in various regions received. Furthermore, olive oil in the EU is culturally significant.

The UC AIC staff that worked on this project learned that the U.S. domestic and global olive oil market continues to expand and California is capable of competing with EU producers in producing high quality olive oil. The demand for olive oil in the U.S. is not greatly influenced by changes in price of other cooking oils. Olive oil is viewed as a unique product by U.S. consumers and is becoming more and more valued for its health benefits and for its use as a cooking oil. The main source of influence on the demand for California olive oil is the relative price of oil imported from the EU. American consumers value the "Italian" and "Spanish" brand. Changes in consumer income also influence the demand for olive oil in the U.S. As income increases the demand for olive oil also increases. This was an unexpected outcome from UC AIC's work.

The challenge for California agriculture in trying to meet U.S. demand for olive oil is the enormous investment that will be needed on the part of producers within the state. California currently has approximately 41,000 acres of olive orchards, which produces about 1.3% of U.S. demand for olive oil. The investment in land needed to increase California's share of the U.S. olive oil market to even 10 percent would be over 300,000 acres.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

New Demand for Old Food: the U.S. Demand for Olive Oil Bo Xiong, William Matthews, Daniel Sumner. http://aic.ucdavis.edu/publications/OO_demand_0927.pdf.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 33	Project Title: Green from Grapes to Glass: A Marketing Communications Campaign for California Wine	
Grant Recipient: Wine Institute	**Grant Agreement No.:** SCB11033	**Date Submitted:** December 2014
Recipient Contact: Nancy Light	**Telephone:** 415-356-7520	**Email:** nlight@wineinstitute.org

Project Summary

The purpose of this project was communicate California wine's leadership in sustainable practices to wine trade, media and consumers in order to create accurate perceptions, influence purchase decisions and increase tourism and sales for the long term benefit of California's winegrape growers and wineries. California vintners and growers have the most comprehensive and widely adopted sustainability program in the world but efforts had been focused on growing participation within the industry rather than communicating about sustainable attributes. With wine purchase decisions increasingly based on environmental and social responsibility factors, especially among millennial consumers who represent a growing market segment for wine, the Green Grapes to Glass (GGG) project sought to understand key audience priorities on sustainable attributes for wine and to implement a coordinated marketing campaign to communicate California's competitive advantage in this area.

The program aimed to benefit California's winegrapes and wines, one of the top value-added agricultural products of the state, impacting 8000 individual farms/businesses and growing California's sales in the highly competitive U.S. market which became the world's largest wine market in 2010. Differentiating California wine with key trade, media and consumers based on its sustainable winegrowing credentials was timely in the U.S. market where wine imports held a 30% share and many competitor countries (New Zealand, Chile, South Africa) and states (Oregon) were marketing wines and wine country tourism based on green attributes. Establishing California wine as the sustainability leader was important at the early stages of consumer awareness of sustainable practices for wine and appropriate given the industry's decade long investment in sustainability

GGG built upon Wine Institute's previous project with California Wine Growers and regional partners- CA First: Spotlight on California Wine Regions – which enhanced marketing skills and built awareness and sales based on the unique attributes of the state's diverse wine regions. Leveraging those partnerships as well as the more than a decade of collaboration with the California Sustainable Winegrowing Alliance, GGG highlighted state and regional sustainability practices, programs, certifications to heighten awareness of California wine's leadership and enhance its appeal and sales.

Project Approach

- Conducted consumer, trade/media and industry research to measure awareness, interest and knowledge of green and sustainable wine practices, specifically of California wines, and communicated results and best practices to 3,000 California vintners and growers at meetings, workshops, through newsletters and news releases. This research also helped guide the successful implementation of the GGG program by establishing a benchmark for sustainable awareness and information on its role in purchase and buying decisions. See news release at http://www.wineinstitute.org/resources/pressroom/05072013

- Produced three California Wine Month (CWM) tasting events and participated in seven Visit California events attended 1000 members of the wine trade and media and 500 consumers in each of the program years. CWM events involved 9-15 wine regions, 50-90 vintners, growers and regional representatives from around the state, and 100 wines presented with sustainable winegrowing messaging to powerfully communicate this theme directly and through publicity.
- Implemented statewide promotional campaigns for CWM in September 2012 and 2013, focused on sustainability messaging and generated record participation by wineries which hosted more than 100 regional and individual events in each year. National, regional and local (CA) restaurant and retail partners highlighting California wines during CWM were 19 in 2012 and 32 in 2013 further extending the impact of the program and messaging.
- Initiated a new annual statewide promotional event, Down to Earth (D2E) Month, in April 2012 (timed to coincide with Earth Day on April 22) to highlight the sustainable commitment of California wine. Regions and wineries hosted more than 25-40 green-themed consumer events each year in 2012, 2013 and 2014. See news release at: http://www.wineinstitute.org/resources/pressroom/03262012
- Provided 13 cost share incentives to regional wine and grape associations throughout the state to expand participation in events and promotional activities and to facilitate special print publications and broadcast coverage of sustainable wine tourism routes, experiences and events. Example of
- Conducted an on-going public relations program that resulted in total media impressions of more than 1 billion from coverage of grant events, activities and news. One example of a cost-share program is a video produced by California Life TV with Santa Cruz Mountains available on www.discovercaliforniawines.com under videos on the Trade and Media page, link on YouTube here: https://www.youtube.com/watch?v=4aR7FEOflQs
- Implemented a social media program on Facebook (California Wines- 5000 fans), Twitter (CalifWines_US - 2,084 followers) and Pinterest (http://www.pinterest.com/californiawines/) that generated visibility and engagement for California wine sustainability messages.
- Published a consumer-focused book, Down to Earth, A Seasonal Tour of California Sustainable Winegrowing, in April 2014 to highlight sustainable winegrowing and making practices around the state and to provide an introduction to the subject through winery profiles and beautiful wine country photography. The book, a vehicle for generating publicity, social media engagement and word-of-mouth awareness, generated 27.3 million impressions from media coverage in the three months following its release. More information at http://www.discovercaliforniawines.com/downtoearth/
- Developed and implemented a new expanded section on sustainable winegrowing and winemaking on Wine Institute's consumer website, www.discovercaliforniawines.com which includes an interactive guide to images and text about 36 sustainable practices in California vineyards, wineries and community/employee relations http://www.discovercaliforniawines.com/sustainable-winegrowing. Launched in April 2014.
- Developed and implemented an online master class on California sustainable winegrowing for industry, trade, media and interested consumers to foster increased knowledge about California sustainable winegrowing through a training course with certificate of completion. Project Staff experienced some delays in completing this deliverable and expects to go live early 2015. http://dev-wine-institute.gotpantheon.com/

This project solely enhanced the competitiveness of California-grown winegrapes, a specialty crop, and wines produced from them.

Wine Institute provided the expertise and staffing to implement the project. Key project partners were the than 15+ regional winery and grower associations and hundreds of wineries that participated in tasting events hosted by Wine Institute and hosted events during statewide celebrations for CWM and D2E. Wine Institite also worked with CSWA on research, the Down to Earth book, the expanded sustainability website section and online course. CAWG supported the project by sharing information with growers. As mentioned, CAWG did not provide in-kind or financial contribution toward the project due to a change in staffing and focus.

Goals and Outcomes Achieved

1. Provided education, tools and cost-share incentives to 3000+ vintners, growers and regional association executives to enhance green marketing skills through six industry workshops/meetings, five newsletters and four news releases. Regions and wineries developed more than 100 sustainably focused consumer events and communications tools during the grant period (during statewide celebrations of California Wine Month/Sept. 2012 and 2013 and Down to Earth Month/April 2012,2013, 2014) reaching an audience of 1.3 billion through media impressions and approximately 3 thousand consumer attendees at events in each year of the grant.
2. Generated 1.3 billion impressions for program messages in print, broadcast and online media coverage during the project period through media events, publicity (news releases and pitching), interviews and special editorial projects. Estimated advertising equivalency in excess of $10 million.
3. Engaged 1000+ wine trade and media “gatekeepers” in direct participation in 10 tasting events and media receptions. Grew visits to expanded sustainability section on consumer website to 500 views following launch in April 2014. Goal of 100+ wine trade and media completing online sustainable ambassador course will be measured after grant period since tool will be launched in late August 2014.

Long-term measurable outcomes to which the project contributed include:

- Increase of 20% in the retail value of California wine sales in the U.S. market to $23.1 billion in 2013 and an increase of 46% in the farmgate value of California winegrapes to $3.2 billion in 2013, the most recent year for which information is available. See statistics at: http://www.wineinstitute.org/resources/statistics/article80
- Wine Institute did not conduct an economic impact report since the start of the grant project and was therefore unable to measure the goal of increasing tourism to California wine regions by 2.5% from 20.7 million annually in 2010.

Actual accomplishments for this project include:

- Shared results of research on best practices and cost-share incentives with 3,000 California vintners and growers (grant goal was 2,000) through meetings, workshops, newsletters/releases and statewide campaigns around CWM and D2E.
- Reached attendance goal of 1000 members of wine trade media at three California Wine Month (CWM) tasting events and seven Visit California media events for a total of 10 events. The grant goal was to conduct five events during project.
- Regional associations and individual wineries hosted more than 100 events each year in 2012 and 2013 as part of the statewide promotional campaign for California Wine Month in September, and 25-40 events each year for the new Down to Earth Month statewide campaign in April. Consumer attendance at these events exceeded 9,000 or 3,000 per year against the grant goal of 500 consumer attendees per grant year.

- Provided 13 cost share incentives (grant goal was 8) to regional wine and grape associations throughout the state to expand participation in CWM events and CWM and D2E Month promotional activities and to facilitate special print publications and broadcast coverage of sustainable wine tourism routes, experiences and events.
- Public relations program for the GGG program resulted in total media impressions of 1.3 billion during the grant period exceeding the grant goal of 100 million in media impressions.
- Additional consumer visibility and engagement for California wine sustainability was achieved through social media activity on Facebook (5000 fans), Twitter (2,084 followers) and Pinterest. No grant goal was established specifically for social media traffic or engagement.
- Generated 27.2 million impressions from media coverage in the first three months of publication of Wine Institute's new consumer-focused book, Down to Earth, A Seasonal Tour of California Sustainable Winegrowing released in April 2014. Wine Institute anticipates achieving the grant goal of generating 100 million media impressions within the first year of publication.
- Introduced a new expanded section on sustainable winegrowing and winemaking on Wine Institute's consumer website in April 2014. Reached 500 visits within first month and anticipate reaching goal of visitation by 800+ visits within the first year of launch.
- Implementing new online master class on California sustainable winegrowing for industry, trade, media and interested consumers by late August and anticipate reaching grant goal of 100+ trade and media taking class and earning certificate within the first year of launch.

Baseline data that has been gathered to date showing progress toward achieving set targets:

- Baseline data gathered through consumer research with the Natural Marketing Institute (NMI) on its 11th annual LOHAS Consumer Trends Database which quantified the size of the consumer base for environmentally responsible products and services included the following:
  - There is a strong correlation between consumers interested in sustainability factors related to wine and wine consumers;
  - More than half of the consumers concerned with environmental attributes consider sustainable practices when purchasing wine;
  - A majority identify wines grown and made with sustainable practices at the point of purchase, i.e. on the label, shelf or in store.
- Baseline data gathered in a phone and online research by PE International with buyers and sommeliers at 59 top retail, restaurant and hotel outlets to understand the importance of sustainable attributes in wine to the wine trade included the following:
  - Sustainability attributes were a factor for wine purchases across all trade segments.
  - The interest in sustainable attributes in wine are driven by customer requests, personal values and, to a lesser extent but more common among larger organizations, by organizational goals
  - Wines with sustainable attributes are identified by trade by winery marketing materials and testimonials, certifications and information on labels;
  - A majority believe that sustainable certification programs are helpful and favor a certification seal or logo on wine bottles.

Successful outcomes quantified:

1. The program provided 3000+ vintners, growers and regional association executives with direct access to information to enhance green marketing skills and reached thousands more with messaging through

communications around statewide celebrations, publicity and social media activity. 300 sustainably focused consumer events during the grant period engaged an estimated 9 thousand consumers.
2. The program generated 1.3 billion media impressions for program messages in print, broadcast and online media coverage during the project period through media events, publicity (news releases and pitching), interviews and special editorial projects. Estimated advertising equivalency of media impressions exceeds $10 million.
3. The program engaged 1000+ wine trade and media "gatekeepers" in direct participation in 10 tasting events and media receptions. Grew visits to expanded sustainability section on consumer website to 500 views following launch in April 2014. Goal of 100+ wine trade and media completing online sustainable ambassador course will be measured after grant period since the tool will be launched in 2015.

Beneficiaries

California's 4,600 winegrape growers and 4,100 (as of 2013) wineries were key beneficiaries of the project's accomplishments. Statewide associations including Wine Institute, the California Association of Winegrape Growers (CAWG) and the California Sustainable Winegrowing Alliance (CSWA) as well as the 59 regional grower and winery associations in the state whose membership is comprised of these growers and wineries benefited from the project http://www.wineinstitute.org/resources/external-links/regional-winery-grower-associations-of-california.

The potential economic impact of the projects accomplishments include California's 4,600 winegrape growers benefiting from an increase of 46% in the farmgate value of California winegrapes from $2.05 billion in 2010 to $3.2 billion in 2013 and California's 4,100 (as of 2013) wineries benefiting from an increase of 20% in the retail value of California wines in the U.S. from $18.5 billion in 2010 to $23.1 billion in 2013, the most recent year for which information is available.

Lessons Learned

Project staff were able to significantly exceed most performance outcomes of the grant so overall the project far exceeded expectations. Staff enhanced the effectiveness of the collaboration with regional associations by hosting webinars and calls several months in advance of statewide celebrations and other major activities which resulted in greater participation and receiving valuable input from project partners.

A positive outcome from the grant was greatly increased communications by regional winery and grower associations and individual wineries and growers about their sustainable practices. A key factor behind the introduction of the new Down to Earth Month statewide celebration was to encourage wineries to host events that highlighted sustainable practices and would engage consumers and communities in fun learning experiences. In addition, Sonoma County and Santa Barbara County, both made public commitments for their vineyards to be 100% sustainably certified within a certain number of years.

Grant deliverables for this project were extensive and ambitious and, as a result, final performance outcomes for several activities (book publicity, website section visits, completion and certificates generated by online sustainability course) were not available by conclusion of the grant. Lesson learned for future grants is to limit project deliverables and plan more realistic time frames, allowing for inevitable delays. Publication of the book in particular, involved many new lessons about planning for external deadlines and the amount of time required for such a project.

Additional Information

- California Wine Green Tour is an entertaining new video on California Sustainable Winegrwoing http://www.wineinstitute.org/resources/pressroom/04022013 launched in April 2013.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 34	**Project Title:** California Blueberry Commission International Market Survey	
Grant Recipient: California Blueberry Commission	**Grant Agreement No.:** SCB11034	**Date Submitted:** December 2013
Recipient Contact: Alexander Ott	**Telephone:** 559-221-1800	**Email:** aott@calblueberry.org

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

The newly formed California Blueberry Commission (CBC) needed access to timely market data and commercial intelligence to make effective marketing decisions. This project allowed the California blueberry industry to quickly discern where it could be competitive in international markets. In September 2010, the CBC held a strategic action plan meeting (SAP) with the blueberry industry. One of the main strategic goals conceived was for the CBC to develop new export markets for its members. Roughly 25% of California blueberries are expected to be exported. Since US blueberry production is expected to double within the next 3-5 years, new markets will be crucial to maintain sustainable pricing as US consumption is not expected to grow with the rate of production. Of the 19 blueberry packing sheds in California, roughly half will participate in the export programs. Although this may seem like a small percentage, the per dollar return to growers is significantly higher when blueberries are exported to specific countries.

A critical component and starting point of any successful marketing campaign is research of the market potential in the targeted countries. The grant allowed the CBC to evaluate certain international markets. Preliminary research by the CBC demonstrated that Japan, Australia, and England (U.K.) had high demand and market accessibility, and those three countries were targeted in this grant. The objectives of this project are to determine if the targeted countries are a plausible and a sustainable market for California blueberries. To do this, the CBC bought marketing data and conducted surveys among the targeted countries' major produce retailers which allowed the CA blueberry industry to focus on those retailers that demonstrate the best opportunity for CA blueberries.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

The CBC's main goal and objective was to determine if Japan, Australia, and U.K. were viable and sustainable export markets for California blueberries. Preliminary data obtained by the CBC indicated that these countries were plausible markets and offered high returns to the California growers. The grant was designed to provide more detailed and comprehensive data before the industry moved forward with additional funding. Once data of these countries was complied and analyzed, the California blueberry industry hoped to see several benchmarks over the next several years:

1) An increase in California blueberry shipments to target country compared to baseline;
2) Increased number of supply contracts with wholesalers/distributors/retailers in target countries;
3) Increased visibility of California-grown blueberries; and
4) Increased consumer awareness in target country.

The CBC hired two consultants to provide the necessary research and data for the targeted countries. In addition, the CBC staff visited each country and met with retailers and government officials to discuss California Blueberry imports.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

During the duration of the grant, the CBC met and completed all of the workplan objectives. The consultants provided an in depth report on the targeted countries and the CBC's Board decided that each country should be explored in more detail with CBC staff visiting each country to gather more data. After site visits, all information was presented to the Board and to the industry during California Blueberry Day where 90 blueberry industry leaders were present. The grant has accomplished all objectives with many of the objectives ongoing. All California exporters were given targeted countries information and important data. Also most major importers from targeted countries were provided California blueberry industry information including statistics and Handler contact information.

Full results of the research are provided as Attachment 1. Brief summaries of the results are:

<u>Japan</u>

- A growth opportunity remains due to very low per capita consumption.
- California has a potentially strong market position in the April-to-May period.

- A preliminary estimate for 500,000 pounds of potential sales of California berries during this period. California exports to Japan during this period in 2012 were estimated at approximately 284,000 pounds, suggesting room for an increase.
- Due to increased domestic demand, shipments to Japan in 2012 and 2013 were below grant estimates. After speaking with handlers to determine the cause, the CBC was told that demand from Japan was up or consistent with prior years but the domestic price limited international sales.
- In 2013, the CBC hired Yamano & Associates to help in Japan. Yamano & Associates will be responsible for disseminating California Blueberry information. This includes shipper/handler lists, educational and nutritional information. The CBC met its goal of getting 5 exporters into Japan. In 2011-2012, 9 handlers shipped to Japan and in 2012-2013, 8 handlers shipped to Japan. In Addition, Yamano & Associates was also tasked with tracking consumer awareness of California blueberries. Consumer and importer awareness of California blueberries in Japan was initially very low. With the use of the grant, importer awareness has grown as 7 major importers have been contacted and more will continue to be contacted by Yamano. Developing and improving consumer awareness will be an ongoing portion of this grant and will be conducted by the CBC and Yamano. Over the next several years, a larger consumer sample size will be available with the CBC intending to provide the blueberry industry with the findings.
- The CBC distributed materials to the 5 major exporters of California blueberries and to the major importers of Japan but with limited success. The materials were designed to provide Japanese importers with California Blueberry handler information. Although several of California handlers indicated that they received information requests from new buyers in Japan, which may have come from the information that was being distributed, most did not engage in new clients due to the domestic demand and domestic price.

<u>Australia</u>

- A growth opportunity exists: per capita consumption is only half that of the U.S. and Canada.
- California has a potentially strong market position in April-to-July period due to the low availability of domestic and southern hemisphere product.
- Preliminary estimates were for 1.6 million pounds of potential sales during this period if Australia opens its market to U.S. producers.
- During reverse trade mission, CBC staff met with BioSecurity Australia and the U.S. Embassy to discuss getting California/U.S. Blueberries access to the Australian market.
- Initially, it was thought that the CBC would be able to get blueberries into Australia before the completion of this grant. Unfortunately, due to phytosanitary restrictions in trade between the US and Australia this was not able to happen. California is not allowed to ship blueberries to Australia. The CBC was not able to accomplish the grant goals of 50k pounds annually, 5 targeted exporters, and increased consumer and importer awareness. All of these goals were in direct relation to being able to ship to Australia. Fortunately, the CBC learned valuable intelligence on why blueberries are not allowed to enter Australia. In addition, the CBC Board hired Bryant Christie Inc. to begin negotiations to gain entrance into Australia. The CBC

anticipates entrance into Australia will be agreed to by 2015. Original goals of this grant will continue once the market opens to US trade.

U.K.

- Blueberry consumption and demand is strong and there is a small market window opportunity for California.
- Market conditions will be initially difficult until U.K. retailers see firm commitment from California Blueberry Exporters.
- Processed/Frozen market demonstrates the most initial promise and fresh has potential as long as desired varieties are planted and strict European phytosanitary guidelines are adhered to.
- After preliminary discussions regarding the UK market, the CBC Board ultimately decided that spending additional resources in the UK market was not in the best interest of the California blueberry grower. The UK lacked significant market potential for fresh blueberries which is what California primarily deals in. The goals of this portion of the grant were obtained because California handlers were made aware of the market restrains in the UK. Additionally, the UK was given all California blueberry handlers information for future use. Increase in consumer awareness was not tested as the CBC did not want to explore the market further until more commitment is made from the UK importers.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

The CBC and its 78 growers and 19 packers benefited directly from this grant. The information obtained by this grant was distributed throughout the industry, and provided crucial market data that detailed why or why not the CBC should be involved in marketing campaigns within each targeted country. Although many of the handlers may have shipped to some of these countries before, many of the handlers did not know many of the major importers in each targeted country.

The grant provided the handlers with in-depth knowledge of the country and the importers within, and should allow for more blueberries to be exported to the targeted country. It also provided the handlers inside knowledge of what the consumers of each country desire. For example, the grant demonstrated that Japanese consumers are heavily reliant on products of convenience. One California handler has started developing a marketing apparatus that will specifically target this highly valued customer. The baseline knowledge of each country was relatively zero when including consumer preferences, historical pricing data, retailer contact info, and specific marker window opportunities. At the conclusion of the grant, all California blueberry handlers and growers were provided this information. Likewise, all California blueberry industry information was distributed to major importers of the targeted countries.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

A major development that came out of the grant is that the CBC began the process of trying to gain access to the Australian market shortly after the site visit. During the site visit, the CBC learned from BioSecurity Australia that certain pest and disease issues would be discussed and need to be rectified before access is granted. In order to expedite the access process, the CBC used that information to begin addressing those issues immediately.

This information obtained from this project demonstrated to be enormously useful as the CBC began aggressively going after Market Access Program (MAP) and Technical Assistance for Specialty Crops (TASC) funding provided by USDA/FAS. Based on the information obtained, the CBC applied for funding through FAS which specifically targeted the countries that were listed in this grant. The CBC has turned over the FAS application to the U.S. Highbush Council (USHBC, national blueberry organization) in hopes of receiving larger funding. Through the grant, the CBC realized the potential growth opportunities in two of the three export markets explored and would like to dedicate more resources to them. Unfortunately, the CBC felt that after further scrutiny U.K. has limited fresh blueberry potential. The conclusion of the survey was that fresh blueberries will be difficult to break into the U.K. market and if California was able to get fresh blueberries in the market maintaining a significant market share would be difficult due to local/domestic production. However, the research suggested that processed blueberries may demonstrate sustainable market potential if California was committed to send blueberries to this market. U.K. retailers suggested that California needed to make a long term commitment and continually supply the U.K. market with processed blueberries before any real discussion of fresh blueberries is initiated. Additionally, several large Caifornia blueberry shippers have demonstrated interest in exploring the U.K. market further due to the fact that they are already shipping other commodities there. Thus, they have instructed the CBC not to completely close the door on the U.K. market; however, more preliminary work needs to be done before more investment is made.

One unexpected setback was the project was scheduled for completion before the industry’s “California Blueberry Day,” which is a gathering of all blueberry growers, handlers, and other industry members to discuss the status of the California blueberry industry. The CBC felt that it would be beneficial to have one of the consultants that participated in the project research do a presentation on the results of the grant. The project schedule was extended to disseminate the information to the entire industry. It is recommended that annual industry meetings be taken into consideration when project timelines are developed to take advantage of the opportunities to disseminate project information.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

None.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 35	**Project Title:** California Leafy Greens Consumer Public Campaign in Canada	
Grant Recipient: California Leafy Green Product Handler	**Grant Agreement No.:** SB11035	**Date Submitted:** December 2013
Recipient Contact: April Ward	**Telephone:** (916) 441-1240	**Email:** april@caleafygreens.ca.gov

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

The project's initial purpose sought to raise consumer confidence in California leafy green quality and safety. Since the widely publicized E. coli outbreak in 2006, the industry has lost market share in Canada. Many Canadian consumers remain concerned about leafy green safety, associating California's leafy greens with inadequate food safety protections. Exports have recovered, but remain well below peak levels. According to Statistics Canada, California leafy greens exports to Canada dropped from 358 million kg in 2002 to 273.8 million kg in 2010. The project was developed to rebuild consumer confidence in California leafy greens' safety, educate consumers about the numerous health benefits, and demonstrate Leafy Green Marketing Agreement's (LGMA) commitment to the Canadian market.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

From October through December 2011, LGMA initiated a pre-campaign survey in Toronto, Montreal and Vancouver targeting at least 500 consumers. The contracted PR agency compiled survey data into a report for submission to LGMA. In January 2012, 1,527 Canadians were surveyed to determine the frequency of leafy greens consumption in Canada, and awareness of leafy green health benefits and food safety measures implemented by the industry. The survey indicated that a very small number of Canadians were aware of the safe leafy green farming practices relative to the number of Canadians aware of the E. coli outbreak and those that were concerned about leafy green safety.

In April 2012, a consumer media campaign was implemented emphasizing the safe handling practices and food safety in the fields – the first of three media outreach campaigns initiatives. Seeking to create a strong connection between consumers and the farmers who grow the food, media materials included a profile of a kale farmer information on the LGMA food safety program and two original recipes featuring leafy greens. Media kits included a food safety booklet, memory stick loaded with the recipes and LGMA marketing materials and a batch of kale chips prepared using kale shipped directly from the farm.

In mid-July 2012, the second consumer media campaign was launched focused on food safety in the home by sending media kits to Canadian food and lifestyle writers. The writers' media kit contents included a food safety-themed booklet with three original recipes featuring leafy greens, home food safety tips, color-coded cutting boards, a kitchen scrub brush, a food safety magnet and a memory stick loaded with recipes and materials from the LGMA presentation. Daily media scans were performed and media outreach conducted with follow up of Canadian print and online media to track coverage of the campaign. In addition, in April, July, September and late October 2012, e-newsletters were developed and distributed to the Canadian trade audience.

In April and May 2012, LGMA extended its online communication outreach in Canada by partnering with UrbanMoms, an online network of Canadian mommy bloggers, to target primary consumers. UrbanMoms conducted two recipe contests highlighting leafy greens with a LGMA themed gift basket giveaway (at no cost to the grant) for one reader and promoted leafy greens through blog posts about food safety. The UrbanMoms' publicity through Urbanmoms.ca and social media channels, such as Twitter, Facebook, etc., reached 310,000 target consumers.

In May 2012, three camera-ready stories (matte stories) and photos were distributed to community newsrooms across Canada. Articles, including two original LGMA recipes, focused on food safety at home. Through various pickups in Canadian publications, the stories reached 3,089,650 target consumers. In addition, during the week of June 18, 2012, Kevin Freeborn, LGMA's spokesperson and Canadian food safety expert, participated in television interviews discussing California leafy greens and LGMA's safety food program in Toronto and the Greater Toronto Area (GTA), and Freeborn bylined an article distributed to Canadian community newspapers and trade magazines. The combined audience for the spring and summer campaigns and spokesperson tour was 2,520,000 target consumers.

From June 4-7, 2012, influential Canadian food writers and bloggers attended a California leafy greens field and farming operations tour. The tour included two farms visits and a visit to a bagged salad processing plant. Resulting media coverage reached an audience of 2,749,612 target consumers.

In October 2012, LGMA conducted another online survey to measure post-campaign awareness, attitudes and purchase behaviors with respect to leafy greens. The post-campaign survey was conducted October 15-17, 2012 among a sample of 1,514 Canadians. Overall, pre and post-campaign survey results suggest little change was made between Canadians' purchasing habits as a result of the campaign. However, 97% of Canadians report purchasing leafy greens in both surveys, with an average purchase made once a week. These finds are extremely favorable to the California leafy greens industry.

Further, LGMA participated in the Canadian Produce Marketing Association Convention and Trade Show in April 2013, which helped contribute to a growth in exports of California leafy greens to Canada by increasing trade awareness and exposure to LGMA's comprehensive food safety program.

Note: This additional activity contributed to the purpose of the project as it generated more awareness among the trade of the availability of California leafy greens in Canada.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

The goals of this project were to increase the percentage of consumers aware of LGMA's food safety measures and record, increase exports of California leafy greens to Canada, and expand media coverage of the health benefits and safety of California leafy greens.

Unfortunately, due to a broad sample group used to gather survey information, LGMA found the results of its pre- and post-campaign research to be unreflective of the scope of its public relations efforts. Given the targeted and specific nature of its public relations and social media outreach, a narrower sample group for its consumer research survey would have yielded better results. Therefore, the survey results indicate that the project had little impact on consumer awareness of the health benefits or safety of California leafy greens. Regardless, survey results revealed 97% of Canadians reported purchasing leafy greens in both surveys, with an average purchase made once a week increasing from 62% to 65%. Additionally, over half of Canadians are concerned with the safety of fresh leafy greens with residents of British Columbia and Ontario more likely to have safety concerns than residents of Quebec (62% and 56% versus 48%, respectively). These figures remained unchanged pre and post-campaign. Lastly, awareness of implemented food safety measures pre and post-change increased from 10% to 11% post campaign.
However, export value in recent years suggests otherwise. Although LGMA plans to track the project's impact on exports through 2013, initial reports suggest that the value of California leafy green exports is increasing. In 2012, according to the USDA Global Agricultural Trade System (GATS), the value of leafy green exports to Canada rose to approximately $420 million, up from $364 million in 2006.

Media coverage and advertising value achieved as a result of this project exceeded LGMA's expectations. Advertising value through media coverage alone surpassed $100,000 each month, and, from May through September 2012, total media coverage reached 7,568,878 consumers. LGMA's e-newsletter campaign generated 94 unique visits and 146 page views, and the program's online partnership with UrbanMoms bloggers reached approximately 407,000 consumers. As a result of the media tour and resulting publicity of eight representatives from different Canadian media outlets participating, over 2.7 million consumers were reached.

Lastly, LGMA's participation in the Canadian Produce Marketing Association trade show and convention in Toronto, Canada in April 2013 resulted in the development of 30 contacts and trade leads, including one representative of the Canadian Food Inspection Agency. By exhibiting at this trade show, LGMA was able to distribute information on the industry's food safety program and further communicate its message in Canada, which could lead to an increased export volume and value to the market.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

LGMA's public relations consumer campaign directly benefited 104 California leafy green producers/handlers, which represent 99% of leafy greens shipped from California and 100% of all California leafy greens exported to Canada. Canada remains a major export market for California leafy greens. In 2002, California leafy greens exports to Canada exceeded 358 million kilograms. Yet, in the years following 2006's leafy green associated E. coli cases exports declined dramatically. In 2010, California exported only 27.3 million kilograms to Canada. A return to previous Canadian export levels would bring the industry roughly $105 million.

Overall, LGMA's food safety program and various trade outreach efforts, such as this campaign, have helped educate retail buyers and consumers in North America and encouraged greater leafy green consumption and expanded California shippers' trade. In fact, according to the USDA GATS, export value of California leafy greens rose to approximately $420 million in 2012, up from $363 million in 2006.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

The chosen survey methods and sample group illustrated few changes in Canadian purchasing habits. According to the survey results, Canadian consumers are no more or less concerned with leafy green safety pre-and post-campaign. However, the positive coverage and exposure achieved as a result of the public relations outreach, as well as the media tour in California, suggests that the campaign was effective in educating consumers (most notably by outreach to nutrition journalists and bloggers) about the safety and nutritional benefits of California leafy green consumption.

In the future, LGMA would recommend selecting a narrower sample group more reflective of the targeted consumer segment that is likely to be influenced by the social media tactics of a public relations campaign.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

None.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 36	**Project Title:** Solano Grown Marketing	
Grant Recipient: Solano County	**Grant Agreement No.:** SCB11036	**Date Submitted:** December 2014
Recipient Contact: Simone Hardy	**Telephone:** (707) 784-1475	**Email:** jshardy@solanocounty.com

Project Summary

Local growers are looking at ways to expand their sales both within Solano County and to the greater bay area. By increasing their "market" they hope to improve on farm income. Although there are over 116,000 cars that transverse the county between San Francisco and Sacramento each day, Solano growers had not been able to capitalize on their proximity to this market. In addition to vehicle traffic Solano County is also considered to be part of the bay area "Food Shed" but has seen limited benefit to its proximity. In 2009 Solano County received a grant to develop market branding for area growers. That grant funded logo development, a website for growers, promotional materials and provided educational opportunities on direct marketing. It also spurred the development of "Solano Grown" a grower marketing cooperative.

The objective of this grant project was to build on the success of the "Solano Grown" logo and branding effort, by developing an advertising campaign that promotes locally produced agricultural products and also reaches into the bay area.

To ensure grant funds were used solely for the promotion of specialty crop producers, all advertising was monitored by the project manager and focused on a specialty crop or crops. The project ensured marketing coincided with the seasonality for a specialty crop, and that locally grown specialty crops were featured within the body of any advertisement produced with this funding. Grower input was used to select the advertising message with the greatest potential benefit to the specialty crops featured in the advertisement, and marketing venues (including billboards) were selected to be in as close proximity to the specialty crop production area as possible.

Previous work was not funded through a Specialty Crop Block Grant Program.

Project Approach

Meet and develop project scope for Market Development Plan for Solano County Specialty Crop Growers. Contract for Market Development Plan. Market Development Plan is Completed.
A marketing plan was developed (Attachment 1). In the original grant submission the work was to be performed under contract to an outside party. It was found that the funds requested were inadequate to complete the scope of work envisioned. The marketing plan was reduced in scope and developed by utilizing the expertise of a graduate student.

Survey printed and mailed to Solano County Residents in the 5 cities. Baseline and Final Report.
The survey was mailed using a random selection address list requested from the County Tax Assessor's Office. The survey was sent to 105 residents in 2012 and again in 2014 (Attachment 2). The results were tallied before and after the advertising campaign. Survey returns, despite prepaid mailing, were low with only 37 surveys returned in 2012 or 35%, and 25 surveys in 2014 or 24 %. Survey results showed no changes over

the two year period in knowledge of the brand or availability of local produce. Unsolicited comments were received indicating that the signs, radio ads and direct mailings had in fact raised awareness. What appears to have been the difficulty was finding a method to quantify the effect of an all-inclusive advertising campaign designed to benefit a variety of growers. It is generally easier to see the effect on one specific commodity area. In trying to quantify the results, what was learned was that larger sample sizes, perhaps distributed in multiple manners would have been of more beneficial. If repeated for this purpose, surveys would be distributed at grower outlets, as well as online, and survey sizes would be increased.

Directing mailing to 22,000 residents.
Direct mailings were conducted to residents in five cities within Solano County (Attachment 3). Mailings highlighted specialty crops and producers and sought to drive traffic to local venues of distribution.

Farmers' markets were selected as one venue used in direct marketing. Certified Producer certificates, which are applied for and issued by the Solano County office, are required for participants. These certificates, in which an inspection is required to verify that the producer is growing the crop offered for sale, directly identifies the market and crops sold. Review of those certificates show that this is one of the prime means of direct sales to consumers of specialty crop produce for small producers.

The second selection was promotion of local farm stands for sale of specialty crops directly to consumers. Local farm stands have been visited by staff, and the crops offered for sale are specialty crops by definition. They include in season vegetables such as tomatoes, squash, corn, and seasonal fruits such as peaches and persimmons.

Billboard Placements, 8 placements
Billboards were found to be a very effective means of communication. Although funding was for only 6 placements, due to the generosity of the contracted companies some boards were donated and the time left in place were significantly lengthened, with one board being left up for over 6 months. All billboards featured specialty crops and specialty crop producers and were placed along the I-80 corridor with placements in Dixon, Vallejo, Vacaville and Fairfield, California. Producers and the general public independently reported seeing the signs and the messages (Attachment 4).

Purchase Advertising Space in "*Buy Fresh, Buy Local Bay Area Guide.*"
Unfortunately the guide was not published during the grant timeline. Advertising funds were diverted and used to purchase bus ads. Placement was selected for routes that included the Bay Area. These ads were used in 2012 and 2013, and several ads were still in place in 2014. This method of advertising was found to be a very economical means of reaching a large audience as the ads were not static (Attachment 5).

Radio Ads-10 flights which include a total of 20 to 28 spots per 2 week period during the growing season or 48 spots when the expected goal was 21.
The quantitative goal was exceeded for the number of spots due to a match of time provided by the radio station. A local station with coverage which extends into the Bay Area and Sacramento was selected. The station developed the scripts and commercials based on seasonal specialty produce or grower events. A "reporter" was developed for delivery of the scripts by the name of "Russell Sprout". Russell was an intentionally corny, somewhat clichéd character, designed to be remembered. The station, in addition to

providing a match, also provided an opportunity to participate in the station's public outreach program, which was utilized as a "Meet the Farmer" interview.

Newspaper Ads
Newspaper ads were placed in local additions, but costs for newspaper advertising was prohibitive for the number of placements desired. In order to stretch the funding, monthly magazines, specialty publications (summer additions or food related), and web-based advertising were used. The benefit found from switching to these publications was that it targeted a subset of consumers who were interested in local foods or local events (Attachment 6).

Funding was limited to advertising specialty crops and specialty crop producers. All advertising featured a specialty crop or crops and events that where advertised were for promotion of those crops (for example the Tomato Day Festival in Fairfield, California).

The Solano Grown Board of Directors was consulted monthly as the advertising was developed and on the marketing plan, Farm Bureau members participated by providing photos for advertising. Slow Foods Solano encouraged shared activities and promoted grower events.

Goals and Outcomes Achieved

The scope of work was identified for the marketing plan. When it was found to be over the allotted budget it was reduced in scale and completed.

The website analytics for 2012 from May 1, 2012 to October 1, 2012 (usual production season in this area) showed 438 distinct visits. The website analytics for 2013 from May 1, 2013 to October 1, 2013 showed 732 distinct visits.

Surveys were distributed to the residents in the 5 (five) Solano County cities in 2012 and 2014. 37 surveys were returned in 2012, and 25 surveys were returned in 2014. No distinct difference was found in the survey results on the key questions. The question: ***"Have you heard a commercial or seen advertisements for produce grown in Solano County"?***, resulted in 11 "yes" and 3 "no" answers out of 37 replies in 2012. In 2014, for the same question the response was 8 "yes" out and 1 "no" answers out of 25 replies. Additionally, the question: ***"Would you be interested in learning more about local agriculture in Solano County?***, resulted in 29 "yes" and 1 "no" answers out of 37 replies in 2012. In 2014 the response was 19 "yes" 2 "no" answers out of 25 replies. The question: ***"Have you heard of Solano Grown?"***, resulted in 13 "yes" answers out of 37 in 2012, and 7 "yes" answers out of 25 replies in 2014.

As discussed earlier a larger sample size would be used if repeated.

Activities to achieve these results included: researching and contacting various media outlets, reviewing bids, selecting media types, site selection for outdoor placement of billboards (high traffic visibility), contracting, developing ads and graphics for placements (in-kind match from the County for art work), developing an in-house photo library, reviewing and developing content with specialty crop growers, and approving design and receiving media approvals.

Media included 24,000 direct mailings, 8 billboard placements, 14 radio flights on Coast Radio with a total of 50 spots, ad placement in area magazines such as Edible East Bay (web and magazine), 7 X 7 San Francisco (summer edition), The Daily Republic, Sacramento Bee (web), Contra Costa Market Place Magazine, The Breeze, Rio Vista Beacon, and 8 bus ads.

The overall goal was an increase of 2% to 5% in income for specialty crop growers. Growers indicated sales increased overall from 2012 though many did not provide a percentage, and those who did gave 5%. The nexus between the advertising and the sales increase could not be directly established. Web analytics showed an increase in web traffic but the link equating that increase to the advertising activities was not established.

The work plan was followed, and 100% of listed activities and numerical goals were accomplished. The overall goal of increasing awareness and increasing sales could not be directly established with the measures employed. Anecdotal evidence and non-numeric measures, such as word of mouth, establishment and maintenance of small farms, speaking with area growers like the Farm Bureau, Slow Food Solano and Solano Grown, suggests that the campaign was successful, but better metrics were needed to capture that impact.

Survey results did not show a 20% increase in overall knowledge and in fact showed little to no change over the two and half year period.

Web site analytics did show an increase from 438 in 2012 to 732 in 2014, or a 67% change between the measurement periods.

Growers responding to the poll asking about the effects of the advertising on sales gave answers that showed that Bay Area clients held steady or increased from 20% to 40% over the measurement period. On the polling question, "I feel Solano Grown advertising for local products has benefited my sales by __________% in the last 2 years." The replies included question marks in the % area and the word "significantly".

Over 24,000 households were reached directly and encouraged to purchase specialty crop products locally. With an average of 116,000 commuters per day on I-80, 8 billboard placements minimally provided 928,000 potential viewers of the specialty crop advertising, and more likely many more based on placements that exceeded the 2 month average. Radio ads, according to station statistics, reached 225,000 weekly listeners and the station has a 50% market share within Solano County. Given 14 two week flights at least 3,150,000 potential specialty ads were heard. Bus ads have a broader geographic reach and have remained in place in some cases for 2 years. Magazine and web-based ads are dependent on circulation. Sacramento Bee web based images had a total of 75,549 impressions over a four month period; Edible East Bay distributes 50,000 to 70,000 print readers with 4 yearly publications contracted or 200,000 readers; 7X7 magazine based in San Francisco has a circulation of 50,000 (one ad publication).

Beneficiaries

Members of the Solano Grown Association (180), auxiliary members of the Solano Grown organization known as locavores (100 members), the 3000 third graders who attended the Solano County Youth Ag Day who were exposed to specialty crops grown in Solano County, and the community at large, benefited from greater exposure to locally grown specialty crops. Solano growers benefited from in season promotion of their specialty crops.

280 growers of specialty crop products are the beneficiaries of the extensive promotion effort funded by this initiative.

Solano Grown is comprised of small and mid-sized growers, predominately producing specialty crops and directly marketing those crops. Time is a very valuable commodity for these growers—time away from the farm or marketing activities equates directly to a loss of income or reduction in production. The human resources needed to produce a basic marketing plan were not available. The marketing plan which was developed using other successful models for local marketing organizations gives Solano Grown a starting pathway to proceed along to successfully market local specialty crop producers.

Lessons Learned

Leverage was provided by Public Service Announcements and non-profit status. Media outlets were generous due to the public benefit aspect of the campaign, providing matches in time and services.

Use of the Solano Grown board to craft the message, provided an in-house focus group for contacting choices that were selected by producers for producers.

Additionally in-kind match for outwork, layout, etc. were contributed by County professionals.

Good faith in the brand has been achieved, and there is recognition by local policy makers who have pledged their future support to continue the promotion of local specialty crop agriculture.

Goals for this grant were achieved; the work was performed and contracted. Better response in the surveys would be needed to adequately evaluate the performance measures. Either larger sample sizes or better participation by respondents appears necessary.

Additional Information

Attachment 1: Survey Response
Attachment 2: Example of Post Cards Mailed
Attachment 3: Example of Bus Ad

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

<table>
<tr><td>USDA Project No.:
37</td><td colspan="2">Project Title:
Specialty Crop Market Enhancement and Promotion, Buy Fresh Buy Local, North Valley</td></tr>
<tr><td>Grant Recipient:
Northern California Regional Land Trust</td><td>Grant Agreement No.:
SCB11037</td><td>Date Submitted:
December 2014</td></tr>
<tr><td>Recipient Contact:
Noelle Ferdon</td><td>Telephone:
(530) 894-7738</td><td>Email:
noelle@landconservation.org</td></tr>
</table>

Project Summary

At the outset of this project there were few resources available to farmers and ranchers in the area of marketing and promotion for locally grown specialty crops. The University of California Cooperative Extension offices provide technical assistance in agricultural best practices focusing primarily on the production-side of food, including on-farm techniques and research projects while agricultural commissioner's offices tend to focus on product safety, standards, and implementation of regulatory programs. In Butte, Glenn and Tehama counties, the region targeted by this project, there were 3,800 farms at the time of the 2007 census with annual sales of less than $100,000. These farms tend to be the scale of operation most likely to increase profitability from expansion of local food markets and increased visibility for locally grown food. The entire population of the Tri-county region targeted by this project is less than 250,000 people so the area is very rural in nature. However, at the time of the project's launch it was becoming increasingly evident that the consumer demand for and interest in locally produced food was growing. The purpose of the project was to expand Buy Fresh Buy Local, North Valley (BFBLNV) to provide marketing opportunities connecting specialty croppers to consumers in ways that increase profitability and build stronger, more secure local economies. The project also sought to understand the problem of access to local markets in greater detail through surveys of growers and consumers, and to begin implementing solutions that help to enhance specialty crop competitiveness through the use of BFBLNV marketing materials.

Project Approach

Summary of activities and tasks performed during the entire grant period:

- The project coordinator presented the local food baseline and capacity research as well as about BFBLNV generally at countless events and venues including Butte County Economic Development Corp's *Ag Speed Dating* event (co-sponsored by BFBLNV), the Butte County Department of Public Health's *Local Food Summit*, Northstate Public Radio's *In a Northstate Garden* and *The State of the Northstate Foodshed*, two different CSU, Chico This Way to Sustainability Conferences, Chabin Concepts, 3CORE Economic Development Corp and Glenn City/County Economic Development Committee, the International Food Studies conference and CSU, Chico's Pop Up Anthropology Museum's *The Farmer & The Chef*, a presentation to BFBLNV members and over 140 consumers at the Local Food Guide Kick-off Party, to name a shortened list.
- Designed, published and distributed 15,000 Local Food Guides;
- Tabled at and distributed Local Food Guides (LFG) at farmers' markets in Butte, Glenn and Tehama counties, the California Nut Festival, Taste of Chico, to name a few events.
- The LFG was also distributed to local high schools as part of a CSU Chico Center for Nutrition and Activity Promotion research project *Nourish*, aimed at teaching students about the seasonality of fresh fruits and vegetables and the impact food choices have on personal and environmental health. The guide

was also distributed at Buy Fresh Buy Local, North Valley (BFBLNV) membership booths at the local farmers markets, the county farm bureau offices and the county resource conservation district offices.
- Two consumer workshops held.
- Two grower workshops held.
- Applied results of the capacity research to help develop the North Valley Food Hub online, a tool for increasing consumption and distribution of locally grown specialty crops and other local foods in the region.
- Distributed BFBLNV t-shirts, BFBLNV stickers, signage for business and additional marketing materials for outreach and promotion.
- Participated in Butte County's annual Farm City Celebration restaurant program coordinating use of the logo and table tents on menus and in restaurants to promote local specialty crops
- Assisted with coordinating and facilitating a grower focus group with BFBLNV members to instruct an on-farm cold-storage prototyping project underway between 3CORE Economic Development and CSU, Chico's College of Engineering, Computer Science and Construction Management.

Favorable or unusual developments include the online and grower surveys being utilized to instruct the development of markets for an emerging online food hub, the long-lasting community based partnerships with the agricultural, nutrition, academic and economic development communities as a result of the BFBLNV network forming and the region's first organized local food systems network formed.

Project Activity:	**Results, Accomplishments & Conclusions:**	**Recommendations:**
Conduct Online consumer survey using SurveyMonkey to accurately evaluate consumption of local foods	Consumer survey conducted through Survey Monkey with 263 final responses.	It is very hard to get an accurate account of local food consumption. Consumers have very different definitions of local and reaching consumers through surveys takes extensive time and resources that were not included in the proposed budget. Categories of food are also hard to isolate.
Conduct outreach to regional specialty croppers to solicit participation in BFBLNV program	Extensive outreach was conducted to the specialty crop community including more than 30 presentations in 2.5 years, mailings to grower lists, social media promotion and support from community partners and collaborators.	Outreach as a tool to solicit participation was an essential part of this grant and proved to be very effective at reaching the desired audience.
Conduct two (2) grower-centered direct marketing workshops targeting specialty croppers in the North Valley and provide relevant marketing materials	Two workshops held titled "Building and Sustaining Profitability for North State Farmers" and "Business Planning Workshop" with Northern California Farm Credit to teach specialty crop producers	The workshops were well attended and the project coordinator would recommend doing this type of activity again to support specialty crop promotion and enhancement. The workshops were very well received by attendees.

	skills for becoming financially ready to work with various financial lenders and institutions. BFBLNV materials were distributed along with other general materials on business development and marketing.	
Conduct two (2) consumer-centered workshops targeting North Valley residents	A consumer-oriented workshop was held in March 2014 to help increase visibility for the Local Food Guide and to increase general consumer awareness about local food in the region. Another Consumer workshop was held in May 2013 at the Kick-off Party for the 2nd edition of the North Valley's Local Food Guide.	These consumer workshops were very well attended and the project coordinator would recommend doing this type of activity again to support specialty crop promotion and enhancement. The workshops were very well received by attendees.
Conduct design and content development for the 2012-13 North Valley Local Food Guide with stakeholders	The Local Food Guide (LFG) was designed and developed with the support of more than 10 contributing writers and editors.	The LFG was also an essential and effective tool for promoting BFBLNV and the project coordinator would recommend support the production of future LFGs to enhance the competitiveness of specialty crop producers.
Publish and distribute 15,000 2012-13 North Valley Local Food Guides throughout tri-county region	15,000 guides were published and distributed.	Distribution of the guides was challenging without resources or additional staff time to do so. A recommendation would be to partner with organizations like school districts, health care partners, etc that can help disseminate the publication.
Continue distributing general BFBLNV merchandise to new members	BFBLNV stickers, T-shirts, flyers, LFGs and signs were distributed at countless events, businesses and organizations throughout the project time period.	The materials were an effective medium for outreach as evidenced by the countless number of cars around the region displaying the BFBLNV sticker.
Update online Buy Fresh Buy Local database (www.buylocalca.org) to reflect new farm, retail, and restaurant business partner profiles	The buylocalca.org database managed by Community Alliance for Family Farmers is no longer active. A Local Foodshed Map was developed collaboratively with CSU,	There are a number of online search engines available for finding local food. The more regional specific sites and publications proved more effective for this area.

	Chico, which now lists all of the members.	
Maintain and grow BFBLNV Facebook Book page	Started the Facebook page at the beginning of the grant and currently has 403 "likes."	Facebook is a great tool for supporting members. BFBLNV staff "liked" all member pages and regularly "like" and "share" their posts. This activity will continue after completion of the SCBG support.
Evaluate online survey data, and make recommendations	See section on Goals and Outcomes Achieved	See section on Goals and Outcomes Achieved

Some favorable and unusual results include:

- The informal survey conducted by the project coordinator inspired a research team led by an Agricultural Economist (AE) to conduct a more comprehensive and formal growers' survey of 200 growers in the region evaluating barriers to expanding local food markets;
- The organized grower and buyer network in BFBLNV helped to provide important knowledge for the development of the North Valley Food Hub online;
- The development of the "baseline" at the end of year 1 inspired the Estimating Capacity for Local Food Consumption research done by the project coordinator in collaboration with the AE from CSU, Chico's College of Agriculture;
- Unexpected invitations to participate as a key sector leader in the economic development community representing local food systems.

The project director worked with lists provided by the county departments of agriculture to conduct outreach specifically to specialty crop producers about the project, the Eater's Guide to Local Food (the primary program promotion tool) includes a North Valley seasonality chart that lists solely qualified specialty crops, and all specialty crop grower members of BFBLNV sign a standardized certification from with their application that indicates the types of specialty crop(s) that they produce. Other funds were used for any efforts, including outreach, administrative tasks or research, conducted by NCRLT's Local Food Systems program that potentially benefitted non-specialty crops.

All BFBLNV members completed a membership application and the program utilizes different membership applications for specialty crop producers and non-specialty crop producers. The program has conducted an "informal" audit of its membership applications to ensure that all specialty crop members have signed the standardized certification form indicating the types of specialty crops that they grow and/or purchase for sale (ie: restaurants, grocers, etc).

A CSU, Chico Nutrition Sciences professor, assisted by promoting the consumer survey on behalf of this project summary analyses of the findings.

3CORE Economic Development Corporation (EDC) provided support as a partner for the project by inviting the BFBLNV membership to participate in projects like the CSU, Chico's College of Engineering, Computer Science and Construction Management cold-storage prototyping project to help understand how to resolve barriers like limited access to cold-storage for the region's small and medium-sized specialty crop producers. 3CORE EDC also provide business development, marketing and technical assistance to specialty crop producers when referred to them by the project director.

The AE from the CSU, Chico College of Agriculture, was a substantial partner in this project and assisted with research for the local food capacity baseline. In partnership with the AE, the project coordinator used this research to help instruct next steps for implementing solutions for growing local food economies for specialty crops. The informal survey conducted by the project coordinator inspired a research team led by the AE to conduct a more comprehensive and formal growers' survey of 200 growers in the region evaluating barriers to expanding local food markets.

Goals and Outcomes Achieved

Activities:	Performance Indicator:	Measurable Outcomes:
1. Created online consumer survey using SurveyMonkey to accurately evaluate consumption of local foods.	Professional and meaningful consumer survey created	Survey was administered at the beginning of years 1&2.
2. Conducted and promoted the consumer survey in collaboration with a local economic development agency and other community partners. The survey was conducted online and was shared with local farm bureaus, farmers' markets, CA Women in Agriculture, the BFBLNV network and Facebook.	Data gathered on per capita consumption of locally grown specialty crops, ability to identify BFBLNV logo in the region, change in buying habits, website hits on Facebook page, and estimated dollar amounts spent choosing local farm products	263 survey responses gathered addressing all of the points identified in the Performance Indicator list and revealed results specific to these questions.
3. Data management - The Project Manager established updated record keeping files to manage data and communications including a member email list, membership spreadsheets and development and distribution of materials promoting BFBLNV. The grantee organization, Northern California Regional Land Trust (NCRLT), automatically backs up all computers and stores a back up drive off site to ensure data is always protected.	Develop detailed data entry sheets; timely entry of data into computer; regular backup of data	Completed data sheets with all project data backed up within NCRLT's procedures.
4. Data evaluation – The consumer and grower surveys were developed with the consultation of three academic professionals through CSU, Chico with experience in statistical analysis.	Perform periodic analyses to evaluate data trends; consult with statistician as necessary	Data was analyzed by statisticians and input provided on data trends.

5. Adaptive project management – Results at the end of year one indicated that key limitation for growers and buyers wanting to participate in local food systems revolved about the lack of infrastructure. As a result, efforts were made to begin address and exploring solutions to this including work on developing an online food hub and a project with CSU, Chico's College of Engineering working to developing a mobile cold-storage unit for specialty crop producers.	Based on survey results, consumer needs are identified and new baseline targets for increasing local food consumption are determined	Online food hub developed and a prototype mobile cold-storage unit was built.
6. Project reporting – Progress reports were submitted in a timely manner throughout the project. Countless presentations were conducted during the process to producer groups, consumers, at conferences, board meetings and other community based and industry consultants and organizations.	Communicate with producers, consumers, industry and researchers about project and results obtained	Stakeholder investment and collaboration increased and formal advisory committees resulted to instruct aspects of the project.

The project coordinator completed final deliveries of the 2nd edition of the Local Food Guide including deliveries to all BFBLNV members, nutrition agencies, libraries, farmers' markets, farm bureaus and other events. Results from the second year grower survey, consumer survey and buyer interview tool utilized to assess and evaluate any perceived change in behavior or perceptions after 2.5 years of utilizing the BFBLNV marketing materials in the region. The project coordinator consulted with statisticians for help analyzing and comparing the final results with the results generated at the end of year one. Based on the work conducted during this grant time period, the final report recommends proposed solutions to local food system barriers including a food hub (and other infrastructure). The project coordinator distributed ten branded BFBLNV point-of-sale cards to members along with the membership renewal letter. Membership renewals to date are 25 and renewals continue to arrive daily.

Original Baseline Reported
The local food baseline was based on a survey of 49 growers, 120 consumers and select conversations with buyers, in addition to the "Estimating Capacity" research that was conducted in collaboration with the AE. The baseline data is listed again below:

Baseline:
The baseline has four components aimed at evaluating local food consumption: 1) Estimating growing capacity and consumption for local specialty crops in Butte, Glenn and Tehama counties; 2) A Grower's Survey; 3) A Consumer Survey; and 4) Analysis of various market channels and their sales of local specialty crops.

1) Estimating Capacity
In collaboration with the AE, the Project Manager conducted research that resulted in an estimate of the capacity of Butte, Glenn and Tehama counties to meet local consumption needs given existing specialty crop production patterns.

Determining local food capacity requires obtaining comparable measures of local production and local consumption. The value of local specialty crop production in Butte, Glenn, and Tehama counties is tracked and recorded by major food categories in the USDA Census of Agriculture, but a comparable value for consumption in the area does not exist. To overcome this challenge, staff adapted an approach presented in Timmons, et. al. (2008) that uses trade-adjusted national production by major USDA food category (e.g., milk and other dairy, poultry and eggs) to estimate consumption per person on a national basis. Timmons, et. al. argue that food remaining after adjusting USDA food production for imports and exports must be consumed or wasted domestically, and represents an estimate of national consumption.

To generate estimates for 2007 local food capacity in Butte, Glenn, and Tehama counties, staff used 2007 USDA Census of Agriculture data to update Timmons, et. al.'s estimates for national consumption per person and generated local per person production estimates for each county. The estimates represent an estimated maximum percentage of local food consumption that could be met by local production (food categories in which local production exceeds local consumption needs are capped at 100%), and can be represented as

$$\% \text{ maximum local food} = \frac{\text{per capita food value produced and useable locally}}{\text{U.S. per capita food production (consumption)}}.$$

As discussed by Timmons, et. al., it is important to note that maximum local food percentages computed using this method rely on incomplete data, assumptions about consumption behavior, and aggregation of production and consumption into coarsely defined categories, but are likely the most reliable indicator available of local food capacity. The estimates are computed taking current land use and agriculture production patterns as given; if land use and production were adjusted to more closely match local consumption needs, the achievable maximum local food percentage would increase, so the method approximates a lower bound on local food capacity.

The overall estimates of local food capacity for Butte, Glenn, and Tehama counties are 39%, 87%, and 60%, respectively. The differences between the estimates reflect the combined effects of differences in county populations, agricultural production distribution, and land use patterns. All three estimates are well above the highest estimates of actual local food consumption anywhere in the United States, and therefore indicate that there is significant room for growth in local food consumption in all three counties. The full results of this study, available upon request to the Project Manager, allow more detailed analysis of how each major category of consumption could be met using local production.

2) Growers' Survey

The second piece of the local food baseline is the growers' survey that staff conducted to assess to what extent growers were specifically targeting the North Valley region for sale and distribution of local specialty crops. Grower surveys were conducted to gain perspective directly from the grower community regarding the potential market for local food distribution. Specifically, staff wanted to identify the market needs, barriers and opportunities that growers face when attempting to sell their products back into the North Valley. Growers were invited to respond to the survey through a variety of networks including farmers' market vendor lists, non-profits, partner Facebook pages, farm bureaus, agricultural commissioner's offices, a

Beginning Farmer and Rancher email list and outreach directly to growers at farmers' markets. There were 50 local growers that responded to the survey. The survey results revealed that most, if not all, pursue multiple avenues to sell their products with the most commonly desired sales channel being restaurants (63%), followed by farmer's markets (50%) and online sales (41%). Seventy-seven percent said they currently sell through farmers' markets, 46% through retail, 40% market online, 40% currently sell to restaurants, 38% sell wholesale and 27% sell through a Community Supported Agriculture (CSA) program. Other highlights from the survey include that 79% of the growers who responded indicated that they would raise more crops if they had a market for them. This response indicates that the majority of these growers are not currently producing and/or selling to full capacity, indicating an opportunity to increase returns to growers if they could access additional markets, and more than one-half of the growers stated that economies of scale limit their ability to pursue mainstream or conventional markets because they do not produce enough to meet the minimum quantity buyers require. (Survey and/or full summary available upon request.)

3) Consumer Survey
The third component of the local food baseline is a consumer survey. The survey was designed and conducted in collaboration an Assistant Professor (AP) of Food Science in CSU, Chico's Department of Nutrition and Food Sciences. The survey was distributed via multiple Facebook pages and was sent to a number of email lists including California Women in Agriculture, BFBLNV members, the CSU, Chico Department of Nutrition, the Chico Natural Foods Cooperative and others. The survey was also administered at farmers' markets throughout the North Valley including markets in Chico, Paradise, Oroville, Orland, Willows and Red Bluff.

Included are some initial observations from the survey data generated so far. The primary reasons for purchasing local food are, first, better quality and nutrition, and second, to support local farmers and the economy. Issues of environmentalism and sustainability are important to people, but not as important as the perception of better quality and nutrition. Further research may be conducted to understand what these local foods "replace", e.g., eat local carrots rather than potato chips. As for what respondents most agree or disagree with, most agree that local food tastes better and is more nutritious, plus have environmental benefits. Also, many say they are more likely to try new foods when shopping for local food, which has potential nutritional benefits, according to the AP who provided this initial analysis. As for shopping, the farmers' market and the local specialty stores seems to be where people most expect to find local food.

4) Market Channels
The fourth component is a look at various market channels and the corresponding sales of local specialty crops. Data was gathered in three areas: distribution, institution and retail.

Distribution:
Reports provided by ProPacific Fresh Distribution Company for fiscal year September (8/26/12 thru 9/29/12) showed an average of 387 units (cases) and $2,118.50 per week in BFBLNV sales. Those numbers equate to about .1% of the overall sales for the company. ProPacific Fresh joined the BFBLNV program in July 2012 and the Project Director is working closely with the marketing team to expand BFBLNV marketing efforts of local specialty crops with the goal of doubling or tripling that number in a few months. ProPacific Fresh will continue to provide this data over the next year so staff can continue to gauge the impact on sales of local food.

Institution:
The Center for Nutrition and Activity Promotion (CNAP) works throughout a multi-county region in Northern California to promote healthy eating and active lifestyles for school-aged children and their families. Their flagship program is the Harvest of the Month, nutrition education program, which purchases approximately $40,000 of produce per year to help teach children about fresh fruits and vegetables through the school system. During the 2011-12 school year, spending for Harvest of the Month was 80% local, meaning that about half of what they spent in a year on food for their various programs was considered local. The Harvest of the Month program considers local to be produce from the immediate region or secondarily Northern California. Total expenditures for local food for the 2011-12 school year equaled $24,612. CNAP will continue to share this data so staff can gauge the changes in local food sales.

Retail:
Chico Natural Foods Cooperative (CNFC), an independent member-owned retail grocery store, provided data to show their sales of locally grown products over a one year period. The store sold $316,782 worth of produce between January 2011 and September 2011, of which $75,486, or 23.83%, was from local sources. CNFC is a BFBLNV member, continues to use the marketing materials throughout the store, and will continue to share sales data with us so staff can gauge the changes in local food sales.

Year Two Survey Results

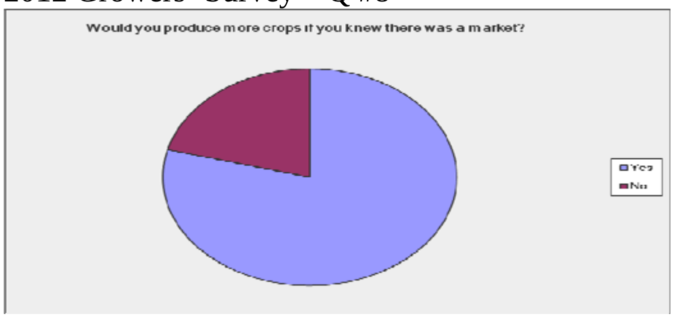
1) 2014 Growers' Survey Data
A randomized survey of 200 growers was conducted toward the end of the project term and included several questions that were similar to the original grower survey. This enabled the project coordinator to estimate change in behavior or perceptions potentially correlated with the growth and implementation of the BFBLNV program. While some of the survey respondents may have taken both surveys, it is likely that most of the respondents were different. The pool of respondents was also much higher in the second survey at 200, while the first survey had 49 respondents. Below are just a couple examples of the results from the survey in year 2 of the project as compared to the results generated in year 1.

In the first grower survey 53% (25 growers) said "yes" and 38% (15 growers) said "maybe" to utilizing product aggregation as a method for meeting scale requirements that allow growers to expand into new, local markets. In the second survey, 25% (25 growers) said "yes" they are interested in combining products for big volume growers. The result is that growers are consistently interested in finding ways to increase market access, including utilizing local marketing programs like BFBLNV to help co-brand their products and facilitate those increased transactions

2012 Growers' Survey – Q #9

Growers were also asked in the first survey whether they would produce more crops if they knew there was a market for them and 79% of growers said "yes" they would produce more crops. Similarly, in the second year survey growers were asked whether they were utilizing all of their possible land area to produce crops and 20% said that they were not using all of their possible land area, with the main reasons why being costs of production (compared to expected revenues) and access to financing for expansion. However, the data also suggests that people would use their land area to produce more food if they had a market, and the high number of respondents to the food hub question suggests that people would grow more to support local markets.

2012 Growers' Survey – Q #8



Based on both the original grower survey results and the year 2 survey results, the project coordinator recommends as possible solutions to increasing market opportunities for growing local food systems continuing to utilize the BFBLNV marketing materials to help growers co-brand their products as "locally grown"; continuing to support the development of a food hub (and other infrastructure) necessary to help distribute locally grown food and finally, to continue providing educational opportunities/workshops that help growers overcome barriers to accessing local food markets.

2) Final Consumer Survey Data
An online survey targeting consumers was developed and launched at the beginning of project year 1 to assess people's perceptions of local food as well as their purchasing habits. The survey was closed at the end of year 1 and the results reported at that time. The survey was then reopened in the middle of year 2 in order to gather more data to assess changes in people's perceptions and behaviors after increased use of the BFBLNV marketing materials in the marketplace.

In the year 2 survey, almost 50% of respondents said they purchase local fruits and vegetables once a week, which is about the same as the results from the first survey. In the year 1 survey, 39% said they spend more than $30 a week on local food and the results were nearly the same in the year 2 survey with more than double the respondents. When asked whether they recognize the BFBLNV logo 58% said "yes" up from 54% in the year 1 survey. When asked where they most recognize seeing the logo 29% said in restaurants, up from just 19% from the year 1 survey. The BFBLNV restaurant membership more than doubled after year 1 of the project indicating that the increased use of the marketing materials is effectively increasing consumer awareness of local food in the marketplace.

Survey Conclusion
The conclusion from reviewing the grower and consumer survey data is that the BFBLNV project played a substantial role in increasing buyer awareness of local food, helped to drive consumer demand and interest in local food, and that growers are more than willing to participate in local food markets with the right support and resources. The recommendation is to continue using BFBLNV marketing materials to promote local food and also to increase the attention placed on infrastructure (food hub, distribution, cold-storage, etc) and markets to begin actually making these local food transactions happen.

Successful outcomes of the project include:

- Published and distributed 15,000 copies of the North Valley Eater's Guide, 2nd Edition.
- Coalesced a network of approximately 100 local producers and local food buyers around promoting and enhancing California's specialty crops;
- Conducted a survey of 49 growers in the region to gain knowledge of their needs and how to shape the project to address those specific needs;
- Conducted a survey of 263 consumers to gain knowledge of their purchasing habits and interest in supporting local producers and locally grown specialty crops;
- Presented more than 30 times to audiences throughout Butte, Glenn and Tehama counties about BFBLNV to increase awareness about the diversity of specialty crops grown in the region and where to purchase those products.

Beneficiaries

This project was designed to enhance the competitiveness of specialty croppers through marketing support and outreach. The specialty crop growers have more outlets for sales in large part because of the visibility that the marketing materials provided and also as a result of the visibility created through the Local Food Guide. The local food business members are also more easily able to identify locally grown foods, allowing for increased access and consumption from consumers.

By increasing the membership in the BFBLNV network and consumer awareness of local food, specialty crop growers benefited from:

1) Increased income for specialty croppers from new local food sales
2) Increased income for specialty croppers from higher prices in local markets
3) Increased income for local businesses that sell local specialty crop products because of increasing numbers of customers and higher willingness to pay

These direct economic impacts are difficult to measure because of the proprietary nature of farm income data and a lack of local/regional data sources suitable to provide evidence of overall increases in local specialty crop economy. Efforts to improve data collection to measure local food economy and impacts have begun at the national level. Informal feedback from new and existing BFBLNV members indicates that their business' profit has increased as a result of marketing their BFBLNV membership and overall increases in consumer interest in local food. In addition to direct impacts, indirect (secondary) economic impacts are generated as new/increased income is spent in the local/regional economy. These impacts are typically measured using a "multiplier" that translates the direct economic impacts into additional indirect impacts. There is no established multiplier for local food economy, but some estimates have indicated a multiplier of between 2 and 4, meaning that a $1 direct impact from new local food economy could generate an additional $1-$3 of indirect impacts.

Lessons Learned

It is actually hard to quantify or even explain the incredible impact that development and expansion of BFBLNV has had on enhancing the competitiveness of specialty crops as well as creating more visibility for this region's small and medium-sized direct market and intermediated market producers. At the outset of this project, surprisingly, this region was not having widespread conversations about the potential benefits of growing a more localized food system. At the end of the project term, it feels like it is part of the mainstream throughout the region. Restaurants and farmers' markets throughout the counties have the BFBLNV logos plastered around to excite consumers about their support for locally produced specialty crops. This was a very well received project that resulted in a well-organized local food grower and buyer network, as well as a dedicated and motivated stakeholder group within the community poised to keep moving forward to increase the competitiveness of specialty crops in the region and in turn create more profitable farms and businesses.

There aren't really any unexpected outcomes or results that had a consequence on the implementation of this project. One thing that did come up for the project is that it was unexpected that it would take extensive time, resources, and funds to reach consumers through surveys, or that consumers would have very different definitions of "local." Regardless, the project was still able to get 263 responses on the consumer survey.

Additional Information

- http://landconservation.org/local-food-systems/?cdg-s=6 - Food guide link (also attached)
- http://Northvalleyfoodhub.com

Grower Centered Workshop

Consumer Centered Workshop

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 38	**Project Title:** Specialty Commodities Promotion in Disadvantaged Communities	
Grant Recipient: National Hmong American Farmers	**Grant Agreement No.:** SCB11038	**Date Submitted:** December 2014
Recipient Contact: Chukou Thao	**Telephone:** 559-313-3339	**Email:** Cxthao05@gmail.com

Project Summary

Fresno County produces many of the specialty crop fruits and vegetables consumed in the United States, but it is also one of the poorest areas of the country. There are high rates of malnutrition, obesity and diabetes with many of the socially disadvantaged residents having little access to the fresh fruit and vegetables themselves. Even though Fresno Unified School District (FUSD) recently spent $25 million building a central kitchen for the schools so that children may eat healthier, no connection between local growers and children's plates was established. This project was designed to improve the health of communities through promotion of healthy eating habits by: 1. supplying school meal programs with locally grown fresh specialty crops 2. developing school farm stands to offer healthy choices at prices below market value while educating students and teachers, and 3. establishing mobile vending to visit disadvantaged communities to sell specialty crops.

Constraints were established so that this project solely benefited specialty crops. Each specialty crop producer was required to complete an application to verify that their product classification code is consistent with eligible specialty crops as defined by the U.S. Department of Agriculture. The Director reviewed and verified each application prior to participation in this project.

The classroom education program taught students the importance of healthy eating habits and impacted not only the 240 target students, but their families as well. The mobile vendor reached into disadvantaged communities and impacted over 25,000 residents who normally would have no access to fresh, locally grown specialty crop products. Lastly, this project helped change the eating habits in the targeted communities to ones that promoted healthy choices through fresh specialty crops.

Project Approach

The National Hmong American Farmers (NHAF) hosted four Advisory Committee meetings in January 2012, March 2012, December 2012, and March 2013. The meetings focused on project activities for the specialty crop grant as well as developing a strategic plan to pursue wholesale, direct sale and farmers markets for project participants. The committee members were to provide constructive feedback to the Director as well as recommend partners, vendors, speakers, and quantitative methods of record outcomes.

The NHAF hosted two listening sessions. These Listening Sessions took place March 22, 2012 and March 27, 2013 during the NHAF's annual conference, held at the Ramada Inn in Fresno, California. The target audience consisted of small limited resource farmers from diverse and economic backgrounds, including Hmong, African American, Latino and Caucasian farmers, as well as non farmers. Many of the audience grow and consume some or most of the specialty crops identified under the specialty crop definition. Others who were in attendance were representatives from the USDA office of Risk Management Agency, Rural Development, Farm Service Agency, Natural Resource and Conservation Service and members from the USDA Office of Civil Rights. During these listening sessions, panelists presented on the health advantages of adding various specialty crops to the diets of children and adults. This discussion included an overview of this specialty crop project as well as accessing healthy foods, improving health and reducing chronic disease, and its relationship to eating specialty crops. The listening sessions both had approximately 200-300 people in attendance.

NHAF administered over 1,000 healthy eating habits surveys to community residents, teachers and students at 7 Fresno Unified Schools during the 12 classroom presentations.
The NHAF also conducted two surveys and the findings are listed below: Pre-survey was conducted at the NHAF Conference with members of the FUSD staff and students during the school presentations:

- Less than 50 % of household converse about eating healthy and childhood health
- Less than 50% of household were concerned about not eating healthy
- Less the 50% of households were encouraged to eat vegetables
- Less than 50% were encouraged to eat fruits
- Less than 50 % of children were spoken to about nutrition
- Less than 50% remembered seeing healthy food being brought home
- Less than 50% remembered fruits and vegetables being brought home

These findings indicate that many of the households:

- Did not speak or were educated about food nutrition and healthy eating habits
- Did not have regular access to fruits and vegetables
- Further indicating that the habits and items they consume now will follow the rest of their lives and maybe into the next generation of consumers

Nearing the end the project a Post- survey was also conducted with parents/FUSD staff and students and the findings were as such:

- Students enjoy eating more fruits including bananas, grapes, oranges, apples
- Less than 50% were not aware of any health issues relating to children
- More than 50% remember eating fruits and vegetables now
- More than 50 % remember eating fruits and vegetables 2-4 times per day now
- More than 50% believe they are healthier with the addition of fruits and vegetables
- Therefore hoping that the habits and opportunity to have access to fruits and vegetables will also follow them into their homes and their lives.

In conclusion, this project benefitted many of the households, mostly children in low income neighborhoods that did not have education on health issues affecting young children, relating back to their eating habits. Fruits and vegetable they were willing to try, purchase and take home, were not accessible to them on a regular basis.

Through this project the NHAF and its partners were successful in bridging the gap. The mobile vending, farmer's market stand and school presentations made available fresh, locally grown fruits and vegetables to a low-income community that did not have regular access to them. One of the most encouraging indications was watching the transformation from students snacking on a bag of potato chips or sweet candy bars after school, to replacing them with fruits and vegetables on a regular basis. Their parents would arrive early to purchase the fruits and vegetables.

The NHAF established a mobile vendor selling only specialty crops to disadvantaged low-income communities in Southeast Fresno, Central Fresno, and Southwest Fresno. The mobile vendor operated during the months of April to November 2012 and restarted March 2013 through the end of June 2014. The mobile vendor averaged $70-$80 per day with all revenue going back to the farmer who consigned the specialty crop commodities with the mobile vending truck. The mobile vendor routinely operated twice a week during the months it was active.

The NHAF recruited 25 farmers in Fresno County to participate in this project and provide specialty crops for sale.

The NHAF established 3 Farm to School Stands within FUSD. These farm stands, established through a contract with FUSD allowed the NHAF to operate a farm stand on campus. Items provided in the farm stands were locally grown specialty crops from farmers. All revenue was given back to the farmers from whom the NHAF received the produce.

The NHAF's farmer members only cultivate, grow and sell specialty crops. They are familiar with the methods and places to cultivate and grow. Small limited resource Hmong farmers grow these items because there are many realistic benefits for them: 1. Seeds are collected and passed down generation to generation. 2. The cultivation process and methods are passed to the next groups of young farmers 3. Because it is a specialized crop and requires knowledge and experience, limited resource Hmong farmers have also developed many markets and uses for these specialty crops as well. For example, they will market their crops with the NHAF under this project in the hopes of creating one more new market in addition to their roadside stand and one or two farmers markets. Their goal is to be able to sell all of their specialty crop produce at one or more of these markets as farming is their only source of income for the year.

This project identified and established partnerships with organizations that touch the lives of socially disadvantaged residents in Fresno County every day. Key partners such as Central California Regional Obesity Prevention Program, University of California Cooperative Extension, Fresno Unified School District and Sia Produce played a significant role in this project's success by providing outreach through established networks, sharing their expertise in the classroom, and being part of this project's advisory board. This was a unique opportunity to leverage resources of these various groups, and provide opportunities to promote nutrition and healthy eating habits through specialty crop produce.

Goals and Outcomes Achieved

The NHAF recruited an Advisory Board and hosted 3 community listening sessions. The listening sessions identified the project goals and needs such as establishing farmers markets, operation of the mobile vendor, the benefits of specialty crops, available resources for socially disadvantaged farmers, and marketing tools for specialty crop farmers and community members/consumers. The NHAF was able to recruit 25 farmers through Sia Produce to supply fresh fruit and vegetable specialty crops to the farmer's market stands within FUSD and a mobile vendor that operated in socially disadvantaged areas in Fresno.

The following goals were accomplished throughout the duration of the project:

1. Supply school breakfast/lunch programs with locally grown fresh specialty crop fruits and vegetables.
    - The NHAF was able to work with FUSD to supply 2 schools, Vang Pao and Anyesworth with fruits and vegetables.

- The fruit that was donated was fresh locally grown strawberries. This is a very popular item and was used in their breakfast programs.
- The NHAF growers also donated locally grown Hmong mustard greens to the school in an attempt to introduce a new green vegetable into the lunch program.

2. Develop school farm stands to offer healthy specialty crop choices below market value and educate students and teachers
   - Farmer's market stands were established at Vang Pao, Anynesworth and Mayfair, part of the FUSD.
   - Locally grown fruits and vegetables were pre- packaged into $1.00 plastic bags and sold to parents, students and teachers after school, below market price.
   - Education to students, teachers and parents came in the form verbal education (e.g. "what is this?")
3. The NHAF was able to establish mobile vending to outreach into the community to sell specialty crops.
   - Mobile vending was active in the community on Tuesday and Thursdays from 3 to 5pm
   - From November to June in the first year and September to June in the second year

One of the most successful outcomes of the project was the mobile vendor. With the mobile vendor, the NHAF was able to establish an on-going continuation of this service after this project period. The mobile vendor provided fresh fruits and vegetables to residents in Southeast, Southwest, and Central Fresno. It operated twice a week in different locations: 1. stopping in neighborhood streets, 2. apartment complexes and 3. recreational and community events. The mobile vendor served an estimated 25,000 people during this project. The mobile vending was successful because residents now have access to specialty crops, as many of them do not have a vehicle to drive to the stores to make these purchases. The mobile vendor was the first of its kind in the city of Fresno. It provided many limited resource farmers an opportunity to sell their produce to a new group of consumers.

Another successful outcome was the farm to school stands. The farm stands had three locations: 1. Vang Pao Elementary, 2. Aynesworth Elementary, and 3. Mayfair Elementary. Introduced to different specialty crops, many of the students, school administration, and community members were astonished by the texture and different tastes of the specialty crops. The NHAF estimated more than 6,000 students participated in the farm stands.

Beneficiaries

Limited resource farmers benefitted by this project. The NHAF worked with over 25 Hmong farmers who provided specialty crops for sale and distribution. The completion of this project also allowed local farmers to establish relationships with FUSD. Farmers also benefitted from having the opportunity to provide fresh fruits and vegetables to local schools and low-income areas of Fresno County and Fresno Unified, and from participating in mobile vending, providing new markets in which to sell their specialty crops.

Other beneficiaries of this project include elementary school students, teachers, and community residents. It is estimated that over 6,000 elementary school students participated in the breakfast/lunch program at 3 schools and received healthy snacks with their meals. Additionally, students, teachers, and parents had access to 3 farm stands to purchase fresh fruits and vegetables below market value before and/or after school. Due to the accessibility of specialty crops, they were provided an opportunity for fresh fruits and vegetables. In addition, Central California Regional Obesity Prevention Program (CCROPP) administered assessments on healthy eating habits while educating teachers and students during classroom presentations.

Over 25,000 people benefitted from this project at the three FUSD schools, where students, parents and teachers had access to fresh locally grown specialty crops, and in the underserved low income communities in Southeast, Southwest and Central Fresno, where the mobile vending machine also made available fresh fruit and vegetables to those who otherwise would not have access.

Lessons Learned

In conclusion, this project provided the NHAF with experience in working with the promotion of specialty crops in disadvantaged communities. Positive outcomes included establishing specialty crops in low-income areas of Fresno County as well as providing specialty crops within Fresno Unified School District. Without this project and partners involved, the NHAF would not have been able to provide specialty crops to the schools or create farmers markets in the school districts, as well as establish a mobile vendor. Goals were met during the duration of this project as measured. The NHAF plans to continue the farmers markets in contracted schools and continue operating the mobile vendor at the close of the project.

Getting involved with Fresno Unified School District has opened many doors for local specialty crop farmers. Being able to have access to local crops has benefitted both the school districts and farmers. School districts will have the ability to work with local growers to purchase items for the cafeteria and farmers will have another source of revenue.

During the duration of this project, the NHAF did not expect students and families to be as participative in the farm stands and mobile vendor. Students and families acknowledged that the farm stands were beneficial for them due to low-cost, easy access ways to locally grown specialty crops. Many of the students established healthy habits with the produce provided to them with the farm stand and mobile vendor.

Additional Information

NHAF website: www.nhaf.org

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 39	**Project Title:** Food Bank as Food Hub: Building a Local Food System	
Grant Recipient: Sacramento Area Council of Governments	**Grant Agreement No.:** SCB11039	**Date Submitted:** December 2014
Recipient Contact: David Shabazian	**Telephone:** (916) 340-6231	**Email:** dshabazian@sacog.org

Project Summary

This project has assessed the feasibility of a sustainable local food system predicated on a supply of fresh, healthy, locally-grown specialty crops. Despite the attention given to the local food system, key barriers inhibit growth in this market segment. Large institutions such as hospitals and retail food buyers are demanding more locally grown specialty crop, but the volume and infrastructure needed to serve them is inadequate. The project addresses this infrastructure challenge through a set of financial feasibility tools and models around a food hub, including how food banks fit within a food hub concept. Furthermore, local demand is largely for specialty crops yet most farmers need more information about the feasibility of growing for the local market. To respond to this issue, the project estimates local specialty crop supply and demand imbalances in the region as well as to show that growing specialty crop for a locally-serving food hub can be a financially feasible endeavor. Finally, farmers face a series of issues such as price, food safety and traceability, storage and cooling, and marketing that make local specialty crop production a challenge. The project provides a series of economic incentives and programs that support specialty crops grown for the local market. With these incentives, farmers do not have to shoulder the entire risk of a shift to locally-grown specialty crops.

The project provides business tools, market indicators, and possible incentive programs that support local specialty crop production. As such, it serves a wide range of specialty crop stakeholders from growers to food banks. First, growers themselves noted they need to see a strong market case to shift production to specialty crops targeted to the local market. The project aims to document the market case for specialty crop production. The project's testing of the food hub concept delivers qualitative and quantitative indicators around needed infrastructure to service an increase in specialty crop production. This data in particular will be of interest to inform investment decisions in the region. The food hub discussion also helps showcase a model to generate the volume and scale needed to supply specialty crops to institutions, wholesale and retail markets; linking the model to food banks can improve access to fresh, healthy food in underserved, low-income communities, where malnutrition, hunger and obesity rates are high. And the incentives analysis expands the project's framework to include local decision-makers. Thus the primary importance of the project is it provides feasibility analysis along the entire specialty crop value chain, from grower and investor to local public sector support and end market.

The project is very timely in that it responds to burgeoning, but perhaps unrealized demand in the local food system. The project team found that this demand has rapidly accelerated, even compared to a few years ago, but that growers in the region have been slow to respond to the new market signal. Thus the project's completion provides valuable information to help stimulate development of a local specialty crop system.

The project did not build upon a previously funded Specialty Crop Block Grant Program project.

Project Approach

To meet the project goal of analyzing the feasibility of a scale-up in specialty crops serving the local market the project developed along parallel tracts. The first of these work areas centered on the incentives component of the work plan. As reported in the work plan, the first activity in this work area was to document the impediments to supplying locally grown specialty crop through a local grower survey, targeted interviews with growers and stakeholder, and a broader literature review. Both the survey and the interviews raised the same barriers; based on these sources the project team centered on the barriers of operating cost and infrastructure, market access, labor availability and intensity, and regulation. In addition, the team documented the strength of current commodity system as a disincentive for many producers to expand into local specialty crop production.

The project team then analyzed existing economic development practices that would respond to the identified barriers in correspondence to the activities listed in the work plan. As related in the grant proposal, however, the project team is not aware of any analysis of incentives targeted solely to local food systems. As such, the review raised general practices in economic development but no direct incentive packages to model. To develop specialty crop-specific incentive packages based in existing economic development theory, the team turned to agriculture stakeholders in the region to help build out possible programs. Through this outreach the team came across recent developments in the state's economic development landscape as well as ways local decision makers could help support specialty crop production. Based on this outreach and the data collection discussed below the project team constructed and analyzed the economic impacts of four possible incentive programs that respond to the four key barriers identified above. The team them shared these incentives with stakeholders for refinement and revisions.

The results of the analysis provide economic indicators of grower incentives and programs, a novel contribution to the local food system dialogue. Each of the four incentives lists the public cost and expected outcome in terms on new jobs and purchasing power as well as the direct increase in gross regional product. The conclusion documents the dollars leveraged for every dollar of public investment across each incentive as well as synergies that reduce public costs when multiple incentives are in operation. Key conclusions from this major work activity include:

- Incentives targeting local food systems are economically feasible, as benefits far outweigh costs
- Public costs vary across incentive and target different elements of the value chain
- Different public sector actors can help implement the incentives
- The region is well positioned to capitalize on the state's emerging economic development direction to help support specialty crop producers

The second work activity for the project centered on testing the concept of a food hub. This resulted in a series of deliverables, each described in turn. First, the project team conducted a qualitative analysis of food hub trends across the nation. The review included the definition and key characteristics of a food hub, top-level reporting of food hub activity and growth across the nation and models from around the country of different food hubs. In this later section the project team showcased food banks in comparison to other non-profit and for profit hood hub models. The review found that food hubs are rapidly emerging across the nation; the breadth of food hub models, however, shows how different communities have responded to the local food system trend.

With the review in place the project team pivoted to test the concept of a food hub in the Sacramento region. The business plan deliverable describes mismatches in specialty crop production and consumption in the region and how the project team's recommended business model responds to this market opportunity (as for all the other food hub deliverables, the business plan analyzes a facility that only processes specialty crops). Next, the facility cost estimate delves into line-item capital costs of a facility best serving the recommended business model. Finally, the pro forma analysis lists the financial feasibility of the facility through time and the financial feasibility toolkit deliverable serves as a user manual for the Microsoft Excel-based pro forma. In conjunction, these deliverables find that over time a food hub in the Sacramento region that aggregates, processes and distributes locally-grown specialty crops can be a financially profitable operation. Importantly, however, the hub runs at a net operating loss during the initial years of operation, showcasing the risk of the investment. Once the hub reaches adequate scale, however, it provides the needed infrastructure to supply nearly 8,000 tons a year of specialty crop to the local market. The hub becomes net cash positive in year five, with a positive internal rate of return by year eight. By this time the hub generates profits of over $1.5 million a year. Overall the food hub work provides favorable results for specialty crop production, making a business case for a piece of infrastructure that improves the competiveness of the local food system.

With this substantial analysis in place the project team conducted a case study on Yuba County applying the tools developed during the grant. The case study shows substantial potential for specialty crop production in the county, with the specialty crop scenario quadrupling the gross annual agriculture value in the county compared to the base. Average return on investment (ROI) also increases in the scenario. However, the scenario shows how labor demand increases to reach this elevated economic output. Finally, the project team worked to situate the findings of all the above deliverables within the region's existing system, especially how the food hub model fits with the region's food banks. The results of this work are discussed below in the lessons learned section.

This project only covers specialty crops produced, aggregated and distributed for the region's fast-growing local markets. Oversight by the Project Manager has ensured that all funds target specialty crops. Project deliverables developed during this period demonstrate this result. For the food hub analysis, the project team only analyzed specialty crops as potential throughput. The target crop list found in the business plan and the pro forma shows the analyzed specialty crops. As such, all the financial findings for the facility stem solely from a locally-grown supply of specialty crops.

Likewise, the economic analysis is based off of exclusively specialty crop data to construct the incentive programs. The data includes the labor component of specialty crops, costs of specialty crop production compared to expected revenue, establishment period of specialty crops and market channels for local specialty crop production. The expected impacts of the incentives—measured in terms of jobs and output—only target local specialty crop producers. Finally, the Yuba Case Study compares potential specialty crop production in the county to the base case scenario to document the economic opportunity of increased specialty crop production. The local food hub scenario in the case study applies the food hub, which mentioned above, only processes specialty crops. And the full specialty crop scenario models a cropping pattern on specialty crops spread throughout the county's agricultural lands. As mentioned above, this scenario quadruples revenue, raises return on investment (ROI) and actually cuts water compared to the base case, showcasing the competiveness of specialty crop production in the county. The Project Manager ensured that grant funds for the case study only targeted the competiveness of specialty crops in the county. Part of this analysis involved an economic comparison to existing conditions and competing uses.

The continued contribution of the project's partners underpinned the successful completion of the project. SACOG staff benefited from significant regional buy-in and participation to help in the analysis. The team worked with the region's agriculture commissioners to document current production and yields of specialty crops in the region. This provided data for specialty crops that often are not covered in commonly used data sources such as annual county crop reports. The team also met with local economic stakeholders to discuss how existing and new tools could translate to the agriculture sector. For example, the team met with a local farmsbudsman whose insights shed light on how economic theory translates to the realities of local production and how assumptions needed to be refined in the methodology. Another example of project partner contribution comes from the meetings with University of California Cooperative Extension scientists to discuss soil capacity to grow specialty crops as well as water purveyors concerning water supply and the effects of the recent drought.

In addition, the project team worked with three of the region's major food banks, Placer Food Bank, Sacramento Food Bank, Family Services, and Yolo Food Bank. The team used the feedback provided by the food banks to refine the estimated start-up costs for the food hub as well as update the model in the project's business plan. The project team incorporated insights of these participants and many others to produce a more contextualized and accurate analysis. Finally, the project benefited from the time contribution of growers from across the region. Growers provided invaluable insights into their view of the local market and barriers, as well as what it would take to make a switch to specialty crop production. Many growers noted that they need to see a stronger market case to shift production, a theme woven into the project's various deliverables.

Goals and Outcomes Achieved

First, project work activities identified stakeholders to provide data, information and feedback on project materials. The project's consultants then led the outreach effort, interviewing stakeholders from every county as well as representatives of regional, state and national organizations. The section above describes the invaluable contribution of regional stakeholders.

The consultants also led the engagement with the region's food banks for both outreach and to meet the performance goal of food bank assessment. The standalone deliverable Sacramento Valley Food Banks and Food Hub Development documents this work and includes the activities conducted to assess current food bank operations in facilities, storage and refrigeration capacity, costs, labor needs, client services, business models and expansion plans. The project's food engineers worked with the food banks on capital costs estimates of expansion; providing industry-validated cost estimates helps serve the performance goal of supporting food banks in the region.

The project team reported the project findings on August 28, 2014. In addition, SACOG will add project deliverables to the new RUCS website when it becomes updated in late December of 2014 at www.sacog.org/rucs.

The project's expected outcomes center on ways to measure the goal of increasing the supply of locally grown specialty crops. The outreach documented above helps showcase the opportunities for specialty crop production in the region. Importantly, through the SACOG Board the project's outreach has access to representation from all local jurisdictions in the region. The incentives component of the analysis provides a series of tools that these local jurisdictions can employ to improve food access in underserved communities.

To the best of project team's knowledge, no reporting of this topic currently exists. Thus, this data gives decision makers the framework, analysis, and models they need to help improve the regional food system.

As no current incentives exist to measure against, the project relies on longer-term performance measures. In addition to the performance of any incentive adopted in the region, these measures include tracking changes in acres where local specialty crop is grown and the economic value of those products. SACOG's core Rural-Urban Connections Strategy (RUCS) program monitors these indicators: the crop map tracks field-level changes in production, and the program's economic modeling produces sophisticated analyses of costs of production, revenue and return of a wide swath of specialty crop production. SACOG will follow these indicators through time. For the food hub analysis, SACOG has met the measurable outcome of the grant by examining a local food bank in-depth, and through the project's food engineers the project team has provided a review of the food bank's operation and ability to expand.

The accomplishments of the project match very closely with the stated goals. Overall, the project has provided an extensive and novel toolkit that showcases the competiveness and potential of local specialty crop production in the Sacramento region; these findings have relevance and transferability to other regions and states as well. The incentives analysis documented financially feasible tools local governments and other stakeholders can take to support local production. The analysis suggests these to be sound public investment, as each dollar of public outlay leverages additional dollar of economic output.

The tools testing the concept of a food hub also meet the project goal. Together, these tools make a sound business case for a facility targeting a key gap in the region's local specialty crop infrastructure and provide data and metrics to help inform investment decisions. The food hub report documents numerous food hub models across the nation. The business plan delves into the financial specifics of a single model to supply fresh specialty crop to institutions and wholesale outlets. Finally, the pro forma not only produces year-by-year financial indicators of the proposed food hub model but also allows for customizable analysis based on changing market conditions, target customers, and desired specialty crop mix.

The one area where the project differs from its original envisioning comes from the role of food banks as local food hubs. As the deliverable Sacramento Valley Food Banks and Food Hub Development describes, the project team met with all the food banks in the region and conducted in-depth analyses for recent expansion plans. While the original research goal of the project focused on food banks serving as the region's food hubs, the project team found that instead of being the site of the hub, food banks more likely would serve as partners in the local food system and could help in the initial phases of hub development. The client service goals of the food banks may not be the optimal model for the for-profit food hub recommended by the project team. One key issue is the significant effort needed to start and run a food hub, which would tax existing staff resources and impact the core mission of the food bank. Related to this is the concern that the food hub would cause confusion with donors as to the food bank's mission and operations. Finally, the space needed to scale up a food hub is not available at a food bank unless there is significant investment in new facilities. Given the limited funding available from the public sector for urban food hubs and the concerns about donor confusion, the food banks do not appear to currently be a good place to expand and operate a food hub.

The project has produced a suite of data illustrating the economic feasibility of building a local food system. Please see the feasibility toolkit (attached) to reference the figures mentioned below. On the food hub side these include financial feasibility indicators. The pro forma shows:

- The food hub becomes net cash positive in year 5 of operation.
- The facility provides a positive internal rate of return (IRR) on investment at year 8.
- By year ten the facility generates revenues of $18 million a year, with net operating income at 12 percent of sales and profits of over $1.5 million a year.
- By the end of the pro forma the local specialty crop food hub provides an IRR of nearly 25%.
- The facility requires a total capital investment of $3.5 million, with further costs financed.
- Despite these positive economic indicators, the facility operates at a loss during its initial years, showcasing the risk involved in investment.

The incentive analysis also provides baseline data that support the project goals. This data includes:
- The incentive addressing infrastructure barriers has a public cost of $75,000 a year but supports a local economic expansion of $4 million and 35 new jobs in the local specialty crop system.
- The second incentive responds to market access barriers. The incentive carries a public cost of $191,000 compared to a leverage of $1.28 million in gross output.
- The labor incentive has the highest public cost, at almost $835,000 a year. However, it also supports the most jobs (75) and the largest estimated increase in specialty crop production ($5 million).
- Finally, the fourth incentive provides regulatory help to local specialty crop growers. Based on local data, the incentive would cost $116,000 a year to the public sector with a leverage of $13.5 per public dollar expenditure.

Note that this cost/benefit analysis represents the best estimates of the project team given the lack of existing incentive programs.

Finally, the application of the project's tools in the Yuba County case study also provides baseline data in support of local specialty crop production.

- Yuba County and the region have a marked supply/demand imbalance in the project's specialty crop target list. All of the target crops have more demand than local supply: apples, asparagus, bell peppers, blueberries, broccoli, carrots, kale, lettuce, onions, spinach and squash.
- The fastest growth in the county's agriculture sector has come in orchards. Walnuts are the county's new top crop by value and in the last four year the county has added over 1,500 acres of that crop.
- In-depth analysis of walnut production shows high potential earnings balanced by high establishment costs. On average a walnut grower does not make back initial investment until the 11th year of operation.
- The specialty crop scenario quadruples the overall agricultural value of the county's agriculture sector over the base, while average ROI increase by 10 percent and water consumption decreases by 78,000 acre feet. The scenario, however, results in 30 million more hours of labor demand.
- Urbanizing specialty crop production (Food hub) has significant economic impacts. A full build-out of Yuba County's Valley Growth Boundary could result in the loss of $150 million in agriculture value if those acres were dedicated to specialty crop production. The Valley Growth Boundary is a local land use designation that would allow urban development to expand into existing working lands, including 11,000 acres of current agricultural production. The project modeling shows that the agricultural value of these 11,000 acres would be over $150 million a year in farmagate output if all the acres were in specialty crop production. The scenario in question models the impacts to the region's agriculture sector if all the agricultural land in the boundary was instead converted to urban uses as is designated in the growth boundary. In short, fully urbanizing the land

within the boundary would replace the 11,000 acres of agricultural production with urban uses, with a resulting drop of $150 million in agricultural value as these acres are no longer in agricultural production. Thus the agricultural loss factor in the scenario is because the specialty crop acres have been replaced with housing and commercial land uses. The scenario results help illustrate to local elected officials the significant economic value of specialty crop production in the county as well as the amount of agricultural economic activity that is forgone when lands are urbanized.

- Finally, the case study reports an interim food hub model for Yuba County. The 16,800 sq. ft. facility would cost about $3.5 million (including building, equipment, engineering and contingency) with estimated annual revenue of $4.4 million. The facility adds a processing line to glaze walnuts, Yuba County's top crop by value.

The above section lists the many quantifiable metrics of the project. These include development and analysis of four financially feasible incentives. On the food hub side, the project produced a business pro forma with twenty years of detailed financial analysis, 14 analyzed food hub models and one recommended model, and a detailed cost estimate for a 22,000 square foot facility. Finally, the project completed a case study applying the developed tools of the overall agriculture infrastructure project.

Beneficiaries

The primary group that benefits from this project's accomplishment is local specialty crop growers, both current and also those considering expansion into local specialty crop production. The project provides market data on the growing demand for locally grown specialty crop, especially areas where there is a marked supply/demand mismatch. Additionally, the project includes data on the cost of production and revenue for a wide array of specialty crops. The Yuba County case study includes soil and water data for specialty crop production in that county.

In addition to growers, the project has benefited the entire food system. Notably, the project provides a suite of business tools that can help direct investment to needed agriculture infrastructure serving specialty crop production. The food banks in particular have gained from targeted outreach and analysis to help inform future expansion decisions. And the region's institutions also will benefit from the project's hub business plan as a model to increase the supply of fresh local food.

Finally, the project benefits local jurisdictions seeking to increase access to healthy local food, especially in underserved communities. The incentives give concrete examples of steps local jurisdiction can take to support production as well as raising awareness of key barriers growers face. The region's six agriculture commissioners, five Farm Bureaus, five county economic development departments and five farm advisors gain from updated data and tools analyzing the financial feasibility both of local specialty crop production and needed off-farm infrastructure. These stakeholders work with countless growers, advocacy groups, educators and institutions. Through the case study Yuba County also has access to an updated crop map and targeted data on local market opportunities.

The region's five food banks serve more than 90,000 clients. The project's hub model also targets regional institutions. The largest institutions include school systems—regionally these 65 districts serve 327,000 students—and hospitals. And the region's 28 jurisdictions together consume over 1 million tons of specialty crops a year. Finally, the region has over half a million acres of specialty crop production currently valued at

$1.1 billion that benefit from the accomplishments of the project. As mentioned above, the region's six agriculture commissioners, five Farm Bureaus, five county economic development departments and five farm advisors also benefit, as do the growers themselves.

The food hub pro forma models a direct economic impact of $18 million a year in new specialty crop revenue. Likewise, the four incentives combined model a $10 million annual increase in specialty crop output.

Lessons Learned

Overall the project team gained valuable insights into the market feasibility of the local food system. First, the team documented the rapidly emerging demand for local, fresh specialty crops. This demand stands out even compared to a few years ago. Despite this latent potential, the team came to better understand the acute challenges in the local food system. In addition to the infrastructure, labor, cost and other challenges mentioned above, the project team noted that many growers themselves are skeptical of the local market trend. Many view it as a fad and don't believe consumers will shift consumption patterns in accordance. Thus the team found a disconnect between grower sentiment, and shifting consumption patterns. The project's various deliverables can help bridge this disconnect.

Next, the project team analyzed local specialty crop production in comparison to export production, the mainstay of the region's specialty crop system. This review provided context for the local feasibility study and reiterated grower reluctance—many prefer the convenience and familiarity of their existing operations. So while the project team feels comfortable with the breadth and coverage of the project, the project team acknowledges that ultimately, the success of the local food system will be predicated on growers making the market decision to increase the supply of specialty crops grown for the local market.

A further lesson learned comes from the food hub feasibility analysis. Like other investment opportunities, the pro forma shows this specialty crop facility to operate at a loss initially, highlighting the risk inherent in production. Once the facility reaches scale, however, it leads to a very positive economic return, showcasing the investment opportunity for those willing to deal with the risk. Finally, the project team found that there are many different ways that many different actors can support the local food system. Food banks will play a vital role as partners and perhaps incubators. Furthermore, the incentives review showed economically feasible ways for local governments to support the local food system.

One unexpected outcome of the project is that it brought to the forefront the numerous local-market efforts already percolating in the regional agriculture sector. For example, through the Yuba County case study the project team was exposed to the work of the North Yuba Grown group, a collection of small, often part-time growers providing fresh fruit and vegetables to the hyper-local market. The group had made connections with local schools and was already discussing the need of a food hub type facility. Through the project the work of this group is broadcast to a wider audience. The food hub report discusses other similar efforts in the region's food system.

The project team feels the goals and outcomes of the project have been met. Still, as the first bullet in the section describes, the project produced important lessons learned that can help other efforts. One lesson learned is the need to phrase discussions with growers in an economic context. Like any other business activity, growers apply a market lens to production decisions. The project team found that more progress was made when discussions were framed in an economic manner. Likewise, when talking to public sector stakeholders the project team found it beneficial to hit on both the economic and social benefits of increasing the supply of local, healthy specialty crops.

Further lessons learned include both the value and challenge of advancing multiple deliverables under a single umbrella. The value comes from the breadth of the project outcomes, including means to engage more stakeholders in the value and feasibility of building a local food system. The challenge comes from ensuring that all deliverables are progressing concurrently, and to avoid overlap between projects. To successfully deliver on all the project's work activities the team employed an active project management regime. The team believes this technique greatly contributed to the success of the grant project.

Additional Information

This section lists the various deliverables of the project and briefly describes how they address the project proposal and they are also included in the attachments to this report.

Impediments to Supplying Locally Grown Specialty Crops: This deliverable documents the major barriers local specialty crop producers face. The second half of the document contains the project's analysis of possible incentive programs.

The project's work testing the feasibility of a food hub is divided into the following deliverables.

Research Analysis of Food Hub Trends and Characteristics:
This report provides an overview of food hub trends across the nation. It shows top-level statistics of national food hub operations, a review of existing capacity in the Sacramento region, and a summary of various food hub models employed throughout the nation.

Food Hub Cost Estimate Analysis:
This deliverable develops the cost, layout and operations of the proposed food hub facility. It includes the phasing analysis of the facility, capital costs, project operations and detailed line-item budget categories.

Food Hub Business Plan:
The project's business plan lays out the project team's recommended food hub model. First, the business plan documents regional market analysis findings. Next, the plan describes how the model proposed in the analysis best capitalizes on these market trends. The financial feasibility section provides a proof of concept for this proposed business model. Finally, the business plan makes reference to key barriers and possible financing resources that will affect successful deployment of the business plan.

Food Hub Tool Kit:
The Microsoft Excel-based spreadsheet provides in depth financial indicators of the proposed food hub facility over a twenty year horizon. In addition to detailed monthly operations, this pro forma reports data on costs of goods and sales price as well as operating, labor and capital costs. The pro forma tool kit also supports customizable analysis, described below.

Financial Feasibility Toolkit:
This companion deliverable to the Excel-based Food Hub Tool Kit pro forma walks the reader through how to interpret the various financial indicators of the pro forma. It also provides an explanation of how to conduct customized analysis testing various food hub models and assumptions.

Food Banks and Food Hub Development:
This report documents the work undertaken by the project team to gauge the role of food banks in the local food system. It provides a summary of food bank expansion activities, estimates of early food hub operations, and summary conclusions of food hub incubation analysis.

Finally, the project completed a case study on Yuba County, described below:
The case study applies the tools developed during the project to the local context. It documents local specialty market trends in the county and then compares specialty crop production across various measures.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 40	**Project Title:** Mandela MarketPlace Emerging Markets (MMP-EM)	
Grant Recipient: Mandela MarketPlace	**Grant Agreement No.:** SCB11040	**Date Submitted:** December 2014
Recipient Contact: Dana Harvey	**Telephone:** (510) 433-0993	**Email:** dana@mandelamarketplace.org

Project Summary

A child born in low-income communities is more likely to be born premature and forced to seek nutrition in liquor/convenience stores. Meanwhile, capital for local business ownership and expansion is scarce with only 8% of businesses in the Bay Area identified as minority-owned. The 2007 Ag Census shows the number of full-time farmers continues to rapidly decline in California.

Mandela MarketPlace Emerging Markets (MMP-EM) will increase consumption of California grown specialty crops by a minimum of 150,000 pounds (lbs.) while providing a distribution network for minority-operated specialty crop producers and educating local retailers and an emerging consumer base to the benefits of sustainably produced California fruits and vegetables. All related outreach activities will feature California grown fruits and vegetables. Mandela MarketPlace will also document its successful locally-owned food system model as an instructional manual and distribute it for use in rural and urban low-income communities throughout California.

MMP-EM is a targeted specialty crop produce distribution project expanding from a realized opportunity in West Oakland to link unmet community demand for fresh foods with markets that expand income avenues for underserved specialty crop producers. Mandela MarketPlace's distribution center links minority-operated specialty crop producers with low-income urban consumers by developing and supplying small retail grocery and booth markets. This Mandela MarketPlace Emerging Markets project operated with separate activities in tandem with current objectives of the Alameda County Public Health Department's Building Blocks Collaborative, a partnership of multi-sector community organizations in Alameda County that is developing a blueprint to improve community conditions in order to support the well-being of children, starting from the earliest stages of life.

This project did not build upon a previously funded Specialty Crop Block Grant Program (SCBGP) project.

Project Approach

<u>Conduct outreach and research to identify new potential network farmers</u>.
Mandela MarketPlace has achieved and exceeded its goal to add four new network member farmers by April 2014. Mandela MarketPlace currently works with 25 farmer partners and has completed 12 new operator assessments to identify how Mandela MarketPlace can best support the farmers and understand their farming practices to assist with marketing sustainably farmed specialty crops in urban markets.

<u>Increase Network Farmers to a minimum of 20.</u>
MMP-EM exceeded its goal of 20 member farmers. MMP-EM currently has 25 eligible specialty crop producer members and is currently purchasing over 180,000 lbs. of produce annually – well above its expected minimum purchase of 80,000 lbs.

Increase same farmer sales to meet volume targets.
Mandela MarketPlace provided financial and market support to limited resource and minority specialty crop farmers and increased sales and distribution of specialty crops in low-income, low-access communities. Overall produce volume exceeded targets by over 100% - increasing from 80,000 lbs. to over 180,000 lbs., annually with anticipated sales of over 200,000 lbs. in 2014.

Support retailers with marketing and outreach activities and social marketing presence.
Mandela MarketPlace updated the web/social media presence to raise awareness about specialty crop farmers sourced from, and containing access points, throughout the community. During this grant, MMP-EM provided 85 nutrition education and cooking demonstrations to encourage increased consumption of and purchase of specialty crop products at markets, retail outlets, and workshops. These events were conducted at the retail sites where specialty crop foods were distributed, including at corner markets, community produce stands, and grocery retailers. The purpose was to educate consumers about, and direct them to purchase, fresh, local fruits and vegetables to increase the sales, and thus increase the demand for specialty crops from the farmer/producer network.

Increase network member retailer outlets from nine to 12 locations.
Mandela MarketPlace currently services eight outlet locations with four additional locations expected in the very near future. The current outlets include four convenience markets, two market stands, one grocery retail, and one local organization that distributes food boxes and operates market stands. Two community stands will be added at low-income housing units in September 2014 when Mandela MarketPlace's EBT application is finalized, and two stands will be added at local schools when the school year begins. An additional two market booth locations are planned for 2014/2015, in partnership with Oakland Unified School District and one café will be opened in July 2014. By accepting EBT at the market stands, MMP-EM will be able to expand its consumer base to include EBT recipients and add to the number of successfully operated community produce stands. Currently, selling to low-income residents who receive some form of public assistance tend to need to be conservative with their cash, keeping cash purchases to non-food items. MMP-EM can increase its distribution of consumer sales, and thus, purchases directly from specialty crop producers if consumers can pay with EBT at the produce stands. The SCBGP funds have not, nor will be, used to add the EBT accommodation.

Develop Toolkit:
Mandela MarketPlace completed a Food System Toolkit. The Toolkit was not completed prior to the grant period ending to report on the number of downloads. Mandela MarketPlace conducted significant research in completing the toolkit, which took longer than anticipated. One challenge was implementing a system for tracking downloads, although it is possible to track the number of "hits" on the website, the Mandela MarketPlace does not have a mechanism to track hits on specific downloads. In order to resolve this issue, the team can distribute an identified number of copies or e-copies and track the number distributed.

All SCBGP funds were directed specifically to supporting the specialty crop farmer by increasing access points for distribution and purchase of their produce and building a consumer base to increase the purchases of specialty crops in urban centers. Mandela MarketPlace's food system focuses primarily on increased access points and consumption of fresh fruits and vegetables in urban centers where farmers rely on specialty crop sales to sustain their livelihood.

Key project partners for this program included a farmer partner network. Farmers worked with Mandela to adapt their growing and sales practices to integrate wholesale, and worked closely to begin to create planting plans for Mandela purchases. Mandela Foods cooperative played a key role as a major purchaser of the produce, committing to purchasing 100% of produce through Earth's Produce Distribution. Alameda County Public Health/Health Care Services were key in providing support and information for the nutrition education and outreach activities that increased reach and sales to community residents particularly at community produce stands and convenience retailers. Convenience retailers played a key role in expanding their offerings of specialty crop products in their stores and promoting the products to their customers.

Goals and Outcomes Achieved

EXPECTED MEASURABLE OUTCOME	STATUS	OUTCOME
Increase farmer member network to at least 20 farm partners • Consulted with existing farmer partners & ag networks to identify additional producers • Consulted existing directories such as USDA Directory of Farmer, Rancher & Fishery Cooperatives and internet data to identify partners • Visited farms to assess farming practices • Identified farmer needs & capacity as a supplier to urban retail markets • Conducted farmer profile interview • Identified urban markets for member's specialty crops • Developed metrics/benchmark for retail sales • Identify/enroll 12 new locally-owned retail outlets to sell specialty crops • Consulted with existing retail partners to identify new venues • Coordinated customer needs surveys with key retail venues • Assessment of potential retail partners • Conducted retail assessment to assess market size • Conducted customer base assessment • Conducted analysis of capacity to store/display perishable items • Assist retailers with marketing activities – shelving and display materials, weekly order sheets, education about seasonal specialty crops.	**Exceeded**	**25 farm partners**
Increase same farm sales • Supported retailers with marketing and outreach activities to build their customer base; • Conducted local outreach activities such as classes, meet the farmer events, door to door marketing; • Highlighted retailers on social media networks including monthly newsletter; • Released regular press releases on featured specialty crop farmers; • Conducted social marketing campaign to change buying behaviors; • Designed campaign to align with existing local farm campaigns, i.e. Buy Fresh, Buy Local; • Released regular outreach through newsletters, twitter, Facebook, webpage;	**Achieved**	**Sales increased by >100% to $180,000**
Identify new retail partners: a minimum of 12 new locally-owned retail outlets for specialty crops • Consulted with existing retail partners to identify new venues; • Used existing data/GIS mapping of retail outlets, identify venues to contact;	**Achieved**	**Identified 20 potential clients**: *1 grocery retail, 1 café, 4 school*

• Coordinated customer needs surveys with key retail venues; • Assessed potential retail partners; • Conducted retail assessment to assess market size; • Conducted customer base assessment: defined preferences & determined marketing approach; • Conducted analysis of capacity to store/display perishable items; • Signed Memorandum of Agreements with members; • Assist retailers with marketing activities – shelving and display materials, weekly order sheets, education about seasonal specialty crops. • Supported retailers with marketing and outreach activities to build their customer base; • Conducted local outreach activities such as classes, meet the farmer events, door to door marketing; • Highlighted retailers on social media networks including monthly newsletter; • Released regular press releases on featured farmers.		*produce stands, 8 neighborhood markets, 4 community produce stands, 2 restaurants,*
Signed agreements with 4 new retail partners annually • Executed memorandum of understanding agreements with retailers and community produce stand locations.	**Achieved**	**12 retail outlets active:** *4 small markets, 2 school produce stands, 1 grocery retail, 1 café, 4 community produce stands*
Create Community Toolkit • Created outline of toolkit with project partners; • Documented processes, logic model, and budget; • Developed templates from existing documents; • Collated toolkit and distributed for review; • Edited/finalized toolkit; • Uploaded toolkit on social media.	**Achieved**	**Toolkit Complete**

Over the term of this program, Mandela MarketPlace developed new markets in low-income, low-access communities for specialty crop producers. Working with farmer partners, Mandela was able to provide the technical assistance and support to local specialty crop farmers who can now expand their sales through wholesale market streams. MMP-EM established sustainable new access points throughout the community, doubling sales, and creating new demand for over 400,000 lbs. of specialty crop foods. MMP-EM produced a toolkit that will be available for other communities to learn from its successes and challenges, in establishing new markets for specialty crop producers in low-income communities.

Overall program impact to date:

- $500,000 in specialty crop purchases, an increase from $70,000 per year to $180,000 per year in final grant year;
- $200,000 in purchases directly from limited resource farmer partners;
- 500,000+ lbs. in produce distributed in low-income, low-access community;
- Increased client base and increased specialty crop purchases by 100% in the grant term;

- Enabled one farmer to transition from farmers markets to wholesale through Mandela Distribution;
- Executed MOU with Oakland Unified School District to operate school-based produce stands throughout Oakland low-income, low-access communities;
- Established a community produce stand at West Oakland Health Center to reach clients receiving care at the health clinic, and provide nutrition education;
- Redeemed over $20,000 in coupons in partnership with Alameda County Public Health and West Oakland Health Center for pregnant women to increase their purchases of specialty crop produce by $60 per month. The coupons were funded by a grant with Alameda County Public Health Department/Kresge Foundation. The benefit to the specialty crop farmers was a $20,000 increase in specialty crop purchases at Mandela Marketplace supported food outlets.

MMP-EM achieved its program goals. In addition, this project enabled MMP-EM to establish working partnerships with other local organizations, including ALBA Farms, to provide wholesale readiness training to farmer partners, and with FarmLink to provide a pre-harvest finance fund, so that farmers can be paid in advance for orders into MMP-EM distribution network. This enabled one of its farmers to stop depending on farmers markets for his living.

Project success included:

- Increased the aggregation and urban distribution of sustainable specialty crops from 25 minority-operated small farm members, from 80,000 to 180,000 lbs. of specialty crop sales per year, which exceeded the stated goal of 150,000 lbs.
  - Farm sales are recorded and tracked in a custom-designed inventory tracking system on FileMaker Pro.
  - Records of pricing, farmer and retail mark-ups are recorded in FileMarker Pro, and assist with developing price-sheets for clients and for farmers to establish wholesale pricing.
- Expanded healthy food access in low-income, Alameda County communities at 12 new retail outlets.
- Developed a 'how to' manual on creating successful, locally-owned food distribution systems for use by underserved urban and rural communities throughout California.

Beneficiaries

Beneficiaries included local farmers, low-income seniors, clients at the West Oakland Health Center, customers at Mandela Foods Cooperative grocery retail, low-income residents who shop at convenience markets, or at community product stands, low-income school families. Some of the benefits are:

- 25 farmer partners and 10,000 customers in low-income, low-access community.
- Over $500,000 in specialty crop sales and over $200,000 directly to farmer partners.
- Increase in local specialty crop farm sales directly from under-resourced and minority farmers who otherwise do not access wholesale markets of average $68,000 per year.
- Increased access points throughout low-income, low-access communities for specialty crops from one retail grocer, to four convenience stores, two low-income housing complexes, one local health clinic, one senior center, two to four schools, one café, and one community-based organization.
- Distribution in a low-income, low-access community of over 500,000 lbs. of specialty crop produce
- Increased consumption of local specialty crops by 65% of consumers surveyed over a two-year period, over 500 consumers surveyed.

Lessons Learned

The following list consists of positive and negative results and lessons learned at the conclusion of the project:

Positive results and lessons learned were:

- Adding more clients and markets to increase sales of specialty crop produce;
- Establishing Farmlink partnership to provide purchase order financing to farmers;
- Setting prices with farmers to assure that farmers receive a fair price, and urban, low-income consumers receive affordable, fresh produce;
- Building relationships with farmers and adding farmer partners to focus on meeting their needs, to improve their capacity to sell wholesale;
- Having farmers deliver when they can and offering a delivery fee to free up warehouse staff time to increase sales/clients;
- Structuring the Healthy Neighborhood Store Alliance into a produce "consignment" model to increase the number of specialty crop offerings in small stores and increased purchases by local residents; and
- Increasing warehouse/distribution efficiencies to better serve farmers and clients.

Negative results and lessons learned were:

- Transportation challenges continue to be a barrier to small farms entering wholesale sales; this includes, limited access to refrigerated trucks and lack of capacity to deliver or access delivery trucks to get crops to market;
- Lack of refrigeration at the farm site limits retail shelf-life of produce;
- Lack of storage, especially cold storage, near the farm site limits capacity to sell higher volume;
- Lack of consistency of produce quality can be difficult in retail marketing; and
- Lack of methods of communication for farmers—not answering phones for orders, no or limited access to internet, email, fax, and language barriers—make interaction and streamlined ordering difficult.

Additionally, unexpected outcomes or results that were an effect of implementing this project included:

- Establishing $100,000 pre-harvest finance fund with FarmLink to provide "up front" payments to farmers;
- Enabling one farmer to transition from farmers markets to wholesale through Mandela Distribution; and
- Executing MOU with Oakland Unified School District to operate school-based produce stands throughout Oakland low-income, low-access communities.

Lastly, and most importantly, MMP-EM was able to achieve all of its project goals.

Additional Information

Link to www.mandelamarketplace.org, *then click on the* ***Projects tab*** *for more information about our projects – including Summary of all projects and Distribution*

https://www.facebook.com/pages/Mandela-Marketplace/131273713549358

https://www.youtube.com/watch?v=ooWNHgRk49o&list=UUEubpqFwzid4bkThmZDHwmQ

https://www.youtube.com/watch?v=GFJc4EgmEpI

Mandela Foods, Impact

2010-2013

40% of the produce purchased by our distributor company is sourced directly from local farms = $180K in additional revenue for local, under-resourced, minority farmers

$3M in new revenue generated at Mandela Foods Cooperative a successful community-owned business keeping revenue in the community.

400K lbs of produce made available in a food insecure community - most of which is sustainable grown.

76% of community shoppers reported an increase in consumption of fruits and vegetables as well as a stronger connection to their food source, an increase in self-efficacy regarding healthy food preparation, and feeling healthier.

16 job /ownership opportunities supported through the Mandela Foods Network:4 store worker owners 3 store youth employees
3 distribution employees
4 core staff
1 Nutrition Educator1 TA provider

1

MANDELA MARKETPLACE

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 41	**Project Title:** Oak Park Farmers Market	
Grant Recipient: Sacramento Neighborhood Housing Services, Inc.	**Grant Agreement No.:** SBC11041	**Date Submitted:** December 2013
Recipient Contact: Sharon Eghigian	**Telephone:** (916) 452-5356 x217	**Email:** sharon@nwsac.org

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

The Oak Park neighborhood and many of the surrounding neighborhoods have been identified by the Sacramento Region Food System Collaborative as 'food deserts', a term used to describe neighborhoods without access to adequate, affordable healthy food. Oak Park is a low-income, ethnically diverse neighborhood of approximately 16,000 residents. According to the 2008 Census update, more than 65% of households have an income of less than $35,000 a year.

Oak Park Farmers Market was developed in response to these needs. In the first year (2010), the Market sold more than 20,000 pounds of produce, was one of the only farmers markets in Sacramento to accept Cal-Fresh (food stamp) EBT benefits and brought more than 400 residents from nearby communities into Oak Park each Saturday. In recognition of these successes, the market won several awards during its first year, including 'Best New Farmers Market' in Sacramento Magazine. Vendors developed a loyal following of weekly customers. Many of the customers appreciate the smaller size of the market and the "community feel".

This project built on the success of the Oak Park Farmers Market to leverage more benefit for the community, including the specialty crop vendors. The Sacramento Neighborhood Housing Services Inc. sought to increase the volume of specialty crops sold and increase the number of customers shopping at the market.

Project goals were to double the number of specialty crop vendors from 12 to 24 vendors, increase the pounds of specialty crops sold by 50% and increase the volume of Cal-Fresh EBT sales by 100% over the project period.

This project was timely because the Oak Park Farmers Market established itself as a new market with the potential to serve thousands of residents in the low-income community of Oak Park, and the surrounding communities. As a result of this project, outreach to vendors, customers and potential customers increased, and incentives were provided to encourage increased consumption and understanding of the value of California grown specialty crops.

This project benefitted the specialty crop industry by increasing sales of specialty crops and benefitted the public, including low-income consumers, by increasing access to and appreciation of specialty crops.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

In early spring 2012, the Farmers Market Manager attended the California Small Farm Conference and other conference attendees shared feedback that a customer “punch card” from their experience had not been very successful in bringing in new customers. Instead, other Farmer Market mangers shared that holding vendor promotions had been a successful marketing strategy to attract and retain customers. With this new information, the project was revised to include a specialty crop promotion using social media and other outreach (print ads, calendar listings, etc.). This promotion included developing and promoting a "Word of the Week" along with a facts/information about the particular specialty crop highlighted that week. Promotions were run several times during the 2012 and 2013 season. During each of the approximately 20 promotions held during the project period, up to 50 customers received $5 of script that was used on that market day to purchase specialty crops. The customer visited the Farmers Market customer service booth to provide the 'Word of the Week" and then was provided script for purchase of specialty crop items only.

Customers shared with the Farmers Market staff that they enjoyed the promotion and the fun nutrition facts and recipes highlighting specialty crops posted on the Market’s Facebook page. Also, specialty crop vendors appreciated the promotion and the new opportunities the promotion provided to attract new customers and help vendors build ongoing relationships with customers.

The Farmers Market Manager focused much of her efforts on retaining and attracting vendors. During the project period, the Farmers Market manager made more than 1,600 calls to specialty crop producers, including cold calls and follow-up calls to current and potential specialty crop vendors. The Farmers Market manager also participated in more than 80 visits to local Farmers Markets to recruit vendors, and participated in more than 20 visits to farm sites of potential new vendors. Approximately 80 specialty crop vendors received applications to join the Oak Park Farmers Market.

In addition, the Farmers Market Manager developed relationships with market vendors and was responsive to their needs. For example, the Farmers Market Manager conducted at least one annual visit to market vendors Farms to meet/visit with the vendor and learn about their operations. This visit were an opportunity to help develop/build relationships, and was one avenue of quality control to ensure farmers were meeting their obligation to actually grow what they are certified to grow. In addition, she participated in weekly visits to many of the Farmers Markets in the local area to share information about the Oak Park Farmers Market and the benefits of the Market. Based on the relationships established with participating vendors, the Farmers Market Manager was able to receive numerous vendor referrals. Finally, vendor meetings and ongoing communication with vendors provided valuable feedback and input to make the Market more successful. Thus, the vendors expressed appreciation for being valued as partners in the Market.

Due to the extensive outreach efforts, the number of specialty crop vendors increased at the Market. For the 2012 and 2013 Farmers Market seasons, the Oak Park Farmers Market had an average of 11 specialty crop vendors each week. By the end of the project term, the Market had a total of 14 specialty crop vendors.

During the course of the 2012 and 2013 Market seasons, more than 60,000 pounds of specialty crops were sold each year; this was an increase of 30% over the pounds of produce sold in 2011 (28,300 lbs.). The increase in pounds sold was due to a combination of factors. These include providing the Specialty Crop Promotion and EBT incentive. Market EBT sales grew from an average of $840 per week in 2011 to $1,200 per week in 2013. Also, additional specialty crop vendors were added and the customer base increased at the Market.

Specialty crop vendors reported that the specialty crop promotion and the EBT incentive made a significant and positive impact on their sales. For example, one vendor shared:

> "During the course of the 2012 season, I encountered many new patrons brought to the market by social media or word-of-mouth promotion of the Specialty Crop Buck and Cal-Fresh EBT programs. Due to the increased demand for my product last season, I intend to increase my plantings of both heirloom tomatoes and nursery plants in the 2013 season. I run three markets, and this market has seen the strongest growth in sales. This is due, in large part, to increased exposure to my product from programs like these. We are a small specialty vendor struggling to compete with larger mega vendors; markets and programs like these help to educate consumers on our products and level the playing field."

On opening day of the 2013 season, the Oak Park Farmers Market also unveiled new site improvements at McClatchy Park. These improvements were made possible by an investment of $500,000 from the City of Sacramento. The improvements include new awnings, electricity, new walk-ways and landscaping. These improvements will help the Market eventually run year round. The City was also recently awarded a $2.8 million grant to improve McClatchy Park. These improvements will include a walking path, a new playground and many other improvements that will help attract more customers to the Market. These improvements and changes will benefit specialty crop producers by lengthening the Market season and adding additional customers.

Partners include, as noted above, the City of Sacramento, which has helped the Famers Market both improve the physical infrastructure and helped promote the market. The Oak Park Farmers Market has also worked with several local organizations both to perform outreach and to hold special events at the Market. These partners include the California Food Literacy Center, Master Preservers, and Soil Born Farms.

Note: Sacramento Neighborhood Housing Services had tracking mechanisms in place to ensure all incentive coupons were used to purchase specialty crops. All vendors were educated at vendor meetings about the promotion to ensure vendors understood coupons were only to purchase specialty crops. On the days that promotions were held, the specialty crop vendors were required to turn in their coupons in order to receive reimbursement the following week. Reimbursement forms were submitted to the Finance Department, which clearly delineated between EBT and specialty crop reimbursement. Furthermore, since the project team was aware of which vendors sell specialty crops, and only specialty crop vendors are required to submit the coupons to be redeemed, Farmers Market staff ensured that all incentive coupons were used to purchase specialty crops. Furthermore, Sacramento Neighborhood Housing Services has very sound accounting measures in place, which ensured that the specialty crop incentive funds only went to support specialty crop purchases.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Goal 1: Increase the number of specialty crop vendors from 12 to more than 20 vendors.
The Oak Park Farmers Market increased the number of specialty crop vendors from an average of 7.57 per week in 2011 to more than 12 specialty crop vendors per week in 2013. This goal was achieved by targeting outreach efforts to retain specialty crop vendors and recruit additional specialty crop vendors. There were a total of approximately 20 specialty crop vendors participating in the market in the 2012 and 2013 market season.

Goal 2: Increase specialty crop pounds sold from 30,000 per year to 46,875 per year by 2013.
The Oak Park Farmers Market increased pounds of specialty crops sold by vendors at the Farmers Market from 30,000 pounds in 2011 to more than 60,000 pounds by the end of the 2013season. This goal was achieved through the specialty crop promotion, EBT promotion, and outreach using local media and social media.

Goal 3: Reach 10,000 potential EBT and WIC customers through media and outreach.
The Oak Park Farmers Market tabled at the Department of Human Services several times during each season, reaching approximately 4,000 EBT families. Sacramento Neighborhood Housing Services also partnered with the local California Department of Public Health, Women, Infants and Children Program (WIC) office to provide WIC Farmers Market coupons directly at the Market. This initiative led to an increase in the participating week from an average of $20 redeemed in WIC coupons to more than $1,200 redeemed in WIC coupons for specialty crop purchases during that week. Less than 40% of WIC Farmers Market coupons are redeemed statewide; a higher redemption of these coupons helps specialty crop vendors and low-income families.

In addition, specialty crop promotion and EBT incentive were advertised by providing flyers to agencies serving local low income populations, including Sacramento Food Bank and Family Services, La Familia, River City Community Services and the Oak Park Community Center. More than 1,000 flyers were distributed to these organizations. Also, flyers were provided door to door to families in low-income neighborhoods, including Oak Park, Tahoe Park and Fruitridge Manor. Through the door-to-door distribution, more than 5,000 low-income households were reached in Oak Park, Tahoe Park, Colonial Heights and South Sacramento. Finally, the EBT incentive was promoted through tabling at other community events, including the Soil Born “Day on the Farm” event, State “Financial Literacy” Fair, Kaiser

"South Sacramento" Earth Day, Sacramento School District "Parent Information Exchange", South Sacramento "HUB" meetings and many other events. More than 2,000 families were reached during the report period through tabling at these events.

Goal 4: Increase number of EBT customers and EBT purchases by 100% by 2013.
Through promoting the EBT incentive and specialty crop promotion, EBT customers and purchases increased significantly in 2012 and 2013. In 2011, the Market had an average of 29 EBT customers each week and an average of $820 in weekly sales for a total annual EBT sales figure of $19,625. By the end of 2013, the Market had an average of more than 40 EBT customers each week and an average of $1,221 in weekly sales for a total annual EBT sales figure of $31,768.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

Through this project, the Oak Park Farmers Market provided several benefits to the specialty crop producers that participated in the Market. First, through the specialty crop promotion and EBT incentive, specialty crop vendors benefitted from an increase in their sales. Second, specialty crop vendors benefitted from attracting new customers and increasing customer loyalty.

Customers of all economic backgrounds benefitted from this project through their increased access to locally grown specialty crops, and their increased knowledge of how to use less common specialty crops (for example, bitter melon) through recipes and information provided by the vendors and Farmers Market staff.

During the first market season (May 2010 to Oct 2010), specialty crop vendors sold more than 20,000 pounds of specialty crops; this translates into more than 80,000 servings of fresh produce. Through this project, this figure increased to more than 60,000 pounds (240,000 servings) by the end of the 2013 Market season. Using an average of $1/lb. for purchases, this translates to a total of more than $60,000 in revenue to specialty crop farmers.

While these figures may seem modest in comparison to larger projects, the benefit to specialty crop farmers is greater than what these numbers indicate. This project supported small specialty crop farmers who are struggling to continue to operate during a challenging economic time. Many of the vendors were new to Farmers Markets and appreciated the Farmers Market staff efforts to support them as new and developing specialty crop vendor.

In addition, this project increased access to and appreciation of specialty crops for consumers who do not have convenient access to fresh, locally grown specialty crops. This project provided a promotion to encourage purchase of specialty crops and included a focus on low-income consumers. The Market is one of a smaller number in Sacramento that accepts EBT benefits for Cal-Fresh clients.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

In 2012, the Oak Park Farmers Market was awarded funding from the City of Sacramento Ann Land and Bertha Henschel Memorial Fund Commission and Rabobank to continue to provide a dollar for dollar incentive match for EBT for the 2013 season. In addition, the Market was recently awarded funding for the 2014 season from the City of Sacramento Ann Land and Bertha Henschel Memorial Fund Commission. Sacramento Neighborhood Housing Services has a strong and ongoing relationship with Rabobank and Rabobank was very pleased to partner on the EBT incentive. In the future, it is expected that Rabobank will continue to support the EBT incentive in some capacity.

One of the lessons learned for the Farmers Market staff during this project is the need to provide support to local farmers to develop their capacity and business acumen. Several specialty crop farmers were forced to stop participating in the market because of one or more reasons, including (1) limited staff capacity to staff a booth; (2) not having the equipment necessary (truck, canopy, etc.) to staff a booth; and (3) not having enough produce to participate, especially late season product.

These limitations held Farmers Market staff back from adding and retaining as many specialty crop vendors as had hoped during the project. To address this challenge, Farmers Market staff are currently developing a fact sheet of resources to help farmers access training resources and funding resources to help them build capacity to return to Oak Park Farmers Market and/or add additional Farmers Markets to help them sell more product.

Farmers Market staff also learned that farmers greatly appreciated efforts to support their sales by providing the specialty crop incentive and EBT incentive. Farmers directly benefitted from these programs, and several have noted to Farmers Market staff they had the largest percentage of sales increase at the Oak Park Farmers Market. They also appreciated the community feel of the market, including the live music, free yoga and special events that added to the community feel of the market, which was at no cost to the project.

The specialty crop incentive was very popular with customers, and provided opportunities for the Farmers Market to increase efforts to provide nutrition education through posting recipes and providing nutrition facts. The increased postings on the Market's Facebook increased traffic and helped add followers. By the end of 2013, the Market had more than 1,800 followers on its Facebook page.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

The Oak Park Farmers Market Facebook Page (https://www.facebook.com/oakparkfarmersmarket) includes postings of recipies featuring specialty crops, information and facts about featured specialty crops, and postings by customers indicating their appreciation of the Famers Market and the specialty crop promotion and EBT incentive.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 42	**Project Title:** Ecology Center Nutrition Food and Farming Policy Programs	
Grant Recipient: Ecology Center	**Grant Agreement No:** SCB11042	**Date Submitted:** December 2013
Recipient Contact: Martin Bourque, Executive Director	**Telephone:** (510) 548-2220, ext 234	**Email:** martin@ecologycenter.org

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

California's low-income populations suffer disproportionately from diet-related diseases, and in 2010, 1 in 8 Californians were in need of the Federal Supplemental Nutrition Assistance Program (SNAP). In 2011, California had gone from receiving $2.5 billion to $4.3 billion yearly in SNAP funds. As of December 15, 2012, California was receiving $7.09 billion in SNAP funds. Simultaneously, California specialty crop farmers struggled with high production costs and losses due to perishability that increases the farther California specialty crops are shipped. Industrial scale cooling, packing, and distribution houses take a share of profits out of farming communities, making direct sales to local shoppers a critical avenue for many small farmers to survive and thrive. EC sees this as an opportunity to drive a significant revenue stream to CSC growers by directly connecting farmers with new SNAP/Electronic Benefits Transfer (EBT) shoppers for the benefit of all. However, making that connection work is complex. Challenges of availability, affordability, infrastructure, policy, convenience, familiarity, and preference must all be addressed. A 2000 Berkeley Food Policy Council survey of low-income shoppers showed the top barriers to purchasing specialty crops were convenience, money, and knowledge about preparation. EC’s NFFP programs address these barriers in order to connect specialty crop farmers and urban communities with the goal of expanding the market for specialty crops and reversing California's epidemic of diet-related diseases.

EC received funding from the SCBGP in 2009 (Project 33) and 2010 (Project 39). Previously funded components that were built on in this project included:

1) Assisting 20 more Farmers' Markets/Associations in becoming EBT capable. In 2010 EC was able to help 33 California Market Associations (each with one or more farmers’ markets) become EBT capable. In 2011, EC assisted 47 new markets to provide EBT access for the first time. According to California Department of Social Services (CDSS), in 2011 only 39% of California's Markets were accepting EBT. EC is one of the only organizations bringing new markets online and funding in 2012 assisted EC in getting 62 more markets to accept EBT in order to connect more specialty crop growers to California’s billions in SNAP funds.

2) Increasing direct specialty crop sales by expanding EC's 4th Farmers' Market. In 2010 and 2011, funding supported EC’s 3 markets in Berkeley for $3.7 million in direct specialty crop sales annually. In 2010, EC

won the bid for a 4th market in neighboring Albany that opened in May 2011. 2012 funding helped EC to build direct sales for local specialty crop growers by growing the Albany shopper base and moving EC's South Berkeley Market to a new location where average weekly customer attendance has been 150% that of the previous location.

3) The Berkeley Food Policy Council (BFPC) was funded in 2010 and 2011 to convene and complete a strategic plan. Funding in 2012 enabled EC to build on past funding through the formation of the city-wide School Gardening & Cooking Initiative that has brought together a coalition from across the city to increase healthy food preferences in children and their families, increase self-efficacy for SPECIALTY CROPS preparation, and ensure the ongoing use of specialty crops in the Berkeley Unified School District's school lunch program.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

During this grant period, EC focused on specialty crop market expansion through: 186 Ecology Center Farmers' Markets (ECFM); piloting a Fruit and Vegetable Prescription (FVRx) program providing no-cost specialty crops via physician prescriptions for low-income patients with diet-related diseases; city-wide Berkeley Food Policy Council (BFPC) planning to increase specialty crop availability; and utilizing the Ecology Center's Statewide Farmers' Market EBT (SFM-EBT) program to provide assistance to 20 more Farmers' Markets/Associations statewide with getting and using wireless EBT devices. Activities began on January 1, 2012 and were completed on December 31, 2012.

The EC's expenditures in this grant were used solely support the competitiveness of California's specialty crops. The Ecology Center used strong internal fiscal mechanisms for ensuring this. All operational and subcontracted expenses were tracked and approved through direct project manager oversight and though monthly reporting and expense monitoring. Expenses were further reviewed and scrutinized by the financial staff prior to payment. Our electronic payroll system ensured that wages and benefit expenses are accurate. Any expense that was dedicated to the competitiveness of CSCs through growth and expansion of farmers' markets or EBT sales was billed at a maximum of our USDA approved 67% rate. For example, the contracted services to expand CSC purchasing through SNAP use at FMs were billed at the approved 67% level, even though recent evidence suggests that over 80% of SNAP purchases at FMs in California are CSCs.

Staff time spent on the Fruit and Vegetable Prescription Program (FVRx) was billed at a maximum of 67% even though 100% of the benefits of this program go towards CSCs vendors at the farmers market. The FVRx prescriptions themselves can only be spent on fresh fruits and vegetables and are thus billed at 100%. EC ensures that this is enforced through training, at-market inspection and oversight, and strict vendor re-imbursement policies. EC also trains staff that issues the prescriptions, participants, vendors, and market staff on this issue explicitly. The tokens used for this program say "Fresh Fruits and Vegetables Only" on each token, and market managers can only reimburse CSC vendors for prescription tokens.

Ecology Center Farmers' Markets (ECFMs)

Measurable Outcome Goal: ***Facilitate $4.3 million (up from $3.78 million in 2010) in direct farm-to-consumer Farmers' Market specialty crop sales, and expand EC's 4th ECFM to 36 weeks per year.***

The four ECFMs were open for 175 Markets total: the Tuesday Market in South Berkeley (50 markets), the Thursday Market in North Berkeley (50 markets), the Wednesday Market in Albany (25 markets), and the Saturday Market in downtown Berkeley (50 markets). This year had two major, added ECFM projects: renewing the permit for the Albany Farmers' Market 2nd year of operation, and moving EC's 27-year-old Tuesday Market to a location that provides greater food access for 11 census tracts in Oakland, Emeryville, and Berkeley that otherwise have very limited access to specialty crops. Many of the residents that are now being served by this move have no grocery stores within 1 mile other than Whole Foods, which they cannot afford.

Fruit and Vegetable Prescription (FVRx)

Measureable Outcome Goal: ***Provide physician prescriptions for free specialty crops for 6 months for 30 low-income pregnant women with 30 additional women in a control group, redeemable from specialty crop farmers at EC Farmers' Markets.***

During this grant period, EC partner, Lifelong Medical Care, identified and recruited 42 participants. The program had a 93% participant retention rate, a 96% token redemption rate, and 70% of participants became regular or frequent shoppers. In 2012, funding of FVRx allowed EC to leverage a position in Wholesome Wave's (WW's) national consortium of FVRx providers.

Berkeley Food Policy Council (BFPC)

Measurable Outcome Goal: ***Coordinate the implementation of the programs laid out in the 2010 BFPC strategic plan while continuing existing health and nutrition programs.*** The full BFPC met four times in 2012 (March, June, September, December); the BFPC Steering Committee met four times as well. No SCBGP funds were invoiced or used for any lobbying or advocacy work. As part of the work, key members of the BFPC, including EC's Executive Director, were instrumental in developing the statewide California Food Policy Council (CAFPC), now being facilitated by Roots of Change. The second major activity was the formation of a Berkeley Unified School District (BUSD) Working Group.

Statewide Farmers' Market EBT (SFM-EBT) program

Measurable Outcome Goal: ***Increase the number of Certified Farmers' Markets and/or Associations in California that accept EBT by a minimum of 20 (from 280 to 300) markets/associations.*** During the grant period, the SFM-EBT program helped 39 Market Associations representing 73 total Markets and over 1,000 specialty crop farmers to establish or implement an EBT program. This included 53 new Market locations opening access to new income for over 700 specialty crop farmers.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Ecology Center Farmers' Markets (ECFMs)

Measurable Outcome Goal: ***Facilitate $4.3 million (up from $3.78 million in 2010) in direct farm-to-consumer Farmers' Market specialty crop sales, and expand EC's 4th ECFM to 36 weeks per year.***

The four ECFMs were open for 175 Markets total: the Tuesday Market in South Berkeley (50 markets), the Thursday Market in North Berkeley (50 markets), the Wednesday Market in Albany (25 markets), and the Saturday Market in downtown Berkeley (50 markets). The Markets served 52 CSC farmers and over 478,000 local shoppers. Past EC farmers' market shopper surveys have estimated $60,000 in daily sales at the Saturday Market (50 weeks x $60,000 = $3,000,000) and $33,800 in daily sales at the Thursday and Tuesday Markets (50 weeks x $33,800 x 2 = $3,380,000). EC has not yet surveyed the Albany Market, so EC has very conservatively estimated Albany's sales at $10,000 per market ($10,000 x 25 = $250,000). This results in the ECFM's total sales of $6,630,000 for the 12-month grant period. When multiplied by 67% (to ensure only specialty crop sales are being reported), specialty crop sales for this grant period are estimated at $4,442,100.

The expansion of EC's 4th ECFM, the re-opening of the Albany Farmers' Market, faced significant delay. Concern by businesses in the vicinity, over the impact of the market on their businesses, held up the process. Ultimately, concessions made by EC, combined with tremendous community support, put EC on track for a re-opening on June 6, 2012. Unfortunately, the delays meant that the Albany Market could not achieve the expansion to 36 weeks in 2012 as planned, but rather 25 weeks. 36 weeks should be possible in 2013.

Fruit and Vegetable Prescription (FVRx)

Measureable Outcome Goal: ***Provide physician prescriptions for free CSCs for 6 months for 30 low-income pregnant women with 30 additional women in a control group, redeemable from CSC Farmers at EC Farmers' Markets.***

During this grant period, EC partner, Lifelong Medical Care, identified and recruited 42 participants who redeemed $6,170 of specialty crop prescriptions directly from specialty crop farmers at the ECFMs. The program had a 93% participant retention rate, a 96% token redemption rate, and 70% of participants became regular or frequent shoppers. In 2012, funding of FVRx allowed EC to leverage a position in Wholesome Wave's (WW's) national consortium of FVRx providers. The WW partnership included $6,000 that covered all of the prescriptions, and a stipend for the staff time required to execute and track the program. EC's project funds were shifted to cover supplies for SFM-EBT promotion activities. As part of the WW coalition, EC was required to synchronize its FVRx program so the data could be compared to others around the country. Due to the short growing season in the majority of the country, the WW study was only 6 months long with only four months of produce for participants. As such, the Measurable Outcome goal for the FVRx portion of this project was shifted slightly to provide prescriptions for four months for 35 low-income pregnant women total (a goal that was exceeded), all with pre-pregnancy Body Mass Indexes in the obese range. The method for filling prescriptions and the involvement of the specialty crop farmers stayed the same; there was no longer a control group.

Berkeley Food Policy Council (BFPC)

Measurable Outcome Goal: ***Coordinate the implementation of the programs laid out in the 2010 BFPC strategic plan while continuing existing health and nutrition programs.***

The full BFPC met four times in 2012 (March, June, September, December); the BFPC Steering Committee met four times as well. No SCBGP funds were invoiced or used for any lobbying or advocacy work. As part of the work, key members of the BFPC, including EC's Executive Director, were instrumental in developing the statewide California Food Policy Council (CAFPC), now being facilitated by Roots of Change. The second major activity was the formation of a Berkeley Unified School District (BUSD) Working Group. Budget cuts have left BUSD's garden and nutrition programs imperiled. These programs have been shown to have a major impact on the CSC preferences of children and on their ability to recognize, prepare, and enjoy a wide variety of specialty crops. To ensure the ongoing stability and growth of these vital programs (and shopper base for specialty crop growers), the BFPC formed the BUSD Working Group, which has now become the Superintendent's Cooking & Gardening Taskforce. The Task Force developed two subcommittees, one that is focused on curriculum development for a district-wide program that builds on the last 10-years of program findings, and the other focused on identifying and pursuing funding for the BUSD program. In addition to these larger efforts, each BFPC meeting provides the members with training on current issues and topics related to specialty crop consumption, farming, and/or health. BFPC members also share findings and resources across programs and numerous partnerships have developed. One example is EC's new partnership with the Alameda County Department of Public Health and the Alameda Department of Social Services for the delivery of farmers' market tours, nutrition education, and cooking classes in nearby Hayward and Oakland.

Statewide Farmers' Market EBT (SFM-EBT) program

Measurable Outcome Goal: ***Increase the number of Certified Farmers' Markets and/or Associations in California that accept EBT by a minimum of 20 (from 280 to 300) markets/associations.***

During the grant period, the SFM-EBT program helped 39 Market Associations representing 73 total Markets and over 1,000 specialty crop farmers to establish or implement an EBT program. This included 53 new Market locations opening access to new income for over 700 specialty crop farmers. The SFM-EBT program is also having a cumulative "snow ball" effect. According to CDSS: as of December 1, 2012, there were 145 new EBT California farmers' market (CFM) authorizations in 2012, compared to 41 in 2011; and the total CFMs with EBT authorization in 2012 grew to 279, up from 142 in 2011. Funding for SFM-EBT and the added funds shifted from FVRx were also used to: a) include SFM-EBT information in its quarterly mailing; b) present at three statewide conferences on the ease and importance of adding EBT at Markets; c) increase statewide EBT tracking at markets to include the number of specialty crop farmers being served and the number of weeks the market is open; d) work with CDSS to provide outreach and technical support to markets/associations for Food and Nutrition Service (FNS) applications to obtain multiple Point Of Sale (POS) devices under a single FNS number; e) partner with Roots of Change on county by county tracking and education on EBT accessible markets; f) execute a training for market managers and partners in San Diego; g) present to county staff and farmers' market managers in Santa Clara; and h) produce and distribute SFM-EBT outreach/promotional materials to partner markets statewide.

Please see Attachment A to view the Performance Measure Table.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

Through the Farmers' Market EBT Program EC served 1,000 specialty crop vendors at 73 markets by helping the market associations to move forward in accepting and promoting EBT. It is important to note that FNS doesn't distinguish between a market and a market association. (For example, EC's four Farmers' Markets would count as one market in FNS's count.) Using FNS's counting system, the 73 new markets that EC helped become EBT authorized would only be counted as the 39 market associations. According to FNS, EBT redemptions at California farmers' markets from January 1, 2012-November 30, 2012 equaled $5,215,825. Using past FNS reports showing the average annual EBT transactions per authorized market association to be 727 and the average redemption per market association to be $15,456, if the 39 market associations brought online for EBT sales with this project each made the average of $15,972 in new EBT sales, this would mean that in 2012 there were 24,160 new EBT shoppers/transactions that resulted in $511,104 in new EBT redemptions that went directly to specialty crop farmers.

At the EC Farmers' Markets EC directly served 52 specialty crop growers with at least $4.4 million in direct farm-to-consumer sales. The BFPC is benefiting the specialty crop growers and at-risk community members that the Council's members serve. The BFPC is bringing together specialty crop growers, service providers, government, Berkeley's children, and at-risk residents to change the way people shop, eat, and live. FVRx benefited EC's 52 specialty crop growers who benefited from new shoppers and over $6,000 of new revenue, and 42 obese, under-resourced pregnant women and their entire families with nutrition education, cooking classes, and free produce to help build healthier shopping and eating habits.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

EC has opened two markets in business districts in the last two years; the organization has learned a lot about how to work with businesses for the benefit for all. The challenge is that while the overall district may benefit, individual businesses may suffer. EC now works to proactively identify those businesses to offer them greater visibility and promotion opportunities within the market to ensure all that the farmers' market is a universally positive force for the community's residents and businesses owners.

EC has learned that this program really works. However, EC has also learned that there are both benefits and challenges to working in the context of a national program. Working with WW put EC into a greater pool of data, but has also removed EC's readily available access to the data.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

None.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 43	Project Title: Plant It, Grow It, Eat It!	
Grant Recipient: Life Lab Science Program	**Grant Agreement No:** SCB11043	**Date Submitted:** December 2014
Recipient Contact: Don Burgett	**Telephone:** (831) 459-3833	**Email:** don@lifelab.org

Project Summary

California is the largest producer of specialty crops in the world. Even with the abundance of produce available, few children eat their fruits and vegetables, leading to rising rates of childhood obesity. According to the California Center for Public Health Advocacy, in nearly 65% of California counties, at least one in four children are overweight. Current research shows that students involved in garden-based nutrition education increase their fruit and vegetable consumption by 2.5 servings per day (McAlseese and Rankin 2007). The workshops in this project include activities that promote understanding and encourage increased interest in the consumption of California Specialty Crops. This project's focus was to provide nine full-day Creating and Sustaining Your Garden (CSYSG) workshops that instruct educators to create and sustain school gardens to grow California specialty crops. Also, provide 12 full-day Garden-Enhanced Nutrition Education (GENE) workshops that instruct educators how to use gardens for GENE instructions; 12 Train the Trainer workshops to train other school garden promoters; and 60 workshops conducted by new trainers, who will receive the mini-grant stipends to provide trainings in their communities.

Note: The grant agreement and initial proposal refers to a workshop entitled Plant It, Grow It, Eat It (PIGIEI). During the workshop development process, Life Lab Science Program (LifeLab) changed the name of the workshop to Garden-Enhanced Nutrition Education (GENE) in an effort to make the title of the workshop more specific to the project's goals and objectives.

Through Life Lab's research, it was found that teachers and children consumed more fresh fruits and vegetables after receiving the workshop trainings and garden-based curriculum in schools; as a result, this benefited specialty crop farmers, as well as the health of California children and adults. School gardens have continued to grow in popularity and there was a need to educate teachers and students to use school gardens effectively, connecting them to the real world of crop production and benefits of healthy eating. In 2009, the California Department of Education (CDE) included the California Instructional School Garden (CISG) grant program, which provided over 1/3 of all school's financial support to create or enhance school gardens. With 3,900 schools now interested in using school gardens, it was critical that LifeLab provide technical and instructional support to these schools through this program.

While this project does not build upon a previous Specialty Crop Block Grant Program-Farm Bill project, it does build on two previous federally-funded grants. The 2007 Specialty Crop Innovation grant was a collaborative effort of Life Lab/University of California (UC) Santa Cruz, UC Davis, San Diego Resource Conservation District, and the California Department of Education (CDE) to enhance learning in school gardens. Under this 2007 grant, Life Lab trained 56 educators at 16 schools; as a result, reaching 8,570 children in California. In addition, under a 2008 Specialty Crop Block Grant Program grant, Life Lab collaborated on a statewide movement to promote fresh fruits and vegetables.

This project further enhanced the previous grant programs by training more educators to (CSYSG), and brought in a new workshop on (GENE), which focused solely on giving teachers the skills to promote the consumption of fruits and vegetables by utilizing school gardens.

Project Approach

2011-2014:
The summary of total workshop participants trained by project partners is as follows: 326 people in 12 GENE workshops; 176 people in 9 CSYSG workshops; 150 trainers in 12 Train the Trainer events. Project partners oversaw 27 CSYSG and 29 GENE mini-grant funded workshops that served 1,077 participants (565 CSYSG and 512 GENE). Total of 1,579 educators trained (1,729 with the addition of train the trainers included). Project partners shared Life Lab's project model and resources at six conferences reaching 229 people.

2011-2012:
The project team revised the CSYSG workshop and created online resources to share workshop materials, which was easy to understand and efficient to access from anywhere. Also, conducted six CSYSG workshops to 101 participants, as well as created and conducted six CSYSG Train the Trainer workshops for 87 new trainers. 30 CSYSG mini-grant applications were distributed and commenced in the fall of 2012. Additionally, collaborating partners developed and piloted three GENE workshops serving 80 participants. On October 25, 2012 UC Davis shared the CSYSG model and resources to 37 participants at the California Foundation for Agriculture in the Classroom Conference (CFAITC).

2013
27 CSYSG mini-grant funded workshops were completed across the state, serving 565 educators. Project partners led six GENE workshops for 164 educators. Additionally, project partners conducted six GENE Train the Trainer workshop events for 63 trainers. GENE web-based resources were created for educators and trainers. Later that same year, additional project partner CSYSG workshops were conducted for 50 more educators. Project partners shared the GENE workshop model and resources at the following conferences: July 12, 2013 for 50 participants at California Foundation for Agriculture in the Classroom Conference in San Diego, California. October 25, 2013 included 45 participants at the California Science Teachers Association Conference in Palm Springs, California. November 20, 2013 included 27 participants at the Northern California Farm to School Conference in Stockton, California.

2014
29 GENE mini-grant funded workshops were completed across the state, serving 512 educators. Three project partner GENE workshops were conducted for 82 educators. One project partner CSYSG workshop was conducted for 25 educators. Project partners shared the GENE workshop model and resources at the following conferences: January 23, 2014 for 70 participants at the Ecological Farming Association Conference in Asilomar, California and February 8, 2014 for 38 participants at the Early Childhood--Science, Technology, Engineering, and Math (STEM) Conference in Costa Mesa, California.

This project was not designed to promote other commodities as the project's primary focus was promoting consumption of fresh fruits and vegetable which are a California specialty crops.

Life Lab's project partners worked closely to develop the workshop materials; in addition to that, project partners were responsible for seven workshops and four Train the Trainer workshops for a total of 33 workshop events (11 each). Project partners also reviewed mini-grant applications from their region and each directly managed 20 mini-grant funded workshops.

In addition to creating workshop content, conducting workshops, and managing mini-grant funded workshops, the lead partners UC Davis and San Diego Resource Conservation District (RCD) each shared the workshop model at state-wide or regional conferences. UC Davis shared the workshop model at the CFAITC conference in Sacramento, California and Northern California Farm to School Conference. San Diego RCD shared the workshop model at the CFAITC Conference in San Diego, California. Project lead partner UC Davis, was instrumental in bringing webinar capabilities to this project. They created the Train the Trainer webinar component that was delivered in place of the face-to-face Train the Trainer day, and paired that with face-to-face time during the workshop observation day. This Train the Trainer webinar model seemed more efficient and economical, and the future plan is to implement similar webinar training programs. Additionally, UC Davis created and ran webinars to support and assess the mini-grant funded workshops.

Western Growers, who manage the Collective School Garden Network (CSGN) website, supported the project by hosting materials for the GENE and CSYSG training programs. Additionally they helped to communicate and interpret the training events. The program evaluators worked to create an evaluation tool to assess pre and post effectiveness of GENE lessons, and to compile all the post workshop evaluation surveys. Finally, the 37 recipients of the training mini-grants subsequently conducted their own 56 mini-grant funded workshops to 1,077 educators.

Goals and Outcomes Achieved

Project Partner outcomes:
The project met its first goal by reaching 1,077 educators through 12 Train the Trainer workshop events that trained 150 new trainers. These new trainers provided 56 workshops for 1,077 educators. Project lead partners conducted 12 Train the Trainer workshops to 150 potential new trainers. 37 of these people, who were trained, subsequently conducted their own 56 workshops across the state. Furthermore, project's lead partners and evaluators provided pre and post test vegetable "Rate the Taste" evaluation tools for workshop participants to conduct prior to, and after sharing GENE lessons learned at GENE workshops. Post-test results suggested that children reported liking fruits and vegetables more at the conclusion of the project than at the beginning. Also, it seemed that the types of foods children preferred broadened in variance after the workshops, as evidenced by the post-test results.

Educator outcomes:
It is difficult to project the future behavior of workshop participants, but based on the final survey of CSYSG and GENE workshop, Life Lab has short-term data that is on a positive trajectory toward significant long-term achievement of increasing fruit and vegetable consumption. Participants in the final survey stated that after the CSYSG workshops, 27% had started gardens, 77% had existing gardens, and 63% increased hands-on learning in a garden. The same participants stated that after the workshops, they had marked improvements in their skills and abilities for garden based implementation. For example, 92% stated they had some or significant improvement in their effectiveness in implementing garden-based activities. Ninety percent stated that students improved or significantly improved their healthy eating choices.

The GENE workshop participant feedback demonstrated similar trends, for example, 57% stated they have increased the total amount of fruits and vegetables grown and harvested. Seventy-six percent had increased the fruit and vegetable tasting and activities, while 68% stated that they have increased the time spent using a school garden to teach nutrition education. After the workshop, 94% of the participants stated they observed significant improvement in the children's attitudes toward fruits and vegetables. Ninety-one percent saw some or significant improvements in the children's consumptions of fruits and vegetables. Interestingly, there were changes observed in families as well. For example, 78% saw some or significant improvement in families' attitudes toward fruits and vegetables, while 76% noticed some or significant improvement in the families' consumption of fruits and vegetables.

Student Outcomes:
The attitude and perception of teachers, students, and their families about fruits and vegetables identified in the survey of CSYSG and GENE workshop was shown by the "Rate the Taste" Assessment. The "Rate the Taste" assessment activity was developed to assess whether children's attitudes and willingness to eat fruits and vegetables would change after they participated in garden-based nutrition activities. Teachers and garden educators participated in the assessment after completing one of the GENE Workshops held across the state in 2013. All materials required for the assessment were sent to participating programs in October 2013, and returned by January 2014. The "Rate the Taste" activity involved a pre-test fruit and vegetable tasting, followed by a minimum of two garden-based nutrition activities; and then a post-test activity using the same fruits and vegetables methodology. The children rated each fruit and vegetable on a five-part 'like' scale that gave 1 point for loving a food, and 5 for disliking it. Thus, a lower score represented an improvement in attitude and willingness to eat a fruit or vegetable. Ten teachers and garden educators successfully completed the assessment protocol. 187 children from pre-kindergarten to 5th grade successfully completed both "Rate the Taste" activities. Decreased average and sum ratings at post-test suggested that children reported liking target fruits and vegetables more at the conclusion of the project. Furthermore, it suggested that the types of food children preferred increased in variance and number at the time of the post-test. Results also showed that cucumbers, strawberries, kale, lettuce and potatoes were all rated as being most liked at the post-test. Only tomatoes were rated as being less liked.

The actual accomplishments compared to the actual goals established are as follows:
Life Lab Science program trained 1,729 educators in CSYSG and GENE workshops compared to established goal of 1,500. Trained 150 new trainers of whom 37 subsequently taught 1,077 other educators, compared to the initial goal of 180 new trainers of whom were intended to subsequently teach approximately 900 other educators. Increased the number of trainers who received workshops from 56 to 206 compared to the initial goal of 116 trainers. Conducted 56 mini-grant workshops across the state compared to the established goal of 60 workshops. Lead project partners conducted 33 workshops across the state compared to the initial goal of 33 workshops. Lead project partners shared workshop model at six statewide and regional conferences compared to the initial goal of two statewide or regional conferences. And finally, 57% of the students showed to have an increased preference for fresh fruit and vegetables after participating in GENE lessons compared to no established or known percentage in the beginning of this project.

This project was primarily a training and outreach program rather than a research based project; there was no established baseline data collected at the start of the project. In the beginning of this project, there were 56 trainers that have been previously trained in conducting CSYSG workshops, and the initial goal was to have 116 new trainers; this goal was exceeded by 150 trainers.

The Rate the Taste Assessment initiated in September 2013 and completed in January 2014 demonstrated the impact of garden-based activities on children's nutritional attitudes and choices. This assessment was comprised of taste test assessments completed by students prior to, and after the garden-enhanced nutrition education. Educators were recruited from the GENE workshops held in 2013. Thirty three teachers or garden-educators agreed to participate after being contacted. All participants were sent a packet of instructions and class materials appropriate to their class age groups. Of the 33 participants, ten fully completed the assessment protocol. Five provided partially completed materials, and three returned completed materials but were not included in the data because they had not completely followed the assessment protocol. The ten completed assessments reflected the geographic areas of the state and the range of grades. Five were from Northern California and five were from Southern California. The grade levels were: prekindergarten (1), kindergarten (1), first grade (4), second grade (1), third grade (1), third grade special education (1), and fifth grade (1).

The results reflected moderate gains in attitudes and willingness to taste fruits and vegetables after a minimum of three garden-based nutrition experiences. One hundred and eighty seven children fully completed the pre and post assessment fruit and vegetable tasting activities in addition to the intervening garden-based nutrition curriculum activities. Fifty-seven percent (106 children) of the participants increased their preferences for fruits and vegetables. 14% (27 children) showed no change in preference, and 29% (54 children) showed a decrease in preference for the same fruits and vegetables during the second tasting activity.

Cumulative analysis of evaluations for CSYSG, CSYSG Train the Trainer, GENE, and GENE Train the Trainer workshops revealed that the majority of participants (over 90%) were satisfied with their trainings and benefited significantly from the shared resources and materials, hands-on trainings, and networking provided by this project. Workshops were evaluated individually and then cumulatively to assess quality of trainings, and then again at the conclusion of the project to assess overall impact of project. Major successful outcomes included: 1,729 educators attended CSYSG, GENE, or Train the Trainer workshops; 150 new trainers were trained at Train the Trainer workshops; 56 mini-grant funded workshops were conducted serving 1,077 educators; lead project partners shared workshop model at 6 statewide and regional conferences; 57% of the students sampled showed to have an increased preference for fresh fruits and vegetables after participating in GENE lessons.

GENE Workshop Participant Final Survey results are as follows:
77% of final survey respondents stated they increased the amount of fruits and vegetables they tasted/ate with students. 67% said they increased time spent using the garden to teach nutrition education. 97% noted some (56%) or significant (41%) marked improvement in their effectiveness in implementing garden-enhanced nutrition education. 75% noted some (59%) or significant (16%) marked improvement in student's families' consumption of fruits and vegetables.

CSYSG Workshop Participant Final Survey results are as follows:
27% installed a school garden; 76% improved an existing school garden; 73% shared what they learned from the Creating and Sustaining Your School Garden workshop with colleagues; 93% noted some (45%) or significant (48%) marked improvement in their abilities to access resources to support their garden program.

Beneficiaries

This project benefited children, principally, as demonstrated in the goals and outcomes; as a result of this project, participating children ate more fruits and vegetables and increased their preferences for fruits and vegetables. Below are some of the qualitative reflections and excerpts collected from students and teachers on the impact this project had.

"[My favorite thing I learned about in the garden was] drinking strawberry water. It tastes good and it's good for you." - 4th grade student, after making strawberry lemonade on a hot day and talking about the vitamins in strawberries.

“After my kindergarten students experienced "eating a rainbow" and the rainbow body… while eating their mid-morning snack at the snack table, they would hold up vegetables and fruits and bring them to the part of the body that the vegetable or fruit made healthy and say things like "my carrot is eye food" or "my grapes are brain food" - Teacher

“One of my high school students is on the football team. One day when we were working on our school garden I saw him staring at the football field. When I asked him what he was doing, he said, "I was just thinking about how much food we could grow if we converted this football field." – Teacher

“I am a community partner working in an elementary school that has a majority of youth in the free and reduced lunch program. They often get vegetables they do not like in the packaged meals and have a bad association with eating their vegetables. We grew fresh carrots in the garden and the kids came out of the garden so happy to be carrying their harvest! In fact, it has made them more adventurous to try new items that the school district is implementing. Some kids I never expected to be trying new items are eating and enjoying raw sweet potatoes! Just like me, when you invest time into something and care for it, you are that much more likely to try it and be empowered to grow more!” – Teacher

“I didn't know worms and bugs were so much fun to play with! I didn't know I liked Kale! Now I know I like 3 different kinds of kale!” – Student

“I never ate a snow pea pod before, now I will eat millions!” - Student

These children, in return, impacted their families. Here are some of reflections and excerpts from parents on the impact this project had:

“Hello, So my daughter has learned so much from you this year and I just wanted to say thank you! Her excitement over the school garden has been super cool. Today, as we walked into Sprouts to get our produce, I told Hannah she got to pick out 5 fruits and veggies. In the store, she came bouncing up to me with excitement, telling me she wanted jicama. Hannah told me she just tried it at school with you, that it is delicious, and she wants it at home. I know you also made green smoothies at school this year, which helped me in getting Hannah to drink the green smoothies I make at home. Thank you!!! I've always tried to introduce Hannah to a variety of fruits and veggies, but without fail some of my favorites (spinach, pineapple, cucumber) are ones Hannah won't eat. I'm happy to see Hannah finding healthy foods that excite her and can become her favorites. Thank you for all you do for our kids. It has not gone unnoticed!” - Parent

“I've run into students in the grocery store who were with their parents, buying ingredients so that they could make a recipe that we made in class. I think that shows that the classes are having an impact on students and their families.” – Teacher

“A parent said, "Oh my gosh, my son who would never eat vegetables wants us to grow (and eat) everything at home that you have grown at school!" ” - Teacher

"I can't wait to go home and tell my mom about these vegetables, and to ask her to buy some." - Student

The workshops also impacted teachers, informal educators; and also empowered a new cadre of trainers to lead educator workshops statewide. 593 educators, or 86% of the educators trained in GENE reported they had more ideas and resources for using an edible garden to engage young people in “hands-on nutrition education” after their training.

Initially, this project faced a challenging goal to reach. The goal was to train 700 educators in CSYSG or GENE workshops; 1,579 educators were trained by the end of this project. These trainings fundamentally change the attitudes and eating habits of children and their families. The research indicated that a garden-based curriculum focused on fruits and vegetables had the potential to increase consumption by 2.5 servings per day (McAlseese and Rankin 2007). More recent research by Heim and Stang (2009) supports the increase in positive attitudes, willingness to eat, and asking behaviors by children involved in a short-term garden-based curriculum. The research was confirmed by the “Rate the Taste” assessment conducted as part of the evaluation of this project. A more positive attitude and willingness to try fruits and vegetables after only a few garden-based activities was noted.

By utilizing the work done by McAlseese and Rankin (2007), there can be an estimate of the number of beneficiaries and the potential economic impact of this project. 1,579 educators have been trained in our CSYSG or GENE workshops. It was estimated that each one of those educators will work with about 30 children during an academic year. Using the research that estimates each child will increase their daily intake of fruits and vegetables by 2.5 servings, expectations can be 118,425 (1,579 x 30 x 2.5) additional servings per day. On an annual basis (118,425 x 365 days) there will be an additional 43,225,125 servings. The Produce Marketing Association’s publication “The Cost of the Recommended Daily Serving of Fresh Produce” 2010 http://www.dhhs.nh.gov/dphs/nhp/documents/costfv.pdf estimates each vegetable serving at $.21 and each fruit serving at $.28. By multiplying the average serving cost with the total number of yearly servings (43,225,125 x .245), the potential increase in specialty crop revenue would be around $10,590,156.

Lessons Learned

Training trainers can be a powerful act; sustained networking and support opportunities can maintain the momentum of a workshop well past the presentation date. Specifically, mini-grant recipients who had led their own CSYSG or GENE workshops after a Train-the-Trainer event together via webinar, shared successes and challenges, as well as gathered feedback to shape future work in this field. In these webinars, it was discovered that these trainers often took what they have learned far beyond leading only one workshop. For example, a middle school teacher from Valley Springs, CA has taken the inspiration of the Train the Trainer workshops and conducted additional workshops, independently from this project. Additionally, this teacher has helped to form the Mother Lode farm to school regional network. This confirmed that it can be very helpful for trainers to have this level of ongoing networking with one another, and to develop a Professional Learning Community where they can ask questions and share ideas for improving the trainings.

One lesson learned was that it can be very challenging and costly to collect useful data on consumption of fruits and vegetables. The initial plan was to have teachers ask students to complete food diaries, but many teachers reported that this homework assignment was challenging for the age groups of children. Instead teachers suggested an in-class taste test before and after engaging students in GENE, which proved more achievable. Still, some educators were already doing some GENE before the pre-test was given, which added unintended variety into the baseline data. Also, this assessment tool required teachers to provide five fruits and vegetables for the children to taste before and after their GENE classes, and for some educators, that requirement proved cost prohibitive.

The workshops were tremendously popular; in the pilot round of GENE lead partner workshops; there were 179 applicants for 80 spots. During the first year of GENE workshops, 235 applied for 164 spaces. It was rewarding to observe the impact this project had not only on children, but also on their families. As described above, the final survey submitted by educators who took the workshop had positive outcomes: 78% of respondents reported some or significant improvement in families' attitudes toward fruits and vegetables, and 76% noticed some or significant improvement in the families' consumption of fruits and vegetables. In any similar future project, it is important to provide extra focus on educators and make sure they have necessary resources to send home with families and/or preparing educators to lead events that might include families.

Stated goal of this project was to fund 60 (30 CSYSG and 30 GENE) workshops across the state via mini-grant workshop awards. These 60 workshops were intended to train 700 participants. Only 56 mini-grant workshops occurred during the project period serving 1,077 participants. It fell short by four mini-grant funded workshops, but surpassed the initial goal of training 700 new trainers by 377.

There were over 60 mini-grant workshop awards that were requested, but this project was only able to fund 60. For various reasons, four of these 60 were not able to lead a workshop. In hindsight, there should have been more than 60 awarded or included on a wait-list, assuming that some of the awardees would not be able to follow through with their intentions. From this experience, a lesson learned was to set earlier deadlines and increase communication with mini-grant awardees during their mini-grant period. The unused four mini-grant funds were reallocated to provide additional curriculum and teaching materials to the mini-grant recipients who did deliver workshops in their communities.

The initial plan was to train 180 new trainers in the CSYSG and GENE Train the Trainer workshops, but only 150 were trained. The lower than expected number was possibly due to the under-estimation of the costs/time associated with observing a training and participating at a Trainer the Trainer workshop. Additionally, it was apparent that not all attendees of the Train the Trainer workshops felt ready to lead workshops of their own. Some of the Train the Trainer events were modified to be webinars versus face-to-face gatherings because it was preferable by a good number of Train the Trainer participants as it reduced travel time and costs. In the future, increasing the mini-grant award amount, and conducting Train the Trainer workshops via webinar would help recruit more future trainers.

As far as the Food Diary, the impact of GENE curriculum needed to be assessed, specifically; it's impact on children and their family's attitudes and eating habits by using the Food Diary activity. However, the complexity of the assessment tool and the cost of coordinating the assessment proved to be too difficult. The cost of the assessment was underestimated, and some GENE mini-grant workshop participants did not find it a realistic assessment. The food diary assessment provided the most relevant information about the actual eating habits of children and families in the home. In the future, a larger budget would allow this type of assessment to be more successful.

As far as the Rate the Taste Assessment, GENE mini-grant participants were asked to sign up to participate in the assessment. There was no stipend to cover the extra work involved. There were over 30 participants who signed up from around the state, but only ten correctly completed the entire pretest, GENE activities, and post-test protocol. In the future, offering an additional stipend for the assessment may significantly increase the number of participants who successfully complete the assessment.

Additional Information

Our project had extensive web resources developed to share our content.
www.csgn.org/gene 7 extensive pages have been created to share garden-enhanced nutrition education resources.
www.csgn.org/gene-trainer this page has downloadable trainer material packets which include trainer outlines and all handouts as well as two power point presentations to support workshop delivery.
www.csgn.org/csysg 12 extensive web pages have been created to share resources for creating and sustaining school gardens.
www.csgn.org/csysg-trainer this page has downloadable trainer material packets which include trainer outlines and all handouts as well as two power point presentations to support workshop delivery. Additionally there are many CSYSG resources that been translated into Spanish.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 44	**Project Title:** From the Mouths of Babes: A Children's Campaign for Home-based Food Access – a *working model for fresh food accessibility & food security in small rural communities.*	
Grant Recipient: RISE (Rural Innovations in Social Economics) Inc.	**Grant Agreement No.:** SCB11044	**Date Submitted:** December 2014
Recipient Contact: Cathie M. Wicks, Ag Projects Coordinator	**Telephone:** (530) 787-4110	**Email:** cathie@riseincservices.org

Project Summary

California rural communities typically experience a counter-intuitive phenomenon: the large numbers of agricultural workers who produce the finest specialty crops in the world rarely eat them. This project defied that trend by creating a sustainable and engaging community food model. The immediate, primary benefits were an increase in food security and access, the provision of seasonally fresh food, and enlightened children to combat obesity, re-focus community health consciousness, and increase rural self-sufficiency.

This project is a working model for re-shaping attitudes, accessibility, and food security in small rural communities of California. The project is a paradigm reversal: it teaches children, not adults, how to garden and become ambassadors of edible landscapes, building a community food system using school-home-community resources effectively. The project establishes a sustainable concept of edible schoolyards, community garden networks, and edible residential landscaping to change food security for low-income, under-served rural populations. The impact will be communities that strategically shift their food production for family use to community sites and home landscapes, making food sources accessible, user-friendly, and family-focused.

Access to healthy foods in rural and low income areas is pivotal to improving self-sufficiency, self-reliance and family health. California has an expansive growing season, rich soils, and residential communities perfect for edible landscape conversion. This project solely benefits specialty crops: it promotes specialty crop production in school, community and home environments; it encourages enhanced accessibility, increased consumption, and convenience harvesting; it supports innovative resource utilization and water conservation through specific crop production strategies. This project uses specialty crops as the foundation to establish a sustainable concept of edible schoolyards, community garden networks, and edible residential landscaping. It targets food security for low-income, under-served rural populations. The project creates a sustainable community food model using specialty crop production.

Adults in rural communities are often mired in tradition. Innovative food access models are not readily available. Families, especially children, suffer from food inaccessibility, poor eating habits, and affect public health systems. This project is a working model for re-shaping attitudes, accessibility, and conscientiousness to address food security and healthy eating in small rural communities. The California Central Valley is uniquely positioned to capitalize on edible landscaping in schools and community sites and home yards as a viable, integrated food system. The project actualizes the opportunity by teaching children, not adults, how to grow fresh food and become ambassadors of edible landscapes. The project builds a community food system through trained children/youth as the agents for family food production, eating nutritiously, and using school-home-community resources effectively. The successful model can be duplicated in other isolated, rural communities to build community commitment to innovative off-farm food solutions.

Project Approach

Activities Performed throughout the Project Term: Site Development: The Edible Schoolyard campus site was established, sustained, re-planted (when appropriate), and maintained as part of the "edible schoolyard" project. This schoolyard conversion includes (1) an orchard established (designed & planted) to provide fresh seasonal fruit and tree landscape care/maintenance; (2) the expanded front school entry project – a complete edible landscape - that includes the entire width of the entrance to the school; (3) the "Adopt-A-Box" project which gives older students with "ambassador-level" interest the opportunity to do box gardening (raised bed gardening) year round; (4) the Children's Garden designed to offer unique edible landscape ideas to delight the youngest children on campus (tree stump sitting area, pole bean teepee, sunflower house); (5) the Herb and Perennial Garden for taste testing exploration, (6) the North Campus Training Gardens; and, (7) the Potato Patch that is a suitable home and ground storage area for growing potatoes. In the last quarter, a 120 sq. ft. greenhouse (donated by a local hardware store) and a melon growing area (approximately 200 sq. ft) were added to the school garden areas. This brings the total sq. ft. of Schoolyard Edible Landscape to 11,420 sq. ft. [100+% of Plan]. In addition, the Community Garden completely developed a 1.5 acre site. This objective also achieved at 100% of Plan. Teaching Stations/Learning Labs: Ten teaching stations ("project labs") were implemented. The creation of 10 Teaching Stations / Learning Labs as proposed is 100% complete. Work and emphasis is continuing to be placed on curriculum development and increased utilization by students, student "ambassadors", and classrooms. Due to the drought, special attention was given to water conservation methods. Children Grades K-8 Achieving "Ambassador" Status: Eighty (80) children K-8 grades achieved "ambassador" status; this objective completed at 106% of Plan. {Goal: 75 "ambassadors"; Final Outcome: 80 "ambassadors".} New "Active" Learners: Two hundred and eighty-six (286) K-8 children were actively involved with sufficient repetitive participation to be considered "active learners" 95% of planned objective for entire Grant period was achieved. {Goal: 300 "active learners"; Final Outcome: 286 "active learners".} Food Production: In the last quarter of the grant term, winter crops grown on campus were harvested including asparagus (perennial), artichokes (perennial), leek, onions, lettuce (various kinds), spinach, turnips, chard (various varieties), strawberries & herbs (various kinds). Final harvests of these commodities netted over 184 pounds, harvested by children, teachers and classrooms. Minimum days continued to feature the "G2T" (Garden-to-Table) events that are especially popular with campus children/youth. Final summer crops were planted in April and May. They included cucumbers (3 types), squash (4 types) tomatoes (numerous varieties), okra, peppers (5 types), melons (5 types), sweet corn, beans, peas, pumpkins and numerous other specialty crops. These are being harvested through June 30, 2014; 1,368 pounds of summer crops have been harvested. For the entire grant term, a total of 8,186 pounds of food were produced and harvested by children. This is 113% of Plan. This outcome has been admirably achieved. {Goal: 7,200 pounds of food produced and harvested; Final Outcome: 8,186 pounds of food grown and harvested.}

This project was solely devoted to edible, harvestable, and/or garden-benefitting specialty crops/commodities.

The School Board responded enthusiastically to any requests made by the Project. They have been flexible with requirements and campus rules to allow the Project specialized resources and unique on-campus privileges. They have provided maintenance worker time to assist to identify existing water lines, install useable water valves, and alter, when necessary, water availability. They have allowed off-campus visitors during school hours to visit tour and discuss the gardens. In Board meetings, they have been unanimously enthusiastic about the Project. Teachers have voted to continue and expand the utilization of the gardens into the regular school day and authorized an application to the California Teachers Association-Chapter for funds to continue the garden effort. On-campus staff assisted to prepare two additional grants (Sierra Health Foundation, Monsanto) to continue the project after June 30, 2014. Farmers have continued their active engagement; they have been a constant source of donated seeds, consultation expertise, and support. The FFA Chapter has allowed use of their greenhouse for projects and the community person who owns the site for the off-campus Community Garden has upgraded her well to insure the success of the project. This project was very well-received with partners and in the community, and it continues to be popular with students.

Goals and Outcomes Achieved

● Site Development: An edible landscape was incorporated into the Esparto K-8 School, providing seven (7) distinctive gardens at the school, in various locations (including an edible landscape as the entire entrance to the school). A total of 11,420 square feet of landscape was converted, 100+% of Plan. In addition, the Community Garden completely developed a 1.5 acre site; this objective was also achieved at 100% of Plan. ●Teaching Stations/Learning Labs: Ten [10; 100% of Plan] teaching stations ("project labs") were implemented and continued as important, functioning components of the project; this represents 100% of Plan. ●Children Grades K-8 Achieving "Ambassador" Status: The Plan was to skill-build to an "ambassador" level 75 local children; a total of 80 children achieved competency and "ambassador" status. This objective performed at 106% of Plan. ●Children Grades K-8 participating as "Active Learners": The goal was to reach 300 children with sufficient replication that they be recognized as "active learners"; 286 children were identified as "active learners" representing an achievement rate of 95% of Plan. ●Youth Employees Ages 12-18*:* During the entire Project period, a minimum of 25 youth aged 12-16 were to be employed as wage-earners. Twenty-three (23) youth employees were hired during preceding quarters and four (4) new youth employees were added during the last report period. The new total for the project term was 27 youth employees who have actively worked on the project in an employed status. This objective performed at a 108% completion rate. ●Garden Production and Harvest Distribution: During the entire Project period, the community garden planned to produce at least 7,200 pounds of food for a minimum of 100 needy households. A total of 8,186 pounds were produced and harvested during the project; this objective is now 113% complete. Including the final report period, 137 low-income families (137% of Plan) representing 841 persons (105% of Plan) were steady beneficiaries of fresh harvested food. ● Edible Landscape Home Owners / Community Food Recipients: During the entire Project period, 225 rural families (representing over 800 persons) will be directly engaged beneficiaries in the project, as edible landscape home dwellers (125) or community food recipients (100). As mentioned, 841 persons (105% of Plan) were directly served with food. In addition, edible landscape and community plot families totaled 111 families (representing 88% of Plan).

RISE Inc. is pleased that three long-term measures of success, not originally planned or outlined in the grant application, have been achieved: (1) the concept of edible gardening on-campus has been endorsed by the community and the school to be an incorporated component of student learning and the campus landscape. Teachers backed several grant applications to continue the edible landscaped areas on campus, set up "harvest zones" to be accessed by students, and are dedicated to blending garden skill-building into the outdoor education curriculum at the school. Two continuation grants were funded (Sierra Health Foundation and the

Monsanto Corporation). Therefore, the work started and funded by this project will be sustained. (2) Tours of the gardens and edible landscape conversions resulted in three new activities, one local and two in neighboring communities: a “Grass-to-Garden” project was initiated in Davis and has resulted in a “Permaculture Guild” being organized, the Yolo Co. Health Dept. has set up Community Garden plots for families designed after the off-campus Community Garden implemented in this grant, and the local Catholic Church Knights of Columbus has sponsored 29 individual family garden plots in Esparto, behind the church. The long term benefits of this grant will be felt and experienced locally and regionally.

The grant performed at between 88% - 137% in every established benchmark / outcome. See above supporting data regarding these accomplishments.

This project had baselines of zero: no gardens had been established on campus, no student involvement in gardening, no Community Garden, no youth employees focused on the production of food, and no gardening activities were part of the after school program. This final report gives the quantitative data to support its completion of planned outcomes (88%-137% complete for all measures, all quantitative results). Please see the narrative specifics presented in previous sections.

In summary: 11,420 square feet of landscape was converted to edible gardens, 100+% of the Plan; a Community Garden was completely developed on a 1.5 acre site; 100% of Plan; ten teaching stations (“project labs”) were implemented, representing 100% of Plan; 80 children achieved competency and “ambassador” status in the project, 106% of Plan; an additional 286 children were identified as “active learners” - 95% of Plan; 27 youth employees worked on the project in an employed status, 108% of Plan; 8,186 pounds of food was produced and harvested during the project, 113% of Plan; and, the number of families directly benefitting as food recipients exceeded 137%. This project has been very successful and responsive to its proposed outcomes.

The project also had tremendous local support, with the school’s teacher community rallying to continue the garden work on campus, including the award of two additional, continuing grants to institutionalize the food production component into the regular teaching day. The project had regional support, with notable spin-off programs starting in the communities of Davis and the County Health Department in Woodland.

Beneficiaries

The most dominate group benefitting from the project was young children grades K-8; these children participated in numerous gardening activities, took ownership in converting their school to an edible landscape and were even youth wage-earners in garden activities. The second most important group to benefit from the project was the food recipients, all of whom were low-income persons or inactive seniors (elders). Several out-of-community but “in County” groups were also engaged beneficiaries: the new “Grass-to-Garden” group started with a tour of the project gardens; the local Farm-to-School group leader cited the gardens as the “best he has seen”; the Yolo County Health Department used the project’s Community Garden as a template for their new “family plot” gardens; and, the project coordinator actively participated in the development of a local food hub initiative to move fresh produce more effectively into local school cafeterias.

In summary, 80 children received extensive gardening experience, over 286 other children gained gardening exposure as “active learners”, 27 youth were gainfully employed, and over 248 households and 841 persons benefitted through increased food security.

The potential benefit is more difficult to calculate than the exact quantitative deliverable; children who now carry solid food production skills are reaching into the future in ways we cannot calculate. Already, employed youth have set up gardens, on drip systems, at their homes and their relatives' homes. Already, elementary age children have taken home garden starter kits and planted edible plants around their homes, amidst their traditional landscaping. Already, this project has provided the blueprint for lawn-to-garden conversions and community garden plots. Those benefits, and others, reach into a future time past which data is being collected.

Lessons Learned

Goals were achieved as planned and planned objectives were measurably successful. Staff with very extensive experience managing performance-based grants was closely involved in the project and were very closely watching the goals, objectives and outcomes expected. The most difficult aspect of the project was working with the residential areas and community folks to covert yards and traditional landscapes to create edible gardens. To achieve these goals, RISE staff often partnered with churches, apartment complexes, and low-income housing groups. It was not expected that this portion of the grant objective would be so difficult to achieve. This work and the problem-solving around this effort created a very big surge in activity in the last quarter of the project. The need to work this hard to achieve the outcome of engaging 125 families in garden conversions was not anticipated.

While most adults ages 25-40 appear to know very little about how to grow food, elders seem to know almost everything about growing food and preparing and utilizing food directly from the gardens; therefore, grandparents were effective coaching children. • Most families would rather convert their back yards to gardens than their front yards. They were afraid their produce would get stolen, or that their neighbors would disapprove of the look of the gardens, or that they would be criticized for not knowing how to garden well. • Many homeowners were surprised that a clean, nice garden was "so much work" – however, they were also interested in the fact that Americans spend over 300 million gallons of gas and 1 billion hours caring for residential lawns that produce nothing. Sharing this fact helped many folks to re-focus back on food-producing landscapes. • Many were amazed that the fresh picked food "tasted so much better!" • Most local children had never tasted asparagus, artichokes, chard, kale, or leeks despite the fact that these crops are organically grown in great abundance in the Region. • Children proved to be very efficient and competent gardeners, mastering important techniques about planting by seed, transplanting, and water conservation very quickly.

● Children can be engaged, positive and productive residential farmers. Children, given the opportunity, can also be great food prep people and cooks – and they tend to eat better when they grow and harvest their own food and are their own cooks and food preparers. ● Children like to eat for pleasure and conversation – they like the concept of "slow food" eating when given the opportunity. This cannot and does not happen in the regular school day – lunch periods are short and rushed. ● Young people are very capable employees – and have no place to work because they are not hired due to their age and employment restrictions – this often holds them back from developing a strong self worth.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 45	**Project Title:** City Farm Phase II: Bringing the First Crops to Harvest	
Grant Recipient: Central Coast Ag Network	**Grant Agreement No.:** SCB11045	**Date Submitted:** December 2014
Recipient Contact: Jenna Smith	**Telephone:** 805-769-8344	**Email:** jenna@centralcoastgrown.org

Project Summary
Agriculture and food related sectors provide one fifth of the jobs in San Luis Obispo County, and yet most of the food consumed comes from non-local sources. Growing, buying and eating locally produced specialty crops provide many social and economic benefits to the SLO community. This project identified three main objectives to bring greater understanding of the opportunities, resources, and limitations facing local specialty crop production, distribution and consumption in the SLO community:
1. Establish City Farm- San Luis Obispo as an urban community education farm, serving as a resource to the community and specialty crop farmers.
2. Conduct a local foodshed assessment in partnership with the San Luis Obispo Food System Coalition (FSC).
3. Survey all publicly owned land in the county to document underutilized but agriculturally viable lands that may bolster new and young specialty crop farmers without land of their own.

The resources of this grant have provided the necessary support to get City Farm established and bring the first crops to harvest in May 2014. Without these resources Central Coast Grown (CCG) may not have been able to create City Farm in the timeframe sought by the City of San Luis Obispo (City), and the land may have remained under non-specialty crop production. The Foodshed Assessment was begun around the same time the FSC was completing the Hunger Free Communities strategic plan and was able to capitalize on shared resources and strong leadership at the outset of the study.

This project was not designed to build on previous SCBGP funds.

Project Approach
City Farm – Since 2008 CCG has been involved in the creation of City Farm—San Luis Obispo as part of the City's Calle Joaquin Agricultural Reserve open space. In 2012 CCG secured a 20-year lease with the City for management of City Farm's 20 acres, in 2013 selected subtenants for the establishment of two new specialty crop farming enterprises, and in 2014 oversaw the first planting of crops on 14 acres. In April 2014, CCG organized an "Urban Farm Fun-Raiser" at City Farm, which was attended by 300 community supporters enthusiastic to experience the farm and learn about specialty crops. This inaugural event welcomed and introduced the only urban farm to San Luis Obispo County and community. The event offered a variety of hands-on experiences around growing and cultivating fruits and vegetables—planting veggies, making eco pots, creating veggie puppets, included informational and educational booths, and showcased several local caterers serving and teaching about the local foods used for their dishes. Technical and on-farm volunteer support for City Farm is strong and the Farm is well on the way to being a productive, multi-farm enterprise with programming open to the public.

Foodshed Assessment Study – CCG conducted the Foodshed Assessment in partnership with the UC Sustainable Agriculture Research and Education Program and the FSC. The FSC was instrumental in bringing together a collection of more than 15 agencies to identify the parameters of the study and identify what type of data would be useful to the community. The data analysis and report narrative were conducted by SAREP UC Davis. The report assessed San Luis Obispo County's food system and examined the relationships between agriculture, regional environmental quality, human health, and local livelihoods. This study identified that one-fifth of the jobs in the county are in the food-related sector, and in 2007 farmers in San Luis Obispo County sold $4.3 million of agricultural products directly to consumers, an increase from previous years. The report suggests that continued promotion of local and direct marketing of food can assist all specialty crop producers, including new farmers, in entering the market place and bolster the local food system overall.

Those markets will be especially important as the number of farmers in the county grows. In 2007, there were 850 more agricultural producers than ten years prior. But the majority of farms in 2007 reported gross sales of under $250,000 per year, with nearly half of all farms in the county reporting less than $5,000 in annual sales. The final study was adopted by the FSC and the group is making plans to hold four community forums throughout the county to present and discuss the study. The final study can be viewed at: http://centralcoastgrown.org/wp/wp-content/uploads/2012/09/SLO14_fullreport.pdf

Public Land Survey – The Public Land Survey was began and completed during the life of this grant. The first step was to develop a methodology for the study, with support from local experts in geographic information systems (GIS), agriculture, zoning and planning. The data was analyzed using GIS over the period of a year and the narrative and report layout was created over the course of another year. The completed study identifies 72 parcels of publicly owned land that is agriculturally viable with two-thirds of the parcels identified as either farmland of statewide importance, prime farmland if irrigated, or prime farmland if irrigated and drained. This study identifies valuable agricultural resources in the community and provides tools for the community or farmers to initiate agriculture education or specialty crop production on these parcels.

The Public Land Survey can be found at http://centralcoastgrown.org/projects/public-land-survey/ and includes a narrative explaining the study's purpose and ways the information can be used.

Outreach – CCG communicated grant activities and educational programing through a variety of ways. Five press releases resulted in seven printed articles in local newspapers, two radio appearances, and two video news slots. CCG did direct outreach through 16 tabling events and 11 public speaking engagements. Further engagement was conducted through CCG's website, social media, and newsletters.

Local Food Resources Survey – The purpose of the Local Food Resources Survey was to do a basic assessment of the existing demand and available supply of locally grown produce in San Luis Obispo County. The survey gathered information from farmers, restaurant owners, farmers' market managers and local retail outlets about what they currently sell, where they sell it (direct/indirect sales, inside county/outside of county) and challenges they face in local sales. This included information on local distribution pathways and processing needs. The results provide a foundation of knowledge to build upon as CCG pursues endeavors to support local farmers and specialty crop production into the future.

It provides the organization with current, first hand knowledge about how staff can best support local specialty crop farmers, strengthen the local food system, and what projects would fill existing processing, aggregation, distribution and procurement needs to cycle specialty crops through the community.

It is difficult to create programs and studies that support specialty crop producers without supporting all agricultural producers, and to promote local food without promoting all local food products. Volunteers and interns undertook any blogs, surveys, or data analysis that supported non-specialty crop producers and their time was not charged to the grant or included in the in-kind hours of this grant's metrics.

Project partners throughout the life of this grant included SAREP UC Davis, the FSC, the City and Nico Farms. SAREP UC Davis conducted and completed the Foodshed Assessment, their efforts to support CCG included volunteer intern hours to gather and process information in the report that covered non-specialty crop food production. Volunteer hours were not charged to the grant. The FSC participated in the development of the Foodshed Assessment. The City of San Luis Obispo gave the gift of 20 acres of prime agricultural land for City Farm and the installation of an agricultural well. The City continues to provide ongoing technical support for the farm. Nico Farms, City Farm's first farming tenant, provided food for the grand opening of the farm, has made infrastructure improvements in the installation of a deer fence along the perimeter of the farm, and engages tractor services for CCG given the absence of equipment.

Goals and Outcomes Achieved

To bring City Farm into production, CCG created a ground lease designed specifically to partner a public entity and private organization, a Request for Proposals for farmers to farm the land that communicated the programmatic goals of CCG and the vision of the community for the public farm, and a sub-lease between CCG and Nico Farms that allows for agricultural production while promoting the land as a community resource. These three tools were included with a variety of maps and data to create a comprehensive Public Land Survey now available to the community. The study can be viewed at: http://centralcoastgrown.org/projects/public-land-survey

The twenty acres of City Farm were secured through the negotiations of a twenty-year lease and a portion of the land stewarded under row-crop production through a five-year sub-lease with Nico Farms. Negotiations are underway for an additional two acres to be managed by Green Gold Organic Farms. In addition, two partnerships are being developed for educational activities with a local high school and an independent agriculture educator. The "Urban Farm Fun-Raiser" promoted the production of specialty crops by providing a hands-on experience for event-goers to plant veggie starts that are now being harvested. While planting, experts were able to provide feedback on technique and engage in conversations about growing and cultivating produce and the importance of specialty crops. Event–goers learned about the urban farm project and its part in the local San Luis Obispo County food system at the Information and Education booth. Attendees were given produce seeds with information about the seed, care instructions, and a recipe for how to use the produce once grown.

The newsletter subscription list has increased by 287% from the beginning of this grant to a total subscription base of 1448. To maintain the subscription base the newsletter has been re-designed and is sent out regularly each month. The re-built website had 15,061 visits in the last 12 months July 2013-June 2014. Of these visits

7,713 were unique visitors with 51.21% of those visitors visiting the website for the first time. This indicates a 293% increase in site visits from baseline. Additionally, now more than 1,000 people engage with CCG and City Farm on the social media platforms Facebook, Twitter, and Instagram. This success is due in part to the development of guiding documents that unifies the messaging.

The Foodshed Assessment, Public Land Survey and Local Food Resources Survey all provide important information about the community and food production that offer guidance for CCG and many other organizations to provide better services for specialty crop producers and consumers in San Luis Obispo County. This information can be useful for local specialty crop farmers, the FSC, public institutions, public agencies, school districts, San Luis Obispo Ag Commissioner's office, the local Farm Bureau and Resource Conservation districts and a variety of community groups.

Actual accomplishments are fairly similar to the goals of the grant. However, development of City Farm requires more time and resources than anticipated so CCG has not pursued acreage beyond the current 20 acres. Instead of creating six proposals to public landowners for additional acreage CCG developed a comprehensive Public Land Survey containing tools designed for farmers or other community organizations to leverage proposals to public landowners. Additionally, while CCG's newsletter has been improved over time to include more information about activities, staff have opted not to include a Farm to School update in each newsletter. A permanent page on the website communicates necessary Farm to School information. The number of farmer profiles on the website has not increased at the rate that was anticipated. The farm profiles were updated twice during the life of this grant. However, since the featured farms on the website are small farms and what they grow and sell annually and seasonally changes frequently, some of this information may be outdated by next year. For this reason, it is difficult to maintain updated information about local small-scale farms that would most benefit from marketing efforts. Additionally, specialty crop producers have a wide variety of processing needs, which makes it difficult to identify what added infrastructure to the County's food system would achieve the greatest benefit to the most people. A supplemental survey and follow up to the Local Food Resources Survey may be necessary annually. Project staff are undertaking a site design process for City Farm that will extend into October 2014.

Set targets have been completed through the production of the Public Land Survey, Foodshed Assessment, City Farm lease agreement, Local Food Resources Survey, more than 15% increase impact in outreach, the launch of City Farm, and bringing the first crops to harvest.

More than 4,000 volunteer hours were leveraged to bring the deliverables of this grant into fruition. Partnerships are strong and healthy and City Farm is under specialty crop production.

Beneficiaries

More than 15 students gained internship experience across a range of business planning, partnership development, volunteer management, data analysis, and social media skills. The FSC benefitted from CCG's leadership through CCG's Executive Director's service as vice chair for one year and chair of the coalition for one year. Stewardship of and improvements on City Farm ultimately benefit the landowners of the property, the City of San Luis Obispo. Nico Farms benefits from CCG's outreach efforts to promote City Farm.

Fifteen interns gained job skills, 15 participating agencies of the FSC and their constituencies gained important data to direct their efforts to produce, distribute and purchase local specialty crops, 300 participants of the "Urban Farm Fun-Raiser" had a positive on-farm experience and learned about specialty crops, an immeasurable number of community members were impacted by outreach, tabling, and media efforts, dozens of farmers and restaurants were featured in CCG's newsletters, and fifty-three specialty crop farmers maintain profiles on CCG's website increasing their visibility and marketing efforts.

Lessons Learned

The Foodshed Assessment shows that of the 2,784 agricultural producers in the county 1,278 sell less than $4,999 of product per year. It is very difficult to survey small farms, but CCG is able to survey between 50-60 small producers each year. Other agencies supporting farmers in the county also have little communication with this population of farmers. This means that nearly half of the farming community in San Luis Obispo County is operating at very small scale. Given the increasing average age of farmers in the community, it is very important to better understand these small-scale farms and identify ways to support them in scaling up specialty crop production. This grant supported the collection of useful data and tools to identify next steps.

Efficiencies have been found through the complete rebuild of CCG's website and the installation of a powerful data management system. The data management system stores all of the findings of the Local Food Resources Survey. While some information appears on the public end of the website, additional information is stored for internal purposes in the database and can be generated into a variety of reports on specialty crop production and distribution.

The "Urban Farm Fun-Raiser" demonstrated the value of on-farm experiences. A great way to teach people and get people excited about specialty crops is to let them get their hands dirty by direct involvement on the farm. Children were particularly engaged with eco pots, planting, and finger puppets providing a unique way to teach kids about produce.

CCG was very pleased with the attendance of the "Urban Farm Fun-Raiser", surpassing the expectation for the demand of community engagement with specialty crop farms. The agricultural production information communicated in the Foodshed Assessment has been especially illuminating about the percentage of farms in SLO County that are minimally successful.

CCG would like to partner with the Ag Commissioner and the Farm Bureau to jointly identify the resources needed by nearly half of the farming operations in the County to scale up farm production and profitability to a living wage.

Additional Information

Attachments include:

--Local Food Resources Survey
--Local Food Resources Summary

USDA Project No.: 46	Project Title: North Coast Opportunities Farm2Fork Project	
Grant Recipient: North Coast Opportunities (NCO)	**Grant Agreement No.:** SCB11046	**Date Submitted:** December 2014
Recipient Contact: Patty Bruder	**Telephone:** (707)467-3282	**Email:** pbruder@ncoinc.org

Project Summary

The Farm2Fork project of North Coast Opportunities was initiated in 2011 in response to the growing demand and interest in developing the local food system in Mendocino County beyond the farmers market. For over ten years before the inception of the project, grassroots community efforts had been gaining traction in efforts to revitalize local production and consumption of specialty crops and had identified the need to build the institutional and commercial markets as additional sales channels for small-scale producers previously focused strictly on direct sales. Local institutions were eager to invest their significant purchasing power in the local rural economy and the schools were particularly interested in building Farm to School partnerships in the cafeterias to augment their vibrant school garden programs. Several schools and hospitals had adopted wellness policies that prioritize using locally-produced fruits and vegetables for student and patient meals, and many businesses and restaurants were also seeking to meet the growing local demand for locally-grown specialty crops.

However, local schools, in particular, faced numerous barriers to increasing their purchasing and utilization of local specialty crops. Prior to the project, much of the fruits and vegetables utilized in school meals were purchased from food service providers in pre-prepped and packaged forms. The school kitchens were not set up to process and prepare fresh, whole produce and lacked basic but essential equipment to efficiently utilize fresh specialty crops in the meals programs. Additionally, the school menus and corresponding recipes had shifted away from scratch cooking towards a reheat-and-serve model that utilized processed foods that were not produced on site, thereby decreasing the need for fresh, whole, raw fruits and vegetables. Tight school budgets required Food Service Directors to minimize costs, resulting in limited labor hours in the kitchens and little funding for costly fresh produce. Lastly, most the staff working in the school kitchens had very little culinary training, if any, and lacked the skill and interest needed to produce quality school meals featuring fresh, locally-grown specialty crops.

In addition to these challenges, local growers were skeptical to interface with institutional buyers due to some widespread assumptions and lack of information about this particular market. Many assumed that the schools would not be able to purchase their products due to the budgetary restraints described above and therefore never considered schools as a potential market outlet. Growers thought that schools were required to purchase produce only from Good Agricultural Practices (GAP)-Certified farms and were afraid that their on-farm composting practices would not be acceptable to schools. Smaller growers feared that their production levels would not be sufficient for the schools' needs, and larger growers did not believe that the quantities of produce required would warrant sales and distribution on the local level. Farmers lacked access to busy school Food Service Directors and very little communication had occurred between growers and buyers to discuss production planning, availability, price, and delivery.

The lack of a coordinated local ordering and distribution system further hindered the development of Farm to School partnerships, and sales of specialty crops to other commercial buyers such as restaurants and grocery stores was also limited due to this issue. In the five years preceding 2012, only three local farmers had successfully sold specialty crops to schools in Mendocino County.

The Farm2Fork project was developed to reduce the barriers described above for both producers and institutional buyers in order to increase purchase and utilization of locally-grown specialty crops in school meals, primarily, but also to build relationships between growers and restaurants, grocery stores, hospitals and regional distributors. Four core Mendocino county school districts were identified as key partners in the project and grant-funded efforts focused on building the ability of these districts to successfully develop and implement Farm to School programs in their cafeterias. The Farm2Fork project was implemented at the ideal time in the development of the local food value chain in Mendocino County. The Project Coordinator was one of the few local producers who had successfully sold specialty crops to the Fort Bragg Unified School District and understood the complexity of the challenge. When the project was launched in the spring of 2012, the community of food producers, buyers, cooks, advocates and consumers were ready to embrace and implement the Farm2Fork project of North Coast Opportunities.

Project Approach

In the fall of 2011, the Project Manager (PM) announced the launch of the Farm2Fork project, confirmed the participation of the four core institutional Unified School District (USD) partners, and recruited, hired, and trained the Project Coordinator (PC). The PC researched best practices in the field and met with various community stakeholders working within and around the local food system to inform the project and align work strategies. The PC then coordinated a series of meetings with the partnering Unified School District's (USDs) to develop collaborative relationships, gather qualitative and quantitative information about each food service program, collect baseline data on their current utilization of locally-grown specialty crops, and map out individualized implementation plans for the kitchen assessment and training activities at each site. With the exception of the Fort Bragg USD, which has an on-site Farm to School program at its high school run by a non-profit partner (The Noyo Food Forest) that was providing approximately 5-10% of their produce needs depending on the season, the USDs were not purchasing any locally grown specialty crops (0% benchmark). Less than 10 of the 65 food service staff in those districts had ever participated in any type of culinary training and most of the kitchens were sorely lacking in equipment essential to producing healthy meals from scratch. All were operating on very strict budgets and had limited personnel to complete even the most routine tasks.

Considering the unique needs and circumstances of each USD's food service program, the PC recruited and contracted with qualified Chefs and Nutritionists (C/N) to work in partnership with the Food Service Directors (FSDs) and carry out the assessment and training activities. Great care was taken to make appropriate matches between C/Ns and FSDs in order to ensure the success of the capacity building efforts at the schools. Kitchen assessments were completed at 22 school sites, purchase orders were developed based on the assessment results, and a range of vegetable processing equipment was obtained and delivered to the kitchens. The sites began utilizing Robot-Coupes (industrial food processors), fruit sectionizers, chef's knives and other fresh-prep tools and small kitchen wares to more efficiently incorporate fresh, locally-grown specialty crops into their meals programs. Once the kitchen assessments were completed and the kitchen equipment obtained, culinary training activities focused on shifting school menus and recipes to align with seasonal availability of local specialty crops as well as training the 65 kitchen staff at the 4 core USDs to prepare these foods utilizing the new kitchen equipment provided through the project. The PC promoted the trainings and stipends to the food service staff, delivered trainings in partnership with the C/Ns, assessed learning via pre- and post-session surveys, and delivered additional trainings based on identified needs. By the end of the project, over 100 school food service staff from 14 school districts participated in 57 culinary training and capacity building activities provided by the Chef/Nutritionists (C/Ns) and the PC, including on-site trainings in fresh produce preparation and utilization, one-on-one technical assistance with developing menus and recipes based on seasonal availability, and two regional "Feeding Our Future" training events held in August 2012 and August 2013. "Feeding Our Future: A Celebration of School Food and Nutrition Services" was a larger group event for all of the school food service staff in Mendocino and Lake counties held just a few days before school started. Participants learned techniques for using fresh, locally-grown specialty crops from leaders in the Farm to School movement in California, networked with their regional colleagues to share best practices, and worked with their own kitchen teams to determine priorities for the subsequent school year. The content generated from the workgroups provided focus for the Farm2Fork trainings in the months following the event and the excitement and enthusiasm inspired from the event catalyzed rapid adoption of new practices in the USDs.

Additionally, the C/Ns and the PC worked with the USDs to identify recipes, scaled for institutional use, that feature readily available crops like kale, and then assisted with "taste-test" trials of these recipes in school cafeterias. A cafeteria taste test "tip-sheet" was created and shared with similar projects across the region. In partnership with the North Coast Nutrition and Fitness Collaborative, which supported nutrition education throughout Northern California, the PC developed the produce schedule for the 2013-2014 "Harvest of the Month" program to be aligned with the seasonal availability of specialty crops to enable local purchasing for that program for the five-county region. Marketing materials were developed to promote the locally-grown specialty crops being served in the cafeterias and Harvest of the Month programs, including posters, salad bar placards, and Farmer ID cards, and were shared with other programs throughout the region.

Concurrently to the capacity building efforts with the USDs, the PC conducted market development activities and began by recruiting specialty crops producers interested in developing or expanding their institutional and wholesale/commercial sales as well as restaurants, grocery stores, and hospitals interested in procuring local products. 25 farmers, 8 grocery stores, 3 hospitals and 15 restaurants joined the effort and were provided with direct technical assistance by the PC. Only three of these participating farmers had sold specialty crops to institutional buyers and most previously relied primarily on direct-marketing channels to move their product. In order to shift this trend and increase access to locally-produced specialty crops for the institutional and wholesale markets, the PC provided information to farmers to make the case for scaling up production to meet the market demand. The PC interviewed participating end-users (restaurants, markets and institutions) to quantify their demand for locally-grown specialty crops and assessed the quantities and varieties desired, ordering and delivery specifications, contact information and other relevant data to inform farmers of the new market opportunities, encourage additional production, and facilitate new sales. By the end of the project period, the number of farmers who successfully sold specialty crops to local institutions was increased from 3 to 18.

Project staff developed a comprehensive list of local farmers to utilize for project outreach, recruitment, and marketing purposes. In the second year of the project, the PC arranged one-on-one planning meetings between the USDs, grocers, chefs and farmers to coordinate the production, ordering and delivery of specialty crops with school and restaurant menus and produce department demands. The PC worked with local grocers to increase their local purchasing commitments and was instrumental in developing the first "local section" in a produce department in the county, made feasible through the development of "Local Grower Guidelines" to facilitate the buying process. Relationships between growers and buyers that were initiated and facilitated by the Project Coordinator (PC) began operating independently, ensuring the long-term success and sustainability of the project. In addition to these activities, the PC researched the local food distribution network to map out assets, identify opportunities, coordinate efforts and troubleshoot challenges for local farmers, distributors and buyers. Collaborative distribution arrangements were attempted with marginal success and the lack of a coordinated distribution system for small producers continues to hinder additional sales of locally-grown specialty crops in the region.

The continued development of the local food supply chain and supporting farmers in successfully accessing the institutional and commercial/wholesale markets was the primary focus of the second year of the Farm2Fork project. The PC conceived of and developed the First Annual North Coast Farmers Convergence which provided training and technical assistance to over 100 farmers in a range of topics including on-farm food safety, micro-regional distribution, and production planning for schools, grocers and restaurants. As a result of this event, new specialty crops producers were enlisted in the Farm2Fork project, regional networking opened new possibilities for collaboration between farmers, and several new purchasing arrangements were established with both local and statewide food distributors which amounted to significant income gains for local specialty crops producers. Producers asked for additional training and support around food safety and the PC co-organized a Food Safety on the Farm workshop with the Community Alliance with Family Farmers (CAFF) that trained 17 farmers in Good Agricultural Practices. The PC was also a key contributor to the development of a local "Approved Source" program in Mendocino County. Three rounds of meetings with 45 participating producers resulted in the development of a list of "Best Management Practices" that became the heart of the program and was officially adopted by the County of Mendocino and implemented January 1, 2014. The Farm2Fork program was instrumental in ensuring broad and meaningful participation of producers in this process and rural counties across northern California are now looking at the Mendocino County program as a model for communities that have similar farming economies and environments.

A number of organizational partners contributed significantly to the success of the project and will ensure that the impact of the activities will scale up over time. The Mendocino County Food Policy Council (MCFPC), which shared the goal of strengthening the local food economy via increased institutional purchasing of local food, acted as an initial liaison to connect the PC with key stakeholders in the local food system. The MCFPC provided a forum for monthly feedback to the PC as she implemented the project and fostered partnerships with both the Mendocino County Agricultural Commissioner and the Director of Environmental Health. These two leaders became important partners in the development of an Approved Source program that meets the needs of specialty crops producers and institutional, commercial and wholesale buyers. The Agricultural Commissioner provided producer data and contact information and served as an important ally throughout the project. The Mendocino County Farmers Market Association assisted with project promotion and outreach to farmers to encourage their participation and allowed the PC to publicize trainings as well as institutional and commercial/wholesale sales opportunities in their monthly newsletters.

The Fort Bragg, Willits, Ukiah and Anderson Valley Unified School Districts were the four core partnering USDs that worked tirelessly with the Farm2Fork project to increase their purchase and utilization of locally-grown specialty crops. They participated in regular coordination meetings throughout and beyond the grant, collected and reported project data, contributed to the development of implementation strategies, coordinated trainings in partnership with the C/Ns and the PC, participated in production planning meetings with farmers, shifted their menus and recipes, and bent over backwards to make Farm to School programs happen in their districts. The Food Service Directors and food service staff at the districts were essential allies and partners in the project and their enthusiastic participation ensured success. The Noyo Food Forest, which operates a school farm at Fort Bragg High School, provided additional support in the Fort Bragg Unified School District by contributing fresh produce for trainings, educational tours for food service staff through the farm, and implementation of taste-test activities and specialty crops nutrition education for children in the cafeterias and after-school programs.

The Ukiah Valley Medical Center's Food Service Program was another key ally in the Farm2Fork project. Their Executive Chef, who had experience procuring specialty crops from local growers, provided culinary expertise and pro-bono training services to the PC and to the Ukiah Unified School District's Food Service Program. He catered the Feeding Our Future events to be in line with the National School Lunch Program while featuring local specialty crops and provided supplies for the hands-on component of the event. The Mendocino College Culinary Arts Management Program provided space and supplies for two Culinary Boot Camp trainings and contributed content and expertise to the Feeding Our Future event. The Community Alliance with Family Farmers (CAFF) contributed staff time to produce the Food Safety on the Farm workshop and provided staff support for the Farmers Convergence and Feeding Our Future events. CAFF's North Coast staff also contributed expertise with institutional market development and collaborated with the PC to expand regional institutional and commercial/wholesale marketing opportunities and distribution channels for specialty crops producers from Humboldt, Mendocino, Lake, Sonoma, Napa and Marin counties.

Goals and Outcomes Achieved

The Farm2Fork project accomplished the overall goal of increasing and institutionalizing the production, purchase and utilization of locally produced specialty crops in schools, hospitals, markets and restaurants across Mendocino County via the activities outlined above in the Project Approach.

Expected Measurable Outcome #1: Increase the purchase and utilization of fresh local produce by institutional buyers (GOAL) to at least 10% (TARGET), assessed by data provided by participating institutions at the beginning (BENCHMARK) and at the end of the project (PERFORMANCE MEASURE).

Associated activities and results: As a result of the culinary training, equipment purchases, and technical support provided by the Project Coordinator (PC) and Chef/Nutritionists (C/Ns) to the four Unified School Districts (USDs), significant quantities of local specialty crops were purchased, with an average year-round local purchasing percentage of 18% for the Willits, Ukiah and Anderson Valley USDs, representing a substantial increase from the baseline of 0% at the beginning of the grant period and exceeding the expected outcome of 10% of total produce purchases. Fort Bragg USD had the most notable increase to its local purchasing percentage from a baseline of 5% to 43% during the high season. For the first six months of the 2012-2013 school year, before their program funding was eliminated, the Harvest of the Month program at Ukiah Unified School District purchased 100% of its produce from local specialty crops producers resulting in approximately $10,000 of new sales for five very small local producers. All of the USDs are serving locally-grown apples from August thru February and have utilized at least 10 additional local specialty crops including pears, tomatoes, cucumbers, melons, lettuce, broccoli, carrots, peppers, basil, and squash. Purchasing relationships with producers have been formalized and the USDs are committed to continuing to procure specialty crops from them. These positive results are expected to increase as the ability of the USDs to access and utilize local specialty crops continues to develop over time, as producers continue to respond to this expanded market opportunity, and as challenges around local distribution of specialty crops are addressed.

Expected Measurable Outcome #2: Increase local food preparation and utilization skills and knowledge of food service staff (GOAL) by at least 20% (TARGET), assessed by retrospective pre/post testing conducted at the end of the project (PERFORMANCE MEASURE).

Associated activities and results: 65 staff from the 4 core USDs participated in a wide range of training activities and reported an average of 25% increase in their skills and knowledge in preparing and utilizing local specialty crops. The PC chose to perform surveys at every training in order to assess efficacy and determine content for subsequent trainings. Participants expressed increased interest in participating in the Farm2Fork trainings and by the end of the project, the PC had to organize multiple days of the same "Culinary Boot Camp" training to accommodate the number of enrollees.

Twenty-two sites' ability to process and utilize fresh, locally-grown specialty crops for school meals and snack programs was greatly enhanced through increased efficiency and reduced prep time as a result of the kitchen equipment. While it is difficult to quantitatively assess this enhancement and correlate it to the increase in purchasing, anecdotal reports suggest that this reduced prep time increases staff's willingness to boost the amount of fresh fruits and vegetables served in their cafeterias, which in the long term will result in increased purchases of specialty crops. The PC observed food service staff in all four USDs serving new presentations of fresh fruits and vegetables, resulting from techniques learned in the trainings and made possible by the sectionizers, food processors, and other fresh prep equipment provided. Children were more likely to consume the cut produce versus whole fruit and vegetables that are less appealing and more cumbersome to eat, resulting in increased demand for fresh produce in the lunch line and reduced waste in the cafeterias.

The Willits USD, which prior to the project relied primarily on pre-prepped, processed foods for their food service program, began producing three days of scratch-cooked meals per week which greatly increased their purchase and utilization of fresh, locally-grown specialty crops and has improved the meals participation rate at their district. Fort Bragg USD reports a 15% increase in overall specialty crops purchasing in the 2013-2014 school year, resulting from an increased demand from students, teachers, and food service staff for more fresh produce. The Ukiah Unified School District also reported increased interest in serving specialty crops in the cafeterias and is now developing strategies to offer salad bars at all of their schools. As a result of the efforts of the C/N and PC, the Anderson Valley Unified School District revamped their entire food service program and implemented a daily fresh salad bar featuring local fruits and vegetables which has increased participation in their meals program at their high school. These results were directly connected with the efforts of the Farm2Fork program and while they were not specific expected measurable outcomes outlined in the project, these developments will ultimately enhance the competiveness of specialty crops in the institutional market in Mendocino County in the long term.

Expected Measurable Outcome #3: Increase local farmers' understanding of and access to institutional markets (GOAL) so that they can develop responsive productions plans and demonstrate an increase of at least 25% in income generated through produce sales to local institutions and businesses (TARGET).

Associated activities and outcomes: Through providing training, technical assistance and facilitation of new grower-buyer relationships, the Farm2Fork project met the goal of increasing farmers' understanding of and access to the institutional market, clearly quantified by the increase in local purchasing percentages at the USDs and the increase in the number of producers interfacing with this market, but it is unclear if it resulted in at least a 25% increase in farm income generated through produce sales to local institutions and businesses. The data to measure this outcome proved to be challenging to collect. Only one farmer willingly shared his sales figures, did so with a great deal of hesitancy, and asked that they not be shared. Others reported "significant increases" and genuine satisfaction at the new market opportunities, but were reticent to share actual financial figures.

Prior to the launch of the Farm2Fork project, most local specialty crops growers did not see the institutional market as a viable option for their enterprises due to a widespread assumption that schools could not afford to buy local product and were difficult to work with. By the end of the project, one of the growers had become the "go-to" local apple producer for schools, universities and hospitals across Northern California and had significantly increased his sales to these markets since the launch of the project. Interest in producing specialty crops for the local institutional and wholesale market has grown significantly and farmers are in general much more eager to interface with schools, hospitals, restaurants and grocery stores in Mendocino County. With the development of a local distribution strategy, sales of specialty crops to these markets should scale up significantly in the next five years.

Beneficiaries

- 18 farmers increased sales of specialty crops to local institutions as a direct result of the project and benefitted from one-on-one technical support provided by the PC. An additional 15 growers received direct support in connecting with restaurants, grocery stores and hospitals, resulting in increased sales to these markets. Over 100 additional farmers participated in Farm2Fork trainings and events and will benefit in the long term from the development of stronger and more varied markets for their specialty crops in the future.
- Approximately 10,000 students and school staff from the 4 core USDs benefitted from improved nutrition in school meals as a result of the project. The districts are rural, under-funded, and have high percentages of Free/Reduced Lunch Program participants (55% county average). These children will continue to benefit in years to come as the schools increase their utilization of fresh specialty crops in the meals programs. As meals participation rates increase

due to an improvement in the quality and reputation of school meals, reimbursements to the USDs will increase, thereby generating additional revenue to sustain the Farm to School efforts.

- 100 school food service staff from 14 school districts benefitted from the 57 training and technical assistance activities provided via the project. Their increased knowledge and skills in preparing and utilizing locally-grown specialty crops will result in improved meal participation rates and a long-term increase in the demand of the fresh produce market in Mendocino County. Staff job satisfaction has improved as the role of school food service staff has been elevated in importance and as individuals take pride in providing quality meals to children.
- 15 restaurants, 8 grocery stores, 5 distributors and 4 hospitals were able to increase the quantity and variety of specialty crops purchased from local growers, which increased their customers' access to and consumption of locally produced specialty crops. The PC facilitated the development of purchasing relationships between these entities and farmers and produced marketing materials to be utilized in these establishments to promote their use of local crops.

Lessons Learned

Working in partnership with the USDs and their food service staff to increase their purchase and utilization of locally-produced specialty crops was the most challenging and rewarding aspect of the Farm2Fork project. School food service is a highly regulated industry and the demands put upon the underpaid and undertrained kitchen staff are oftentimes overwhelming. At the beginning of the project, staff fatigue was palpable and posed a significant challenge to the PC in her efforts to build collaborative relationships with the school food service staff. It took a great deal of time to establish rapport, but enthusiasm for participation in the project picked up with the kitchen assessment and receipt of the kitchen equipment in the first half of the first year of the grant.

Providing kitchen equipment was absolutely critical to the success of the Farm2Fork project. The school food service staff was very grateful for the investment in their programs after years of using outdated and broken kitchen equipment. The process of assessment and follow-through with providing the kitchen equipment built a relationship of partnership and trust with the Project Coordinator that enabled her to lead them into the next, more challenging phase of the project, and the staff now had the tools they needed to be able to ramp up their purchase and utilization of locally-grown specialty crops. It is highly recommended that future projects involving school food service include some funding for kitchen equipment as the impact for the investment is substantial.

It is of utmost importance that anyone working in partnership with school food service understands the complexities of the industry and be able to work within the constraints of the National School Lunch Program. The PC spent considerable time and effort to familiarize herself with the nutritional standards, policies and procedures, and day to day reality of school food service so that she could build informed implementation strategies that would produce results. Great care was taken to select C/Ns who had experience with school food service and would be able to build rapport with the food service staff by speaking their lexicon and understanding the challenges they face everyday. School food service has long been criticized by the public at large and as a result, staff is often defensive of their programs and unwilling to listen to suggestions from consultants. It took almost a year to find the right consultants for the project.

Scheduling trainings with the school food service staff was another challenge that the PC and C/Ns faced. Whenever possible, the C/Ns provided one-on-one training during production hours to reduce the amount of after-hours requirements for already over-worked participants. While staff were initially reluctant to participate in additional trainings due to challenges around coordinating with their busy work schedules, after a couple of fun, informative, and meaningful experiences they were excited to be involved. Training stipends encouraged broad participation in these events. Without this component, it would have been very challenging to ensure participation in the longer trainings.

The importance of good “matchmaking” was another key lesson learned over the course of the Farm2Fork project, not only with the C/Ns and schools as described above, but also with facilitating relationships between buyers and growers. It is critical to understand the needs, wants and assets of the various actors in the market and link up those who have synergy not only with supply and demand but also in their business style, schedule, and location. It is also important to choose the right crops for the right market, particularly when attempting sales of specialty crops to local institutions where school budget restraints pose a major financial barrier for small scale growers trying to step into this market. Schools must make tough decisions about which crops are best purchased from their broadline distributor and which ones are worth the local premium. Apples, pears, cucumbers, melons, and tomatoes proved to be excellent farm to school crops, whereas onions and potatoes were not.

It is imperative to speak frankly about cost and determine which crops are the best fits for both producer and buyer. In the beginning of the project, specialty crop growers were convinced that schools could not afford their products, which was true for some items (carrots and potatoes as examples) but not so for many others. The PC worked diligently to shift this perspective by identifying school programs, like the Fresh Fruit and Vegetable Snack Program, that would be able to afford the local premium, and also by developing clear lines of communication between growers, buyers, and regional partners. Gowans’ Orchards, who had never sold product directly to a local school district prior to the project, is now widely recognized throughout the region as the go-to specialty crop producer for Farm to School programs and has dramatically increased their income generated via institutional sales. In addition, this apple producer began working in partnership with the Johnson Family Ranch, a longtime commercial pear grower whose product was rarely consumed in-county. Thanks to the facilitation and support of the PC, these producers developed and implemented a cooperative strategy to store and distribute their products to local and regional institutional and retail markets. Additionally, these two producers were assisted by the PC to sell their products to larger regional distributors and grocers whom they had never worked with before. The support services provided by Farm2Fork were key to these developments, as these small-scale family farmers did not have the time nor the contacts to pursue these marketing channels. The role of the PC as the local relationship “broker” was essential and proved to be a valuable asset for Specialty Crops producers and buyers.

Additional Information

Articles about the project:

Coverage for “Feeding Our Future” conference:
http://www.ukiahdailyjournal.com/news/ci_21380916/conference-focuses-culinary-training-food-service-workers

Showcasing Harvest of the Month and Farm to School Success:
http://www.mydigitalpublication.com/display_article.php?id=1222807

Changes in Willits USDs Food Service Program:
http://www.willitsnews.com/ci_23210966/shift-food-willits-unified-students

Event photographs:
Feeding Our Future: http://www.flickr.com/photos/30744981@N02/sets/72157635158244843/
Farmers Convergence: http://www.flickr.com/photos/30744981@N02/sets/72157632991462196/

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 47	**Project Title:** Expanding the Promotion of Specialty Crops and Increasing Healthy Food Access to Federal Nutrition Benefit Clients	
Grant Recipient: Trust for Conservation Innovation/Roots of Change	**Grant Agreement No.:** SCB11047	**Date Submitted:** December 2013
Recipient Contact: Laura Deaton	**Telephone:** (415) 421-3774	**Email:** laura@trustforconservationinnovation.org

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

The Roots of Change (ROC) managed California Farmers Market Consortium (CFMC) was initially formed in 2009 as a statewide partnership to increase the promotion, marketing and access of specialty crops through farmers markets to a consumer base that utilizes food assistance programs (CalFresh, Women, Infants, and Children (WIC), Seniors Farmers Nutrition Program (SFMNP)), with an additional goal of increasing access of healthy and fresh fruits, vegetables and nuts to underserved communities that suffer disproportionately from nutrition related diseases. The pilot year launched with six partners that brought more Electronic Benefits Transfer (EBT) access to 46 participating farmers markets in 10 counties—the only way CalFresh and WIC benefits could be accessed—and a program called Market Match that offers EBT cardholders a match based on the amount of fruits, nuts and vegetables they purchase at eligible farmers markets, to be used to purchase specialty crops.

This project builds on 2009 SCBGP Project 36 and 2010 SCBGP Project 13.

ROC and its partner organizations have scaled up CFMC's success by increasing the revenue of the specialty crop farmers at participating farmers markets, and increasing the number of consumers from low-income underserved communities that are spending their federal benefit dollars at farmers markets on fresh produce. Funding from SCBGP enabled the CFMC to initiate programs, including Market Match, which spurred fundamental changes in buying patterns by federal nutrition benefit program clients. Additional SCBGP funding allowed the Consortium to increase the number of farmers markets with EBT access and implementing Market Match; leveraged SCBGP dollars with matching philanthropic support; and enhanced the competitiveness of specialty crops by direct marketing fresh, healthy produce to federal nutrition benefit clients. In addition, ROC has annually brought on new partner organizations, expanding CFMC's outreach to more families statewide who are CalFresh and WIC eligible, and increasing partnerships with local Non-Governmental Organizations (NGOs) and agencies working to connect vulnerable communities with farmers markets.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

The following 12 partners made up the CFMC with a combined total of 134 farmers markets in 12 counties operating Market Match and EBT. Partnerships included:

1) Agricultural & Land-Based Training Association (ALBA) – working in Monterey and Santa Cruz counties.
2) Agricultural Institute of Marin (AIM) – operates farmers markets in Marin, Alameda and San Francisco counties. AIM promotes a viable food system by educating the public about the nutritional and economic benefits of buying locally grown food directly from farmers.
3) Alchemist Community Development Corporation (ACDC) – operates farmers markets in Sacramento and Yolo County, and is dedicated to nurturing and strengthening the ability of residents to shape the future of their neighborhoods and benefit equitably from development.
4) Fresno County Economic Opportunities Council – operating farmers markets in Fresno County.
5) Hunger Action Los Angeles – advocates for communities in Los Angeles County.
6) North Coast Growers Association (NCGA) – sponsors farmer-run farmers markets in Humboldt County, promoting direct marketing for farmers and ensuring that consumers buy a local product.
7) Pacific Coast Farmers Market Association – operating farmers markets in Alameda, San Francisco and San Mateo counties.
8) Phat Beets – a food collective started in Oakland in 2007 to support social businesses and farmers of color. Phat Beets now supports two farmers markets, one youth led farm stand, and a youth market garden in partnership with a hospital.
9) Puente de la Costa Sur – leverages resources that foster economic prosperity and security, and promotes individual and community health and wellness in San Mateo County.
10) Visalia Farmers Market – supports its local food system by providing Tulare County with a wide selection of locally grown produce and handmade products.
11) Sustainable Economic Enterprises of Los Angeles – operating farmers markets in Los Angeles County.
12) Ecology Center – a strategic partner of CFMC working statewide.

The following are project activities completed against its Work Plan and Expected Measurable Outcomes. In the 10 target counties, the following were implemented (with targets and measurable outcomes based on the pilot year's benchmarks):

1) Leverage matching funds from philanthropic support and distribute top up tokens to CalFresh/WIC recipients and seniors, resulting in $570,000 in specialty crop sales for farmers at participating markets. (Pilot year sales: $481,000)

- ROC leveraged $115,000 amount of matching funds and distributed nearly $157,000 of market match. Including WIC/Calfresh sales of approximately $628,000, this resulted in nearly $900,000 amount of specialty crop sales.

2) Partner with at least 11 organizations to distribute posters, flyers and other CFMC materials to 960,000 California consumers. Partnerships include 8 lead organizations working in the 10 California counties, the Ecology Center, California DSS agency, Fair Food Network and Wholesome Wave. (Pilot year: 9 partners)
   - ROC partnered with these 12 organizations to distribute posters, flyers and other CFMC materials to more than 1 million Californian consumers.

3) Expand existing or start new market match programs to a total of 63 farmers markets. (Pilot year: 46 farmers markets)
   - Top up programs were started or expanded at 71 farmers markets.

4) Increase CalFresh/WIC/senior redemption rates in at least 30 of the original 46 pilot farmers markets by providing market match and promoting the program and CalFresh/WIC benefits to clients at 63 markets. (Pilot year: 46)
   - CalFresh/WIC/senior redemption rates were increased in all 46 of the original 46 pilot farmers markets.

5) Increase participation in the federal nutrition benefits by establishing pre-enrollment screenings at 10 farmers markets. (Pilot year: 2 farmers markets had pre-enrollment screenings)
   - Established new pre-enrollment screenings at 10 participating farmers markets throughout the state.

6) Administer 30 customer surveys that question purchasing patterns at eligible farmers markets to determine the role of the market match on specialty crop purchases
   - Administered 800 customer surveys at 61 eligible farmers markets that helped the Consortium determine the role of top up on specialty crop purchases.

7) Establish a state-level advisory committee with ROC, 8 lead partner organizations and California DSS agency (with possibly 2 additional partner organizations in 2 new counties, to be determined)
   - ROC has established a state-level advisory committee called the California Food Policy Council with interest and involvement from all 12 partners. In addition, Ecology Center has created a statewide farmers market committee that will also be an opportunity for all Consortium partners to participate.

8) Monitor distribution, evaluate program results, and share results with farmers markets throughout the state

- ROC has shared the evaluation results with current Consortium partners and a national farmer's market consortium led by Wholesome Wave and Food First. With the national team's help, ROC plans to release a report that will share results with farmers markets throughout California and the nation.

9) Generate local and statewide media support highlighting the work of the CFMC partners and their communities' access to healthy, fresh and affordable fruits, nuts and vegetables.
   - Many of the partners throughout the state generated local and statewide media, and in addition, Roots of Change highlighted the Consortium's work on its website and blog. A few highlights include articles highlighting Market Match in the Fresno Bee and in the Half Moon Bay Review; and Market Match being highlighted in LA County for CalFresh Awareness Month.

- Convened all partners for monthly conference calls and two in-person meetings to collaborate on best practices and share resources.
- Maintained monthly reporting of EBT and Market Match redemption with 10 partner organizations. The 11th partner, Ecology Center, is a strategic partner that provided EBT assistance and training to farmers markets new to the technology.
- Branding exercise of Market Match, creating new logos and taglines. In 2013, the Consortium's name will be changed to California Farmers Market Consortium.
- Established Market Match at new and existing markets throughout CA.
- Conducted consumer surveys at over 61 farmers markets. See attached.
  - 710 participants
  - 15 questions
  - 18% male and 81% female

  In addition, ROC created a vendor survey that most of the partners implemented for the first time this year. ROC's national partners will consolidate the relevant data from these surveys to glean best practices from the different regions, and share the report nationally. (Vendor survey paid for with non-grant funds. Survey attached)
- Leveraged SCBGP funding to bring in an additional $115,000 combined local support for Consortium's Market Match projects.
- ROC followed the plan laid in the project purpose section of the approved project Scope of Work. Specifically:
  - ROC signed formal contracts with each of its lead partners/subgrantees/contractors that stated that their projects would 'solely enhance the competitiveness of specialty crops'.
  - The tokens that CalFresh/WIC clients were given to spend in farmers markets had 'produce only' printed on them and could not be used at non-specialty crop vendors.
  - ROC provided each of the CFMC members with resources and information on eligible specialty crops.
- ROC staff conducted site visits to the lead partners' farmers markets to monitor procedures and ensure standardization.
- ROC developed tools that track the amount of top up money and federal benefits spent at each market for each specialty crop farmer.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

In addition to the activities completed in the Work Plan, the follow activities were accomplished against its Performance Monitoring Plan:

- The Consortium's goal was to expand Market Match to 63 farmers markets, and instead expanded to 134. ROC was also tasked with increasing redemption rates in at least 30 of 46 farmers markets. As the increased revenue will reflect (see below), ROC increased redemption rates in nearly all of the markets, including the Market Match. In most cases, it was an increase of 200 percent, and in some cases, an increase of 300 percent.
- Increased revenue of specialty crop farmers in eligible farmers markets to total $879,131. This is an increase of $263,000 from last year's revenue ($616,437) and an increase of $555,000 from its pilot year ($324,350).
- ROC was tasked with administering 30 consumer surveys at eligible farmers markets. Staff gathered over 700 consumer surveys in 61 farmers markets statewide. In addition, staff conducted vendor surveys with specialty crop farmers selling at participating farmers markets, and gathered nearly 200 vendor surveys. As part of non-grant activities, analysis will be completed and shared with farmers markets and specialty crop farmers nationwide in 2014.
- Increased participation of 3,789 new and pre-screened CalFresh, WIC and senior consumers to bring in new patronage to eligible farmers markets. This is a 42 percent increase from the Consortium's pilot year (2,195 consumers).

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

ROC created a customized database to gather metrics of each farmers market partnering with CFMC, showing progress on EBT redemption and number of CalFresh participation to date, as well as the accumulation of data collected over previous grant years. With this customized database, ROC was able to more accurately track the beneficiaries of Market Match. They include consumers who have better access to fresh, healthy produce and can purchase more of it with an incentive match; and specialty crop farmers who are selling at the 134 participating farmers markets in 12 California counties.

In addition, the Consortium expanded to include four new partners, organizations that were able to use the SCBG funding to create an infrastructure for implementing EBT. This helped increase the consumer base to their farmers markets, which in turn, attracted more specialty crop vendors to their markets, creating more direct marketing opportunities for small specialty crop farmers in their regions.

Relevant database metrics noted below:

- Expanded Market Match programs at a total of 134 farmers markets in 12 California counties, serving 840 specialty crop farmers
- Total number of clients receiving Market Match - 17,358
- Market Match funds distributed - $156,348
- Market Match funds redeemed - $153,695
- CalFresh amount distributed - $57,072
- CalFresh amount redeemed - $53,364
- FMNP amount redeemed - $199,418
- New and prescreened clients at eligible farmers markets - 3,789 clients at 10 farmers markets
- Partners distributed nearly 300,000 flyers, brochures and other materials in multiple languages, including Spanish, English, Hmong, Chinese, and others. In addition, many partners launched PSAs and ads on Spanish radio and television stations. All of this successfully brought in new patronage to participating farmers markets, showing a 42 percent increase from the pilot year.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

CFMC is still challenged with measuring its full impact statewide. For example, one of the goals was to distribute nearly one million posters/flyers/materials. ROC alone has so far distributed statewide nearly 300,000 flyers, brochures and other outreach materials, but this does not capture the number of residents reached through Market Match radio and TV ads, and PSAs that several CFMC partners have created in multiple languages.

Organizational capacity with grassroots organizations implementing Market Match has consistently challenged the Consortium since its pilot year. For example, this year two of the partners were unable to complete the vendor and consumer surveys at their participating markets due to capacity issues. Although ROC received an overwhelming survey response from the other partners, two regions (Marin and Central Coast) were not included in this year’s data. Changes in leadership at grassroots organizations sometimes aggravate this issue of optimum data collection. ROC and its partners have attempted to mitigate these inevitable staff changes by implementing systems that help build capacity for organizations that have limited capacity to utilize sophisticated streams of revenue from public sources. This year there were several staff and leadership changes, including one at ROC, that were much smoother transitions than expected.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

See attached customer and vendor survey with results.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 48	Project Title: Cultivating a Community Nutritional Health Network	
Grant Recipient: California State University, Chico	**Grant Agreement No.:** SCB11048	**Date Submitted:** December 2014
Recipient Contact: Karen T. Hansen	**Telephone:** 530-898-8626	**Email:** kthansen@csuchico.edu

Project Summary
Cultivating Community North Valley (CCNV) was conceived by a design team of 10-15 representatives from diverse parts of the local food system. Farmers on the team sought to address the attrition of local small and midsize multi-crop growers, and to boost their competitiveness by harnessing the CalFresh market. Agri-ecologists on the team aimed to develop a program that encouraged a thriving alternative to the regional dominance of high-pesticide, water-intensive and largely exported mono-crops, and that encouraged planting techniques that support ecosystems, lessen water use, build healthy soil and utilize biological and non-toxic pest control. Agricultural educators on the team sought to build toward a university program specializing in organic fruit/vegetable growing, robust and networked enough to supply specialty crops to university cafeterias, dormitories, and ultimately to the university community in the form of a CSA program. Team nutritionists sought to address the logistic and financial difficulty low-income resident's face in accessing fresh local produce.

Butte County faces conditions inadequately addressed by a local food economy dominated by largely exported, water-intensive mono-crops. These conditions include persistent drought, a non-replenishing farmer population, twenty-three urban/rural food deserts, 10 percent unemployment and much-higher underemployment, 60 percent suffering from diet-related illness, and 31 percent of residents facing increasing food insecurity. CCNV was designed to address, in some measure, all of these concerns.

Project Approach
Cultivating Community North Valley (CCNV) was created as a partnership of programs and players serving residents who are systemically under-supported in the local food system: students, low-income farmers, and under-resourced populations. CCNV provided instruction, consultation, networking and targeted resources, working to strengthen the community through local, sustainable cultivation and promotion of specialty crops by the following objectives:

Convene Management Team. Under the direction of the Project Director, CCNV's Management Team met an average of twice monthly from October 2011 to June 30, 2014 to report progress, collect forms from players re: project progress, targets; collect feedback/data from participants and players, identify problems, assess reports, co-develop strategies, and list action items.

Convene Project Stakeholder Coalition. CCNV convened its Tri-annual Stakeholder Coalition of 20-plus collaborators, beneficiaries and advisors from educational, help-agency and farming sectors eight times throughout the project period. Over the course of these meetings, organizations from multiple sectors of the regional food system joined CCNV's coalition in organizing shared visions, identifying community needs, strategizing complementary and mutually supportive efforts, cross-promoting, avoiding service overlap, troubleshooting, networking, guiding future steps, sharing achievements, disseminating and analyzing project results, examining obstacles and planning for project sustainability.

Promote CCNV Project. CCNV's outreach strategy utilized press releases and Community Calendar Announcements to local papers and radio stations, and an online newsletter sent to stakeholders and participants. CCNV's outreach team also used social media announcements and invitations, and a project website that explained the project, provided resources and information, and enabled workshop signups online.

Implement and Expand CSUC's Organic Vegetable Project Farm. OVP's student-run organic fruit and vegetable farm employed 9 students-- farmers, researchers and marketers--conducted vegetable variety trials, and served as the platform for 402 CSUC students taking college courses in Independent Field Study and Directed Project work, Entomology, Sustainable Vegetable Crop Production, and Integrated Pest Management. OVP also hosted ten farm tours and FFA field days with tasting contests, and Edible Pedal cooking demonstrations with OVP produce, drawing over 600 K-18 students. OVP also provided ten CCNV farming workshops. OVP events' unique community and K-12 participants totaled 716, and CSUC students: 402.Total OVP sales over the course of the project: $11,259 Total OVP production: 13,568 lbs. of vegetables and fruit.

EBT-enable all County Farmer's Markets. By the end of project year one, CCNV provided technical assistance to all eight previously un-enabled county farmers markets in becoming EBT-accepting, and provided ongoing troubleshooting and technical support for redemption of EBT specialty crop incentives.

Provide biweekly organic specialty crop-based workshops, educational workdays and instructional events for 800-plus students, farmers & community members. CCNV held over a hundred workshops and instructional specialty crop-based events for small and midsize farmers, K-18 students and community members throughout the North State. 62% of participants registered as "low income" (eligible for free workshop-related materials and EBT Learn & Earn Farmer's Market Incentive Coupons). Workshop events drew 1,047 sign-ins with 819 unique participants and 161 repeating. Annual Heirloom Seed Swap events drew an additional 600 participants.

Provide Community Garden Input Assistance, Organization and Volunteer Help, Hosted Workdays & Ongoing Support for 15-plus community gardens on 7-plus acres. CCNV provided input assistance and ongoing consultation for a year-round average of 16 community gardens on 7 acres throughout the project. To date: CCNV's active Community Garden network includes 27 locations on 8 acres. CCNV also provided more than 50 hosted Garden Workday events, drawing 490 unique participants and 245 repeating.

Provide annual cost assistance for up to five small specialty crop farmer's markets. CCNV provided thirteen total $1,000 cost offset mini-grants to specialty crop-only farmer's markets, and to farmer's markets that were able to demonstrate that all mini-grant funds exclusively enhanced the competitiveness of specialty crops—five awards in grant year one, five awards in grant year two, and three awards in grant year three (13 total), all to five unique markets. These cost offsets assisted small specialty crop markets with the cost of insurance, staffing for EBT/specialty crop promotional events, and signage prominently advertising EBT acceptance for specialty crops, and advertising specialty crops specifically and generally at the market.

Implement New/Young Farmer Scholarship Program. Throughout the course of the project, twenty-three unique and five repeating new specialty crop farmers sold their produce a minimum of six times at small neighborhood farmers markets per year, and were provided with cost-offset scholarships of $300/year apiece to assist them with certification fees and operating expenses.

Provide EBT/Specialty Crop Incentive Events. Throughout the course of the project, CCNV redeemed over 1,400 specialty crop incentive coupons from over 800 unique target population members, drawing over $9,500 in matching EBT funds spent on specialty crops.

Provide 24-plus annual Specialty Crop Culinary Demonstrations with Edible Pedal Bike Kitchen. In 2.75 years, CCNV's chef and intern team in charge of human-powered Edible Pedal Bike Kitchen served over 2,800 specialty crop tastings and been utilized for over 90 mobile culinary demonstrations (specialty crops) at farmers markets, help agencies, and events/conferences.

Disseminate results & share project model throughout the North State. CCNV's management team made seven community and conference presentations on various aspects of the project at the CSUC Sustainability Conference, and at the 5th National Conference on Sustainable Agriculture held in Corvallis, OR., where 75 professors, instructors of sustainable agriculture, and university faming researchers attended.

While providing EBT enablement assistance and technical support was vital to offering specialty crop incentive events at all eight county farmers markets, EBT enablement itself benefited other commodities besides specialty crops at markets that sell additional products. With the exception of the time associated with specialty-crop-only EBT incentive events, CCNV's EBT/Farmers Market consultant volunteered (and did not report as match) the time and travel required to EBT-enable and technically support four (4) markets that sell products in addition to specialty crops. Thus, specialty crop block grant program funds were not used to benefit non specialty crops.

Also, providing general cost-offset assistance to farmers markets had the potential to benefit non-specialty crops. To address this, CCNV required cost-offset recipients to document how CCNV funds would be used for the exclusive benefit of specialty crops. Those who managed markets that sold some non-specialty crop items showed how matching funds from other sources were utilized to represent or cover non-specialty crop percentages of offset expenses reimbursed by CCNV.

This project ensured an exclusive benefit to the local Specialty Crop (SC) economy by adhering to the following procedures: (1) targeting, for cost support and technical assistance, small farmers markets and CSA's that specialize in SC's (2) designing all promotional and educational project materials to feature only approved SC language and images (3) providing only SC items to local service agencies (4) making all participation in program activities and EBT promotional events contingent upon managers and collaborators signing Memoranda of Understanding ensuring that project funds will be spent only on activities directly promoting SC's (5) farmers market and CSA growers will be asked to provide standard certification forms to specify the SC's they produce (6) token designs will be uniquely colored and printed with 'Fruit and Vegetables Only' (7) monthly formative assessment and reports will track and help enforce compliance.

Primary Investigator/Director steered the direction and guided the vision of the project, led and oversaw the CCNV Management Team, convened and organized project stakeholder meetings, directed communications and relationships with collaborators, provided quality control and content management for CCNV's workshop training curricula; oversaw CSUC's Organic Vegetable Project Farm (OVP) and its events, and directed CSUC student courses and projects associated with OVP.

The Organic Vegetable Project (OVP) Team, consisting of two graduate student positions, three undergraduate positions and CCNV project director (1) managed the 1-3 acre OVP, growing multiple varieties of vegetables year-round and planting cover crops on resting soil; (2) marketed and sold OVP produce to CSUC dorms and at an on-campus farmers market; (3) supported CSUC students taking OVP-connected directed study and entomology courses; (4) hosted field days, farming workshops and vegetable variety trials for community farmers and high school FFA students.

Project Coordinator integrated management of CCNV with her Master's Degree Studies, assisted with oversight of all OVP activities and output, facilitated the exchange of financial documents and records, and provided much of the ground work that made CCNV operations successful.

Adept Professional, LLC acted as CCNV's Evaluation Team. Adept formatively advised CCNV's Core Players throughout the project, assisted in the designing of data instruments, analyzed feedback and performance data for conclusions and recommendations; prepared formative reports for Management Team meetings and summative reports for stakeholders.

CSUC's Center for Nutrition and Activity Promotion (CNAP) provided CCNV its Lead Culinary Demonstrator who brought her expertise as a certified nutritionist, master chef and cycling instructor to the Management Team and to the design and construction of the Edible Pedal Bicycle Kitchen.

GRUB Education Program's 6-person team (1) provided farmsite input and ongoing support for all community gardens (2) coordinated most urban farming workshops, educational garden workdays and seed swap events (3) supported the project's EBT/Farmers Market Consultant in implementing promotions and providing technical support to farmers markets; (4) maintained CCNV's website and social media pages and provided the lion's share of CCNV's ongoing outreach and publicity, including flyer and signage design, radio interviews and CCNV's monthly newsletter production and distribution.

CCNV's EBT/Farmers Market Consultants enabled all county farmers markets with EBT machines and technical support, and coordinated and implemented all EBT/Specialty Crop promotions at farmers markets, managed and implemented CCNV's farmer's market cost offset program and small farmer scholarship program.

Goals and Outcomes Achieved

To achieve increased networking capability and response capacity, CCNV formed a stakeholder coalition of over 150 members attending at least one of CCNV's eight meetings, and core members representing 20 organizations attending all meetings.

To achieve the goal of increasing educational/experiential resources for K-18 students to encourage organic, sustainable specialty crop farming in upcoming generations, and also the goal of providing an institutional model that removes as many steps as possible between farm and table, CCNV implemented and expanded CSUC's Student-Run Organic Vegetable Project Farm, grew over 13,500 lbs. of specialty crops and sold the produce on CSUC's campus via a farmer's market, to university caterers, cafes, dormitory cafeterias, as well as to local organic produce stores, generating $11,259 in income. All OVP program income supplemented the wages of the students working the OVP farm, allowing them to work additional hours or days tending the farm site. This program employed 9 student farmers, provided a living classroom to 402 CSUC students taking OVP-centered courses, and hosted farm events for 716 unique community members, K-12 students and farmers.

To achieve the goal of training a minimum of 800 students, small farmers and low-income residents to develop skills in one or more of the following: cultivation, preparation, preservation, or marketing specialty crops, CCNV provided over 100 urban farming and marketing workshops and educational garden workdays to 819 unique participants and 161 repeating participants, and 90 culinary demonstrations (specialty crops) with the Edible Pedal bike kitchen, at which over 2,800 specialty crop tastings were served.

To achieve the goal of expanding the purchasing market potential of local specialty crop farmers, CCNV provided EBT enablement and technical assistance to 8 county farmer's markets and held EBT Specialty Crop incentive/promotion events and ongoing programs which brought 620 unique consumers, 1400 card swipes and $9,500 of matching expenditures on local specialty crops.

To achieve the goal of supporting low income residents in developing skills/knowledge related to cultivating, preparing, preserving and marketing specialty crops, CCNV redeemed 790 Learn & Earn specialty crop coupons to farmer's markets from 489 unique EBT users. Learn & Earn coupons were distributed by CCNV as an incentive and reward for attending CCNV instructional events.

To achieve the goal of assisting new/young specialty crop growers in selling product, CCNV provided twenty-seven $300/yr cost-offset scholarships to 23 unique new growers who vended their specialty crops at small farmers markets six-plus times per year. These scholarships covered certification fees and transport/travel expenses. These new vendors reported an average $350 in sales over the 6 CCNV-tracked times they sold produce at the market.

To achieve the goal of improving the competitiveness of small markets specializing in specialty crops, and reducing some of the obstacles they face, CCNV provided thirteen (13) cost offset mini-grants in the amount of $1,000 to specialty crop-only farmer's markets, and to farmer's markets that were able to demonstrate that all mini-grant funds exclusively enhanced the competitiveness of specialty crops.

To achieve the goal of increasing accessibility to locally grown specialty crops for under-resourced residents and the agencies that serve them, CCNV provided groundbreaking, garden input and ongoing sustaining support to 27 community gardens and urban farms serving low-income rural and city neighborhoods, low-income housing projects, cultural centers, homeless and domestic violence shelters, cultural, senior and wellness centers.

Into the future, ongoing specialty crop growing as a result of CCNV's project is projected to produce a minimum of $103,000 worth of crops per year, and $1.03 million over the next ten years ($1.5 million, with a conservative economic multiplier effect estimate). Breakdown: the OVP is expected to continue production of an average $4,000 worth of specialty crops per year per acre (currently, one acre grows specialty crops, and two acres provide floriculture cover crops to build soil and provide habitat for bees. OVP will expand to three acres of specialty crops in upcoming seasons), producing $12,000 worth of specialty crops annually. Community gardens are expected to continue producing $3,500 worth of specialty crops annually per acre, bringing $28,000 worth of produce per year. New CCNV-trained growers are expected to produce an ongoing $63,000 worth of specialty crops annually post-project. These figures anticipate: a.) Ongoing new community garden site input balances attrition post-project; and b.) 25 percent of trainees cultivating upon own/shared plots average .15 acre per person per year post-project, with an estimated attrition rate of 30 percent (estimated production numbers derived from a 2008 US Department of Agriculture National Agriculture Statistics Service study's ratio of 3,100 acres of specialty crops at Unit Production Value of $20 million = $6,451 per acre. CCNV scales down its estimates to $3,500 worth per acre for new growers).

CCNV surveys measuring local specialty crop activity in general, and also following CCNV event attendance, show that habitual specialty crop purchase, consumption, preparation, preservation, cultivation and sale rose as a function of the frequency of participation in CCNV activities.

The comparison of actual accomplishments with the goals established is as follows:

1. Specialty Crop sales for Organic Vegetable Project
   Outcome Goal: 25%+/year aggregate sales increase through mid-2014, an aggregated total of $11,296
   Actual: $11,259 (99.99% of target).

2. Specialty crop sales for CCNV-assisted direct marketers.
   Goal: A 25%+ average sales increase by mid-2014 for locally grown specialty crops.
   Actual: Jan 2014-June 2014: A 60% reported sales increase over the same market period in 2011 was reported by surveyed CCNV-supported direct marketers and market managers (vs. 35% for those markets that were least-supported).

3. Annual EBT-purchased specialty crops sales from direct marketers:
   Goal: Minimum $35,316/year by 2014, representing a 25%+/year increase in specialty crops purchased from direct marketers.
   Baseline: $18,082 in EBT sales at 8 county farmer's markets in 2011.
   Actual: $73,416.02 in EBT sales at 8 county farmer's markets in 2013 (over 200% of target).

4. Number of community gardens and total acreage
   Goal: 15 active new gardens/urban farmsites on 7+ acres by mid-2014.
   Actual: 27 active gardens on 8 acres of land by June, 2014. CCNV maintained 16 sites on 7 acres

5. Specialty crops made available to target populations (students, low-income & disabled residents, seniors).
   Goal: 15,156 total lbs. of produce by the project's end, representing a 25%+ annual increase in produce made available to target service agencies
   Actual: 65,000 lbs. of produce made available to target population members

6. Participation numbers for CCNV instructional events
   Goal: 800+ unique participants in CCNV events by mid-2014; 200+ repeating participants.

Actual: 3,000 estimated unique participants (no overlap with any type of event) of 5,528 total participants counted as "unique" within event categories, and 5,700 total participation units (repeating+unique combined).

7. Longitudinal change in participants
   Target: Nutritional and agricultural literacy and food preparation knowledge/skills; cultivation, purchase and consumption of local specialty crops increased by 30%+ by the end of the project.
   Actual: CCNV workshop participants who reported increase in specialty crop activity:
   --Cultivation: 62.4%--Preparation: 62.4%--Purchase and consumption: 53.3%--Preservation: 36.6%

The following details the completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets:

1. Specialty Crop sales for Organic Vegetable Project
   Target (2011 baseline=$2,645.70; 2012 target =$3,306/yr, 2013 target=$4133; 2014 [$3857 through June 2014]).
   Actual Total OVP sales (integrating the correction of a decimal point error in Year 2's report): $11,259 (Actuals: Yr 1: $6574+Yr 2: $4239+Yr 3: $4,006[Jan-Jun]). Actual aggregate sales ($11,259-$11,296)/$11,296 (target aggregate sales for the period) represent an achievement of 99.99% of aggregate target.

2. Specialty Crop sales for direct marketers:
   Target: 25% total sales increase by 2014 over 2011 baselines for the total project period.
   Baseline: Specific pre-project numerical baselines were not willingly disclosed by surveyed growers. However, farmers and market managers did disclose annual rate-of-change sales information.
   Actual: 2011-2013 average sales increases reported by five county market managers indicate a 60% increase for the markets most-supported by CCNV funds and activities, and a 35% increase in sales for those least-supported by CCNV (an on-target 25% increase likely attributable to CCNV assistance).

3. EBT-purchased specialty crops sales from direct marketers:
   Target: 25% annual increase over the 2011 baseline of $18,082 (2012 target=$22,602/yr; 2013 target= $28,253; 2014 target=$35,316).
   Actuals through January, 2013:
   2011 baseline: $18,082
   2012: $60,052 –this number represents 266% of the target.
   2013: $73,416 represents over 260% of the target
   2014: Market managers and specialty crop farmers have not been forthcoming with dollar totals, but have reported, in surveys and interviews, a modest increase over 2013 trends for EBT expenditures on specialty crops for corresponding months. If 2013-level EBT expenditures are simply maintained, they will represent a 200% increase over-target.

(*These baseline and actual numerical figures indicate total EBT expenditures at farmers markets, including non-specialty crop items. Three of Butte County farmer's markets are specialty-crop-only, and these markets received the bulk of the assistance from CCNV's EBT promotions (e.g., only specialty-crop-exclusive markets redeemed Learn & Earn Specialty Crop matching coupons). Market managers for these markets reported the highest upsurge in EBT use at the markets compared to larger markets that received less CCNV assistance (a threefold increase in EBT expenditure between 2012 and 2013 from a 2011 baseline of 0, versus a one-fourth reported increase over 2012 numbers in 2013). Surveys of market managers and of specialty crop farmers across all markets indicated that the increase of specialty crop expenditures with EBT reflect the general EBT expenditure trends reported above.)

4. Number of community gardens and total acreage
Target: 15+ active sites on 7+ acres by mid-2014.
Actual: In June 2014, 27 total new active community gardens on 8 acres, representing a 12 garden site and 1 acre over-target outcome. CCNV maintained 16 sites on 7 acres *average per project year*
Baseline: 3 formerly input fallow community garden sites (.3 acre total), one active community garden at the Dorothy Johnson Community Center in Chico (.2 acre); one school garden at Parkview Elementary School (.25 acre).

5. Specialty crops made available to target populations from community gardens:
Target: 25%+ annual increase in produce made available to target service agencies/projects
Pre-project baseline: 4,000 lbs. /year to 1 homeless shelter, 1 low-income housing project, 1 low-income neighborhood center.
Progressive Target: (2011 baseline=4,000 lbs.; 2012 target=5,000 lbs.; 2013 target=6,250 lbs.; 2014 target=3,906. lbs [through June, 2014])
Whole project target: 15,156 lbs. of produce made available.
2012-actual: 22,000 lbs; 2013-actual: 26,000 lbs. 2014 (Jan-Jun) actual: 17,000 lbs. (on-pace to produce 34,000 lbs. in 2014)
= 65,000 lbs. of produce to 27 agency and neighborhood recipients (49,844 lbs. over total project target), directly feeding an average of 750 target population members per year.

6. Participation numbers for CCNV instructional events
Pre-project 2001 baseline: 0 for Urban Farming Workshops, Educational Garden Workdays, and Culinary Demonstrations. For the Organic Vegetable Project, student and community participation in 2011 included 3 students working at the OVP farm, 2 students engaged in OVP independent study, and 50 total community participants at OVP farm events.
Target: 800+ total unique participants in CCNV events by mid-2014; 200+ repeating participants.
Actual: Urban Farming Workshops: 1047 sign-ins, with 819 unique and 161 repeating participants.
Actual: Educational Farming Workdays: 490 unique and 245 repeating participants.
Actual: Seed Swap Events: over 600 total participants.
Actual: OVP event unique community participants: 716, and CSUC students: 402.
Actual: Culinary demonstration participants: 2,501, enjoying 2,800 tastings.
Totals: 3,000 estimated unique participants (no overlap with any type of event) of 5,528 total participants counted as “unique” within event categories, and 5,700 total participation units (repeating+unique combined).

7. Longitudinal change in participants
Target: Nutritional and agricultural literacy and food preparation knowledge/skills; cultivation, purchase and consumption of local specialty crops increased by 30%+ by the project’s end.
Baseline: Implied in the comparative nature of the report by respondents

Actual: CCNV workshop participants who reported increase in specialty crop activity:
Cultivation: 62.4%--Preparation: 62.4%--Purchase and consumption: 53.3%--Preservation: 36.6%

The major successful outcomes of the project include the following:

CCNV has achieved a successful demonstration model encompassing partnerships with service agencies, farmer networks, conservation organizations, neighborhood revitalization groups and schools. CCNV has also developed substantial specialty crop industry supporting capacity, as evidenced by:

1. Over 3,000 urban and rural specialty crop industry farmers, agriculture students, and low-income residents having increased knowledge and skills to inexpensively prepare, preserve, buy and market specialty crops and to cultivate them in diverse growing environments.
2. Over 50 master gardener graduates from CCNV Project 48's three-tiered farmer training series.
3. EBT enablement, cost offsets & CalFresh enhancements to 8 county farmers markets, helping to boost EBT use for specialty crop purchase by 400% over 2011 baselines, & sales traffic by 30% over baselines;
4. Over 25 new growers & students consistently direct-marketing in local food deserts
5. Eight established bio-intensive acres growing specialty crops at over 27 urban/rural sites and a student-run university farm, collectively producing over $32,000/yr worth of specialty crops annually available to two CSAs and food-desert farmers markets, and supplying three shelters, one senior-support agency, two schools, one independent living agency, four low-income housing projects, two wellness centers and one African American Cultural Center.
6. A human-powered Edible Pedal Bike Kitchen that has served over 2,800 tastings and been utilized for over 90 mobile culinary demonstrations at farmers markets, help agencies, and events/conferences focused upon wellness, nutrition and farming.
7. Enhanced competitiveness for specialty crop farmers markets serving three least-resourced county areas, increasing their sales by 35 percent (attributable to CCNV support)
8. Over 400 university students having gained knowledge and skill from directed academic work with the Organic Vegetable Project, four campus caterers, cafes, and dormitories, and over 25,000 CSUC faculty, staff members enjoying greater access to local fruits and vegetables via OVP's CSA and farmer's market. Many more to benefit in the future from the robust, thriving Organic Vegetable Project farming program at California State University, Chico that is showing a consistent 25% rate of growth per year.

Beneficiaries

Beneficiaries include:

Low-income farmers and high-need residents received greater access to fresh produce via strategically located community gardens, EBT-enabled farmer's markets, CalFresh/Specialty Crop matching incentives, and training in growing, preparing, preserving and selling specialty crops.

Small growers in farmer's markets were afforded increased ability to compete against larger markets and retail sellers due to critical cost offsets for staffing, insurance, specialty crop signage, etc., and also due to EBT enablement/support and facilitated access to the local EBT consumer market via EBT/Specialty Crop promotions, as well as due to farmer scholarships, which lowered the risk for new growers vending at farmer's markets, and brought greater vended supply and diversity to the markets.

More than 150 specialty crop growers aided by 25% specialty crop sales increases at farmer's markets, and the quadrupling of EBT expenditures on specialty crops since 2011, adding an average estimated $40,000 per year to specialty crop purchases, a trend expected to continue or increase.

Twenty-three new farmers assisted with cost offset scholarships to sell produce at farmer's markets.

Five small specialty crop only farmer's markets representing 60 unique specialty crop vendors received assistance with high insurance and staffing costs, increasing their viability and their capacity to compete with larger markets and with retail providers.

The regional specialty crop industry and local economy has received the added benefit of a 150 to 240 percent multiplied economic effect of local specialty crop spending.

More than 1,000 K-18 students and over 1,500 low-income residents reported increased capacity for nutritional and economic self-reliance, having gained vocational and health-saving skills to cultivate/prepare/preserve/purchase/sell an estimated collective $1 million in specialty crops per year. These trainees have also added $275,000-plus worth of newly-grown specialty crops to the regional farm economy over 2.75 years (community garden acreage plus a conservatively estimated 20 collective acres of specialty crops grown per year on individual plots as determined by longitudinal surveys), with an expected ongoing annual production of a minimum of $103,000 between the OVP, community gardens and individual growers.

Over 400 university students having gained knowledge/skill from directed academic work with the Organic Vegetable Project, four campus caterers, cafes, and dormitories, and over 25,000 CSUC faculties, staff members enjoying greater access to local fruits/vegetables via OVP's CSA and farmer's market. Many more to benefit in the future from the robust, thriving and growing Organic Vegetable Project farming program at CSUC.

Lessons Learned

Some of CCNV's most exciting results were envisioned at the outset, but the team could not have predicted how powerfully some happenings unfolded. The following lists examples of some of the more important lessons CCNV's Team learned:

If you build it where they already are, you won't have to wonder if they'll come. CCNV learned that building gardens and holding workshops right where target participants live and work significantly increases participation.

Top-down approaches do not work. Bottom-up approaches do work. Creating an application process requiring groups and agencies to demonstrate both short and longer-term commitment before devoting project resources brought needed buy-in and helped CCNV's team to discern where and how to invest efforts for the greatest effectiveness.

Unexpected outcomes that were an effect of implementing this project include:

The community was more eager for CCNV than realized. While it is difficult to distinguish the degree to which CCNV was simply well-timed with the general cultural acceleration of the local/organic food movement, vs. the degree to which CCNV sparked and nurtured the movement locally, organic and fruit/vegetable growing has been embraced by local farming interests, low-income communities and anti-hunger and nutritional service agencies to a degree previously unseen in Butte County.

Individual "ownership" works best even inside community gardens. By far the most successful community garden structure was not one in which "all pitched in," but one that had a manager who invited individuals, community members or interest groups (depending on the garden's intended served population) to lease, or otherwise claim responsibility for, garden plots or certain beds within a greater farming space.

Community gardens can suffer an embarrassment of riches. CCNV-supported gardens' largest hurdle was not, as expected, growing enough food, but eating all that was produced-- distributing/ transporting/selling harvested specialty crops before they began to wilt or rot.

Direct marketing options need to be several. CCNV partners were surprised to learn that direct marketing solutions and strategies other than vending at farmer's markets turned out to be the most practical in many cases, because they removed both the guesswork and a big step between farm and table. Direct marketing to dorms, cafes, caterers, and establishing member-supported CSA programs helped to conserve farmworkers' energies at the Organic Vegetable Project and the CCNV-supported Heartseed Farm allowing them to spend more effort farming, and fewer hours sitting at market and transporting product.

While all of CCNV's target outcomes were technically met, many unforeseen difficulties arose. Some efforts, while achieving numerical target outcomes, were not as qualitatively effective as hoped, and will not be repeated in future iterations of this project.

Many of the most useful lessons learned simply involved ways to keep such a complex project integrated, moving forward, flexible, and efficient. This project hired, trained and served so many people from multiple backgrounds that communication and planning required constant honing, forming of sub-committees, updated and refined job descriptions, and ongoing formative evaluation of processes and performance. Many of CCNV's biggest puzzles and headaches were logistical. For example:

Sign-in sheet processes must account for multiple complications. Participants who were homeless, part of a teen/domestic violence shelter, non-English speaking, or developmentally disabled, or who had concerns about family members' legal documentation, often balked at sign-ins. CCNV's team used photographs of events, consistent participant aliases and proxy sign-ins to address this unforeseen issue.

Tracking spontaneous participants need not be rocket science. CCNV's Team struggled to divine ways to track passers-by who stopped to participate with a crowd in a CCNV Edible Pedal culinary demonstration at a farmer's market or community event. Instead, CCNV's culinary chef and assistant counted tastings that were given out, and counted apparent participants with hashmarks.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 49	**Project Title:** California Hotel Community Crops Project	
Grant Recipient: People's Grocery	**Grant Agreement No.:** SCB11049	**Date Submitted:** December 2013
Recipient Contact: Jumoke Hinton Hodge	**Telephone:** (510) 652-7607 ext. 24	**Email:** Jumoke@peoplesgrocery.org

Grant Award Amount (A)	Amount Invoiced to Date (B)	Remaining Grant Balance (A-B)	Program Income	Committed Match/In-Kind Funds	Match/In-Kind Funds Spent to Date
$52,244.00	$52,244.00	$0.00	$0.00	$0.00	$0.00

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

Through this Specialty Crop Block Grant Program (SCBGP) project, People's Grocery sought to increase the competitiveness of specialty crops by significantly increasing demand at the California Hotel (CA Hotel) and by promoting community health improvements directly related to increased consumption of specialty crops. This project's initial purpose was to encourage a community norm shift to favoring specialty crops grown at the CA Hotel, through other programs, and from other California growers. The project exposed residents to new and different-to-them varieties of produce and offered regular access to crop information, nutrition education, and cooking instruction.

Note: People's Grocery only cooked with crops grown in the garden, and only specialty crop were grown at the CA Hotel. The project team ensured that no outside produce was used in all nutrition/cooking demonstrations.

The CA Hotel is a low-income housing development in West Oakland where People's Grocery has managed an agricultural space since 2009. The West Oakland community faces considerable health challenges with high rates of diabetes, hypertension, cholesterol, and a number of other health disorders related to limited access to healthy, fresh specialty crops. This project specifically focused on CA Hotel residents and neighbors, and their healthy food access issues. The CA Hotel garden was used as a tool to create a safe space to build community and bring attention to the importance of growing specialty crops. The project centered on the garden program, which offered activities related to healthy food, education and leadership development opportunities within the community.

During the course of this project, the East Bay Asian Local Development Corporation (EBALDC) greatly expanded the reach of the project by modernizing the CA Hotel building. This partnership was truly timely because People's Grocery greatly expanded the reach of the project as new residents moved into the revitalized Hotel. In addition, this project directly addressed the need for CA Hotel residents' to have access to specialty crops and information on nutritional health.

People's Grocery developed relevant programs, which exposed residents to the importance of specialty crops and healthy eating. Some of these programs included events centered on specialty crops, garden workshops and Flavas of the Garden activities. Through these avenues the project team was able to influence CA Hotel residents' food choices to increase their nutritional health and wellbeing.

The project team developed leadership opportunities for garden maintenance and activities in order to address food access issues and emphasize the importance of specialty crops in urban areas. The garden was utilized to stimulate interest in urban gardening and consumption of specialty crops. Furthermore, the garden was used to teach residents that production of specialty crops can provide economic stimulation within the neighborhood.

The garden space gave residents of the hotel direct and affordable access to specialty crops. In addition, the greenhouse plant sales program created meaningful economic incentives and encouraged economic self-sufficiency amongst residents. Through the activities at the garden space, the project was successful in creating opportunities for residents to increase their knowledge of, access to, and interactions with specialty crops.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

From October 2011 to September 2012, 2,800 pounds of specialty crop produce was harvested and distributed. During the same time period, 1,700 individuals were reached through the garden space programming. These individuals included 700 residents of the CA Hotel and the surrounding West Oakland neighborhood, and 1,000 of these individuals were from the greater Oakland area.

Sixteen structured garden events were held, of which, four events were organized to show case the specialty crops grown at the garden. All of these events included nutrition education and/or demonstrations, a healthy specialty crop meal, and garden interaction/education.

In October 2011, a Harvest Event was held in collaboration with City Slicker Farms. Specialty crop food demonstrations were provided and fall plant starts were also sold. The Harvest Event provided for the opportunity to create a family friendly event focused on specialty crops and healthy eating for West Oakland families. Children's activities included a garden treasure hunts and healthy food sampling.

In January 2012, a Martin Luther King Service Day was hosted at the garden space where the project team and CA Hotel residents volunteered to install additional planter boxes along the street bordering the hotel. Specialty crops planted in the boxes included kale, squashes, lettuce and chard. The planter boxes not only promoted specialty crops outside the garden space where the community could harvest produce, but also provided easy access for some residents. Work parties were established on Saturday mornings to maintain the planter boxes and garden. After the planter boxes were built, neighbors asked People's Grocery to help them plant specialty crops in an open lot of land.

In April 2012, the Greenhouse Spring Plant Sale was held at the garden site. Specialty crops sold included kale, lettuce, squashes, and chard. The CA Hotel garden had its greatest success in the fall 2012 with plant sales earning double the revenue generated in the past. The original goal was to generate at least $10,000 from greenhouse sales; however, the revenue at the April 2012 plant sale exceeded that goal as approximately $10,500 was generated.

Urban gardeners from the City Slicker Farms Backyard Garden Program in West Oakland and Dig Deep Farms attended the Juneteenth Celebration in July 2012. Both are urban agriculture organizations specializing in training urban farmers and growing specialty crops to make available to low income communities. The 250 residents of West Oakland that attended the Juneteenth Celebration participated in several workshops and activities that promoted specialty crops, such as healthy smoothie workshop that used produce grown in the garden, specialty crop plant starts were sold, and a nutrition workshop was held detailing why specialty crops are a better choice.

Twelve weekly garden workshops or "Flavas of the Garden" were conducted at the CA Hotel garden from July through October 2012. A total of 100 people attended the 12 workshops. Topics and activities included: a Raw Foods 101 Workshop, How To Start A Garden and Fall Planting Workshop, Sonoma Farm Tour, Health Fair, Build A Box Workshop, Youth Day: "System Out Of Your System" Juicing, Stories and Dishes From The African Diaspora.

These Flavas of the Garden gatherings were a harvesting and workshop series for the CA Hotel residents and greater community, which provided education about the health benefits of specialty crops and nutrition assistance programs. Leadership activities were designed to stimulate greater buy-in and ownership of the production of specialty crops, harvesting and preparing these foods.

Outreach methods used to contact residents included email, phone calls and door-to-door outreach. Because of this consistent presence, residents have incorporated Flavas of the Garden into their schedule. The residents view the workshops as an opportunity to assist in the garden, harvest food and try new specialty crop recipes.

Flavas of the Garden participants were asked to evaluate activities and interactions every week. From these evaluations, the project team was able to analyze the effectiveness of each activity. In addition, feedback given on these evaluations was considered for future activities and desired participation. Therefore, topics were generated by the participants.

Leadership development activities included soliciting feedback from residents and developing programs based on their input. CA Hotel residents took leadership in planting, watering and harvesting specialty crops. There were three residents in particular that played a regular role in helping to set up and clean up for the weekly Flavas of the Garden activities.

Finally, from October 2011 to September 2012, $12,340.40 in plant sales was generated by the garden at the CA Hotel. All program income generated from plants sales was used for project related activities. All program income earned went back into the maintenance of the greenhouse, including staff salaries and supplies.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

1. *Increase consumption of fruits and vegetables by the CA Hotel residents and participant members of the West Oakland community by 15%, measured by purchase of produce boxes, distribution of harvested specialty crops, and surveys on health and cooking.*

Flavas of the Garden was a space for consumption and distribution of specialty crops grown directly from the garden. The project team engaged participants in workshops on food preparation, harvesting and growing their own fresh vegetables. The goal for participation was to ensure that at least 15% of the residents participated in activities. In spite of some of the physical challenges and health issues of residents, the project team was successful in getting at least 23% to attend most events in the garden. Participation was increased when the project team brought the specialty crops to their living room at the CA Hotel. Locations for certain demonstrations were moved into the hotel or the front of the building in order to accommodate and eliminate any barriers residents might have in getting to the garden.

Unfortunately, the project was not as successful in collecting and compiling data, which was often a result of a very transient population of residents. There was only a limited amount of health and nutrition surveys collected. Therefore, it was decided to instead collect anecdotes from regular visits residents made to the garden to harvest, as well as their participation in Flavas of the Garden workshops. For example, the project team compiled an anecdote about a CA Hotel resident who approached project staff to express his excitement about his upcoming move to the renovated side of the hotel. Duane discussed his desire to have his new room facing the garden because he enjoyed seeing the progress of the garden. Another example is a story collected about a long-term CA Hotel resident who is battling mental illness. He is an essential and dedicated volunteer helping with many aspects of the garden space. During summer months he is responsible for watering the chestnut corridor boxes, among other tasks. The greenhouse is an important spot for his mental stability. He comes to the garden when he needs to calm down or relax and will spend time there by himself. These are important examples of how residents have connected to the garden space and incorporated specialty crops in daily routines.

To address this data collection problem long-term, People's Grocery is working toward using an online system to collect survey information. For example, residents who attend any event at the garden space in the future will be asked to provide a cell phone number. The software can text several questions, and aggregate their text replies into a survey report. Also, the "entrance questions" will be automated using an iPad for events, so that residents sign in to an online system and answer several questions to enter the event.

People's Grocery was unable to use the CA Hotel as a Grub Box distribution site as it turned out it was too regular a commitment for residents because they preferred to get produce when they wanted it. However, People's Grocery did achieve the goal with food distribution. Of the 5,600 lbs of produce grown that year, 90% of it was distributed to residents with the other 10% going to local partners.

2. *Support the CA Hotel residents in taking leadership roles in the creation and implementation of specialty crop promotion and use (gardens, redevelopment of hotel, sales, workshops). At least 15 residents will show gains as leaders connected to the benefits of specialty crops, measured by participation in a resident council or leading healthy foods projects benefiting the Hotel or larger Oakland community***.**

Three CA Hotel residents served as assistants during the Flavas of the Garden activities**.** Resident leaders support the set up and break down of the event weekly. One resident has provided two workshops based on his interest in the garden.

There have been periodic struggles to involve residents based on some of their health and lifestyle choices. Due to these challenges, People's Grocery was not successful in recruiting 15 residents. Residents have often been able to find a role for themselves based on their own comfort level, and therefore, the project team has relied upon this "self selection" of duties to ensure that some resident leadership did occur. For example, instead of forcing the resident leadership council structure, there were two residents that took responsibility of irrigating/watering the garden. The programming was shifted to allow for that, and other examples of unanticipated leadership that did not fit into our previous design.

3. *Provide meaningful economic incentives through specialty crop programming for CA Hotel residents and West Oakland residents in the vicinity. At least 5 residents and/or neighbors will be benefiting from meaningful economic investment, measured through stipends received from greenhouse and garden plant sales and cultivation participation and tour guiding.*

People's Grocery hired a West Oakland resident from the neighborhood to apprentice as the farm manager and manage the greenhouse production. This individual started engaging People's Grocery first through getting plant starts, giving gardening advice, and eventually began to volunteer. After volunteering he was offered a small stipend position for supporting greenhouse production and plant sales. People's Grocery has been successful in providing him full time employment, and he is currently the Garden Manager. He is now responsible for the overall upkeep of the garden, including grounds keeping, greenhouse maintenance, etc.

Another West Oakland resident was hired on a part time basis to support nutrition education and conduct outreach for garden activities. In addition, periodic stipends have been provided for three residents performing food workshops. In total, the project team did reach the goal of providing 5 residents and neighbors with meaningful economic investment. There was a small group of residents willing to work, but it was based on their own capacity. The project team found individuals interested in the stipend, but were hesitant to commit long-term.

After establishing this goal, it became apparent that there were some significant challenges in the ability to fully engage all of the CA Hotel residents. More than half of the residents in the hotel live with mental illness, substance abuse issues and other severely debilitating illness such as gout or seizures. The project team's ability to engage residents beyond education, food sampling or harvesting specialty crops for them has been improving over time. People's Grocery is hopeful that partners skilled in working with this population will support this garden space at the CA Hotel. Other providers have expressed interest in utilizing the garden space to create a safe space to strengthen residents' coping mechanisms when addressing some of their personal issues.

4. *Further develop the garden and greenhouse space as a healthy, attractive, and accessible hub for promotion of specialty crops through regular safety monitoring, regular planting and maintenance, and increased attendance by the public reaching through nutrition demonstration and community health outreach and events.*

The Director of Programs performed regular safety monitoring during her monthly tours, ensuring that the daily weeding, crop thinning, plant start seeding, soil building, and other tasks occurred according to schedule.

Monthly Saturday workdays were developed to support garden maintenance and community ownership of the garden and garden boxes. Saturday workdays occurred in an informal way before this project, and the Garden Manager recognized the need to formalize these gatherings and provide a more structured space for garden volunteers.

As mentioned above, 1,700 individuals were reached through the garden space programming through events, Flavas of the Garden workshops, nutrition education and cooking demonstrations. These individuals included 700 residents of the CA Hotel and the surrounding West Oakland neighborhood, and 1,000 of these individuals were from the greater Oakland area.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

During this project, 700 individuals without regular access to healthy food, who classify as low-income, received exposure to and interacted with specialty crops, many for the first time. Also, these individuals increased their purchase of specialty crops as a result of this exposure. They received this exposure through events and Flavas of the Garden events. 1,000 individuals from the greater Oakland and Bay Area had an opportunity to tour the garden site and learn about specialty crops, cultivate and harvest specialty crops, and purchase specialty crops plant starts for their personal or professional gardens. The plant starts are being used in edible landscaping throughout the city, being sold at Berkeley Garden stores, and being used in educational institutions. The greenhouse program was the main driver of connecting to the 1,000 individuals from the greater Oakland area.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

People's Grocery did not anticipate that people might harvest the specialty crops and make their own value added products. In some cases, health and nutrition demonstrators regularly harvested herbs and leafy greens for food demonstrations beyond West Oakland.

The work at the CA Hotel was extremely challenging because the project team is trained as gardeners, farmers and community activists. The project team was not prepared to deal with issues of substance abuse, mental health or medical illnesses. Therefore, the project team had to be more creative in how they involved people in the planting, cooking or harvesting process. For example, the size of planting areas was adjusted, and shelving and seating was created so residents felt more comfortable with engaging in the process.

Specific interventions that have improved the project include: (1) shifting the leadership development structures and resident councils, to allow for less structured forms of leadership; (2) shifting the survey data from quantitative answers to qualitative stories; and (3) building a rigorous online system that utilizes community organizing software to aggregate survey data via text message, iPads and cell phones to log responses to events and collect survey answers.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

None.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 50	Project Title: Healing Meals for Healthy Communities	
Grant Recipient: Ceres Community Project	**Grant Agreement No.:** SCB11050	**Date Submitted:** December 2014
Recipient Contact: Cathryn E. Couch	**Telephone:** (707) 799-7489	**Email:** Cathryn@ceresproject.org

Project Summary

More than 56% of the deaths in the United States are caused by chronic conditions in which poor nutrition and the low intake of fruits and vegetables played a significant role. In 2005, only 55% of Sonoma County adults and 20.8% of teens reported eating the recommended five servings a day of fruits and vegetables.

Obesity, which is linked to higher rates of diabetes as well as many other chronic illnesses, is high and growing. The three year moving average shows the percentage of Sonoma County teens who are overweight or obese has increased from 41.1% in 2001-2003 to 44.5% in 2007- 2009. The latter figure compares to 41.9% in California overall. National data shows a strong correlation between low intake of fruits and vegetables and higher rates of obesity.

To combat these issues, this project focused on: 1) educating two specific populations (teenagers 13 to 18 and adults with a serious illness), as well as the broader community about the vital link between a diet high in fruits and vegetables and better health; and 2) increasing fruit and vegetable consumption among the two target populations.

In addition to the data mentioned above, there are currently no programs in Sonoma County that target large numbers of teens (500) to increase their fruit and vegetable consumption and teach them to prepare healthy meals. Giving young people the knowledge, skills and inspiration to make healthy eating a habit is a vital way to improve health outcomes. This project engaged teens in the preparation of whole foods, plant-based meals for people dealing with cancer and other life-threatening illnesses. In doing that, this project accomplished three critical things: 1) taught teens how to cook California specialty crops; 2) made these foods familiar and let teens learn that these foods taste good leading to increased consumption; and 3) “connected the dots” for the teens about the critical link between a healthy diet and long-term health outcomes.

Furthermore, malnutrition is a serious problem for people with illness, especially cancer, and results in worse treatment outcomes, increased side effects and longer recovery times—all of which reduce quality of life and increase health care costs. In addition, illness provides a leverage point for change. For adults dealing with nutrition based illnesses such as cancer, diabetes, heart disease and stroke, the combination of already prepared nourishing meals for 3 to 6 months during treatment along with nutrition education leads to better health outcomes in the short term while setting them on a life-long path of healthier eating by increasing their consumption of specialty crops.

This project did not build on previously funded work.

Project Approach

Ceres staff promoted the teen program and built new referral partnerships with three group homes serving foster and dual diagnosis youth (mental health and drug addiction) and several new continuation high schools serving at risk youth. Program size grew from 158 youth and 5,870 hours of service learning about specialty crops in 2011 to an estimated 500 youth and 19,000 hours of service learning in 2014.

Ceres staff promoted the meal program to low-income people with illness and built new referral partnerships with Petaluma Health Center and Sonoma Valley Community Health Center. Program size grew from providing 28,550 specialty crop meals and nutrition education to 233 clients in 2011 to providing an estimated 80,000 meals to 550 clients in 2014.

465 teens were engaged in learning to cook and eat specialty crops during 33,900 hours of service learning, an average of 73 hours per youth. This is 24% more than the grant goal of 350 – 400 youth and 83% more than the goal of 40 hours per youth. During the project, Ceres also launched a ¾ acre food production garden that extended youth's learning to how to grow specialty crops. Staff instituted a ½ hour per day, focused education program covering the nutrition benefits of specialty crops and developed more than a dozen curriculum blocks related to growing and eating specialty crops.

740 clients received 126,000 organic specialty crop meals during the grant period, 35% more clients than were projected in the grant proposal. Ceres Nutrition Education Program Manager created a weekly Nutrition Bite flyer that was included in each week's delivery. The colorful flyer features a food or food group that is included in that week's meal delivery. There is information about the health benefits of that specialty crop as well as a recipe for one of the dishes clients were receiving. Staff also increased nutrition education training to the volunteer Client Liaisons who work directly with Ceres' clients.

As part of the grant, Ceres completed a two and a half year program evaluation study, collecting base line data on clients and teens as well as data showing the impact that the Ceres program has on cooking habits and consumption of specialty crops.

Ceres Executive Director worked with members of the Advisory Team to create a Communications Plan to leverage the results and learnings from this project. The Program Evaluation Report and an Executive Summary were sent to more than 100 funders, health providers, public health professionals and food system leaders across the San Francisco Bay Area. Ceres Executive Director shared study results with senior staff at Sonoma County Department of Health Services, the Sonoma Health Alliance (coalition of all major hospitals), and with leadership of Health Action and the Food System Alliance. A press release was created and sent on September 1, 2014 to local, regional, and national media.

Moreover, this project exclusively benefited specialty crops. Specialty Crop Block Grant Program funds supported Ceres Community Project's Healing Meals for Healthy Communities program. The goal of this program is to use the structure of a meal delivery program for people facing illness to educate clients, teen chefs and adult volunteers about the vital role that fresh fruits and vegetables play in health and to increase consumption of these foods. All project funds were used to support this project and the outcome of increased specialty crop consumption as follows:

- Project staff tracked their hours and project funds were used only to reimburse for staff time focused on the following: recruiting clients and teens for program participation; preparing meals featuring specialty crops so that clients could learn that these foods taste good and help them feel better; delivering specialty crop meals to clients; educating teens about specialty crops through growing specialty crops and preparing specialty crop meals for clients; and preparing information about the benefits of specialty crops and delivering that information to clients and teen participants.

- All reimbursements for direct costs covered items directly related to the completion of this project such as 1) brochures to recruit participants; 2) materials that promoted the consumption of specialty crops; 3) re-usable containers for delivering specialty crop meals to clients; 4) and non-food items that were essential to the safe and sanitary preparation of specialty crop meals.
- Reimbursement for Contractors covered an outside evaluator in order to insure the effectiveness of the project in meeting goals related to increased consumption of specialty crops.

Ceres receives client referrals from dozens of hospitals, medical groups and other healthcare providers including a number of federally qualified health centers. Youth in the program come from more than 60 schools in Marin and Sonoma counties and Ceres works closely with referral partners who serve the special needs of foster and other at-risk youth. Ceres enjoys very strong community support, including a large proportion of in-kind food donations from local farmers, food producers and grocers.

Ceres Executive Director is a member of the Sonoma County Food System Alliance and works with the Sonoma County Department of Health and members of both organizations have been kept abreast of this project.

Goals and Outcomes Achieved

Ceres engaged 465 teenagers in 33,900 hours of service learning about growing, preparing and eating specialty crops and about the link between specialty crop consumption and personal and environmental health. Teens grew specialty crops in Ceres ¾ acre organic garden and prepared 126,000 organic and whole foods meals featuring more than seven dozen different specialty crops. Teens learned about the specific health benefits of many of these specialty crops as well as how to prepare and cook them. Program evaluation results show that on average teens increased the number of vegetables that they eat by 27% from 15 to 19 and consumption increased for every fruit and vegetable measured in the program evaluation.

Ceres provided 126,000 specialty crop focused meals to 764 families struggling with a serious health challenge. Meals were accompanied by nutrition education through these channels: intake conversation with the client; New Client Packet and home visit with the client’s volunteer Client Liaison; weekly phone calls with the Client Liaison; and a weekly flyer called Nutrition Bites that featured the health benefits of specific specialty crops along with a recipe featuring that food. Ceres staff increased nutrition education training for Client Liaisons to support the project, and developed the Nutrition Bite.

The project goal was to reach an estimated 350 - 400 8th to 12th graders with a minimum average of 40 hours each of service learning in the program, and to increase consumption of specialty crops by 20%. During the grant period, Ceres reached 465 youth (24% above goal) with an average of 73 hours of service learning each (83% above goal). Youth increased consumption of specialty crops by 16%.

The project goal was to provide 500 to 600 adults with life-threatening illness and their immediate family members with prepared meals composed of 75% California specialty crops, and to increase their consumption of specialty crops by 30%. Ceres reached 740 people with serious illness (39% above goal) and an added 518 family members for a total of 1,258 people. Clients increased specialty crop consumption by 23%.

The project goal was to reach 10,000 people with messages about the health benefits of specialty crops. During 2013 alone Ceres conservatively reached 1.5 million people with these messages through 26 separate television, radio and print media stories. This does not include messages created through Ceres mailed and emailed newsletters, website, Annual Reports or social media posts.

Program evaluation data showed the following:

- Prior to starting the program clients reported eating an average of 5.2 servings of specialty crops per day. This increased to 6.4 servings per day when measured three months after completing the meal program (to allow clients to re-establish their own eating habits). In addition, 95% of respondents said that what they learned about healthy eating during program participation was important to them and this is reinforced by the open-ended comments.
- Prior to starting the program, youth reported eating an average of 6.4 servings of specialty crops per day. While this is likely over-stated, when surveyed six months later there is an increase to 7.4 servings per day. In addition, the variety of fruits that youth reported eating increased from 11.7 to 12.3 on average, and the variety of vegetables increases from 15 to 19.

Clients increased consumption of specialty crops by 1.2 servings per day, or 23% on average. As a result, clients served by this project will consume an estimated additional 226,884 servings of specialty crops over the next year and an additional 2,268,840 servings over the next ten years at an estimated value to the specialty crop industry of more than $1,000,000.

Teens increased consumption of specialty crops by 1.0 serving per day, or 16%. Teens reached by this project will consume an additional 169,360 servings over the next year and an additional 1,693,600 servings over the next ten years, at an estimated value to the specialty crop industry of more than $745,000.

Neither estimate includes the added consumption from family members or friends as a result of what they learn through the clients or teens. In addition, an annual survey of Ceres adult volunteers—not targeted as part of this grant application—found that 47% of them have increased vegetable consumption since beginning to volunteer at Ceres.

Beneficiaries

Ceres Community Project targeted two key groups for this project:

1. Youth between the ages of 13 and 18 who volunteer in Ceres organic food garden and commercial kitchen and learn about growing, preparing and eating specialty crops. These young people come from more than 50 middle and high schools, group homes and foster youth programs across Sonoma County. 62% are female and 38% are male. 16% are non-white.
2. Individuals of all ages who are struggling because of a serious health challenge such as cancer. 88% of those receiving meals and nutrition education about specialty crops have cancer, while the other 12% have a broad range of illness. 66% are female and 34% male. 43% are under age 60 and the remaining 57% are 60 or older. 12% are non-white. 72% have household incomes below $45,000 and 21% have household incomes below $10,000.

During the grant period, 740 individuals struggling with a serious illness received 126,000 organic plant-based meals from Ceres Community Project. Assuming 70% of these clients recover from their illness, Ceres estimates that clients who participated during the grant period will consume an additional 226,884 servings of fruits and vegetables over the next year because of the increased fruit and vegetable consumption as a result of what they learned during the project, and an added 2,268,840 servings over the next ten years with an estimated benefit to the specialty crop industry of more than $1,000,000.

For youth the changes in consumption will likely have a much longer impact. During the grant period, 465 youth participated in 33,900 hours of service learning about how to grow and prepare specialty crops and about their health benefits. Program evaluation shows that as a result of what they learned, these youth will eat an additional 169,360 servings of fruits and vegetables over the next year, and an added 1,693,600 servings over the next ten years with an estimated benefit to the specialty crop industry of more than $750,000.

Lessons Learned

Ceres realized through the data collection process that many of the teens who volunteer at Ceres are already very interested in healthy eating. As a result, consumption increases were lower than projected. However, it is clear that program participation exposes youth to new specialty crops and increases the likelihood that they will eat a greater variety of these foods (27% increase in variety of vegetables eaten). What was especially heartening was the 50% increase in the share of teens after six months in the program who report encouraging friends and family members to make healthier choices. Clearly teens are learning important nutrition information and gaining confidence in their ability to talk about these issues with others. As the Ceres program expands over the next two years to reach more youth who are not already healthy eaters, staff expects to see greater improvements in behavior change than was found with this group. [Ceres will be opening a program in Oakland in 2015 and another Sonoma County site in 2016 serving foster and at-risk youth.]

On the client side, it is clear from both the quantitative data and the open ended comments that the program results in significant increases in both knowledge and behavior related to healthy eating and specifically specialty crops. In some ways this is surprising given the fact that clients are in the midst of a very serious health challenge, many are dealing with nausea and impacts to their appetite from chemotherapy and radiation, and learning about healthy eating is not their top priority. Despite this, more than 50% reported in the open-ended comments that learning about nutrition and healthy eating had changed them, and more than 90% said that the following were important benefits of participating in the program: 1) I learned a lot about nutrition and healthy eating; 2) I discovered that eating healthy makes me feel better; and 3) I discovered that healthy eating tastes good. In addition, 100% said that the healthy food helped them recover more quickly. This data reinforces Ceres strategy of leveraging illness as a time to educate people about the link between consumption of healthy foods, especially specialty crops, and health outcomes, and using a meal delivery program supported with small amounts of nutrition information as a vehicle for this education to happen.

It would have been beneficial to collect data on income levels of clients, as well as length of time of service in order to evaluate whether or not these had any impact on outcomes. On the teen side, it would have been beneficial to design the data collection process to evaluate the impact of length of time on consumption changes.

Overall, the project deepened Ceres staff's understanding of the power that the program has to improve healthy eating and cooking behavior among both the teen and client populations being targeted. At the same time, staff gained greater insight into the nuances of changes that are happening. These insights are already shaping program developments to enhance learning about the value of specialty crops, and to support behavior change.

While the project did not reach the targets for increases in consumption, these goals were completely speculative since there was no previous baseline data. Increasing specialty crop consumption by 23% for clients over an average of 14 weeks, and 16% for youth after six months appears significant given the small investment being made to generate long-term health and specialty crop industry benefits. Thanks to this project, Ceres Community Project is now in conversation with Sonoma Health Alliance regarding additional research to evaluate how the impact of healthy meal support featuring a high proportion of specialty crops can lower hospital readmission rates and overall health care costs. If this study demonstrates that specialty crop meals are a low-cost "upstream investment" that results in healthier patients and lower health care costs, Ceres expects to see hospitals and other major players considering paying for specialty crop meals as an essential part of effective health care.

Study results confirm Ceres' approach that meaningful dietary change happens most effectively through direct experience (growing, preparing, and eating the meals) over an extended period of time (clients receive on average 14 weeks of meals and teens are engaged on average for a year). Supporting this direct experience with targeted and easy to understand information about the nutritional value of specialty crops is a powerful way to reinforce and strengthen learning and behavior change. In addition, the cost (on average $740 per client and $2,400 per youth) is minimal for the short and long-term benefits that result from these changes in behavior).

Additional Information

In addition to this Final Performance Report, Ceres is providing the following:

- Attachment 1: Full Report of the Client & Teen Program Evaluation
- Attachment 2: 2013 Ceres Community Project Annual Report
- Attachment 3: Example of Nutrition Bite

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

<table>
<tr><td>USDA Project No.:
51</td><td colspan="2">Project Title:
Development of an effective lure for reliable detection and control of the female navel orangeworm moth</td></tr>
<tr><td>Grant Recipient:
U.S. Department of Agriculture, Agricultural Research Service</td><td>Grant Agreement No.:
SCB11051</td><td>Date Submitted:
December 2014</td></tr>
<tr><td>Recipient Contact:
John J. Beck</td><td>Telephone:
(510) 559-6154</td><td>Email:
john.beck@ars.usda.gov</td></tr>
</table>

Project Summary

The project purpose was to address a critical need of the tree nut industry for an effective navel orangeworm moth attractant. Navel orangeworm is the major insect pest of almond and pistachio orchards of California. This insect pest inflicts serious economic damage annually as well as introduces fungi that cause significant food safety concerns. In order to minimize the total number of pesticide applications each year, growers need an effective monitoring tool. Well-timed applications of pesticides provide the most effective use of these sprays and subsequently decrease the amounts needed, thus saving growers money in addition to minimizing environmental impacts and the chances of insects developing resistance to pesticide active ingredients.

The results from this project have been one of two major advancements toward effective control of navel orangeworm, which has until recently eluded research efforts for nearly 40 years. The one non-related advance was the development of a pheromone-based blend by other researchers made available last year. This pheromone blend can be used to efficaciously monitor male moth populations in California orchards. However, a more important and sustainable tool for growers has the been the advent of mating disruption (MD) treatments used during integrated pest management (IPM) protocols, which combines sustainable control measures with the use of well-timed, higher efficacy pesticide applications. This effectively lowers the amounts of pesticides required for pest control.

The development of the synthetic host-plant volatile blend (the blend) during this funded project was timely because the blend outperformed the current monitoring standard, almond meal, for attracting navel orangeworm in conventionally treated orchards. More importantly, the blend attracts both male and female moths whereas almond meal only attracts female moths (albeit, not consistently and was inefficient), and the pheromone blend only attracts male moths. The attractiveness of the blend for both male and female becomes very important since the blend can be used to monitor moth populations during IPM mating disruption treatments – something the pheromone blend cannot perform since MD uses pheromone components as the active ingredient. The development of the blend and its use as a monitoring tool in IPM treated orchards provides growers with a safe, sustainable method for the effective control of navel orangeworm in California almond and pistachio orchards.

This project was not built on previously funded SCBGP projects

Project Approach

Electroantennographic (EAG) analysis of host plant volatiles – a report outlining an intensive EAG analysis of 105 different almond and pistachio host plant volatiles was recently accepted for publication in a professional peer-reviewed journal. The EAG analysis was a critical component of the project and provided researchers with the electrophysiological responses of the moth antennae, which in turn allowed for the planning and formulation of candidate blends. Numerous blends were evaluated using EAG to determine the relative electrophysiological response and then compare to the trapping studies performed in the field.

Laboratory-based behavioral bioassays – several protocols and variations of methods were investigated for the development of an effective behavioral bioassay. The developed methods and equipment were successful for assaying tissue matrices (e.g., almond meal, almond and pistachio mummies, walnut and fig tissues). This portion of the project was important for the off-season testing and development of synthetic blends in addition to assaying additional tissue matrices for potential semiochemicals. The successful assaying of synthetic blends has not yet been fully realized. Investigations are continuing for the discovery of an effective synthetic background blend that will mimic orchard odors. Researchers have concluded that navel orangeworm require an appropriate background odor blend in order to respond to candidate synthetic blends.

Field trapping studies – 1,000s of field trapping studies have been performed and are still being performed in pistachio orchards on candidate blends to assess their efficacy for attracting navel orangeworm. These studies demonstrated that the current blend consistently outperformed the heretofore standard, almond meal, as well as other candidate blends tested over the last 2.5 years.

Dispersal medium – the proper dispersal of the synthetic blend is an important part of the commercialization of the blend. Studies are ongoing to determine the best medium for diffusion/dispersal of the blend.

Mating disruption studies – the first year of investigation of the blend's efficacy in orchards undergoing mating disruption is ongoing and will continue until late summer. Results thus far have shown the blend outperforms the current standard, almond meal.

The blend developed is an attractant for navel orangeworm moths, an insect pest only to California agricultural commodities, but particularly to almonds and pistachios – both specialty crops of California. Thus, the blend will directly benefit only almond and pistachio orchards/growers.

However, the implications of the blend's efficacy can be transferred to other similar insect pests. The development of an effective synthetic blend comprised host plant volatiles from various tissues of almond was unique to this pest. The scientific results, particularly the actual source of some of the blend's components, can be applied to many other agricultural insect pests. Thus, some of the fundamental knowledge learned during this project will have other significant impact.

UC Riverside Department of Entomology – played a critical role in the development of a laboratory-based behavioral bioassay for testing of candidate blends and their ability to attract navel orangeworm moths. Because navel orangeworm are active only during the growing season, researchers needed a laboratory-based bioassay to assess the numerous candidate blends being considered.

Paramount Farming Company – contributed significantly and played a critical role in the success of the project in the form of in-kind donations including: personnel and supplies for field trapping studies of candidate blends; trucks; gas; and 100's of acres of almond and pistachio orchards. The utilization of the blend for monitoring in mating disruption treatments led to a substantial use of personnel; thus, much larger in-kind funds were utilized during the final months of the grant period. These studies will be ongoing beyond the life of the grant.

Suterra – contribution of expertise and membrane materials for blend dispersal studies with membrane technologies. Suterra was not listed as a project partner, but elected to assist with the dispersal studies of the blend.

Goals and Outcomes Achieved

The stated and actual goals met are listed:

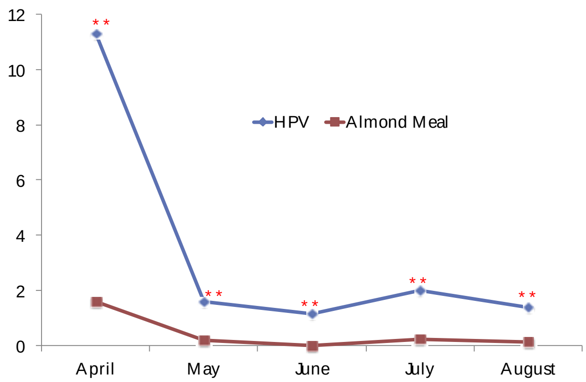
1) Address a critical need of the tree nut industry for an effective female navel orangeworm attractant
    a. A synthetic host plant volatile blend was formulated and implemented for the attraction of both male and female navel orangeworm moths. In field studies over the last three growing seasons, the blend has consistently outperformed the current monitoring standard, almond meal

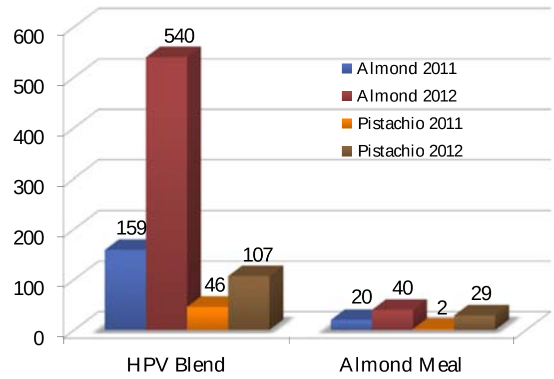
2) Using several candidate blends, confirm and optimize efficacious blends via season-long field trapping studies in almond and pistachio orchards
    a. The current synthetic blend has outperformed numerous other candidate blends in almond orchard field trapping studies. Work is ongoing to find a blend that works as well in pistachio orchards. The current blend outperforms the standard, almond meal in pistachio orchards, but not with the same consistency as its performance in almond orchards
    b. Work to address this goal included electrophysiological and behavioral testing of individual components and candidate blends, as well as field trapping studies
3) Forward the best blends from year one to a second year of testing
    a. The blend's efficacy in almond orchards has been demonstrated and moved forward for commercialization studies. In pistachio orchards, work is ongoing with candidate blends to find a more efficacious blend in pistachios

One of the goals was to also provide an efficacious blend for use in pistachio orchards. While the current blend does outperform the heretofore standard, almond meal, researchers will be continuing studies into a more effective blend specifically for pistachios.

All goals of the project were successfully met. The tree nut industry has been provided with a host plant volatile blend that outperforms the heretofore navel orangeworm monitoring standard and the blend is undergoing studies for commercialization.

Please refer to graphs shown below for comparison of the moth trapping efficacy of the host plant volatile (HPV) blend vs. almond meal in almond orchards (left) and almond and pistachio orchards (right).





In field trapping studies conducted over the past 3 years the developed blend captured navel orangeworm moths 7-12 times better than the current monitoring standard, almond meal.

In ongoing studies, the developed blend is outperforming the current monitoring standard in mating disruption studies. This positive result will have beneficial impact for Integrated Pest Management treated almond and pistachio orchards.

Beneficiaries

Once a proper dispersal mechanism is identified for the developed blend's commercialization, all California almond growers and pest control advisors (PCAs) that currently use almond meal as a monitoring standard will be able to use the resultant product. The developed product will allow more consistent monitoring of moth populations and thus better application of timed sprays.

Pistachio growers and associated PCAs will also benefit from the current blend, however studies are ongoing to identify a pistachio-specific blend with greater efficacy.

California is the largest producer of almonds worldwide, and includes 900,000 acres and an annual yield of greater than 2 billion pounds. Every 0.1% decrease of navel orangeworm damage will translate to $5-10 million saved annually.

Concurrently, California pistachios comprise 250,000 acres and an annual yield of greater than 500 million pounds. Every 0.1% decrease of navel orangeworm damage will translate to $1-2.5 million saved annually.

Lessons Learned

The successful assaying of synthetic blends via a laboratory-based behavioral bioassay has not yet been fully realized. Investigations are continuing for the discovery an effective synthetic background blend that will mimic orchard odors. Researchers have concluded that navel orangeworm require an appropriate background odor blend in order to respond to candidate synthetic blends. Once an appropriate background odor is realized this will have very positive influence on the development of other synthetic host plant volatile blends for navel orangeworm (for other crops such as fig and walnut). Moreover, successful development of a background odor for the behavioral bioassay will provide guidance for other insect pest bioassays.

As a result of this project, an international marketer and distributor of agricultural products (animal feed, and specialty chemicals and ingredients) company located in California and Washington State contacted ARS scientists with an idea to use the developed blend in a biomass, and then use this enhanced biomass as a possible attractant. An agreement has been signed and a project to evaluate this idea is moving forward. The agricultural company will be supplying all ingredients needed for the project.

The conclusion made by researchers that that navel orangeworm requires an appropriate background odor blend in order to respond to candidate synthetic blends under laboratory conditions will be very informative for other researchers encountering similar obstacles.

Additional Information

Recent germane peer-reviewed journal or book chapter articles from this project include:

- Hull split and damaged almond volatiles attract male and female navel orangeworm. Journal of Agricultural and Food Chemistry 2012, *60*, 8090-8096.
- Generation of the volatile spiroketals conophthorin and chalcogran by fungal spores on polyunsaturated fatty acids common to almonds and pistachios. Journal of Agricultural and Food Chemistry 2012, *60*, 11869-11876.
- Conophthorin from almond host plant and fungal spores and its ecological relation to navel orangeworm: a natural products chemist's perspective. Journal of the Mexican Chemical Society 2013, *57*, 69-72.
- Chapter 5. Volatile natural products for monitoring the California tree nut insect pest *Amyelois transitella*. In *Pest Management with Natural Products*, ACS Symposium Series. American Chemical Society, Washington, D.C. Vol 1141, pp. 59-72. 2013.
- *Ex Situ* Volatile Survey of Ground Almond and Pistachio Hulls for Emission of Spiroketals: Analysis of Hull Fatty Acid Composition, Water Content, and Water Activity. Phytochemistry Letters 2014, *7*, 225-230.
- Comparison of the volatile emission profiles of ground almond and pistachio mummies: Part 1 – addressing a gap in knowledge of current attractants for navel orangeworm. Phytochemistry Letters 2014, *9*, 102-106.
- Comparison of the volatile profiles of ground almond and pistachio mummies: Part 2 – critical changes in emission profiles as a result of increasing the water activity. Phytochemistry Letters 2014, *8*, 220-225.
- Book Chapter. Semiochemicals to monitor insect pests – future opportunities for an effective host plant volatile blend to attract navel orangeworm in pistachio orchards. In *Biopesticides: State of the Art and Future Opportunities*, ACS Symposium Series. American Chemical Society, Washington, D.C. Accepted and in print. 4/30/2014.
- Electrophysiological responses of male and female *Amyelois transitella* antennae to pistachio and almond host plant volatiles. Entomologia Experimentalis et Applicata. Accepted. 2014.
- A patent application for the blend has been submitted: Volatile blends and the effects thereof on the navel orangeworm moth. USDA Patent Docket: 0153.10, U.S. Utility Patent Application Filed 12/06/2011, S/N 13/312,981.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 52	Project Title: Alternative Strategies for Pest Control in Commercial Potato Production	
Grant Recipient: The Regents of the University of California, Riverside	**Grant Agreement No.:** SCB11052	**Date Submitted:** December 2014
Recipient Contact: Robert Chan	**Telephone:** 951-827-5535	**Email:** awards@ucr.edu

Project Summary
Until recently, sustainable low input IPM strategies for potato production in California have been widely adopted. However, the introduction of the potato psyllid (*Bactericera cockerelli)*, and the losses associated the bacterium *Candidatus* Liberibacter psyllaurous (Clp) for which it is a vector, is threatening these strategies. Entire fields on both commercial and seed potatoes have been lost in California, and this is an ongoing issue in Texas and other potato-growing regions. Growers have responded by dramatically increasing pesticide use, and costs have reached the point where the economic viability of the crop is threatened. Organic production is particularly at risk, and will potentially be eliminated entirely as the psyllid range expands.

The goal of this study was to develop a scientifically sound, economically viable, and sustainable IPM strategy for the production of potatoes in standard and organic potato grower operations that reduces reliance on pesticides.

At the time of the award, the US potato industry had already lost tens of millions of dollars to “zebra chip” a name used to describe the destructive disease to plague the potato industry. These losses include complete loses to some California potato growers who had complete field failures. This project entailed some of the first comprehensive research on IPM strategies, and related topics, focusing on the zebra chip problem in California potatoes. Prior to this proposal, there was limited information on management of this complex pest in California, and consequently growers were reliant exclusively on pesticide applications, often of harsh materials. Therefore, the timing of this project was excellent as it began while the disease and psyllid were still somewhat novel, and when even minor changes would be important and useful.

Project Approach
This project has been very successful and has generated substantial amounts of data and useful results. Using y-tube olfactometery studies, a series of essential oils were tested that would potentially be repellent to potato psyllids. These studies resulted in the identification of multiple odors that were found to be repellent, and these results were published in a paper (Diaz-Montano and Trumble, 2012-link available at end of report). Based on these results multiple carriers were examined for the essential oils in both the laboratory and field. It was found that the past form of a wax matrix material impregnated with clove oil may have potential as part of an IPM strategy. Specifically, field plots treated with the material as part of an IPM rotation had lower incidence of zebra chip than other treatments. Similarly, in lab studies, psyllids were found to settle less often onto plants treated with the clove-oil infused wax-matrix. A series of dyes (visual repellents) were also examined as potential repellents; however, no significant effect was found of any dye, or other visual repellent, examined. In addition to dyes and olfactory repellents, laboratory studies were conducted of a copper material (Nutricop-20) that had the potential to alter plant physiology and appearance resulting in

repellency. Unfortunately, the studies revealed no significant effect on rates of zebra chip disease. However, there were some indications of repellency and reduced oviposition on treated plants in lab studies. Overall, these projects indicate that there may be potential for inclusion of olfactory repellents as part of an IPM program. However, its inclusion will be dependent on the development of an effective delivery method, and it will only be effective along side other materials that include traditional insecticides.

A second goal of this project was to examine potato germplasm (varieties) that were putatively resistant to potato psyllid, *Candidatus* Liberibacter psyllaurous, or are asymptomatic when infected. Over a dozen of these varieties were examined during the course of this project. These studies revealed multiple lines with either antixenotic or antibiotic properties. The results have been published (Diaz-Montano et al., 2012-link available at end of report), and have formed the basis of further investigations. Collaborators at both the USDA and Texas A&M University are breeding new putatively resistant potato varieties based on the results from experiments conducted between October 2011 through March 2012 and April through September 2013 . The more recent work demonstrated potential and the UCR team and collaborators have obtained funding to continue this work beyond the expiration of this grant.

This project was specifically aimed at managing the potato psyllid and the pathogenic bacteria of which it is a vector (*Candidatus* Liberibacter solanacearum). This insect and pathogen are pests of solanaceous plants, especially potatoes, which are the focus crop of this project. As such, while some of the results of this project will be applicable to other vegetable specialty crops (tomatoes and bell peppers); this project is not expected to benefit any non-specialty crops.

There were three primary partners in this project. The PI contributed to most aspects of this project. This included experimental design, preparation of manuscripts, preparation of reports and all necessary oversight. The first post-doc affiliated with this project, was responsible for most of the y-tube olfactometry, dye, and initial potato germplasm work. He also prepared manuscripts and performed statistical analyses. A final partner assumed this position and contributed to all subsequent experimental designs, performed experiments, conducted statistical analyses, and prepared both reports and manuscripts. He also presented results associated with the project at various meetings.

Goals and Outcomes Achieved

The expected outcomes of this project are primarily long-term in the form of reductions in pesticide use and losses in acreage and yields of potato from potato psyllids and zebra chip disease. However, there were many short-term goals met and much was achieved in the course of this project. Using laboratory based olfactometry experiments odors were identified that are repellent to psyllids and have examined methods of applying this scent to plants in both field experiments and greenhouse-based choice experiments. Laboratory based choice experiments were conducted on various dyes and putative visual repellents, but none were found useful. Putatively resistant potato germplasm was examined in the field and in the laboratory. Both laboratory-based choice and no-choice bioassays were performed to test for antixenosis and antibiosis. In addition, quantitative real-time PCR was performed to test for resistance to *Candidatus* Liberibacter solanacearum infection. Various methods of applying neonicotinoid insecticides were examined in the field and the laboratory. These experiments involved applying the materials via drip or drench and then measuring insecticide residue through Enzyme-Linked Immunosorbant Assay (ELISA). Finally, laboratory studies were conducted to determine LC_{50} and LC_{90} values for neonicotinoid insecticides at various rates in different populations. These values were used to evaluate potential insecticide resistance.

The primary long-term outcomes of this project will be realized by reductions in insecticide applications and crop loss from psyllids and zebra-chip disease. Substantial progress has been made to achieving these outcomes. First, great success has been had in distributing the information generated from this project. This includes presentations at scientific and industry meetings. These include: the annual meeting of the California Potato Board which is attended by growers and consultants from throughout the state; the Zebra Chip Reporting Sessions which are attended by over 200 growers, scientists and industry professionals from around the world, the Entomological Society of America Meetings which are attended by over 5,000 scientists, and to the American Phytopathological Society which is attended by approximately 150 plant pathologists. Additionally, three papers have been published directly associated with this project, and two others that incorporated related work. The papers can be downloaded at:
http://faculty.ucr.edu/~john/2013/Prageretal2013.pdf
http://faculty.ucr.edu/~john/2012/DiazandTrumble_2012.pdf
http://faculty.ucr.edu/~john/2013/Diaz_et_al.2013.pdf

The findings on the use of neonicotinoid insecticides have led to recommendations that already are being adopted by potato growers in California and Texas. Industry partners are developing new materials based on project team's olfactory repellent work that may be used as part of IPM programs.

This project had both short and long term goals. The short term goals included performing experimental evaluations of plant dyes and mulches, experiments examining psyllid development and transmission on putatively resistant varieties, olfactometer studies of olfactory repellents, and lab experiments on visual repellents. Additional goals of this project were to evaluate repellents within an organic program and relative to pesticides within a grower standard program. This goal has also been accomplished as has the associated data analyses. The slightly longer term goal of conducting outreach at venues including: the national Entomological Society of America Meeting, Annual Zebra Chip meeting, California Potato Board Meeting, and Cooperative Extension Meetings has also been completed. All these studies have been completed, and have therefore achieved all of the short-term goals of this project. The project proposal also included post-project activity. In particular, the goal was to evaluate reductions in pesticide use based on 2015 pesticide use reports. The project is on course to complete these evaluations once the necessary data are available.

Prior to this project, there were no data that existed on olfactory preferences of potato psyllids. Some studies had been conducted on visual cues, but these were only in the context of sticky traps, and there had been no studies of mulches or fertilizers in IPM programs for potato psyllids. Thus, with respect to these studies, the baseline is zero data and substantial progress has been made. This can be observed by the numerous papers and presentations based on these experiments. Similarly, when this project commenced, there was no data on potato germplasm that could be considered resistant to zebra chip disease or potato psyllids. Over a dozen different experimental potato lines have been screened and this has led to the identification of multiple lines that warrant further investigation. Additional funding has been obtained to continue these studies. The primary goal of this project is to reduce pesticide applications. At the time of submission, in Ventura County, use of compounds such as carbaryl was approximately 55 applications in 2001, imidacloprid use were 112 applications, and methomyl was 37 applications. Pesticide use data from the years of this study is not yet accessible, but will be published online by the Department of Pesticide Regulation at: http://calpip.cdpr.ca.gov/main.cfm. However, once it becomes available the project team will be capable of making direct comparisons to evaluate progress towards this goal. Additionally, these results may be presented at future grower meetings.

The most important outcomes of this project will not be realized, or measured for at least another growing season because it takes time for growers to adopt recommendations and for insecticide use to be reported. However, this project has already generated three peer-reviewed publications, multiple published conference proceedings, and numerous conference presentations. Five potato germplasm lines have also been identified that exhibit some resistance, antixenosis, or antibiosis to potato psyllids. These are being further evaluated and additional funding has been obtained for further studies. Finally, anecdotal evidence is had that growers are changing their insecticide rotations to use less neonicotinoid pesticides and to apply them via more appropriate methods. This will be quantifiable following publication of 2013 and 2014 pesticide use reports for California.

Beneficiaries

This research will/has benefit nearly all the potato growers in the State of California by controlling costs of production and losses due to psyllids and zebra chip disease. It will benefit other growers of specialty vegetable crops such as tomato and bell pepper that are also subject to infection with zebra chip disease or infestation with potato psyllids. It also benefited all the farm workers in specialty crop grower operations that were applying Class 1 insecticidal materials, by reducing their exposure to these insecticides. Additionally, consumers will benefit both from reduced environmental harm due to insecticides, and from lower production costs to growers, which could be reflected in lowers costs of potatoes and potato products.

Organic potato production in California, which was worth was $2.7 million in 2005 and potatoes are the most widely produced vegetable in the US with production in 2009 of 431 million cwt and sales values of $3.26 billion. California production in 2008 was 14.7 million cwt with a sales value of $204.6 million. The costs of insecticide applications in response to zebra chip and psyllids has been documented in multiple states and routinely exceeds $500/ha. This project will benefit all potato growers in California and western potato growing regions. Eliminating even a single insecticide application can result in $100/ha of savings. Moreover, since zebra chip infection can often result in field failure, and since this project has resulted in many findings that will limit such failures, there will be dramatic savings to potato growers.

Lessons Learned

This project has led to some very important conclusions. First, the studies of dyes, mulches, and a copper supplement material all suggest that potato psyllids are not strongly influenced by visual stimuli. These studies also indicate that the psyllids are influenced by olfactory stimuli, but an effective delivery method for the scented essential oils has yet to be identified. Additionally, it was found that significant reductions in zebra chip disease were only achieved with a combination of insecticides and the olfactory repellents. The most important lesson that the team learned from this project is that, in the field, psyllids density can be extremely low but there will still be instances of zebra chip disease. This has some very important implications for management of the disease, and also demonstrates the importance of developing resistant potato varieties. Conversely, it was also learned that in the absence of the pathogen, there is a far more liberal approach to managing potato psyllids is acceptable.

It is early to evaluate the long-term objective of reducing pesticide use, since pesticide usage reports and similar data are not available yet. Similarly, while potential olfactory repellents and putatively resistant potato varieties have been identified, these are early results and it was not anticipated that they would lead to commercial implementation during the life of this project. Otherwise, the experimental techniques and protocols used proved to be effective in generating data and results.

While there were no particular negative experiences, some important lessons were learned during the course of this project. In particular, a great deal of insight was gained, particularly with respect to field studies of potatoes in California. Most of these lessons pertain to the timing and optimization of planting potatoes in southern California and at the South Coast Research and Extension Center (SCREC) in particular. Since potatoes had not historically been grown at SCREC various changes had to be made with respect to irrigation, planting, and timing to account for limited equipment. Additionally, it was found that gypsum treatment was essential for planting in the slightly damp conditions in Orange County. A critical lesson that came from this project was how to simulate "at planting" treatments of certain pesticide in the absence of commercial potato planting equipment. These combined lessons are important, as the project team is now capable of creating large scale, near commercial plots of potatoes at SCREC. This allows crop destruct studies to be conducted, and studies with untreated control plots that would not be acceptable, or would be extremely expensive to conduct on commercial farms. Finally, it was learned that there is an extremely strong (< 95%) correlation between symptoms of zebra chip disease as detected by chip frying methods, and the presence of the bacterial pathogen as detected by quantitative PCR. This is an important finding since it indicates that these methods are largely interchangeable for most IPM and insecticide efficacy trials. Additionally, it suggests that testing with both methods is typically redundant. Since frying is substantially cheaper per sample than qPCR, future studies can forgo PCR in favor of frying methods, and this will result in costs savings.

Additional Information

Also associated with this project, a series of experiments were performed documenting resistance to two neonicotinoid pesticides commonly included as part of IPM programs. These studies revealed that populations of potato psyllid in Texas are developing resistance to the insecticide imidacloprid, while California populations remain susceptible. Tests of a second neonicotinoid insecticide, thiamethoxam, demonstrated complete mortality at rates as low as ¼ maximum field rates. Similar efficacy was detected in both imidacloprid susceptible and resistant colonies. However, preliminary results suggest a difference in time to mortality between imidacloprid-resistant and susceptible colonies. However, all evidence suggested this insecticide could still be successfully used to control potato psyllids. Various methods of application were also examined for both imidacloprid and thiamethoxam. These studies revealed important differences in efficacy with application method and also demonstrated that the amount of irrigation water applied to plants will alter efficacy of these insecticides. The results of these studies are published in the journal Crop Protection and can be downloaded from:
http://faculty.ucr.edu/~john/2013/Prageretal2013.pdf

Finally, in a project associated with this grant, although not explicitly in the management plan, the project team has been examining monitoring and sampling methods for the potato psyllid both in potatoes and other potential host plants. This has resulted in sequential sampling plans for the psyllid in both tomatoes and peppers. These have both been published.

Manuscripts/publications and presentations associated with this project:

Peer-reviewed publications

Prager, S.M., C. D. Butler, and J. T. Trumble. 2014. A binomial sequential sampling plan for the psyllid Bactericera cockerelli Sulc (Hemiptera: Triozidae) in tomato (Solanum lycopersicum). Journal of Economic Entomology 107(2):838-845.
http://faculty.ucr.edu/~john/2014/Prager_ec13328_2014.pdf

Prager, S. M., I. Esquivel and J. T. Trumble. 2014. Factors influencing host plant choice and larval performance in Bactericera cockerelli. PLoS ONE 9(4): e94047. doi:10.1371/journal.pone.0094047.
http://faculty.ucr.edu/~john/2014/Prager_etal_2014.pdf

Diaz-Montano J., B. G. Vindiola, N. Drew, R. G. Novy, J. C. Miller Jr., and J. T. Trumble. 2013. Resistance of selected potato genotypes to the potato psyllid (Hemiptera: Triozidae). American Journal of Potato Research. DOI 10.1007/s12230-013-9356-6.
http://faculty.ucr.edu/~john/2013/Diaz_et_al.2013.pdf

Prager, S.M., B. Vindiola, G. S. Kund, F. J. Byrne, and J. T. Trumble 2013. Considerations for the use of neonicotinoid pesticides in management of Bactericera cockerelli (Sulk) (Hemiptera: Triozidae). Crop Protection 54: 84-91.
http://faculty.ucr.edu/~john/2013/Prageretal2013.pdf

Prager, S. M. , C. D. Butler, and J. T. Trumble. 2013. A sequential binomial sampling plan for potato psyllid (Hemiptera: Triozidae) on bell pepper (Capsicum annum). Pest Management Science (wileyonlinelibrary.com) DOI 10.1002/ps.3475.
http://faculty.ucr.edu/~john/2013/Prager_etal_2013.pdf

Diaz-Montano, J. and J. T. Trumble. 2012. Behavioral Responses of the potato psyllid (Hemiptera: Triozidae) to volatiles from dimethyl disulfide and plant essential oils. Journal of Insect Behavior. 26:336–351.
http://faculty.ucr.edu/~john/2012/DiazandTrumble_2012.pdf

Presentations at Grower and Scientific Meetings

Sean M. Prager and John T. Trumble. 2013. Status of vegetable pests in Southern California and management of psyllids on solanaceous vegetable crops. 2013 Entomological Society of American Annual Meeting.

Sean M. Prager and John T. Trumble. 2013. Insect repellents, pesticide resistance, and breeding for resistance to potato psyllid to manage Zebra Chip disease. 2013 American Phytopathological Society Caribbean and Pacific Divisions Joint Meeting.

A. Zeilinger, S. Prager, J. Trumble, M. Daugherty. Ecology and Management of tomato psyllids: A research update. 2013 Ventura County Cooperative Extension Meeting.

S.M. Prager, I. Esqivel, J.T. Trumble. Patterns of host plant use in *Bactericera cockerelli*. 2013 SCRI Zebra Chip Reporting Session

S.M. Prager, B. Vindiola, G.S. Kund, F.J. Byrne, J.T. Trumble. An update on resistance and the use of neonicotinoids to manage zebra chip and potato psyllids. 2013 Zebra Chip Reporting Session

B. Vindiola, G. Kund, S.M. Prager, J.T. Trumble. Investigations of Potato Psyllid Repellents. 2013 Entomological Society of America, Pacific Branch Meeting

S.M. Prager, C. Butler, J.T. Trumble. Area wide sampling for potato psyllids: comparisons of distributions and scouting strategies on potatoes, tomatoes and peppers. 2012 SCRI Zebra Chip Reporting Session

J.T. Trumble, S.M. Prager, G. Kund. Insect resistance and other factors affecting neonicotinoids in potatoes. 2012 SCRI Zebra Chip Reporting Session

S.M. Prager, G. Kund, J.T. Trumble. Investigations of Potato Psyllid Repellents. 2012 SCRI Zebra Chip Reporting Session

S.M. Prager, C.D. Butler, J.T. Trumble. A sequential binomial sampling plan for potato psyllid (Hemiptera: Triozidae) on bell pepper (Capsicum annum). 2012 Entomological Society of America Annual Meeting. Knoxville, TN.

J. Diaz-Montano and J.T. Trumble. Repellency of Essential Oils against the potato psyllid, *Bactericera cockerelli* (Sulc): An alternative for control? 2011 SCRI Zebra Chip Reporting Session

J.T. Trumble, R. Novy, C.D. Butler, C.M. Miller, G. Kund, J. Diaz-Montano and W. Carson. New materials and resistant varieties in IPM trials. 2011 SCRI Zebra Chip Reporting Session

Conference Proceedings (available from http://zebrachipscri.tamu.edu)
R.G. Novy, S.M. Prager, J.C. Miller Jr., B. Vindeola, J.T. Trumble, characterization of potato breeding clones to determine mechanisms conferring observed resistance/tolerance to zebra chip disease. Proceedings of the 13th Annual 2012 Zebra Chip Reporting Session.

S.M. Prager, I. Esquivel, J.T. Trumble, Patterns of host plant use in Bactericera cockerelli. Proceedings of the 12th Annual 2012 Zebra Chip Reporting Session.

S.M. Prager, B. Vindiola, G.S. Kund, F.J. Byrne, J.T. Trumble. An update on resistance and the use of neonicotinoids to manage zebra chip and potato psyllids. Proceedings of the 12th Annual 2012 Zebra Chip Reporting Session.

S.M. Prager, Casey Butler, J.T. Trumble. Area wide sampling for potato psyllids: comparisons of distributions and scouting strategies on potatoes, tomatoes and peppers. Proceedings of the 12th Annual 2012 Zebra Chip Reporting Session.

J.T. Trumble, S.M. Prager, G. Kund. Insect resistance and other factors affecting neonicotinoids in potatoes. Proceedings of the 12th Annual 2012 Zebra Chip Reporting Session.

J. Diaz-Montano and J.T. Trumble. Repellency of Essential Oils against the potato psyllid, *Bactericera cockerelli* (Sulc): An alternative for control? Proceedings of the 2011 SCRI Zebra Chip Reporting Session

J.T. Trumble, R. Novy, C.D. Butler, C.M. Miller, G. Kund, J. Diaz-Montano and W. Carson. New materials and resistant varieties in IPM trials. Proceedings of the 2011 SCRI Zebra Chip Reporting Session

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 53	**Project Title:** Navel Orangeworm Biological Control	
Grant Recipient: The Regents of the University of California, Berkeley	**Grant Agreement No.:** SCB11053	**Date Submitted:** December 2014
Recipient Contact: Kent M. Daane	**Telephone:** 559-646-6522	**Email:** kdaane@ucanr.edu

Project Summary
The navel orangeworm (NOW) is the primary moth pest in pistachio, almonds, and walnuts, which are all key California specialty crops. While there have been many advances in control strategies, even with $80-$100 mating disruption (use of synthetic sex pheromone to disrupt moth mating) and $60-$120 winter sanitation (removing old nuts that support NOW), most growers apply insecticides to achieve acceptable levels of less than 1% NOW nut infestation. Moreover, the most common insecticides used are now pyrethroids, which are inexpensive but quite broad-spectrum. This project renewed efforts towards classical bio-control of NOW, using modern importation and evaluation tactics, and investigated control strategies that work synergistically towards a more sustainable program for NOW control.

The project's importance lies in the economic value of California's nut industries, which include over 6,000 almond growers and 115 processors, with more than 550,000 bearing acres of land that stretch between Red Bluff and Bakersfield, California. Similarly, there are over 5,000 walnut growers and about 55 processors (over 210,000 bearing acres), and while there are fewer pistachio growers and processors, California is still the second largest world-producer of pistachios (over 150,000 bearing acres). The navel orangeworm (NOW) can be a damaging pest in these crops, with growers spending $200-1000 per acre for NOW control. A successful biological control program can have the potential to reduce these costs--changing the balance between farm profit and loss for some growers, while allowing the continued profitability of almond and walnut growers, and the continued expansion of the pistachio industry. The sheer acreage and importance of these nut crops, with even slight changes in pesticide use or changes in economic gains, represents a significant statewide impact.

The proposed work is timely as the objectives synergistically add to those in a recently completed U.S. Department of Agriculture (USDA) Risk Avoidance and Mitigation Program (RAMP) project, which includes key growers, researchers, and extension personnel. By investigating biological controls and/or other cultural methods to lower NOW densities, growers may have additional incentive to reduce insecticide applications, and adopt other sustainable techniques, such as mating disruption.

This project did not build on a previously funded SCBG project.

Project Approach
This project had three objectives: 1) The primary objective was the discovery of novel natural enemies (N.E.) that would be manipulated in the field or (if material is discovered from outside if the US) will be screened in quarantine and laboratory to deter select appropriate species for field release. Supporting objectives are: (i) Use of molecular tools to determine the origin of California's NOW and (ii) Study the biology and behavior of resident N.E. to determine both their strengths and short-comings with respect to NOW control. 2) In support

of bio-controls, the goal is to determine the impact of common insecticides on resident N.E. in order to determine how best to manage the orchard ecosystem to support beneficial arthropods and limit pest species. 3) To reduce unnecessary insecticide applications, and investigate sampling methods that improve the predictability of NOW density throughout the season and damage at harvest-time.

(1) Renew a classical biological control program for NOW:
The primary parasitoids of NOW present in California are Goniozus legneri and Copidosomopsis plethorica, which were imported from South America (Uruguay) and Mexico, respectively, in the 1960s and 1970s. Both parasitoids can be found throughout California's almond and pistachio regions, but do not provide adequate control of NOW in the field although they were excellent parasitoids in the laboratory; thus, leading to the conclusion that their biology was not suited to either environmental or biotic conditions in nut crops infested with NOW. For this reason, the goals were to search for natural enemies that might perform better in the nut crop environment and for this, project team looked for natural enemies attacking the carob moth, Ectomyelois ceratoniae, a moth closely related to NOW and commonly found in pistachios in other regions.

To complete this task, collaborations with persons working in Argentina, Chile, Turkey, and Israel were established. In October 2011, a researcher looked for navel orangeworm and carob moth in Argentina. Eight walnut orchards were sampled near Tunuyán and Mendoza. Codling moths were found at most sites, carob moths were found only at the three Mendoza sites. All but one site in Mendoza were commercial and received insecticides. From approximately 70 carob moths collected, no parasitoids were recovered. (Airfare for this trip was funded by another source; the remaining costs were funded with SCBGP funds.)

In February 2012, a researcher began exploration for parasitoids of the navel orangeworm and Carob moth (close relative of NOW) near Las Cruz, Chile, and a region north of Santiago, with similar climate to California's Central Valley, and where walnuts are grown. NOW were not found; Carob moth were collected, but no parasitoids were reared. (SCBGP funds were not used for this trip.)

In April and May 2013, a Chilean researcher, again, searched for natural enemies of the carob moth to find locations for the UC Berkeley research team. Over a two-week collection period, no parasitoids were reared from any collected carob moths. (SCBGP funds were not used for this trip.)

In March 2014, a researcher from Abant Izzet Baysal University and visiting faculty from laboratory, traveled to Turkey. Contacts were made with numerous researchers that have worked with pistachios (the major nut crop that houses Carb moth) and were interviewed about the Carob moth. From these interviews, reports were uncovered: "Pests and Natural Enemies Determined in Pomegranate Orchards in Turkey," which were translated. Reports showed that a number of generalist predators were attacking Carob moth; as well as, the following parasitoids that are associated with Carob moth: Trichogramma evanesces, Bracon hebetor, and Apanteles sp. The plan during year 2014 was to collect materials identified as Bracon, and get a proper identification of this material. (Airfare for this trip was funded by another source; the remaining costs were funded with SCBGP funds.)

In April 2014, UC Riverside researchers looked for navel orangeworm and Carob moth in Chile. Twenty different sites were visited, from Santiago to Las Cruz, and included: Three organic walnut orchards, seven conventional walnut orchards, and ten urban sites with loquats (which are a good host for the carob moth). From these collections, no moth pests were found at the conventional sites which were repeatedly treated with broad spectrum insecticides, Codling moth and Carob moth were reared from the organic walnut sites and the loquat fruit. From these collections, project team reared only Goniozus legneri, from both Carob moth and Codling moth. The G. legneri are currently in quarantine at UC Berkeley University. Molecular analysis showed that this material is molecularly distinguishable from G. legneri collected in California. Laboratory studies to determine biological differences are currently underway. (This trip was funded with SCBGP funds.)

In June 2014, a UC Berkeley researcher was planning to visit a researcher in the Agricultural Research Organization, Volcani Center, Bet Dagan, Israel; however, researchers were unable to locate another researcher that knew of Carob moth parasitoids in Israel.

(2) Study the biology and behavior of resident natural enemies to determine both their strengths and shortcomings with respect to NOW control:
1.1 Resident Natural Enemies: During the 2011-2013 seasons, almonds and pistachio orchards were sampled in the San Joaquin Valley of California to determine levels of control provided by natural enemies resident in the orchards and the 'secondary' moth pest densities in orchards using different control practices. The importance of other related moth pests is that the presence of these 'alternate' hosts may be critical in supporting natural enemy populations.

In 2011 and 2012, collections found that navel orangeworm densities in harvest nuts and overwintered mummy nuts were low (less than 1%) at all conventional sites. Not surprisingly, natural levels of parasitism in both harvest and overwintered nuts were also low, with less than 5% of the collected NOW parasitized (range 0-8% depending on year and site). Copidosomopsis plethorica and Goniozus legneri were the most common parasitoids reared. Other parasitoids reared accounted for less than 5% of the recovered parasitoid material (less than 0.05% parasitism), and were Habrobracon hebetor, Diadigma sp., and an unidentified ichneumonid.

In the 2012 and 2013 seasons, project team increased the numbers of recovered parasitoids by using sentinel nuts (Nuts with laboratory inoculated NOW that were placed in the field for 7-14 days). (See Attachment 1) From these samples, C. plethorica and G. legneri were the most common NOW parasitoids reared from NOW. In the 2012 and 2013 seasons, parasitism levels were relatively higher, especially for G. legneri, reaching parasitism levels of nearly 40% at some sites. In comparison to 2011 fall and winter collections, (when parasitism was below 5% of the sentinel NOW) the project team noted that in the 2012 and 2013 seasons, an organic almond site was included where NOW levels were naturally higher than sites sampled in previous year, and natural enemy activity was greater as well.

In 2012, collections were made in months July, September, and October from 10 different blocks. Sentinel eggs and larvae were left for 3-5 days and 14-19 days, respectively. Field exposed nuts were returned to the laboratory, reared to adult moth or parasitoid, and then examined and sorted from December 2012 to February 2013.

From sentinel eggs, 5,982 NOW eggs were placed in the field from May to October 2013 (six sets of ca. 1000 per set divided among Kerman, Madera and Mendota plots). Of these, 1,968 (32.9%) were killed due to possible field predation (note that predation may be higher on sentinel nuts because of the artificial clustering of prey). There were no Trichogramma egg parasitoids found. Of the remaining eggs, 71.1% hatched and were reared to adult moth or parasitoid to determine levels of egg-larval parasitoids, from which 17.1% were parasitized by C. plethorica.

From the larvae samples, Goniozus legneri accounted for over 99% of the larval parasitoids reared (n = 3657), with only an unidentified ichneumonid (n = 2, probably Habrobracon gelechiae). Parasitism decreased from July (19.6%) to September (11.5%) to October (0.6%). Previous studies suggested little Goniozus legneri activity after September, and this work supports that laboratory study. Parasitism varied among blocks (ranging 1.2 ± 0.5 to 22.4 ± 2.1%).

In 2013, the sample technique was changed from individual nuts to opened buckets containing 100s of nuts, with each nut infested with two NOW larvae. The sentinel nut collections were made beginning in May 2013 and continuing through September 2013; five different almond blocks were monitored. Sentinel larvae were left in the field for 14 days; in the laboratory and each nut was isolated in a plastic container and held to rear to adult moth or parasitoid. From these collections, the larval parasitoid Goniozus legneri was collected, as found in earlier surveys. There were also some previously unreported larval parasitoids that have been tentatively identified as Mesostenus gracilis, Venturia nr sp. canescens, and Habrobracon hebetor. This shift in parasitoid species was unexpected and exciting. All of these ichneumonoids are better known as natural enemies of stored product pests. A working hypothesis is that the low rainfall and mild winter temperatures (2012-2013) led to the higher overwintering survival of these species. Habrobracon hebetor, in particular, was collected in especially large numbers in the spring and early summer, and was studied more closely in 2014.

Manipulating Resident Natural Enemies: Because generalist predators were found to have a high impact, in the 2012 season, project team manipulated green lacewing (Chrysoperla carnea) numbers in both laboratory and field studies.

In a July-August 2012 field trial, sentinel nuts with five NOW eggs per nut were placed in almond trees. Treatments of 20, 50, and 100 lacewing larvae per tree, and a no release control, were imposed. Collections of natural nuts and samples of resident predators were also taken. After 3 days, the nuts (and sentinel eggs) were collected, frozen, and stored for analysis after the field season (October 2013 – February 2013). Results showed no treatment difference in total dead eggs (41.0 to 49.5%); however, there were three times more eggs categorized as ‘eggs with large holes’ in the lacewing release treatments than the control. There were no differences among the release treatments. The results suggest 4-6% of the eggs were clearly killed by predation, and there were few other predators found in the tested trees indicating the released lacewings were the primary predator.

The same basic trial was conducted with NOW larvae in sentinel nuts, and with 20, 50 or 100 lacewing larvae released per tree. The results were not clear, with only 22 of 191 dead NOW larvae in a trial that used small NOW larvae, and while there was more dead NOW in a trial that used large larvae; there was no difference between treatments (range: 11.8 ± 2.8 to 21.8 ± 3.8% across all treatments). What was surprising in the sentinel larvae, was that it was highly parasitized by G. legneri (range: 23.2 ± 3.5 to 40.3 ± 4.4% across all treatments). In the laboratory, this predator was found to have a strong impact, with increased kill with increasing NOW prey (Density dependent), up to a point of prey-feeding saturation, but no numerical increase (Offspring) in the time frame studied.

In a July-August 2013 laboratory trial, the impact of green lacewings on NOW in infested nuts was studied. Almond nuts were infested with two NOW larvae of different stage categories. The nuts were then exposed to 3rd instar green lacewing larvae at different prey rates (e.g., 1, 2, 3, 5 nuts per predator) and different predator rates (1, 2, 3 or 5 green lacewing). After 1 day, the NOW mortality was determined. There were 10 replicates for every host density tested. In three separate field trials, however, green lacewings were not found to have a significant impact on NOW densities. The project team attributes this to intraguild predation, primarily lacewing on lacewing cannibalism and ant-lacewing predation.

The conclusions from this work are that green lacewing releases will have little impact on suppressing NOW densities to economic levels (less than 1% nut infestation).

In 2014, colonies of H. hebetor were established and spring releases in commercial orchards were tested. In two organic almond blocks, pre-release samples were taken in November 2013. From approximately 1000 unharvested mummies (almond nuts) an infestation rate of nearly 40% was found. From these NOW, G. legneri were reared, but no H. hebetor were reared. Four release plots (25 trees) were established, paired with similar control plots, and H. hebetor that were reared in the laboratory were released in the treatment plots in April, May and June 2014 at a rate of 200 – 500 per plot. Mummy nuts were collected in April and May, 2014 (100 – 200 per plot), and sentinel nuts (100 per plot) were placed in the field in June, July, and September of 2014. From these samples, no H. hebetor were recovered. Parasitism by G. legneri in the collected nuts ranged from 0% to 25% in the four plots, but there were no difference between control and release plots. One H. hebetor was recovered from the 1000s of sentinel nuts placed in the trees.

The conclusions from this work did not support releases of H. hebetor. While this parasitoid species showed great promise from the 2013 collections, and was very effective in the laboratory; in the field trials, it was not an effective parasitoid when released, even at very high release rates.

Alternate Hosts: During the 2011 and 2012 seasons, pheromone traps were placed in selected San Joaquin Valley fields. Sex pheromone baited traps for the secondary moth pests were: Peach twig borer (Anarsia lineatella), oriental fruitmoth (Grapholita molesta), filbert worm (Melissopus latiferreanus), obliquebanded leafroller (Choristoneura rosaceana), omnivorous leafroller (Platynota stultana) and fruittree leafroller (Archips argyrospila). Pheromone trap catches showed peach twig borer, obliquebanded leafroller, fruittree leafroller, and oriental fruit moth were often collected at levels more than 50 adults per trap, per week. A total trap catch summary, divided by the three sample regions, shows oriental fruit moth (OFM) and peach twig borer (PTB) were easily the most common ‘alternate moth host.’ (Attachment 1)

There was a clear difference in the numbers of secondary moth pests caught between regional sites, with virtually all caught at the Paramount sites, where there were reduced insecticide applications for NOW, as compared with the Mendota sites, where there were multiple insecticide applications for NOW and other moth pests.

There was no apparent impact of the presence or absence of these secondary moth pests on the abundance or effectiveness of C. plethorica or G. legneri as NOW natural enemies.

This work indicated that whereas there are other moth larvae present in the orchards that could help support natural enemy populations by providing additional host material, there was no measurable increase in NOW parasitism levels when these alternate hosts were present.

Parasitoid biology: A series of studies were conducted on resident parasitoids found in California, (but not in nut crops) to determine their potential to attack NOW. This work was done in conjunction with the alternate host work to determine if the presence of other moth species in or near the orchard was important for the establishment of parasitoid species.

The first resident parasitoid studied was Habrobracon (Bracon) gelechiae, a generalist parasitoid of caterpillar species that was found in almond and pistachio orchards, primarily attacking the obliquebanded leafroller. Ovipositional behavior, adult longevity and fecundity, and the effects of temperature on developmental time and survival were determined. Habrobracon gelechiae develops as a gregarious, ectoparasitic idiobiont on late-instar oblique-banded leaf-roller (OBLR) pest. At 25°C, adult female wasps survived longer when provided honey and water 35.4 ± 4.9 d) or honey, water and host larvae (34.4 ± 2.4 d) than when provided water (8.9 ± 1.1 d) or no food (5.9 ± 0.8 d). Over the adult lifespan, females parasitized 20.6 ± 2.1 hosts, deposited 228.8 ± 24.6 eggs. The intrinsic rate of increase was 0.24; the mean generation time was 18.15 d, and the double time 2.88 d. At constant temperatures, H. gelechiae successfully developed (egg to adult) from 15 to 35°C. The developmental rate was fit to a nonlinear model, providing estimates of the parasitoid's lower (10.5°C), upper (36.0°C), and optimal (33.3°C) development temperatures. Based on a linear model, 155 degree days were estimated for egg to adult eclosion. Temperature-dependent nonlinear model of survival showed similar shape with the model of development rate. The wasp developed under two diurnal temperature regimes, with 31.0 ± 13.3% survival at low (4–15°C) and 63.0 ± 11.4% survival at high (15–35°C) temperature regimes.

Another study with H. gelechiae sought to understand the behavioural and physiological responses of this indigenous generalist parasitoid to an introduced generalist herbivore light brown apply moth (LBAM). In the laboratory, H. gelechiae was able to locate the moth larvae on a series of different plant species, although clutch size (the number of eggs per host larva) was affected by host plant. The moth larvae suffered higher mortality and a slower developmental rate on the known toxic plant than on the other three plants, but the parasitoid's fitness correlates did not differ between the host food plants. These results show a high level of plasticity in the indigenous generalist parasitoid. The work suggested that H. gelechiae could easily switch hosts and environments to attack pests in nut crops, such as NOW and OFM. However, the temperature work described previously indicates that this species has high mortality levels at temperatures commonly found in the SJV nut crops.

Another parasitoid screened against NOW and other moth species is Pediobius ni., (P. ni.) which was found attacking the LBAM. Laboratory biology studies looked at this parasitoid's host age suitability, fecundity, and temperature-dependent developmental time for P. ni as a parasitoid of LBAM. As a comparison of host species suitability, P. ni, was tested with OBLR, NOW, orange tortrix, PTB, and OFM (all of the alternate moth hosts mentioned in section 1.2 Alternate Hosts). The parasitoid readily attacked all tested host species; percentage parasitism was lower on PTB than on NOW, OBLR, or orange tortrix, but similar among the other tested species. Clutch size generally increased with host size, but percentage adult emergence and sex ratio was not affected by host species. Exposure of hosts to multiple P. ni increased the numbers of emerged wasps per parasitized host without obvious costs to offspring fitness.

P. ni Peck is a eulophid parasitoid indigenous to North America. Investigations of P. ni biology included host age suitability, fecundity, and temperature-dependent developmental time Parasitoid offspring survival was higher on host larvae presented as pre-pupa or young pupa than older pupa; P. ni would not attack mature moth larva. The parasitoid's developmental rate was a positive linear relationship between 15 to 28°C, but it failed to develop at constant temperatures of more than 29°C. As a comparison of host species suitability, P.

ni was tested with oblique-banded leaf-roller, navel orangeworm, omnivorous leaf-roller, orange tortrix, and peach twig borer; P. ni readily attacked all tested host species; percentage parasitism was lower on peach twig borer than NOW, orange tortrix and OBLR but similar among the other tested species. More eggs were laid on the larger moth larvae.

As with H. gelechiae, this parasitoid was not found in any of the orchard surveys, and the temperature development studies suggest that its survival during the hot summers found in the SJV is not likely.

The third parasitoid used was the most promising, based on field surveys in almond and pistachio orchards. In 2013 field surveys, G. legneri and H. hebetor were the most common species reared from NOW, with G. legneri common later in the season and H. hebetor common early in the season. From July to September 2014, insectary colonies of NOW, G. legneri and H. hebetor were increased in size to prepare for winter studies on parasitoid biology and spring and summer 2014 studies on the field performance of H. hebetor. Biology studies with this parasitoid were not conducted because it has been studied exhaustively as a natural enemy of stored-product pests.

Determine the impact of common insecticides on resident and imported natural enemies to determine how best to manage both pests and beneficial arthropods in a modern IPM program:
The effects of pesticides on beneficials (insects and mites) were studied in the field and laboratory. An almond orchard (non-pareil cv.) located in the San Joaquin Valley of California was selected and from a 36-acre block, 6 acres were used for the described treatments. Miticides were first tested (2011-2012) as the cooperator believed that some of these materials impacted beneficial arthropods. Four miticides and one insecticide were compared to an untreated control (Appendix 2 Spray Trials). To measure the population densities of phytophagous mites and key beneficial arthropods, leaf samples were collected weekly in both orchards beginning in June 2011 and ended November 2011. Results were disappointing as few treatment differences were found, primarily because of a low natural density of phytophagous mites. Additionally, the densities for the beneficial arthropods were low and the ratio between pest and beneficial arthropod did not differ significantly on any date. The predominant beneficial arthropod was the western orchard predator mite, totaling about 70% of all beneficial arthropods across all sample dates, followed by green lacewings (approximately 20% of the total beneficial arthropods), and the six spotted thrips (10%).

In the laboratory, the lethal and sublethal effect of several agricultural insecticides used in almond production was tested on important beneficial arthropods. Arthropods used in this study include G. legneri, C. plethorica, Chrysoperla rufilabris, S. sexmaculatus, G. occidentalis and Aphytis melinus. Lethal rates and sublethal data were analyzed at each observation period for each arthropod. Arthropods that either escaped or died by drowning in honey streaks were excluded from the analysis. All data collected in the laboratory trials failed to be homogenous or normal even after proper data transformations, thus all data were analyzed via Kruskall-Wallis non-parametric Analysis of Variance (ANOVA). When significance between treatments was present, Mann-Whitney sum test (or test U) was used to separate means. The resulting Asymptotic Significance (2-tailed) value was then corrected via Bonferroni correction. Claims were made at the 95% confidence level. All statistical analysis was conducted on SPSS 17.0 statistical software (IBM Armonk, New York).

The laboratory study indicated that tested pesticides negatively impact the tested beneficial arthropods in the almond system. Of the five chemicals tested, abamectin, bifenthrin, spirodiclofen, hexythiazox and etoxazole, one (bifenthrin) induced significant mortality in every treatment causing 100% mortality within 24 hours in each arthropod except for C. rufilabris. Abamectin caused significant mortality values in A. melinus, S. sexmaculatus and, C. plethorica. Additionally, it negatively impacted the parasitic capabilities of G. legneri. Spirodiclofen caused significant mortality values in C. plethorica (both direct and indirect) as well as S. sexmaculatus (indirect), although these instances did not exceed 30% of the population. Hexythiazox caused significant mortality rates against A. melinus and C. plethorica; there no effects against C. rufilabris. Etoxazole only caused significant mortality rates towards S. sexmaculatus.

Tests were also done on pesticide effects in a large field trial, conducted in 2012 (Attachment 1, Table 1). Treatments were applied using a gas powered backpack sprayer. Each plot was sprayed with 2 liters of solution (approximately 300 liters per acre) with pesticides diluted to field rate as well as containing 1% 415 spray oil (except for the brigade treatments since the material is traditionally used without oil because it can achieve adequate coverage by itself). It took 1 minute, 34 seconds to apply 2 liters per tree, with approximately 23.5 seconds being spent on each quadrant of the tree.

To sample mites and beneficial mite predators, from the center tree of each plot, a total of 20 leaves were collected, five from each cardinal direction (North, east, west, south), with 3 and 2 leaves collected from the outer and inner canopy regions, respectively. Collected leaves were placed in a self-sealing plastic bag, placed in an insulated icebox with frozen gel ice packs, and carried back to the laboratory to be processed under a dissection microscope. Leaves that could not be processed immediately were stored in a refrigerator (~ 10°C) and counted within two weeks of the sample date. All arthropods found were recorded by species and number. 84 trees were sampled at the Hanford site (12 replicates and 7 treatments); 42 trees were sampled at the Reedley site (7 replicates and 7 treatments).

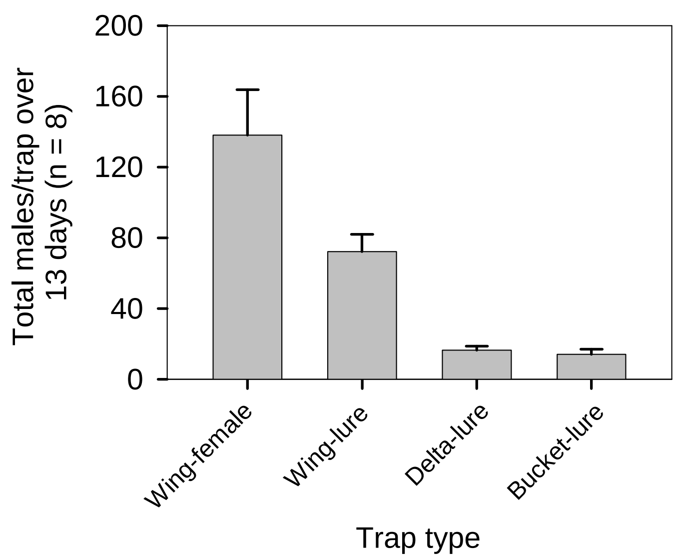
Data were analyzed by conducting a randomized complete block design (RCBD) Analysis of Variance (ANOVA) with block set as a random factor and treatment as a fixed factor in the GLM command of SPSS 17.0 statistical software. Normality and homogeneity of variance were considered in the data analysis.

Mites were used as an indicator of pest densities because this is what the sprays were targeting. Results from the Hanford site, the larger of the two field trials, showed that across all pre-treatment sample dates there was no difference among treatments regarding pest mite population per leaf (ANOVA, $F = 0.58$, $df = 6$, $P = .793$), beneficial arthropod per leaf (ANOVA, $F = 0.864$, $df = 6$, $P = 0.525$), and beneficial to pest mite ratio (ANOVA, $F = 0.993$, $df = 6$, $P = 0.463$). Across all treatments, pre-treatment mite densities were low: 0.3256 ± 0.0427 phytophagous mites per leaf. Similarly, natural enemy counts were low prior to any treatments applied: 0.0042 ± 0.0031 natural enemies per leaf. The natural enemies recorded were: western orchard predatory mite Galendromus occidentalis (Nesbitt), six-spotted thrips Scolothrips sexmaculatus (Pergande), and green lacewings of the genus Chrysoperla.

Across all post-treatment sample dates there was no difference among treatments regarding pest mite population per leaf (ANOVA, $F = 0.518 \leq X \geq 1.158$, $df = 6$, $P = 0.337 \leq X \geq 0.793$), beneficial arthropod population per leaf (ANOVA, $F = 0.522 \leq X \geq 0.861$, $df = 6$, $P = 0.561 \leq X \geq 0.561$), or beneficial arthropod to pest mite ratio (ANOVA, $F = 0.534 \leq X \geq 0.994$, $df = 6$, $P = 0.436 \leq X \geq 0.780$). Post-treatment mite densities were low: 0.393 ± 0.027 phytophagous mites per leaf. Similarly, natural enemy counts were low post treatment when pooling data across all sampling dates: 0.0096 ± 0.0009 beneficial arthropod per leaf.

Taking seasonal changes into account, pesticide treatments had no effect on either pest or beneficial arthropod densities. One problem with this field study is that no NOW were recorded during the trial. Moreover, population densities for beneficial arthropods were consistently low throughout the season. Across all post-treatment sample dates there was no difference among treatments regarding each individual beneficial arthropod. All beneficial arthropods were grouped together for this analysis, which included the total of all life stages of the various species present, namely the western orchard predatory mite (~70%), Chrysoperla species (~20%) and six-spotted thrips (~10%). Additionally the ratio between beneficial arthropods and phytophagous mites did not differ significantly on any sample date (ANOVA, $F = 0.585 \leq X \geq 1.04$, $df = 6$, $P = 0.416 \leq X \geq 0.780$). The ratio between beneficial arthropods to phytophagous mites remained fairly consistent throughout the season.

Almond and Pistachio Environment: Pesticide alternatives will be needed to change the orchard environment to be more conducive to NOW natural enemies. For much of 2012, traps baited with unmated NOW females were used to compare abundance between organic almond sites. Wing traps baited with unmated NOW females were placed in 7 Kerman-area plots ranging from 20 to 40 acres. Females were replaced and data collected weekly from mid-March to the beginning of harvest in mid-August. Trap liners containing captured males were frozen and analyzed between October 2012 and March 2013. Comparison with equivalent trapping from 2011 revealed higher NOW abundance in 2012. Perhaps because of the higher overall abundance and trap saturation (the tendency of sticky traps to become less effective as more moths are captured), difference in abundance between sites was less evident in 2012 compare to 2011.



In 2012, a stable attractive synthetic pheromone lure was provided for testing by Suterra, LLC. This pheromone came 33 years after the principal pheromone component was identified, and seven years after components necessary for an attractive pheromone blend were identified. In August and September, four combinations of this proto-commercial lure and commercial trap types were compared. Wing traps baited with unmated females, a previous research standard, were the first of these treatments. The remaining three treatments comprised wing traps, large delta plastic (LDP) traps, and bucket traps, all baited with the proto-commercial lure. LDP traps are more popular with pest control advisers because they are more convenient to service, and bucket traps have the potential advantage of not saturating like traps with sticky liners. The traps were placed 55 yards apart from each other in replicate blocks at least 55 yards apart. Traps were compared over single nights to maximize the attractiveness of the live females, and 13 such nights were pooled for analysis. These data were analyzed in October. This experiment found decidedly more males in wing traps baited with females compared with those baited by lures, and more males in wing traps than other trap types. Other researchers in 2012 did not find such large differences between female- and lure-baited traps, or between wing traps and other trap types. Interference between female-baited wing traps has been shown at 440 yards, so it is possible that the difference between trap-bait combinations is greater with closer trap proximity. These experiments are to be repeated in 2013 at other locations, with traps farther apart to more closely approximate the likely commercial practice when using these lures.

Two projects executed between April and September 2013 took advantage of the recent commercial release of an attractive lure for navel orangeworm (NOW Biolure, Suterra LLC) to examine potential improvements in control and monitoring. The first of these projects was a mass trapping trial, and the second was a follow-up to trap and lure trials described the previous year.

The mass trapping trial was conducted from April to June 2013, at six almond orchards. Mass trapping was examined at two of these locations, whereas the other four locations served as comparisons. Traps baited with unmated females were used in small plots to compare three treatments: 1) monitoring only; 2) mass trapping; and 3) mating disruption. Monitoring was conducted using six female-baited traps in the center of the plot. Mass trapping was conducted by placing one trap with a NOW Biolure in each tree in the plot (in monitoring trees, on the opposite side from the monitoring trap). The mating disruption plots also had traps with synthetic lures in each tree, but with no sticky liner to capture males. At the two mating disruption sites, control plots were 39 meters from the treatment sites. At the four comparison sites, however, control plots were 0.4 to 15 kilometers from the next nearest study site. Only the monitoring traps were run for the first four weeks of the study (including those in mass trapping and mating disruption sites), whereas the mass trapping and mating disruption traps were active in the final five weeks of the study. The proportion of males captured before and after the beginning of the mass trapping and mating disruption treatments was used as a further measure of impact. If the mass trapping and mating disruption treatments have impact, then the number of males captured in the final five weeks should be smaller relative to the number captured in the initial four weeks.

In both, the mating disruption and mass trapping plots, 98% of the total capture occurred during the initial four weeks. In contrast, this figure was 70% for both the control plots at the mass trapping sites, and for the control sites at the remote sites. This observation indicates that the influence of the mass trapping treatments in the small plots did not extend far beyond those plots; i.e., they did not impact the control plots 39 meters away. Considering only the last four weeks, there was 94-98% trap suppression in the treatment plots compared to the untreated plots at the same sites. While this suppression was considerable, it did not match to more than 99% suppression documented in previous studies the timed aerosol emitters currently marketed for mating disruption of navel orangeworm. The principal findings of this experiment were that the effects of the treatments did not extend beyond the plots, and that suppression of males was due mostly or entirely to mating disruption rather than to capture of males in traps.

The objective of the trial comparing NOW Biolure in different trap types was to confirm results from 2012. As in 2012, females in wing traps were used as a standard of comparison for NOW Biolure in wing traps, large plastic delta (LDP) traps, and bucket traps. This test was conducted in walnuts, in order to obtain data in that crop. Six replicates were used. Traps were placed 200 yards (180 meters) apart. This distance was intended to be closer to commercially relevant distances between traps, while allowing us to conduct the experiment in the fields available to us. Unmated females were changed and data collected on a daily basis, and the positions of the traps were changed each day. The results were the same as last year: wing traps with females captured more males than wing traps with NOW Biolure, and both wing trap-lure combinations captured more males than delta traps or bucket traps. Relatively few males were captured in these latter two trap types, and the difference between them was not statistically significant. These findings suggest that pest managers should use wing traps with NOW Biolure, despite the greater convenience of LDP-style traps. More importantly, significant differences in navel orangeworm captured were observed in neighboring blocks of walnut varieties of differing susceptibility to navel orangeworm, suggesting that greater trap density is needed to distinguish local abundance. This hypothesis is being tested in ongoing studies.

In 2014, the use of phenyl propionate and NOW Biolure was examined for monitoring in mating disruption orchards. A recently-developed NOW Biolure improves options for monitoring navel orangeworm in conventionally-managed almonds, but is minimally effective in the presence of mating disruption. Phenyl propionate is a non-pheromonal attractant for the navel orangeworm. Experiments were conducted to determine if these attractants act in an additive or synergistic manner when presented together. In the absence of mating disruption, traps baited with phenyl propionate captured significantly fewer adults than traps baited with a sex pheromone lure. There was no significant difference in the number of adults captured in traps with both attractants when mating disruption was not used. In the presence of mating disruption, pheromone traps were completely suppressed, and traps with both pheromone and phenyl propionate captured significantly more adults than traps baited with only phenyl propionate. Traps with only phenyl propionate captured equal numbers of both sexes, whereas traps with both attractants had significantly more males. These findings demonstrate that phenyl propionate is potentially useful for monitoring navel orangeworm in the presence of mating disruption. Further studies on formulation and dose-response are needed.

The project did not benefit commodities other than almond, walnut, figs and pistachios, which are all susceptible to NOW infestation and are all California specialty crops.

The project 'partners' include foreign entomologists that helped or tried to help with collections in Argentina, Chile, Brazil, Turkey and Israel. Project partners also include the grower cooperators: Large conventional growers that were part of the mating disruption program, and then the organic farmers that allowed this project team to sample for natural enemies on the pistachio and almond farms, as well as place sentinel nuts (infested with NOW) and parasitoids to determine the impact of Habrobracon releases. The work could not be completed without help from these individuals.

Goals and Outcomes Achieved

Collection of material from Argentina and Chile took place, and colleagues surveyed for carob moth parasitoids in Turkey. Field surveys of NOW natural enemies were conducted, as well as other moth pests that might serve as hosts for natural enemies, in California's San Joaquin Valley. With resident natural enemies, laboratory trials were conducted to determine their potential against NOW and other moth species found in California orchards. One parasitoid species was selected, Habrobracon gelechiae, to further conduct field release trials. Finally, an Argentine population of Goniozus legneri in the UC Berkeley Quarantine was established.

The long term adoption of mating disruption has yet to be determined and will, eventually, be economically based. The parasitoid material in quarantine will be further tested, but it may be more than one year before permits are granted to remove this material from Quarantine and begin field releases.

The primary goal was to discover a new natural enemy that might be more effective against NOW. Surveys in Chile, Argentina and Turkey found the same parasitoid species that are present in California and were initially imported in the 1960s and 1970s. Therefore the accomplishments did not meet the primary goal of the project. Secondary goals were all met and included the investigating resident parasitoid biology, the effect of pesticides on selected natural enemies, and the effect of the orchard environment on the levels of parasitism.

Baseline data include the species and numbers of natural enemies attacking NOW in California almonds and walnut orchards; the relative densities of different lepidopteran pests found in conventional and organic almond orchards; detailed parameters on parasitoid biology; densities of NOW in orchards with and without mating disruption; and the impact of selected insecticides on NOW natural enemies.

The study provides an accurate record of NOW parasitism in conventional orchards using multiple insecticide applications as well as organic orchards using approved materials and/or mating disruption for NOW. In conventional systems, G. legneri and C. plethorica were the only NOW parasitoids reared. In organic systems, six parasitoid species were recovered, with H. hebetor, G. legneri and C. plethorica the dominant parasitoids reared. Levels of parasitism were no high enough to provide effective control.

Surveys for novel natural enemies in Argentina and Chile did not recover any material that was not previously imported into California, although a "strain" of G. legneri recovered in Chile may be different from that imported from Uruguay in the 1970s. Surveys conducted by colleagues in Turkey show some parasitism of carob moth, but all species listed are already found in the United States.

There are a number of moth species found in the almond and pistachio crop systems, but there was no clear relationship between these alternate hosts and levels of NOW parasitism.

A number of natural enemies were screened for their potential to control NOW through manipulating their densities. Green lacewing releases did not show a significant impact on NOW densities. H. gelechiae and P. ni attacking NOW in the laboratory, but their temperature tolerances suggest that San Joaquin Valley summers may be too hot for their successful use. H. hebetor is a parasitoid best known as an effective natural enemy of stored-grain pests and was recovered in high numbers from NOW in spring 2013. Unfortunately, mass releases of H. hebetor in spring and summer of 2014, did not show any impact on NOW densities.

Studies of the almond and pistachio environment showed that commonly used pesticides negatively affect natural enemies. Studies with synthetic pheromone may provide a tool to reduce pesticide inputs, thereby increasing the importance of natural enemies.

A final measurable outcome will be presentations at grower and research symposia and peer-reviewed publications of the results. The project succeeded in extending the gathered information. As listed in the Additional Information section, nine peer-reviewed publications were produced that targeted the research audience. There were 13 presentations made to research and grower audiences. Average attendance at these presentations was 50 persons, or a total of 650 individuals reached.

Beneficiaries

Beneficiaries were the 1000s of nut growers throughout California, households living on or near farms where NOW infestations are present and treated with insecticides, and a reduced pesticide load in the environment.

Researchers investigating NOW biology as well as the biology of parasitoids that this project investigated, also gained useful information from this data.
A possible future impact may include reduced pest management costs and loss from NOW because of increased grower awareness of natural enemy potential in conventional, organic, and sustainable orchards systems.

Lessons Learned

The grant funds provided an opportunity to reinvestigate NOW biological control. Lessons learned were varied, but concern first parasitoid biology, suggesting that the known parasitoids that attack NOW cannot consistently provide high rates of parasitism. Additionally, the almond and pistachio industries in California that have developed pesticide-based controls that can deliver low NOW infestation levels, but would not be sustainable with biological controls. Therefore, for biological controls to play a more prevalent role in almond and pistachio programs for NOW, either the current natural enemies must be manipulated (at a cost to the farmers) or the level of acceptable NOW damage must be raised (at a cost the farmers).

The changing almond environment over the past decade has also reduced the importance of biological controls, especially in the orchard managers' view. A strong almond and pistachio market has resulted in an extremely valuable crop and orchard managers are quick to use insecticides to protect that investment. Compounding this issue is the extremely low price per acre of many of the effective pyrethroids. For these reasons the nut crops systems are receiving multiple insecticide sprays each season, lowering the odds that any natural enemy will be successful. Along with this is the increased expectation of farmers for a clean crop, where 2-3% NOW nut damage was once the goal, 0.1-1% damage is the current goal and this level of control may not be achieved by natural enemies.

It became difficult to work in northern Mexico (along the Arizona/Mexico border) and Pakistan to search for natural enemies. Contacts in those regions were made, but crime or political problems in these regions prompted a decision to search for natural enemies in South America, and attempt to search in Israel and Turkey.

It was difficult to identify the problems, conduct the research, determine the solution, test and implement changes, and gain farmer adoption in less than three years. This project may have been better suited as a multiple-phase project.

Additional Information

Daane, K. M., Wang, X.-G., Duerr, S. S., Kuhn, E. J., Son, Y., Yokota, G. Y. 2013. Biology of *Habrobracon gelechiae* (Hymenoptera: Braconidae), as a parasitoid of the obliquebanded leafroller (Lepidoptera: Tortricidae). *Environmental Entomology* 42(1): 107-115.

Burks, C. S., and Higbee, B. S. 2013. Effect of abundance of the navel orangeworm on sampling range and interference between pheromone traps. *Environmental Entomology* 42(1): 143-149.

Wang, X.-G., Levy, K., and Daane, K. M. 2013. Evaluation of an indigenous parasitoid *Habrobracon gelechiae* (Hymenoptera: Braconidae) for biological control of light brown apple moth *Epiphyas postvittana* (Lepidoptera: Tortricidae) in California. *BioControl Science and Technology* 23(4): 433-447.

Wang, X.-G., Levy, K., and Daane, K. M. 2013. Biology and potential host range of *Pediobius ni* (Hymenoptera: Eulophidae) as a novel parasitoid of light brown apple moth (Lepidoptera: Tortricidae). *Annuals of the Entomological Society of America* 106(3): 351-358.

Wang, X.-G., and Daane, K. M. 2014. Cannibalism of parasitoid-attacked conspecifics in a non-carnivorous caterpillar. *Entomologia Experimentalis et Applicata* 151: 112-121.

Wang, X.-G., Wallis, C. M., and Daane, K. M. 2014. Tri-trophic movement of carotenoid pigments from host plant to the parasitoid of a caterpillar. *Journal of Insect Physiology.* 61: 58–65

Sappington, T. W., and Burks, C. S. 2014. Patterns of flight behavior and capacity of unmated navel orangeworm adults (Lepidoptera: Pyralidae) related to age, gender, and wing size. *Environmental Entomology* 43 (3): 696-705.

Higbee, B. S., Burks, C. S., and Larsen, T. E. 2014. Demonstration and characterization of a persistent pheromone lure for the navel orangeworm, *Amyelois transitella* (Lepidoptera:Pyralidae). *Insects* 5 (3):596-608.

Submitted

Burks, C. S., and Higbee, B. S. Impact of trap design and density on effectiveness of a commercial pheromone lure for monitoring navel orangeworm (Lepidoptera:Pyralidae). J. Econ. Entomol.

Professional presentations

Mating disruption and NOW biology: Central San Joaquin Valley, and Sacramento Valley. *Final Stakeholder Meeting of the USDA-ARS Navel Orangeworm Area-Wide Project in Almonds, Pistachios, and Walnuts.* Parlier, CA. Oct. 1, 2012. *presented by Chuck Burks*.

Impact of common pesticides on beneficial arthropods in the almond orchard. *American Society for Agronomy, California Chapter's 2012 Conference.* Visalia, CA. Feb. 2012 *presented by Nathan Cannell*.

Impact of sex, age, and mating status on flight behavior of the navel orangeworm (NOW). *2012 Almond Conference*. Sacramento, CA. Dec. 13, 2012. *presented by Chuck Burks*.

Navel orangeworm in the southern Central Valley. *Crisp California Walnuts grower appreciation luncheon*. Dec. 7, 2013. *presented by Chuck Burks*.

Monitoring, abundance, and mating disruption for navel orangeworm in California walnuts. *Orchard Pest and Disease Management Conference*. Portland, OR. Jan. 11, 2013. *presented by Chuck Burks*.

The role of biological control in pesticide-based IPM programs. *California Association of Professional Control Advisors Education Seminar*. Kerman, CA. Feb. 2013. *presented by K. M. Daane* Attendance ca. 80 persons

Tri-trophic movement of plant pigment from host plant to the egg of a caterpillar parasitoid. *97th Annual Meeting, Pacific Branch of the Entomological Society of America.* Reno, CA. Apr. 2013 *presented by X.-G. Wang* Attendance ca. 60 persons

Mating disruption for navel orangeworm—is it sustainable? *Pacific Branch Meeting of the Entomological Society of America*. Stateline, NV. April 10, 2013. *presented by Chuck Burks*.

NOW egg trap research. *2013 Navel Orangeworm Management Meeting for Almonds and Pistachios*. Tulare Ag Expo, Tulare, CA. May 1, 2013. *presented by Chuck Burks*.

NOW Flight capacity and monitoring. *Almond Industry Conference*. Sacramento Convention Center, Sacramento, CA. December 5, 2013. *presented by Chuck Burks*.

Monitoring for navel orangeworm with an artificial pheromone lure. *Orchard Pest and Disease Management Conference*. Portland, OR. Jan. 8, 2014. *presented by Chuck Burks*.

Management of navel orangeworm in southern San Joaquin Valley walnuts. *Tri-County Walnut Day*. Visalia, CA. February 6, 2014. *presented by Chuck Burks*.

Biological control: when do natural enemies work and when do they fail? *UCCE Centennial Speakers Series.* Tulare Ag Show. Tulare, CA. Feb. 2014 *presented by Kent Daane*.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 54	**Project Title:** Broad Spectrum Rootstocks to Manage Disease and Pest Infestations in Orchard and Vineyard Crops in California.	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB11054	**Date Submitted:** December 2014
Recipient Contact: Abhaya Dandekar	**Telephone:** (530) 752-7784	**Email:** amdandekar@ucdavis.edu

Project Summary

The competitiveness of California's fruit and nut industry, which contributed a third of the state's gross cash receipts in 2012, depends upon the spraying of chemical pesticides to control vector-transmitted bacterial diseases. Unfortunately, the pesticide kills the vector but does not deplete the reservoir of resident or introduced bacterial pathogens that multiply within infected plant tissues and are freely transmitted to healthy plants via resident or introduced pests. The Regents of the University of California, Davis (UCD) proposed to develop transgenic citrus, walnut, grapevine and almond rootstocks that provide broad spectrum resistance to related bacterial pathogens. Deploying transgenic disease resistant rootstocks will not only curtail disease spread but also depletes the reservoir of bacterial pathogens, an effective integrated pest management tool to maintain quality and productivity while controlling disease vectors, including mechanically transmitted bacterial diseases not controlled by pesticides. The goal of this project was to develop transgenic citrus, walnut, grapevine and almond rootstocks that are resistant to multiple bacterial diseases. This goal was accomplished through two objectives: 1) Development of disease-resistant transgenic rootstocks; and 2) testing and validation of the disease resistance provided by these rootstocks. The strategy employed two compatible resistance mechanisms: RNA interference to block the formation of crown gall and a broad spectrum chimeric antimicrobial protein (CAP) that recognizes and binds bacterial surface protein, causing lysis/death of the pathogen.

This project is extremely timely with the recent introduction of the Asian citrus psyllid (ACP) that now threatens California's citrus industry with the transmission of the dreaded Huanglongbing (HLB) disease. The glassy-winged sharp shooter (GWSS) that transmits Pierce's disease (PD) in grapevines and almond leaf scorch (ALS) can also transmit citrus variegated chlorosis (CVC), a significant threat to citrus.

This project did not build on any previously funded Specialty Crop Block Grant Program (SCBGP) project.

Project Approach

For the first activity, UCD focused on combining two sets of constructs, one expressing a chimeric antimicrobial protein (CAP) that can kill a wide variety of bacterial pathogens and the other a set of genes that provide crown gall resistance (CGR). UCD successfully constructed a new and improved version of CAP that was more effective and tested this by carrying out a co-transformation with genes that provide CGR. UCD conducted citrus co-transformation where the two vectors were used simultaneously. UCD transformed walnut and grapevine using a stepwise co-transformation protocol where the two vectors were used sequentially. A second activity developed a tissue culture system for almond rootstock explants, using the media and culture conditions that UCD had developed to successfully and efficiently propagate almond rootstocks, as none were available. For the third activity, regeneration of transgenic citrus, walnut grapevine and almond rootstocks, UCD initiated the process by identifying citrus, walnut and grapevine rootstocks with commercially relevant backgrounds for co-transformation of CAP and CGR genes. UCD successfully regenerated 42 transgenic 'Carrizo' citrus rootstocks, 34 transgenic '101-14' grapevine rootstocks, 24 transgenic '1103-P' grapevine rootstocks and nine transgenic 'Paradox' walnut rootstocks. For the fourth activity, UCD developed a disease resistance/sensitivity screen for CGR, which can be accomplished very early in tissue culture or at the small plantlet stage in the greenhouse after vegetative propagation. UCD successfully completed this screen for citrus and walnut. For the fifth activity, UCD propagated citrus, walnut and grapevine lines in the greenhouse and identified lines with CGR resistance/susceptibility. For the sixth activity, UCD demonstrated resistance/susceptibility to bacterial pathogens in the greenhouse and identified citrus and walnut lines showing superior resistance to crown gall. UCD identified three transgenic citrus and one transgenic walnut elite rootstocks for further validation in the field. Grape transgenic elite rootstocks will be identified soon as the ongoing CGR screening experiment is close to being finished. Almond was not included in the third, fourth, fifth and sixth activities as UCD has developed an almond tissue culture system but not a regeneration system (see Activity 2 in Goals and Outcomes Achieved).

Specialty Crop Block Grant (SCBG) funds were used solely for specialty orchard and vineyard crops. No project partners were used to achieve project goals and outcomes during the term of the project.

Goals and Outcomes Achieved

Activity 1: Construct vector for multiple disease resistance

For the first activity, UCD focused on combining two sets of constructs, one expressing a chimeric antimicrobial protein (CAP) that can kill a wide variety of bacterial pathogens and the other a set of genes that provide crown gall resistance (CGR). UCD successfully constructed a new and improved version of CAP for greater efficacy and tested it by carrying out a co-transformation with genes that provide CGR. UCD conducted several co-transformation experiments with citrus, walnut, and grapevines rootstocks using both vectors simultaneously, and noticed an incompatibility between the two vectors. As a consequence, successful transformation was obtained with one but not both vectors at the same time. UCD conducted sequential transformations to overcome the incompatibility. UCD developed a stepwise co-transformation protocol for walnut and grapevine rootstocks where the two vectors were used sequentially to avoid the incompatibility. Using different methods, UCD also worked on the construction of an additional vector that will contain two vectors: one is a new and improved version of CAP, and another is a single hybrid gene constructed after two genes that provide CGR were redesigned.

Activity 2: Develop regeneration system for almond rootstock

A second activity of UCD was to develop a regeneration system for 'Hansen' almond rootstock explants. UCD started to develop a tissue culture system using the media and culture conditions that UCD had developed to successfully and efficiently propagate almond rootstocks, as none was available. UCD tried different approaches and used different tissue explants to develop a regeneration system for 'Hansen' almond rootstock. UCD began regeneration experiments focusing on 'Hansen' using tissues from this rootstock in *in vitro* culture. UCD tested leaf explants on 40 different combinations of phytohormones (auxins and cytokinins) over nine months. UCD observed some callus formation but no embryogenesis. UCD used shoot apical meristem (SAM) from young, field-grown shoots of 'Hansen' to test 10 phytohormone (auxin and cytokinin) combinations under two environmental conditions (light/dark) over eight months. UCD observed high meristem survival and callus formation, but no embryos or adventitious shoot regeneration. UCD also tested root explants obtained from *in vitro* shoots treated with auxin, but no embryogenesis was observed.

UCD also used leaf explants to test the effect of thidiazuron (TDZ) and homobrassinolide (HBL) hormones on almond adventitious shoot regeneration; UCD observed callus growth near the cut leaf surfaces in controls and treatments, but no embryogenesis events.

Activity 3: Transform, regenerate and select transgenic citrus, walnut and grapevine rootstock
For the third activity, regeneration of transgenic citrus, walnut, grapevine and almond rootstock, UCD initiated the process by identifying cultures of citrus, walnut and grapevine walnut rootstocks with commercially relevant background for co-transformation with CAP and CGR genes. For citrus, UCD focused on 'Carrizo' rootstock, from which tissues for transformation were obtained from germinating seeds. For grapevine, UCD focused on two commercial rootstocks, '101-14' and '1013-P,' that are currently extensively used by the industry. For walnut, UCD established embryo lines of a 'Paradox' walnut commercial rootstock. UCD regenerated transgenic citrus 'Carrizo' rootstock lines using co-transformation protocols. For grapevine, UCD transformed '101-14' and '1013-P' with vectors expressing CAP and CGR using stepwise co-transformation protocols. UCD established embryo lines for these two grapevine rootstocks, which allowed testing of the combination of CAP and CGR genes in a commercially relevant background; these were regenerated into transgenic grapevine rootstocks lines. UCD also worked on transforming embryo lines of a 'Paradox' walnut rootstock with vectors expressing CAP and CGR genes using stepwise co-transformation protocols that tested the gene combination in a commercially relevant background for the walnut industry. UCD regenerated transgenic walnut rootstocks plants. Almond was not transformed as UCD developed an almond tissue culture system but not a regeneration system (see Activity 2).

Activity 4: Develop disease resistance screens in the tissue culture phase for citrus, walnut and grapevine
For the fourth activity, UCD focused on a disease resistance/sensitivity screen for CGR, which can be done very early in tissue culture or at the small plantlet stage in the greenhouse after vegetative propagation. This was established with walnut shoots, as they are very susceptible to bacterial crown gall. UCD successfully completed this screen for citrus and walnut; for grapevine, the experiments are close to being completed.

Activity 5: Propagate transgenic citrus, walnut and grapevine rootstocks and establish greenhouse propagation
For the fifth activity, UCD established propagation of transgenic citrus, walnut and grapevine rootstocks in the greenhouse and in culture. UCD propagated sufficient clones per citrus, walnut and grapevine line in the greenhouse to run experiments to identify lines with CGR resistance/susceptibility.

Activity 6: Challenge-inoculate transgenic citrus, walnut and grapevine rootstocks in the greenhouse
For the sixth activity, UCD demonstrated resistance/susceptibility to bacterial pathogens in the greenhouse and identified citrus and walnut lines with superior resistance to crown gall. UCD inoculated 42 transgenic citrus and nine transgenic walnut rootstocks with *Agrobacterium* and identified three transgenic citrus and one transgenic walnut elite rootstock for further validation in the field. Transgenic grapevine elite rootstocks will be identified as soon as the grapevine CGR screening experiment nears its conclusion.

UCD accomplished the project goal, "To develop transgenic citrus, walnut and grapevine rootstocks resistant to multiple bacterial diseases." For almond, UCD developed a tissue culture system, as none was available that would allow further research for the development of an almond transgenic rootstock regeneration system in the future.

UCD achieved set targets by successfully regenerating 42 transgenic ‘Carrizo’ citrus rootstocks, nine transgenic ‘Paradox’ walnut rootstocks, 34 transgenic ‘101-14’ grapevine rootstocks and 24 transgenic ‘1103-P’ grapevine rootstocks. UCD developed a disease resistance/sensitivity screen for crown gall disease. UCD identified elite transgenic citrus, walnut and grapevines rootstocks using the crown gall disease resistance/susceptibility screen.

UCD developed transgenic citrus, walnut and grapevine rootstocks and a crown gall disease resistance/susceptibility screen, which can be done very early in tissue culture or at the small plantlet stage in the greenhouse after vegetative propagation.

UCD identified three transgenic ‘Carrizo’ citrus rootstock elite lines and one transgenic ‘Paradox’ walnut rootstock line showing superior resistance to crown gall for further validation in the field. Transgenic ‘101-14’ and ‘1103-P’ grape elite rootstocks lines will be known soon, since the grape CGR/susceptibility screening is close to completion.

UCD developed a tissue culture system for almond rootstock explants, using the media and culture conditions that UCD had developed to successfully and efficiently propagate almond rootstocks, as none was available, a huge step that may allow in the future the successful development of a regeneration system to develop transgenic almond rootstocks.

Beneficiaries

Growers of citrus, walnut and grapevine crops will directly benefit from the development of disease resistant rootstocks. The French wine industry in the mid-19th century was saved from complete destruction by *Phylloxera*, a root aphid pest, by grafting French wine grape varieties onto resistant wild American grapevine rootstocks. The Brazilian citrus industry was saved from a quick decline strain of Citrus tristeza virus (CTV) by grafting onto resistant Rangpur lime rootstock rather than a susceptible sour orange rootstock. Diseases like crown gall that affect grapevine, walnut and almond can devastate productivity. Pierce’s disease (PD) of grapevine is endemic to the southern U.S., where it has eliminated the economic viability of the grapevine industry. The spread of PD threatens the over $50 billion wine and grape industry of California. A focus of this research project was to develop transgenic rootstocks that provide resistance against PD. Citrus variegated chlorosis, caused by a bacterium related to the one that causes PD, is of great concern for citrus growers in California and a high priority on United States Department of Homeland Security‘s list of significant agricultural pathogens. UCD’s strategy could protect citrus against both HLB and CVC, and grapevine against both PD and crown gall.

The beneficiaries of this project are the California growers of fruit and nut crops who collectively grossed $17.21 billion in 2012, or roughly a third of California’s estimated $44.7 billion gross cash receipts in agriculture. These growers, without exception, depend on rootstocks to support the productivity of their crops. The four commodities that were the focus of this research project are among the top 20 in value: grape (2), citrus (14), walnut (9) and almond (3). They are also among the top 10 California exported commodities, almond being 1st ($3.4 billion), grape being 6th (worth $0.2 billion), walnuts being 4th ($1.1 billion) and citrus being 8th (worth $0.66 billion), helping to reduce the trade imbalance. These four crops are planted on 1.9 million acres and are valued at $7.5 billion.

Lessons Learned

The focus of this project on rootstocks rather than scion varieties was an important strategic decision as a few rootstocks can impact a larger variety of scion materials and provide a much greater impact for the industry. The natural ability of rootstocks to regenerate in tissue culture was vital to develop transgenic lines, especially given the short duration of the project period of 2 years and 8 months. In the case of walnut, citrus and grapevine, where the natural ability to regenerate was previously established, UCD could successfully develop methods to obtain transgenic rootstocks; however, in the case of almond where the natural ability to regenerate was never previously established, the project period was insufficient to successfully develop transgenic rootstock lines. Another lesson learned involved the compatibility of vectors used to deliver the disease resistant traits. Since the disease resistant traits were being combined, the compatibility of the two vectors was important but unknown to UCD during the early phase of the project. To overcome the incompatibility observed when the two vectors were used simultaneously, a stepwise protocol was developed to obtain the transgenic grapevine and walnut rootstock lines needed for the project. This took additional effort and time that could have been avoided had UCD known of the vector incompatibility.

In Activity 1, UCD observed vector incompatibilities when the two vectors were used simultaneously; this posed a challenge to developing the transgenic grapevine and walnut lines needed for this project. To avoid delays on completion of this goal, UCD successfully conducted stepwise co-transformations, where the two vectors were not used simultaneously, but sequentially, to avoid the incompatibility.

In Activity 2, UCD worked to develop a regeneration system for almond rootstocks, as none existed before. UCD experimented with 'Hansen' rootstock leaves, shoot apical meristems and roots, but regeneration events from almond explants were not observed. As a consequence of this effort, UCD developed media and culture conditions to successfully and efficiently propagate 'Hansen' rootstocks. UCD's recommendation here is to continue experiments with different explants to see if morphogenesis of shoots or embryos can be induced from these explants using the new in vitro propagation protocol.

In the case of almond where the natural ability to regenerate was never previously established, the project period was insufficient to successfully develop transgenic rootstock lines. For walnut, grapevine and citrus where the natural ability to regenerate was previously established, the project time was sufficient and no changes were made to the work plan or the expected measurable outcomes except for those connected with almond rootstocks, as outlined in the corrective actions.

Additional Information

Information on the project strategy and deliverables was widely disseminated by presentations made on a yearly basis to the following organizations that involved both growers and researchers: annual Walnut Research Conference (40-55 attendees), annual meeting of the Citrus Research Board (40-50 attendees), annual meeting of the Citrus Nursery Board (15-20 attendees), annual Pierce's Disease Symposium (35-50 attendees) and the annual Citrus Health Research Program (45-60 attendees).

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 55	**Project Title:** Development and Implementation of Sustainable Production Methods for Bedding and Container Color Plants	
Grant Recipient: The Regents of The University of California, Davis	**Grant Agreement No.:** SCB11055	**Date Submitted:** December 2014
Recipient Contact: Christine Casey	**Telephone:** 530-752-0479	**Email:** cacasey@ucdavis.edu

Project Summary

California growers produce bedding and container color plants year-round for landscape and container planting. The state has about 600 growers producing crops with an annual wholesale value of nearly $305 million. The crop cycle is eight to 15 weeks (depending on the plant) and there are typically at least three weekly pesticide sprays as well as frequent irrigation and fertilization. These substantial inputs reduce profits, impact workers and the environment, and trouble regulators.

These concerns have been difficult to address in an IPM program because the short crop cycle, high crop value, and high aesthetic standards create a perception among growers that IPM is not feasible for bedding plants; indeed, previous work with bedding plant IPM has looked only at a few individual crop/pest combinations. This project addressed this problem by demonstrating the feasibility of sustainable production practices for bedding and container color plants. Because crops mixes (and thus key pests) are unique to each grower, a program of best management practices that emphasizes reduced inputs that can impact pest and disease levels across many crop/pest situations was developed.

The majority of pesticide applications in these crops are for control of plant pathogens, so that was the primary focus. Each collaborator worked with the project manager to select and evaluate the mix of strategies for their situation. This ‘a la carte’ approach showed that this program is applicable for many growers beyond the collaborating producers. The objectives for each collaborating grower were a 20 percent reduction in the total number of pesticide applications and a reduction of carbamates, pyrethroids, and organophosphate applications to fewer than 15 percent of total, both relative to same crop grown concurrently with conventional methods. While there is currently no market premium for low-input plants, major buyers are moving in that direction and development of this program in California will position growers competitively relative to growers in other states.

Project Approach

The major activities of this grant were field demonstrations of various bedding and container color IPM techniques, grower outreach and education, and development of a project web site.

- Field demonstrations: several IPM techniques and approaches were evaluated in California greenhouses. While the original goals were to investigate reductions in both insecticides and fungicides, as the project developed it was clear that many growers had already limited their use of the insecticides of interest and that plant diseases were their major concern. The demonstrations thus emphasized IPM programs based on biological disease control, using comparisons of conventional practices to biological disease control products. Also evaluated was the compatibility of these biological products with conventional insecticides and fungicides. The final area of work looked at the possibility of reducing fertilizer inputs while maintaining crop quality.

- Grower outreach and education: informal education took place at every grower visit. Grower visits to Santa Clara county occurred in February, March, April, May, July, October, and November 2012 and May, July, and September 2013. Grower visits to San Luis Obispo County took place in May, April, October, and November 2012 and March 2013. The project manager gave formal presentations to grower and research audiences in November 2011 (35 attendees) and March 2012 (25 attendees) and by the principal investigator in March, May, July, and October 2013 (approximately 150 at each meeting). The formal presentations covered project work to date and more general information about bedding plant production best practices for effective pest management.

- Project web site: A web site (http://entomology.ucdavis.edu/BPIPM/) provides a point for growers and other interested people to access the best management practices manual and field reports developed as part of this project.

- Project partners: Project partners included the collaborating growers and University of California campus- and county-based faculty and staff with expertise in horticulture, entomology, plant pathology, weed science, and agricultural economics. Many members of this team have previously collaborated on cut rose and cut gerbera IPM programs. The project manager and a technical assistant did the majority of the work. The principal investigator and a project consultant also provided valuable expertise. The principal investigator did much of the project outreach.

  Two formal planning meetings with the partners occurred in January and March 2012. Meetings after that were informal and took place every two to three months until October 2013. Discussions covered key pest issues, especially root rot disease, and various management approaches. Also discussed were best management practices and reasons why growers might or might not follow them.

- Data collection: It was originally planned to compare pesticide use during the IPM demonstration to use in the year prior to the start of the project. Due to variations in weather and crops, it was decided that it would be more accurate to do a side-by-side comparison of inputs in IPM and non-IPM crops. Data collected included a visual assessment of crop quality, pesticides applied, yellow sticky card insect counts, and analysis for soil pathogens. This information was collected at the completion of each demonstration. Fertilizer and water use was the same in IPM and non-IPM crops so detailed information was not collected, except for one trial that looked specifically at the effect of reduced fertilizer use on crop quality.

- Data analysis: Data analysis was done at the end of each demonstration. Some of the demonstrations were not replicated; when there was replication statistical analysis was performed. Crop quality and crop loss were the main parameters measured; they were assessed at the middle and finish of each crop.

Goals and Outcomes Achieved

The major goal for this project was to reduce the number of pesticide applications per crop in the collaborating greenhouses 20 percent by the end of the project. A second goal was to reduce application of organophosphate, carbamate, and pyrethroid insecticides to less than 15 percent of the total number of pesticide applications in the collaborating greenhouses. As the project developed, it became apparent that the collaborators had already accomplished the second goal due to the availability of safer, effective pesticides. As most pesticide applications in bedding and container color plants were for disease control, the focus switched to reducing fungicide use. The baseline for these targets is pesticide use in the same crop grown concurrently with the demonstration using conventional methods.

Activities to achieve performance goals: To achieve performance goals, grower education and field tests of IPM methods developed through research were used. Presenting positive research results for the materials to be included in the IPM demonstrations left growers open to field evaluations at their sites. In consultation with the grower, the crop and conventional treatments to be evaluated were selected. Growers were provided with the IPM materials and they supplied all inputs and labor to grow the crop and apply the treatments. The project manager and a technician did all field evaluations and the project manager performed all data analysis and wrote reports for the growers on project results.

A second area of evaluation compared crop quality under 100 % (grower standard) and 75 % (IPM) fertilizer rates. No difference in quality was observed, suggesting that growers may be able to reduce their use of this input with no yield loss.

Comparison of accomplishments with project goals: The goal for 20% reduction of pesticide applications was achieved. Pesticide use in the IPM crops was 50% to 100% less than in conventional crops. Across all trials the IPM treatments received zero to four applications of fungicides, while the conventional plants received four to eight applications. As mentioned previously, by the time this project began growers had already made the move away from organophosphate, carbamate, and pyrethroid insecticides. Thus it was not possible to develop effective evaluations of IPM programs for insect and mite pests. Fertilizer and water use did not differ between IPM and non-IPM crops, except for one trial that specifically manipulated these inputs. In that trial, the IPM treatment utilized 25% less fertilizer with no difference in crop quality from the grower standard.

Outcomes vs. baseline data: Effectiveness of the IPM program was determined by comparing crop quality and pesticide use in a conventional crop grown concurrently with the IPM demonstration crop. This ensured that growing conditions for the standard and IPM were as similar as possible.

Beneficiaries

Beneficiaries of this project include bedding and container color growers, farm advisors and consultants who advise them, and customers who purchase their plants. There are just over 400 bedding and container color growers in California. Growers and advisors benefit directly from the information generated on the usefulness of the tested IPM tactics. It is difficult to quantify that benefit for advisors, but for growers it corresponds directly to a reduction in fungicide applications of 25 to 75 percent. While costs per application vary, this corresponds to approximate savings of $200 to $1000 per crop per grower.

The annual wholesale value of the state's bedding and container color plant crop is $300 million (USDA Floriculture Crops Summary, 2010). Two key components that were included in this demonstration are impatiens (1.3 million flats sold/year) and pansy (1.5 million flats sold/year).

While many of the state's farm advisors may have some ornamental plant responsibilities, there are ten advisors for whom bedding and container color plants are their major focus area. The state's major crop consultant organization, California Association of Pest Control Advisors, has just over 3000 members.

The healthier, better quality plants generated from the IPM program ultimately benefit the consumer. Lower quality plants often do not perform well in the landscape, resulting in pesticide applications by the consumer or plant replacement. These costs can be up to $10 per plant.

Lessons Learned

Lessons learned:

1. Biological control of some plant diseases can be effective and should be more widely adopted by growers.
2. Growers were more interested in an IPM program for their key pests than a comprehensive IPM program for all potential pests.
3. While all growers did some type of regular crop inspection, many did not feel that regular monitoring with yellow sticky card counts and keeping detailed records of pest observations was worthwhile in short-term crops.

Unexpected outcomes:

1. Investigation of reduced fertilizer inputs and crop quality indicate that growers could substantially reduce fertilizer applications with no negative impact. This should be tested further.
2. Growers tended to be more aware of greenhouse sanitation on the days that the team visited. It would be interesting to quantify the effect of sanitation practices on crop quality and yield.

Goals and outcomes not achieved:

1. In many cases, the collaborating growers had already limited or ended their use of the insecticide classes that were being investigated, making further reductions impossible.
2. Much of this work took place during a period of record low house sales and construction, which is this industry's major market. This resulted in fewer crops and a more conservative approach to production, thereby limiting the number of demonstrations that could be done.

Additional Information

A web site (http://entomology.ucdavis.edu/BPIPM/) provides a point for growers and other interested people to access the best management practices manual and field reports developed as part of this project.

See attached:

- Bedding and Container Color Plant Best Management Practices
- Bedding Plant IPM Fall 2012 Root rots
- Bedding Plant IPM Management Rotations

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 56	Project Title: Increase Fumigation Efficacy with Alternatives to Methyl Bromide using Low Permeability Tarps	
Grant Recipient: U.S. Department of Agriculture, Agricultural Research Service (USDA-ARS)	**Grant Agreement No.:** SCB11056	**Date Submitted:** December 2014
Recipient Contact: Suduan Gao	**Telephone:** (559) 596-2870	**Email:** Suduan.Gao@ars.usda.gov

Project Summary

The almond industry in California depends on soil fumigation for control of soil-borne pests and pathogens during replanting as well as during production of pest and pathogen-free nursery stock. However, the adverse impact of soil fumigants on the environment due to emissions has resulted in stringent regulations on soil fumigants in order to control potential exposure risks to workers and bystanders and the release of volatile organic compounds (VOCs) to the atmosphere. Loss of fumigants to growers would have serious economic consequences. The goal of this project was to develop effective fumigation methods with reduced environmental impacts, which will help maintain the availability of soil fumigants to growers for establishing productive almond orchards and staying competitive in the global markets. The objectives were to: 1) demonstrate the potential for low permeability tarps (e.g., totally impermeable film or TIF) and improve soil fumigation efficacy while simultaneously reducing emissions; and 2) determine the efficacy and fumigant distribution when reduced fumigant rates are applied under TIF.

This project has great impact on the US almond industry because almonds are almost entirely grown in California. California almond acreage reached 700,000 acres in 2009, producing a farm gate value of $2.3 billion ($1.9 billion as exports). The competitiveness and sustainability of the industry relies on pest and pathogen free planting stock, as well as successful replanting for productive orchards. The almond industry has depended upon successful soil fumigation with methyl bromide (MeBr) and the phase-out of MeBr has resulted in significant challenges to the industry. Only a few alternative fumigants are registered for current use and they are highly regulated by United States Environmental Protection Agency (USEPA) and California Department of Pesticide Regulation because of the potential exposure risks to workers and bystanders and VOC emissions. Strategies that minimize emissions and improve pest control efficacy offer the best hope for maintaining the availability of fumigants to this important specialty crop industry. Prior to this project, research showed that a new low permeability film called TIF has the promise of reducing emissions by effectively retaining fumigants and improving fumigant distribution for better efficacy. This project was to determine fumigation methods for effective use of TIF.

This project did not build upon a previously funded Specialty Crop Block Grant Program (SCBGP) project.

Project Approach
With good planning and great team efforts, two field fumigation trials were successfully conducted in replanting orchards to test broadcast shank application of Telone® C35, a fumigant product commonly used in perennial soil fumigation at different application rates under TIF in comparison with standard plastic tarp (film) or no tarp. Telone® C35 contains 63.4% 1,3-dichloropropene (1,3-D or Telone), 34.7% chloropicrin

(CP), and 1.9% other ingredients. Both 1,3-D and CP compounds were monitored and reported. Data on emissions, the fumigant concentration changes or distribution in soil, pest control efficacy (nematodes, pathogens and/or weeds), and almond tree growth response to fumigation treatments were collected. Using the data collected, evaluations were made on effective fumigation methods and emission control with TIF. The project information has been delivered to the stakeholders through outreach. All proposed tasks and activities are fully met and completed during the course of the project.

The two field trials were established within the first and second year, respectively. The first trial was conducted from October 26, 2011 through November 16, 2011 (2011 Trial). The second trial was conducted from November 29, 2012 through January 12, 2013 (2012 Trial). Some photos recording the two field trials are provided in the Supplementary Information (SI). Both trials tested TIF tarp, reduced rates of Telone® C35, emissions, and efficacy on pests including nematodes, pathogens and weeds. The 2012 trial involved replanting in an almond orchard in grower's field. Tree growth and nematode recovery after fumigation were monitored.

2011 Trial. The field trial was conducted at USDA-ARS, San Joaquin Valley Agricultural Sciences Center, Parlier, CA, in sandy loam soil (3 acre field) that was infested with parasitic nematodes and pathogens after a vineyard was pulled out. The fumigation treatments included TIF, standard polyethylene (PE) film, and reduced rates (2/3 and 1/3 full rate) under TIF in comparison with full rate from bare soil and standard film. Sampling for fumigant emissions, concentration change or distribution in soil and efficacy for nematodes, pathogens and weeds was carried out. Important data from this trial are provided in the SI (Figs 1-3 and Tables 1-3), and summarized below:

- TIF resulted in 98% reduction in peak flux from bare soil as compared to the 58% reduction by PE. 1,3-D emission flux was the highest from bare soil (peak flux up to 60 $\mu g\ m^{-2}\ s^{-1}$) followed by PE (up to 25 $\mu g\ m^{-2}\ s^{-1}$), and lowest from TIF (below 1.5 $\mu g\ m^{-2}\ s^{-1}$). TIF resulted in a total cumulative emission loss of 2% for 1,3-dichloropropene and negligible for chloropicrin (SI:Table 1). The total emission reduction from bare soil was 96% by TIF and 28% by PE. Emissions near TIF tarp-edges were low (SI:Fig. 1,Table 1).
- TIF retained higher concentration of 1,3-D in soil at the 15 cm depth (SI:Fig. 2) although large variations among replicates and a continuous rise in concentration were observed for the first 4 days. As time progressed, the 2/3 rate under TIF maintained the highest 1,3-D concentration, followed by the full rate under PE tarp, and then 1/3 rate under TIF, 2/3 rate under PE and full rate in bare soil with the lowest concentration at the 1/3 rate under PE. Chloropicrin concentration was very low (with most values below 0.2 $\mu g\ cm^{-3}$, data not shown) in this field trial, likely due to the relatively lower application rate and faster degradation compared to 1,3-D.
- All fumigation treatments with Telone® C35 reduced total nematode densities throughout the soil profile, relative to the non-treated control (SI:Fig. 3). The full rate with no tarp, the 2/3 rates under PE, and TIF provided complete control of all plant parasitic nematodes throughout the soil profile. All remaining Telone® C35 treatments provided 100% nematode control at both 30 and 60 cm. At 90 cm, nematode survival was observed at the 1/3 rate under PE tarp only. Live nematodes were found at 120 cm in all three 1/3 rates and the 2/3 rate in bare soil. At the 150 cm depth, nematodes were found at the full rate under PE. Except for the 30 cm depth, the MeBr treatment provided full control. The results

indicate that the control of free-living nematodes at deeper soil depths is a challenge in perennial systems.

- For pathogen control, *Phytophthora* and *Verticillium* were examined (SI:Table 3). The data for *Phytophthora* were extremely variable among replications and as a result, there were no significant differences among fumigation treatments. *Verticillium* density was lower and there were statistical differences among some of the treatments. Generally speaking, there was no clear fumigation effect in controlling the pathogen species.
- Weed recovery after fumigation were counted and data were statistically analyzed on density and biomass (SI:Table 3). At least 13 weed species were identified and enumerated in the study. The data show that weed emergence was most affected by tarping and Telone® C35 application rate, i.e., tarping and increased fumigant rates reduced weed emergency. With respect to total weed density, untarped treatments (123 to 168 plants m^{-2}) were statistically similar to the nontreated control (175 and 156 plants m^{-2}). The full and 2/3 rates of Telone® C35 under PE or TIF were as effective as MeBr (1 and 11 plants m^{-2}). The 1/3 rate of Telone® C35 had mean total weed densities (24 to 85 plants m^{-2}) that were statistically greater than the MeBr standard, but numerically less than the control. Similar observations were recorded for the weed biomass data; the use of the highest rates of Telone® C35 under PE or TIF (24 to 54 g m^{-2}) reduced total weed biomass relative to the control (455 g m^{-2}). The results suggest that weed control was improved by the presence, but not the type, of plastic film.

2012 Trial. A second fumigation trial was conducted at Bluff Ranch of Braden's Farm, Merced, from November 2012 to January 2013. Following this trial, almond trees were planted in February 2013. The field was also infested with a high nematode population, chiefly pin nematodes and some ring nematodes. Fumigation treatments included non-fumigated control and three rates (full or maximum allowed label rate, 2/3, and 1/3 of Telone® C-35) under three surface sealing methods (bare, standard PE tarp, and TIF) with six replicates in a randomized complete block design. During the fumigation trial, emissions, gaseous fumigant concentration under the tarp, and fumigant concentrations in soil profile were determined. Fumigation efficacy on nematodes and pathogens were investigated. Tree growth was monitored from March 2013 through May 2014 and nematode recovery was also determined in the fumigated field about a year after fumigation. Important data collected from the 2012 field trial are provided in SI (Figs 4-7 and Tables 5-6).

- 1,3-D emission flux from the full rate with PE, 66% rate with PE, and 66% rate with TIF as well as off the TIF edge are shown in Fig. 4 (SI). Similar to the first trial, CP emission was much lower than 1,3-D with peak flux <15 μg m^{-2} s^{-1} and its flux were reduced to non-detectable in two weeks (data not shown). The highest 1,3-D emission rate measured was from the PE tarp at the full rate, followed by the PE tarp at 66% rate. The TIF showed over 50% reduction in emission flux compared to the PE at the same rate for most of the measurements. The results confirm the finding from the 2011 trial that TIF effectively controlled emissions. Immediately off-the tarp (0 and 50 cm distance from tarp edge), the measured emission flux was again low, much lower than that from shallow injections in trials previously conducted for annual crops.
- Concentration of 1,3-D and CP in air under the PE and TIF from all three application rates are shown in Fig. 5 (SI). 1,3-D concentrations under TIF were clearly higher than that under PE especially at higher application rates. Further, the peak concentrations under TIF were measured about one week after fumigant application; while peaks under PE were observed the second or third day after application

before declining. This supports earlier observation that the TIF retained the fumigant effectively that led to the low emissions.

- **Fumigant distribution in soil profile.** The average 1,3-D concentrations over time in soil profile from selected treatments are shown in Fig. 6 (SI). Similar distribution patterns were followed for all monitored treatments except higher concentrations were found from higher application rates. There were no apparent differences in the soil fumigant concentrations at the same rate among bare soil, PE tarp and TIF. Large variations were measured from three replicated plots for the same treatment. The field varied significantly in topography and rain events occurred during the trial that led to very different soil moisture profiles; specifically tarped plots received lower precipitation than bare soil. At the end of the trial when retrieving pest begs after tarp was removed, plots at lower elevations were found flooded while those in the upslope were dry. The soil gas concentration data generally show decreasing concentrations at lower soil depths.
- **Nematode control from fumigation**. Prior to fumigation, the field was infested with several plant parasitic nematodes with high populations of pin nematodes (150-660 per 100 cc soil) and low populations of ring nematodes (6-210 per 100 cc soil). Six weeks after fumigant application, the total living nematodes (sum of Pin, Spiral, and Ring nematodes) were plotted in Fig. 7 (SI). Telone® C35 treatments with full and 66% rate under both PE and TIF provided 100% kill at all soil depths above 3 feet. Nematode survival was detected in surface bare soil at full rate and all soil depths at 66% rate bare soil. Below 3 feet soil depth, nematode survival was detected for all treatments including the TIF full rate although population was low. More survivals were found at 33% rates in soil profile compared to the higher rates. The data confirm findings from the 2011 trial that it is indeed a great challenge to control nematode at soil depth below 3 feet in orchard soil.
- **Pathogen control from fumigation.** Four species of pathogens were investigated in this study: *Fusarium, Phytophthora, Pythium,* and *Verticillium (data not shown).* Although the full rate (100%) displayed lower populations than other treatments, statistical analyses indicate that the fumigation treatments do not have significant control of the pathogen populations. Large field variability and non-uniform distribution of the pests were observed. The results were also in agreement with the previous trial that pathogen control in the perennial field is difficult. Fortunately, pathogen problem is less critical than nematodes in causing damage for almonds or most perennials. If pathogens will become emerging problems for some crops, these data will help better understand of the nature of the problem in searching for solutions.
- **Nematode recovery after fumigation.** Nematode populations in soils sampled about a year after fumigation for all 12 treatments and 6 replicates are shown in Table 5 (SI). In comparison with the population before fumigation when pin nematodes were ≥150 per 100 cc (roughly 100 g) in all soil depths, the pin nematode population was substantially lower (~1 count per 100 g soil) and similar observation was made for ring nematodes. This field had relatively high and uneven distribution of ring nematodes in the soil. In almost all the cases, the living nematodes were detected in only 1 or 2 plots, i.e., most field plots had non-detectable living nematodes. The group of free-living nematodes, considered non-harmful to trees, was the highest. Ring nematodes were sporadic with highest population at soils below 3 feet depth after fumigation, indicating the greatest challenge to control.
- **Tree performances after fumigation treatment**. Tree growth data are shown in Table 6 (SI). There were no significant differences in tree diameter following tree planting (measurement on March 8, 2013). After ten months (measurement on December 15, 2013), there were significant differences in tree growth between fumigated treatments and the non-fumigated control. All fumigated treatments

regardless of rate and tarp, had significantly improved tree growth compared to the non-fumigated controls. Among the fumigated treatments, there were no significant differences in tree growth although there is a clear trend that trees performed better with increased fumigation rates. After 14 months (measurement on May 9, 2014), however, only the 100% rate under PE tarp or TIF showed significant improvement in tree growth than the non-fumigated control in bare soils. These data confirm that fumigation improves tree establishment, especially in fields infested with nematodes. Whether this benefit is long term will rely on further monitoring of the tree performance.

- **Conclusions from the two field trials:** TIF significantly reduced emissions from application of Telone® C35 and also off the tarp-edge emissions were low. The 2/3 rate of Telone® C35 sealed with TIF controlled nematodes as effectively as the full rate in bare soil or under standard PE film to a depth of 100 cm. However, effective control of nematodes in the deeper soil remains a challenge for deep-rooted perennial crops. The 1/3 use rate of Telone® C35 rate did not provide sufficient or dependable control of nematodes, pathogens, and weeds in this scenario. Pathogen control varied dramatically and there was no clear benefit from soil fumigation. Most effective weed control from the Telone® C35 treatments was largely attributed to surface sealing with either film or high application rate. Nematodes are the most critical pests in most orchards. Fumigation shows clearly positive benefits for tree establishment in orchard and its long term effects rely on further investigations. Research needs to continue addressing the challenge of increasing fumigant mobility in soil profile to improve fumigation efficiency with the alternative fumigants to MeBr for perennial crops.
- The project information was delivered to the most important stakeholder - almond industry through Almond Board of California (ABC) at their annual conference in December 2011, 2012, and 2013. Many growers for other specialty crops such as stone fruits (e.g., peaches), and walnuts also attend the almond conferences. The project participants have been giving annual reports and presentations to the industry and communicate with individuals whenever requested.

The scope of the project benefits only specialty crops because non-specialty crops do not use soil fumigants. The specialty crops benefited by this project are perennials such as stone fruits, nuts, and grapes although almonds were selected for data collections in this project.

Dr. Suduan Gao, project director (PD), took the primary oversight responsibility for the project including major planning for field trials, ensuring funds are allocated to collaborators, and hiring personnel. In addition, Dr. Gao led the work on data collection of emissions and soil fumigant fate/transport as well as coordinating all efficacy studies in collaboration with all project investigators/participants. The PD conducted regular communication by email or phone calls as well as meetings with individual research groups, ensured that all project tasks were met, and kept the project on schedule. The PD also prepared all progress reports on time and presented the project findings to stakeholders and professional meetings.

Dr. Brad Hanson, UCCE Extension Specialist, has been playing a critical role in the project management at UC Davis. Some important personnel needs for this project are managed through UC Davis. Dr. Hanson ensured UC personnel hiring, and also took the responsibility to conduct weed efficacy studies.

Dr. James Gerik, Research Pathologist scientist at USDA-ARS, Water Management Research Unit (WMRU), Parlier, CA, participated in both fumigation trials and conducted pathogen efficacy studies, data analysis and reporting.

Mr. David Doll, UCCE Merced County pomology farm advisor, joined the team for the second field trial. Mr. Doll identified the nematode infested almond orchard for conducting the trial, conducted soil sampling for nematode counting, and did tree diameter measurements in the field. He also conducted important extension activities directly with growers as well as gave presentations at the 2013 Almond Conferences helped in Sacramento, CA when he was a key speaker on a number of issues associated with almond production.

Dr. Ruijun Qin, a project specialist in UC Davis, participated in both field trials by collecting fumigant emission, fumigant movement in soil, helped nematode sampling analysis as well as laboratory sample processing and analysis, compiling data and reporting.

Dr. Alfonso Cabrera, former postdoc of UC Riverside and now employed at Bayers CropScience, conducted the nematode efficacy study for the first trial in 2011 including preparation and collection of soil samples, performed laboratory analysis, data compiling and reporting.

Dr. Sadikshya Dangi, postdoc of UC Davis, conducted the nematode efficacy study for the second field trial in 2012 and also pathogen efficacy for both trials: prepared and collected soil samples, performed laboratory analysis, data compiling, and statistical analyses.

Dr. Lynn Sosnoskie, a project specialist in UC Davis, conducted weed efficacy studies including weed counting and measurements, data processing including statistical analysis and reporting.

Dr. Dong Wang, WMRU Research Leader, USDA-ARS at Parlier, provided essential leadership and coordination to ensure administration support for the project and also provided field trial support and technical advice.

TriCal, Inc. provided fumigation service including materials and application services for all field trials.

The cooperating growers or land owners allowed the use of their land, prepared for the field trials, established the orchard, and maintained the orchard.

There are a number of technical supports in USDA-ARS, WMRU, UC Davis, and UCCE Merced County, who helped conduct the field trials, laboratory sample processing and analysis.

Goals and Outcomes Achieved

During the course of this project, two fumigation trials were successfully conducted in orchard soils infested with parasitic nematodes. Both trials tested broadcast shank application of Telone® C35 at different application rates under TIF in comparison with standard plastic tarp or no tarp. Data on emissions, the fumigant fate and transport, pest control efficacy (nematodes, pathogens and/or weeds), and almond tree growth response to fumigation treatments were all collected. Based on the data and statistical analysis, evaluations were made on effective fumigation methods and emission control by TIF. The project information was delivered to the stakeholders. All proposed tasks and activities are fully met and completed during the course of the project. The success of the field trials was the key to achieving the performance goals and measurable outcomes. The highly qualified and multi-disciplinary team warranted the project success.

The goal of this project is to develop effective fumigation methods with reduced environmental impacts, which will help maintain the availability of soil fumigants to growers for establishing productive almond orchards and staying competitive in the global markets. The objectives are 1) to demonstrate the potential for low permeability tarps (e.g., totally impermeable film or TIF) to improve soil fumigation efficacy while simultaneously reducing emissions and 2) to determine the efficacy and fumigant distribution when reduced fumigant rates are applied under TIF. The following was accomplished:

1. TIF covering fumigated fields in orchard replanting can significantly reduce emissions, i.e., minimizing environmental impact of soil fumigants through volatilization that not only endanger people's health but also contributing VOCs to degrade air quality (ground ozone formation to contribute to smog). Among the many methods to reduce emissions, TIF was so far the most effective.
2. This project has demonstrated that soil fumigation significantly improved orchard establishment by reducing nematode population in soil and enhance tree growth, especially within the first year.
3. Fumigation efficiency can be improved with TIF because it retains higher fumigant concentration in soil and increases exposure time.
4. While the project achieved its general goal to improve fumigation efficiency and reduce emissions by TIF, this project identified the new challenge in controlling nematode in soil depth below 3 feet with 1,3-D and chloropicrin and continuous research has been planned.

The following list conveys completion of achieving outcomes and progress toward achieving set targets:

1. Prior to the project, standard plastic tarp or no tarp on soil resulted in nearly 50% or higher emissions from fumigants applied in soil fumigation. The TIF tarp in soil fumigation is shown to reduce emissions 50% - >90% in tarped area.
2. Prior to this project, TIF used in soil fumigation with shallow injection resulted in high off-tarp edge emissions and there was no off-TIF edge emission measurement in perennial field fumigation. This project results indicate very low off-TIF edge emissions.
3. There were no efficacy and tree growth data from reduced rates using TIF tarp. This project concluded that in comparison to 100% full rate under standard film or bare soil, reduced 2/3 rate under TIF provided 100% kill or similar control for residential nematodes in the soil above 3 feet depth.
4. There were no prior efficacy data in deep soil, i.e., below 3 feet prior to the project. Residential nematode control investigation from fumigation treatments revealed the challenges or difficulties to control nematode in the deeper soil, because even the full rate under TIF showed survival of nematodes. Innovative further research is needed to address this challenge.

The following items list the major successful outcomes of the project:

1. The two field trial data show that 2/3 rate of Telone C35 under TIF provided 100% control on nematodes or as effective as the full rate under standard PE tarp or in bare soil especially at 3 ft depth or above.
2. Up to >90% emission reduction by TIF was achieved in comparison with standard tarp. Low off-tarp edge emissions were determined from fumigation in the orchard and also extremely low emissions after 3-5 weeks implying low risk of emissions after tarp removal. These measurements were supported by fumigant concentration data in soil profile
3. TIF increased fumigant concentrations especially under the tarp and in surface soil although this effect decreased as soil depth increased. All fumigation treatment reduced soil-borne pests compared to non-fumigated control and parasitic nematode recovery appeared slow.

4. Fumigation clearly improved tree establishment significantly within the first year in comparison with no fumigation.
5. New challenge was identified for control of nematodes in soil below 3 ft depth because nematode survival was found even at the full rate. Further research was planned to address this challenge.
6. The results of this project were presented to growers and stakeholders at the annual Almond Conference from 2011 to 2013 with over 2,000 attendees (growers, handlers, distributors, marketers, researchers, extension specialists and representatives from regulatory agencies) each year. There were over 300 attendees during the 2011 International Methyl Bromide Alternatives Outreach Conference (researchers from governmental, academic and private institutions, as well as extension agents and users). There were over 200 attendees during the presentations related to this project for the 2011 and 2012 ASA-CSSA-SSSA Annual Meetings, which included researchers from all over the world. Additionally, UCCE project collaborators (Dr. Hanson, and Mr. Doll) held a number of field days, and gave presentations to different groups throughout the project period with a total of over 500 attendees.

Beneficiaries

Beneficiaries from this research include growers, and state and federal policy makers and regulatory agencies. The project directly benefits 6500 almond growers who produce a farm value of about $5 billion on 800,000 acres in CA. The US almond industry is almost entirely in California. This project provides the industry the information for sustainable production to maintain the competitiveness in the world market. The growers will use the project information to better understand the behavior of fumigant after application to soil. The growers will also have information that will allow them to select fumigation methods towards increasing fumigations efficiency, minimizing emissions to meet regulatory requirement, and gaining the maximum benefits from soil fumigation. Over the long run, a sustainable production system may be achieved.

This project also benefits other perennial specialty crop producers and nursery growers that require similar fumigation methods. Coincidently, most of the perennial crops (e.g., peaches, almonds, walnuts, grapes) that depend on soil fumigation are all specialty crops. The perennials have a total value of over $10 billion in California. Parasitic nematodes are one of the critical pest problems for these specialty perennial crops. They can spread quickly throughout soil when proper tree growing conditions (e.g., irrigation) are developed and can cause a lack of vigor, poor growth, or complete failure especially for young trees. The project provides quantitative data under the field conditions. The potential economic impact is high in terms of helping the perennial industry meet regulatory standards in fumigant use and maintain its availability for profitable yields for perennial specialty crops.

Another group who benefits from this project is policy or regulatory agencies (California Department of Food and Agriculture (CDFA); Department of Pesticide Regulations; Environmental Protection Agency). Fumigants are highly regulated and emission control is enforced in California non-attainment areas (NAAS), which includes the San Joaquin Valley where most specialty perennial crops are grown. The tools investigated in this project provide the information on agricultural management practices to reduce fumigant emissions. The information serves as a knowledge base for developing regulations that allow the use of some chemicals in agricultural production.

Lessons Learned

For this type of project, i.e., requiring collection of scientific data that will be used by growers and possibly policy/regulatory agencies, it requires team work and involves multi-disciplinary expertise. The foundation for the success of the project is based on the fact that the research team has the expertise and also working experience with stakeholder and the industry.

One unexpected outcome is the realization of the challenge to deliver sufficient fumigant to deep soils (below 3 feet depth) where nematodes exist in most orchards. Both field trials showed that most fumigated treatments provided effective control of soil residential nematodes compared to non-fumigated controls in the top 3 feet of soil. However, both trials also showed high survival of nematodes below the 3 feet depth down to 5 feet (no sampling below 5 feet because of sampling difficulties). 1,3-D and chloropicrin were not effectively delivered to the deeper soil. How fumigants can be effectively delivered to the deep soil should be explored. The approaches include deep injection, carbonation technology, and low permeability tarp. Deep injection is effective but requires more energy and a cost evaluation must be made. Carbonation technology (dissolving carbon dioxide in fumigants and use carbon dioxide as propellant to increase fumigant dispersion) has been demonstrated to improve fumigant movement in annual crops and coarse textured soil, but not in perennial crops or in sandy loam soils. TIF has been demonstrated to reduce emissions but whether it is necessary to be used with deep injection is to be determined. The unexpected outcome actually brings the team one step closer to achieving solutions for effective fumigation in orchards.

Additional Information

Attachment 1:

- Tables #1 – 6
- Figures #1 – 7
- Photos #1 – 6

Project findings can also be found in the following publication and meeting presentations as well as websites:

Peer-reviewed journal publications:

- Gao, S., B.D. Hanson, R. Qin, J.A. Cabrera, J. Gerik, D. Wang, and G. Browne. 2013. Emission control and efficacy improvement by TIF tarp in soil fumigation for perennials. Calif. Agr. 67:217-222.
- Hanson, B.D., S. Gao, J. Gerik, R. Qin, J.A. Cabrera, A.J.M. Abit, D. Cox, B. Corriear, D. Wang, and G. Browne. 2013. A clean start to productive orchards and vineyards: recent research on methyl bromide alternatives for perennial crop nurseries. Calif. Agr. 67: 181-189.
- Qin, R., S. Gao, and H. Ajwa. 2013. Emission and distribution of fumigants as affected by soil moistures in three different textured soils. Chemosphere. 90:866-872.

Proceedings:

- Gao, S., R. Qin, A. Cabrera, B. Hanson, J. Gerik, D. Wang, and G. Browne. 2011. Application of low permeability tarp in perennial field fumigation. p. 12:1–4 *In* Proc. Ann. Int. Res. Conf. on MeBr Alternatives and Emission Reductions, San Diego, CA. (Proceedings).
- Qin, R., S. Gao, and H. Ajwa. 2011. Fumigant degradation as affected by different application rate in five soils. p. 79:1–3 *In* Proc. Ann. Int. Res. Conf. on MeBr Alternatives and Emission Reductions, San Diego, CA. (Proceedings).
- Cabrera, J.A., B.D. Hanson, M.J.M. Abit, J.S. Gerik, S. Gao, R. Qin, and D. Wang. 2011. Efficacy of 1,3-dichloropropene plus chloropicrin reduced rates under two different tarps against nematodes,

pathogens and weeds p. 75:1–3 *In* Proc. Ann. Int. Res. Conf. on MeBr Alternatives and Emission Reductions, San Diego, CA. (Proceedings)

Reports:

- Gao, S. 2012. Minimize emissions and improve efficacy from soil fumigation using TIF tarps. Annual Report to Almond Board of California, Modesto, CA, 17 pp.
- Gao, S. 2013. Using TIF tarp and reduced fumigation rates for almond replanting. Annual Report to Almond Board of California, Modesto, CA 17 pp.
- Gao, S. 2014. Using TIF tarp and reduced fumigation rates for almond replanting. Annual Report to Almond Board of California, Modesto, CA 13 pp.
- Gao, S. Increase Fumigation Efficacy with Alternatives to Methyl Bromide using Low Permeability Tarps. Progress Reports to CDFA for Grant Agreement No. SCB11056 on 04/30/2012 (2 pp), 10/31/2012 (4 pp), 04/30/2013 (3 pp), 10/31/2013 (5 pp), and 04/31/2014 (7 pp).

Website:

- Gao, S. 2012. Emission reduction and efficacy improvement in soil fumigation. USDA-ARS Pacific-Area Methyl Bromide Alternatives. Available at http://ucanr.org/sites/PAWMBA/Emissions_Projects/Emission_Reduction/.
- Gao, S. "Practical emission reduction methods from soil fumigation," Seminar presentation in Cal/EPA, Sacramento, CA. August 28, 2012. Available at: https://www.facebook.com/photo.php?v=10151098648366107&set=vb.440748475958421&type=3&theater.

Presentations:

- Gao, S., R. Qin, A. Cabrera, B. Hanson, J. Gerik, and D. Wang. 2011. Issues and management in using low permeability tarps to reduce emission from soil fumigation. ASA-CSSA-SSSA International Annual Meeting, Oct. 16-19, 2011, San Antonio, TX.
- **Gao, S.**, R. Qin, A. Cabrera, B. Hanson, J. Gerik, D. Wang, and G. Browne. 2011. Application of low permeability tarp in perennial field fumigation. p. 12:1–4 *In* Proc. Ann. Int. Res. Conf. on MeBr Alternatives and Emission Reductions, San Diego, CA.
- Gao, S. Using TIF tarp and reduced soil fumigation rates for almond replanting. Poster Presentation at the 39th Almond Industry Conference, December 7-8, 2011, Modesto, CA.
- Gao, S. R. Qin, B. Hanson, A. Cabrera, J. Gerik, and D. Wang. 2012. Low permeability tarps to reduce emission and improve fumigant distribution in soil from deep shank injection of Telone C35. Abstract #319-13. ASA-CSSA-SSSA International Annual Meeting, Oct. 21-24, 2012, Cincinnati, OH.
- Qin, R., S. Gao, and H. Ajwa. 2012. Effect of application rate on degradation of several important fumigants in soil. Abstract #164-3. ASA-CSSA-SSSA International Annual Meeting, Oct. 21-24, 2012, Cincinnati, OH.
- Gao, S. Using TIF tarp and reduced soil fumigation rates for almond replanting. Poster Presentation at the Almond Conference, December 11-13, 2012, Sacramento, CA.
- Gao, S. Using TIF tarp and reduced soil fumigation rates for almond replanting. Oral and Poster Presentations at the Almond Conference, December 3-6, 2013, Sacramento, CA.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 57	**Project Title:** Integrated Pest Management for Light Brown Apple Moth in California Ornamental Nurseries	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB11057	**Date Submitted:** December 2014
Recipient Contact: Steve Tjosvold	**Telephone:** 831-763-8013	**Email:** satjosvold@ucanr.edu

Project Summary

The invasion of the Light Brown Apple Moth (LBAM) into California threatens the viability of California's $3.8 billion ornamental nursery industry. The responsibility and cost of eradicating and limiting LBAM spread to other areas weighs heavily on nurseries in the 17 regulated counties where LBAM can hitchhike on nursery stock shipments to non-infested areas. The project team will identify key components of an Integrated Pest Management (IPM) program that are lacking, could be greatly improved, or still not demonstrated to be practical or useful. The goal of this project is to develop and demonstrate improved IPM strategies and tools that nursery operators could implement and control LBAM more effectively.

California and Federal regulatory agencies are focused on controlling LBAM in nurseries to prevent inadvertent movement of the pest on nursery stock to other parts of the state or nation. As a result, nurseries in regulated areas undergo regulatory inspections and must be found free of LBAM before shipments can be made outside the regulated area. Life-cycle models have estimated that LBAM could readily establish in most California coastal areas and possibly in the Sacramento and San Joaquin Valleys. Therefore, most of the 3.8 billion dollar California nursery and floriculture industry and nearly 3000 producers must be considered vulnerable to infestation by LBAM and the associated potentially severe economic consequences of regulatory action. Required regulatory pesticide sprays and associated costs have been estimated by nursery operators at up to $500 per acre per incident. The cost of lost or delayed sales due to regulatory holds can be severe; in just one recent incident, these losses were estimated at $100,000.

For nursery operators to ship outside of quarantined areas, new regulations require them to plan and implement an IPM program for LBAM. With the results of this project, it is expected that nursery operators would be able to establish an effective IPM program to allow continued shipping outside of regulated areas. This project will directly and positively impact the 600 production nurseries in the currently regulated areas. Other ornamental producers and growers will benefit if LBAM does not spread into other production areas. Trading partners (other states and countries) and USDA APHIS will gain confidence that LBAM is managed successfully in the regulated areas so that quarantine restrictions on the nursery industry are not placed on the entire state.

This project builds upon a previously funded Specialty Crop Block Grant Program project, 2008 Project 12. In the 2008 project, evaluation of the effectiveness of pheromone mating disruption for the management of LBAM in ornamental nurseries was done. The project team also identified that in-house scouting was the most important part of early LBAM detection and management, and scouting needed to become more efficient. A field guide for LBAM identification would be useful. The team saw that weed and native hosts on nursery perimeters could be important to support LBAM.

Project Approach

Project Activity:	Activity Accomplishments:	Completed (Month/Year):
Field guide development for identification and detection.	For over 2 years, hundreds of photographs and macro-photographs were taken in field and laboratory to support the project. The best images were used in the final products. Identification features for projects were critically evaluated by taxonomic experts at CDFA and Colorado State University. The Field Guide was peer reviewed and approved by UC experts and published by the University of California Agriculture & Natural Resources (UCANR) IPM Program. Text was developed for the printed guide. In lieu of a Spanish version, a 13 minute video training was developed to enhance LBAM field scouting and identification training.	Oct 2011 to Oct 2014
Field guide review and production	1000 field guides printed and distributed. One video training was produced. Information /images were presented as they were developed at 13 professional meetings with 1194 attendees' total.	Oct 2013 to June 2014
Field guide distribution	Distribution to USDA and CDFA regulatory officials, UCIPM, UC Farm Advisors and Specialists, Pest Control Advisors, Grower Meetings, and Grower Consultations. The availability of the Field Guide promoted through meetings and newsletters.	June 2014 and ongoing
Host identification and preferences evaluation in weeds and native vegetation	LBAM population dynamics and weed/native hosts were monitored every two weeks on 8 nursery and farm perimeters in Santa Cruz and Monterey counties since October	Oct 2011 to June 2014

	2011. Over 2,300 LBAM adults have been trapped and over 500 larvae collected on 31 different hosts. The trap counts of migrating moths were web-accessible to alert growers of peak LBAM flight periods and common hosts. Available to view at http://cesantacruz.ucanr.edu/ Host transects were established May 2013 to evaluate the importance of hosts on the field perimeter at all 8 monitored sites.	
Evaluate moth migration risk	Experiments were established in 3 sites of strawberry fields to detect LBAM moth migration from field perimeters into these crops. The experiments detected LBAM on perimeters and in the field, but the numbers were too low and inconsistent to statistically demonstrate moth migration and migration distance. Then 2 new sites were established in non-host crops (lettuce and leeks) but counts there were also too low to produce statistically significant results.	Apr 2013 to Mar 2014
Insecticide evaluation in field conditions	An important insecticide management experiment was established in 2012/2013 to evaluate plant-systemic insecticides to target LBAM larvae at early, mid, and late instars. Six insecticide treatments (methoxyfenozide, emamectin benzoate, acephate, cyantraniliprole, dinotefuran, and spirotetramat) were chosen primarily on their systemic characteristics and their availability to the ornamental industry. The trial was repeated in 2013/2014 to substantiate findings. An organic insecticide (Chromobacterium subtsugae) was added in the second evaluation.	Feb 2012 to Mar 2014

Insecticide data summarization and presentation at grower meetings. Meeting evaluations.	There was excellent control on all larval instars for all insecticides except dinotefuran, spirotetramat and C. subtsugae).	Mar 2013 to May 2014
Spray rig spray evaluations in nurseries for LBAM control	The Project Investigator (PI) developed a scouting and spray application presentation and field demonstration with emphasis on control of LBAM.	May 2012

The project benefited specialty crops only.

Insecticide evaluations: An entomologist from USDA (Salinas CA) provided LBAM moths for infesting plants, and another entomologist from USDA (Maryland) provided previous research data, technical support, and edited the insecticide manuscript.

Field guide: An entomologist from CDFA and from Colorado State University contributed to the manuscript and text.

Host evaluation and population dynamics: A professor of Land, Air, and Water Resources from UC Davis contributed expertise on the evaluation of biomass in field plots, and statistical evaluation of data. A farm advisor from UCCE, Salinas and a herbarium curator from UC Davis provided expertise of weeds and native plants.

Spray rig spray evaluations: A professor of engineering from UC Davis provided technical assistance and a review of experiments in his specialties.

Overall project implementation and monitoring was done by a Staff Research Associate from Watsonville, CA.

Goals and Outcomes Achieved

Project Activity/Measurable Outcomes are as follows:

Field guide review and production:
1000 field guides printed and distributed. A video training was produced and information /images presented at 21 grower and professional meetings with 1796 total attending.

Field guide distribution:
Distribution to USDA and CDFA regulatory officials, UCIPM, UC Farm Advisors and Specialists, Pest Control Advisors, Grower Meetings, and Grower Consultations. Availability made known through meetings and newsletters. From the newsletters: the Field Guide information was distributed through an online statewide newsletter. This reaches nearly 3000 growers and associated industry clientele that are on the mailing

list. The associated industry in this promotion would be Pest Control Advisors (estimated 25) and Farm advisors (5).
It was also promoted at the CDFA LBAM working group, consisting of 20 USDA and CDFA regulatory officials. Over 500 brochures have been distributed to these end users so far.

Information presented at 8 professional meetings with nearly 724 total attending. The trap counts of migrating moths were web-accessible to alert growers of peak LBAM flight periods and common hosts. (http://cesantacruz.ucanr.edu/)

Presentation of moth migration risk:
Information presented at 5 professional meetings with 391 attendees. Concepts of moth migration from perimeters were discussed and illustrated with the data.

Insecticide data summarization and presentation at grower meetings:
There was excellent control on all larval instars for all insecticides except dinotefuran, spirotetramat and C. subtsugae).

Spray rig spray evaluations in nurseries for LBAM control:
The Project Investigator (PI) developed and presented a scouting and spray application presentation and field demonstration with emphasis on control of LBAM on May 24, 2012 in Woodlake, California. 79 attending from all major California growing regions.

LBAM Presentations: (Information produced from this project was presented by the PI at these events with nursery grower or other professional audiences):

California Association of Pest Control Advisors (CAPCA) Management of Sudden Oak Death and Light Brown Apple Moth with Pesticides: in Reno, NV with 145 attendees on 10/17/2011.

CDFA Plant Pest Diagnostics Center Seminar Light Brown Apple Moth Management: Regulatory, Research and Extension Linkages in Sacramento, CA with 42 attendees on 11/17/2011.

Salinas Valley Entomology Meeting Light Brown Apple Moth Control in Nurseries in Salinas, CA with 72 people on 12/6/2011.

Monterey Bay Chapter California Association of Nurseries and Garden Centers
Update on LBAM and Other Invasive Pests in Watsonville, CA with 43 attendees on 3/22/2012.

Entomological Society of America, Pacific Branch Presented: Light Brown Apple Moth: An IPM Approach for a Regulated Invasive Pest in California Nurseries in Portland, Oregon with 65 attendees on 3/25/2012.

IPM Training for Landscape Professionals Light Brown Apple Moth: An Update for Landscape Professionals in San Diego, CA with 139 attendees on 5/10/2012.

Insect ID, Scouting, Spray Evaluation, resistance Management Workshop Presented “Scouting Basics” and “Spray Evaluation” Woodlake, CA with 79 attendees on 5/12/12.

Regional Deputy Agricultural Commissioner's Training Field Research Update on Light Brown Apple Moth in Concord, CA with 17 attendees on 8/15/12.

Pesticide Applicators Professional Association Light Brown Apple Moth an Update for Landscape Professionals in San Jose, CA with 210 attendees on 12/11/2013

Annual Strawberry Meeting New Management Tools for Light Brown Apple Moth in Watsonville, CA with 103 people on 2/5/2013.

Society of American Florist Pest and Production Management Meeting Invasive of Concern: Light Brown Apple Moth in San Francisco, CA with 95 attendees on 2/23/2013.

Best Management Practices Programs for CA Nurseries: Review and Outlook Update on Light Brown Apple Moth BMPs in Salinas, CA with 44 attendees on 5/14/2013

The outcomes that are demonstrated in the sections above are based on the original objectives in the proposal: (1) Improve Scouting (field inspection), (2) Evaluate Nursery-Perimeter Controls with Sterile Insect Moth (SIT) Release and Trap/Kill Techniques, and (3) Improve Control of LBAM with Insecticides in the Field. The outcomes of (1) and (3) are demonstrated with the successful completion of the research and information transfer through workshops, presentations, and publications. The second objective was removed when the USDA SIT moth rearing program was suddenly closed down in 2012 and the project's associated research could not proceed without the production of sterile moths. Instead, the team knew that the host range and migration studies at nursery perimeters were very important and needed more emphasis in this project. These host studies were developed and included in this project. Monitoring of hosts was expanded to 8 nurseries and enhanced with the quantification of host biomass. Outcomes for this objective were completed and demonstrated in the sections above.

Almost all outcomes were completed as demonstrated in the sections above. However, the Field Guide for the Identification of LBAM was to be translated into Spanish, and this was not done. The Field Guide took much longer to produce than expected because of the difficulty in rearing all life stages and photographing macro-level images to illustrate technical taxonomic features. The translation would have taken much more time to create because of the difficulty of converting the already greatly condensed English text to the Spanish version. The Spanish version would require more text and therefore a different layout (requiring more graphic artist time). Most importantly, at this transition, the team became aware of video editing software recently provided by UC that would help produce training videos. This was the perfect enhancement to the Field Guide. The training video can be used online by an individual, or by a trainer to train field workers (perhaps in a small office venue around a computer screen). The Field Guide could be handed out to supplement the online video training. In lieu of a Spanish version of the Field Guide, a 13-minute training video was produced. This video contained many more images and descriptions than the team could practically fit into the Field Guide. This video has been peer reviewed and will be available soon on a UCANR Integrated Pest Management website. The temporary website link:
http://stream.ucanr.org/relay/nbmurray/Scouting_and_Field_Identification_of_Light_Brown_A_-_20140709_154356_7.html

The team has succeeded in the overall objectives of this project, that is, to develop and demonstrate improved IPM strategies and tools that nursery operators could implement and control LBAM more effectively. The overall goal of the project was to support California nurseries so that they could continue business and trade despite regulation due to LBAM. To that end, trading partners in other counties, states, and countries such as Mexico and Canada continue to accept ornamentals and other agricultural products from LBAM regulated counties. The 600 nurseries in regulated areas have been able to ship LBAM-free products to their traditional markets. In addition, there has been a decline in official detections in nurseries through the project period as illustrated in the table below.

LBAM Official Detections* in California Nurseries:

Year	Detections
2010	1108
2011	748
2012	NA
2013	672
*Data provided unofficially by USDA LBAM Project	

There are many variables that could account for lower detections, but certainly the decline in detections is supported by this project's research findings and associated consultations, trainings, and publications. Therefore the heavy financial burden of regulatory actions on the industry and the movement of contaminated nursery stock to other areas of California and beyond have been significantly reduced.

Beneficiaries

With the results of this project, nursery operators are able to establish an effective and mandated IPM program to ship outside of regulated areas. Other agricultural commodities including berries and vegetables are also able to ship outside the regulated areas.

This project directly and positively impacted the 600 production nurseries in the currently regulated areas. Other ornamental producers and growers benefited as LBAM was detected in only 3 new counties since the beginning of the project with a potential spread to most all coastal counties and many inland counties. This project has demonstrated a significant positive impact for California growers and the US. It is therefore estimated that the entire industry of 3000 California nursery growers have benefited from this project.

Lessons Learned

Implementing research projects with a quarantined invasive pest such as LBAM can be difficult with regulations and the low population numbers restricting what can be done in field research.

However, despite the difficulties of working with a quarantined pest, information can be conveyed and informal publications can be distributed in a timely and useful manner as the information is developed.

Additional Information

UC IPM will establish a permanent website link to the Field Identification Guide for Light Brown Apple Moth in California Nurseries and the video training Scouting and Field Identification of Light Brown Apple Moth in California Nurseries. The field guide pdf document is in Attachment 2, and is available at the UC IPM website under the Emerging Pests section on the main page, or in the Leaf- rollers section in the paragraph on light brown apple moth. A direct link for the video training is: http://stream.ucanr.org/relay/nbmurray/Scouting_and_Field_Identification_of_Light_Brown_A_-_20140709_154356_7.html

LBAM Publications:

Tjosvold, S.A. 2013. Current Status of Light Brown Apple Moth: In: Between the Furrows, Vol 37, Issue 1, Jan, pg. 3.

Tjosvold, S.A. 2013. Invasives of Concern: Light Brown Apple Moth. In Proceedings of the Society of American Florists Pest and Production Management Conference. San Francisco, February 21 – 23.

Tjosvold, S.A. 2013. LBAM Field Data Available for Monterey Bay Area Growers. In: UCNFA News. Spring, Volume 17, Issue 1.

Tjosvold, S.A. and N.B. Murray. 2013 Light Brown Apple Moth (Epiphyas postvittana) population dynamics and host range surrounding nurseries in central California. Oral presentation at the annual meeting of the Entomological Society of America. November 10-13, 2013. Austin, Texas. Abstract accepted and published.

Tjosvold,S.A. 2014. Light Brown Apple Moth Update: USDA Decision to Not Deregulate and and Management Strategies. In: UCNFA News. Fall, Volume 18, Issue 1.

Tjosvold, S.A., N.B. Murray, M. Epstein, O. Sage, T. Gilligan. 2014. Field Identification Guide for Light Brown Apple Moth in California Nurseries. University of California Agriculture and Natural Resources.

Tjosvold, S.A., N.B. Murray, M. Epstein, O. Sage, T. Gilligan. 2014. Scouting and Field Identification of Light Brown Apple Moth in California Nurseries. University of California Agriculture and Natural Resources. Video currently available at: http://stream.ucanr.org/relay/nbmurray/Scouting_and_Field_Identification_of_Light_Brown_A_-_20140709_154356_7.html

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 58	**Project Title**: Development of Tools for Rapid Detection, Identification and Interdiction of Torradoviruses before they Invade and Establish in California	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB11058	**Date Submitted:** December 2014
Recipient Contact: Bryce Falk	**Telephone:** 530-752-0302	**Email:** bwfalk@ucdavis.edu

Project Summary

In the early 2000's two new diseases of tomatoes were described: "Marchitez" for a disease found in the Sinaloa state of Mexico and "Torrado" for a disease of tomatoes, originally reported from Spain. Both diseases were subsequently shown to be caused by two new, but related viruses. *Tomato apex necrosis virus* (ToANV) was the name originally used to describe the causal agent of Marchitez and *Tomato torrado virus* (ToTV) was the name used to describe the causal agent of Torrado. Since their discovery, ToANV has continued to be a major concern in Mexico, ToTV has now been reported from more countries in Europe, Australia, South and Central America, and some additional viruses causing similar diseases have been discovered. One of these is *Tomato chocolate spot virus*, causing the chocolate spot disease of tomatoes in Guatemala. Most torradoviruses have plant host ranges and cause disease in tomatoes and sometimes peppers and tomatillo, but this year two new torradoviruses were discovered in lettuce from Europe and in Cassava from South America. Clearly these are emerging plant viruses and represent a potential threat to California tomato production. All torradoviruses are transmitted from plant to plant by whitefly vectors, including those in the genera *Bemisia* and *Trialeurodes*. Whiteflies in both of these genera are widespread and contiguous in Mexico and in California, and several other plant viruses transmitted by whiteflies already occur in California. This raised the concern that torradoviruses might also move from Mexico into California, and if so they could threaten California's tomato, and possibly pepper crops. This effort was designed to develop tools to assess torradovirus identification, incidence, biology, and resistance/susceptibility in tomato germplasm. Information was also extended via meetings and publications.

The work made possible by this research grant is critical for California. The efforts and results provided new fundamental knowledge of value for California regulatory scientists, but also the California tomato industry. California produces ~90% of the U. S., and nearly half of the worlds' tonnage of processing tomatoes, and therefore, any new pests or pathogens that threaten this industry must be pro-actively addressed. The project team did so in this research effort. So far only one torradovirus has been positively detected as naturally occurring in California tomatoes, but it has not re-occurred. But it is now known how to identify torradoviruses and thus, will not be caught by surprise in the future. These efforts and results now allow for rapid responses if torradoviruses do again occur in California.

Project Approach

The outlined project activities were followed and most were completed.

1) Torradovirus cultures were obtained, all with appropriate USDA APHIS and CDFA permits, from collaborators in Spain, France, Mexico, Panama, and Australia, and a Guatemalan isolate from a

University colleague. Some of these were contaminated with other viruses but the project team was able to purify the specific torradovirus isolates giving representative samples of nineteen torradovirus isolates: thirteen of *Tomato apex necrosis virus* (ToANV) from different locations in Mexico; six *Tomato torrado virus* (ToTV) isolates from collaborators in France, Spain and Australia and one *Tomato chocolate spot virus* (ToChSV) isolate from Guatemala.

2) The whitefly transmissibility was assessed for specific isolates of each of the above viruses. All were readily transmissible by the common *Bemisia tabaci*, biotype B in tomatillo and tomato plants with a minimum access acquisition period of 30 min, suggesting a semi persistent transmission relationship. This biotype is common in Mexico where ToANV occurs, but is also widely dispersed in southern California. Furthermore, because the geographic range of *B. tabaci* overlaps with that of the common greenhouse whitefly, *Trialeurodes vaporariorum*, which is a reported torradovirus vector, if torradoviruses emerged into southern California from Mexico, the potential for them to spread even to northern California is real.
3) Nucleotide sequence analysis was performed and direct amino acid sequence analysis for specific regions/proteins of the RNA1 and the RNA2 of different torradoviruses. Also, the full length sequence and partial sequences of the RNA1 and RNA2 was obtained of different ToANV isolates. This allowed for a better understanding of torradovirus gene expression and for the actual proteins making up the virus particle. This information was important for leading into step 4.
4) Very effective torradovirus detection tools were developed that allowed for general identification of all torradoviruses, but also specific separation of ToANV, ToTV and ToChSV. Two types of assays were developed, the first being RT-PCR-based analysis and the second a rapid, simple squash blot assay. For the latter, leaf and/or stem pieces were directly pressed onto a nylon membrane. The membrane was then processed using torradovirus probes which gave accurate differentiation/identification of torradoviruses, even from different plant species (tomato, tomatillo, *Nicotiana benthamiana*); allowing a maximum of 200 samples to be processed per day with this procedure (see Fig. 1 and abstracts by Ferriol et al., and by da Silva et al., Attachment 1 & 2). In collaboration with colleagues in Spain and Panama, a specific tool has recently been developed to detect and quantify ToTV RNA 2 copies based on real time RT-PCR (RT-qPCR). This methodology allowed the project team to quantify as few as 10000 ToTV RNA copies and detect ToTV isolates from different countries and even those with different genetic variability (see abstract by Herrera-Vaasquez et al., addendum 3 in Additional Information).
5) Torradovirus isolates were used for plant host range studies as described in the work plan.
6) Based on greenhouse host range studies (point 5 above), field host analysis was limited to plants of the same taxonomic family as is tomatoes (*Solanum lycopersicum*). The only plant in the same family as tomatoes (Solanaceae) and growing near tomato production fields in Mexico was tomatillo (*Physalis philadelphica*). It is interesting to note that the tomatillo in fields did not show obvious symptoms of virus infection, but tests showed that a high percentage of plants often were infected with ToANV. As a result of this finding, tomatillo has been used as an excellent host plant for ToANV in greenhouse studies. Tomatillo also is preferred by *B. tabaci*, so it has potential to be a very good source of torradovirus inoculum for spread into tomatoes and other susceptible crop host plants.
7) Some of the results have been presented at scientific meetings. A poster entitled "Specific detection of three Torradovirus species with digoxigenin-labeled probes" was presented in the Conference of Biotechnology in Brazil (Florianopolis) in November of 2013 (see Attachment 2). This was presented by a UC Davis Brazilian student who worked in the lab on this project and no grant funds were used for this meeting. In June of 2014 a poster was presented at the Annual Meeting of the American Society for Virology in Fort Collins, CO**,** " Rapid detection of three torradovirus species by using digoxigenin-labeled riboprobes and tissue print hybridization**"** (see Attachment 1) and a poster was presented at the XVII

Congress of Spanish Phytopathology October (2014), in Lleida, Spain "Determination of the cleavage sites of the RNA2-encoded proteins for two members of the genus *Torradovirus* by N-terminal sequencing of the virion capsid proteins (see addendum 4 in Additional Information). The latter is the result of an invited presentation and all expenses were paid by the Spanish Phytopathological Society.

8) A torradovirus handout was presented in January of 2014 at the San Joaquin/Stanislaus/Merced County extension meeting for tomato growers. This was entitled "Tomato torradoviruses: New and Important Viruses Affecting Tomatoes, but not yet in California" and included color photographs of symptoms on tomato plants and fruits (see addendum 5, Additional Information). This was intended to alert California tomato producers to this potential problem, and makes them aware of the diagnostic abilities (point 4 above). 60 handouts were prepared for this meeting and all were gone at the end of the meeting.
9) Two scientific publications are currently being worked on: i) Rapid detection of torradovirus species by using digoxigenin-labeled riboprobes and tissue printing; ii) Determination of the cleavage sites of the RNA-2 encoded proteins of members of the genus *Torradovirus*. In collaboration with colleagues in Spain and Panama, another manuscript has been submitted to the *Journal of Virological Methods* entitled: "Detection and absolute quantitation of *Tomato torrado virus* (ToTV) by real time RT-PCR" (see addendum 3 in Additional Information).

The project team reached out and interacted with partners from the seed and Agricultural diagnostic industries, and to colleagues in other countries where torradoviruses occur. These collaborators, including three multi-national seed companies with research facilities in California, and research scientists in Europe and Central America were instrumental in obtaining torradovirus isolates for this research. The team was also able to work with them to determine that resistance to torradoviruses was present in some tomato germplasm sources. This will be beneficial for California tomato production if any torradoviruses invade and establish in California tomato production areas. The team also worked with Agricultural diagnostic companies to ensure that their serological-based torradovirus test systems were accurate for the specific virus targets. Their tests are commercially available and can be useful for California tomato producers.

Goals and Outcomes Achieved

Most of the performance goals have been met with demonstrated measurable outcomes. The intent was to generate new knowledge on the biology of torradoviruses and the potential risk that they pose to California tomatoes, before they enter and establish in California. The team was able to obtain all three currently-recognized tomato-infecting torradoviruses and develop procedures and establish conditions to work with them safely in the UC Davis Biosafety 3P Contained Research Facility. This included mechanical inoculation assays to various host plants, but more importantly, to assess their whitefly (*Bemisia tabaci* biotype B) transmission characteristics. This is the only facility, worldwide, that has collected and simultaneously worked with ToANV, ToTV and ToChSV, and this project has clearly shown that all three of these torradoviruses can be transmitted efficiently by this whitefly, which is very common from Mexico up in to the southern U. S. including southern California. Thus, the potential for torradoviruses to move into California is real. Furthermore, during the work with tomato germplasm, protocols had to be developed for efficient and consistent inoculation of tomatoes for ToANV. This was not trivial, and without this successful accomplishment the project team would not have been able to effectively screen tomato germplasm and demonstrate effective ToANV resistance (see Figure 2, Additional Information). Fortunately, this research has allowed the team to develop reagents and procedures to rapidly identify the different tomato-infecting torradoviruses (see Figure 1, Additional Information), and via collaborations, it is known that there is resistance to ToANV (the most common torradovirus in the Western Hemisphere) in existing tomato germplasm.

The specific goals were: "take specific and necessary steps to understand torradoviruses, their biologies, and to develop strategies for rapid and accurate identification so that effective measures can be implemented to prevent their introduction and establishment in California." These goals were met. As described above, plant hosts and whitefly transmission properties of torradoviruses have been developed. Tools have been developed for their efficient identification and worked to develop the means to efficiently screen tomato germplasm for ToANV resistance/susceptibility. Furthermore, it is known that ToANV resistant germplasm exists. Finally, information has been extended to California tomato growers/handlers, and will stay involved in that arena even though project funding has terminated. See addenda in Additional Information for specific items published/distributed during the grant period. Finally, torradoviruses are not established in California tomatoes, although the project team cannot take credit for this. They are still important in Mexico and Central/South American tomatoes and the whitefly vectors overlap these areas into California. The potential for their introduction is still here; information is now had and will not be caught by surprise.

Data demonstrating progress and achieving set targets are shown in the addenda, Additional Information. Before this project there was no direct comparison of ToANV, ToTV and ToChSV detection, and there was no assessment of ToANV tomato inoculations for resistance/susceptibility. For the latter there was no methodology developed for these tests. Before these efforts there was no awareness of torradoviruses by California tomato growers/handlers.

Successful outcomes thus far include:

1) Development of tools for rapid, efficient torradovirus identification. Quantifiable support includes presentation of results at two scientific meetings and the accompanying abstracts (see Fig. 1 and Attachment1, 2 and addendum 3, and submitted publication, addendum 4).
2) Development of methods to screen tomatoes for ToANV resistance/susceptibility and demonstration of ToANV resistance in tomato germplasm (see Fig. 2).
3) Extending information to California tomato growers and handlers (see attachment 5; 60 handouts were distributed).

The project team did not participate in grower meetings during the first year. It took longer than anticipated to develop new information that was relevant, therefore the project team decided to wait until an accurate picture of torradoviruses and their potential threat for California specialty crops could be given. As information was developed the project team attempted to find ways most appropriate to present information, thus one was the San Joaquin Farm Advisor meeting with 60 attendees in 2014.
As information was developed the project team also interacted with scientists at commercial seed companies and extended information to them on virus incidence and detection. These interactions were ongoing during the grant and included 3 seed companies with research facilities in Yolo County.

Most recently, the postdoc on this project gave an oral presentation at UC Davis to "Seed Central" which included members from the local specialty crop industry which included growers, seed producers, etc. There were approximately 80 in attendance.

Extending this information will continue beyond the grant funding period.

Beneficiaries

Tomato growers in San Joaquin, Stanislaus and Merced counties are now aware of the potential for torradoviruses to affect California tomatoes. They have information on the viruses and how they are spread, and are aware of the means to clearly identify these viruses and differentiate them from other viruses of tomatoes. This information will further be made to all California tomato growers/handlers via additional meetings and publications. Three international seed companies, with research facilities in California, also have knowledge of torradoviruses and how to screen germplasm. One of them has identified ToANV-resistant germplasm via collaborations with the project team, and the other two have evaluated torradovirus screening procedures developed on their own tomato germplasm. This also will benefit California tomatoes.

California produces ~90% of the U. S., and nearly half of the worlds' tonnage of processing tomatoes. In 2012, this included 260,000 acres with a crop value of just over $1 billion. Clearly any threat to this industry is of great importance to California. So far only one report of a torradovirus has been from California, but research allows for vigilance and rapid response now if torradoviruses do appear. Furthermore, approximately 60 growers/PCAs etc. were at the grower meeting in San Joaquin County in 2014, and all received information handout on torradoviruses (see Additional Information, attachment 5). Additional materials are also being prepared for publication/distribution and will ensure that these results are disseminated throughout California.

Lessons Learned

One major lesson learned here is that the project team is fortunate to have at UC Davis, the Biosafety 3P Contained Research Facility for safe work with exotic plant pests and pathogens.

It was expected that the torradoviruses would become established in California during this project. They are important and common in some tomato production areas of Mexico, and the whitefly vectors overlap Mexico and California. It was believed that like many other recently introduced whitefly-transmitted plant viruses, torradoviruses would invade California and become problems. The good news is that they have not yet done so, and perhaps some as yet not understood epidemiological factors keep them in Mexico.

This project was one of the first to use the new, UC Davis Biosafety 3P Contained Research Facility. This $20 million facility was designed for safe work with exotic plant pests and pathogens that pose a threat to California agriculture and natural resources. We learned that this is an excellent facility and even exotic whiteflies and the viruses they transmit can be researched safely and efficiently in this facility, it is a great facility for California agriculture as exotic pests and pathogens are continually a challenge for our state.

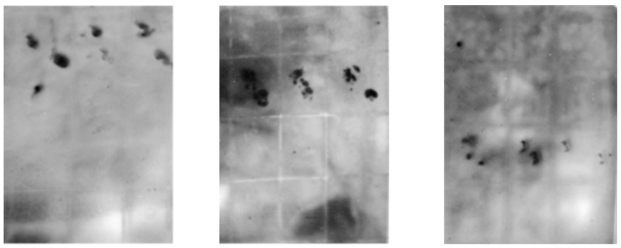
The initial difficulties in efficiently inoculating tomatoes with torradoviruses were not anticipated. Using the whitefly vector was efficient, but cumbersome. However, methods to efficiently transmit torradoviruses mechanically to tomatoes and other host plants without the need for using the whitefly vector were successfully developed, but this took more time than what was initially anticipated.

The difficulties in obtaining torradoviruses from Mexico and Central America also were not anticipated. Some of the problems were the result of the economic and social problems currently in parts of Mexico. The team was only able to obtain one isolate of ToChSV, Guatemala, where this virus was first discovered in tomatoes had very dry conditions affecting whitefly populations and the incidence of ToChSV. Still there was one ToChSV isolate for the work here.

Additional Information

See: Attachments 1, 2, 3, 4, 5

Below are examples of some accomplishments of this research effort. These are cited in the text above.



ToMarV probe **ToTV probe** **ToChSV probe**

ToMarV *N. benthamiana*	ToMarV tomato	ToMarV tomatillo
ToTV *N. benthamiana*	ToTV tomato	ToTV tomatillo
ToChSV *N. benthamiana*	ToChSV tomato	ToChSV tomatillo
Mock *N. benthamiana*	Mock tomato	Mock tomatillo

Tissue print samples

Figure 1. Example of tissue print hybridization using specific probes for each Torradovirus species. The key describing the blot is shown at right.

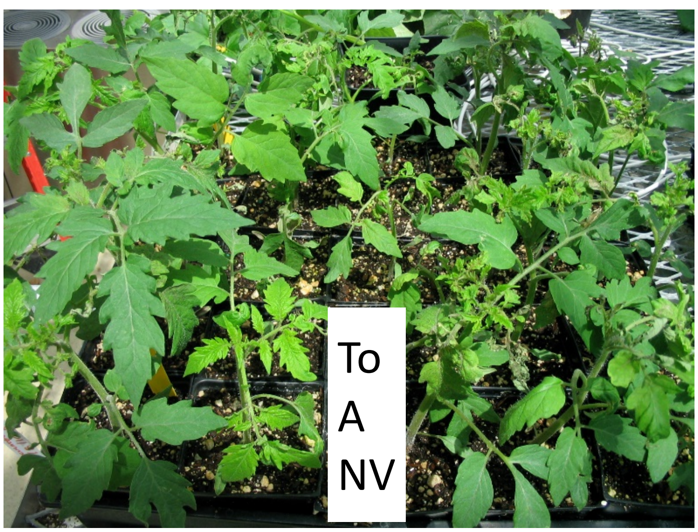


Figure 2. Example of screening tomato germplasm for ToANV resistance/susceptibility. Resistant plants are robust, susceptible plants are stunted and show necrosis.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

<table>
<tr><td colspan="2">USDA Project No.:
59</td><td colspan="2">Project Title: Optimizing Applications of Plant Systemic Insecticides Against Vine Mealybug (VMB)</td></tr>
<tr><td colspan="2">Grant Recipient:
The Regents of the University of California, Riverside</td><td>Grant Agreement No.:
SCB11059</td><td>Date Submitted:
December 2014</td></tr>
<tr><td colspan="2">Recipient Contact:
Nilima Prabhaker</td><td>Telephone:
520-316-6353</td><td>Email:
Nilima.Prabhaker@ucr.edu</td></tr>
</table>

Project Summary

The vine mealybug (VMB; *Planococcus ficus*) is a prolific species that infests grapevine roots, woody tissue beneath the bark, and grape clusters as they develop and mature. The cryptic nature of VMB makes it a difficult pest to target with conventional contact insecticides or control with natural enemies. Systemically mobile insecticides are potentially highly effective against a sheltered pest like VMB because they are transported to feeding sites throughout plants via their conductive tissues. At present there are five acknowledged plant-systemic active ingredients (A.I.s) that are registered for grapes that include imidacloprid (Admire Pro®, Nuprid®, etc.), thiamethoxam (Platinum®), dinotefuran (Venom®), clothianidin (Belay®), and spirotetramat (Movento®). Four of the five A.I.s are neonicotinoid insecticides, the sole exception being spirotetramat which is a Group 23 mode of action (tetramic/tetronic acid derivatives) in the IRAC (Insecticide Resistance Action Committee) mode of action classification scheme. The four neonicotinoid insecticides are routinely applied through drip irrigation systems in vineyards to the soil and taken up by grapevine roots following application. In contrast, spirotetramat is exclusively a foliar insecticide that is not only translaminar but also systemic in both phloem and xylem tissues. Consequently, movement of spirotetramat from leaf surfaces into the conductive tissues of grapevines is faced with fewer challenges than neonicotinoids due to variability at the soil/root interface that can affect the quality of an application.

Different physico-chemical characteristics of these compounds (e.g. solubility) may render certain systemic insecticides more suitable under particular conditions. Additional field research on the uptake and distribution of systemic insecticides in grapevines is needed to determine how applications can be optimized to get the most value out of each product. The responses of pest populations to insecticide treatments provide an indirect indication of what the insecticide residue is doing in the crop and how long it persists, but they are also affected by other factors such as immigration rate and natural mortality that can obscure the suppressive effects of the treatments. In contrast to this indirect approach, measurement of insecticide residues in or on crop plants can potentially provide a direct estimate of the persistence of a pesticide. However, implementation of the direct approach in a decision-making scenario also requires information on what impact various exposure concentrations have on both pest and beneficial populations. By relating direct measurements of insecticide residues in plants to relative toxicity levels of the target pest and the beneficial insects that help control that pest, the activity profiles of insecticides will be better understood and promote more complete integration of chemical and biological control approaches in Integrated Pest Management (IPM).

Effective chemical management against VMB is vital to the continuing productivity and success of California's vineyards. VMB is a serious long-term threat that demands comprehensive management approaches that are scientifically supported and experimentally validated. Despite heavy reliance on insecticides for control of VMB, there has been only limited discussion on how chemical treatments can be optimized and conserved for maximum effectiveness. The overall goal of this project has been to develop a better understanding of the properties of all five systemic insecticides in a variable vineyard environment and enable growers to exploit the strategic advantages they offer against VMB and promote more effective and sustainable management. There is an urgent need to improve performance of the four systemic neonicotinoid insecticides by better understanding the conditions under which they can be most effectively used. Without viable alternatives, overwhelming demand could be placed on spirotetramat, which has rapidly become the go to product for VMB control. A critical risk of resistance development against spirotetramat will persist if current levels of demand continue.

A key element of a previous 2009 SCBGP project 42: *Refining chemical control of vine mealybug to manage resistance, enhance natural enemy conservation and promote integrated control* was the incorporation of systemic insecticides into a vine mealybug management program. The overall goal was to attain a better balance between chemical and biological control by improving understanding of the activity profiles of systemic insecticides. The activity profile of an insecticide can be defined as the duration that an insecticide residue is active in a crop canopy in terms of lethal and sub-lethal effects on pest and beneficial arthropod populations. Application rates, the timing and spacing of applications, as well as the choice of applications could all be influenced by more reliable information on the persistence of insecticides in crops and lead to better-informed pest management. However, consensus results from a total of five field trials performed in Kern Co. table grapes in 2010-11 indicated that relatively minimal concentrations of systemic insecticides were reaching grapevine tissues where VMB were feeding, and that they only modestly impacted VMB infestations. In effect, applications at all but one of the five trials were all but useless, forcing additional treatments to suppress VMB infestations. This raised the more general concern that growers that apply soil systemic insecticides may not be getting a very good return on their pest control investment. A soil texture analysis confirmed that there were considerable differences in soils at the five vineyards, raising concerns that differences in binding characteristics of various soil constituents could affect the availability of insecticides in the soil for uptake by roots. This study was then conceived to focus exclusively on systemic insecticides and evaluate the influence of soil texture and other agronomic factors on uptake of the four soil-applied insecticides and the one foliar applied insecticide. Direct measurement of systemic insecticides in grapevine tissues is a powerful tool for comparing variables such as soil texture, relative age of grapevines, etc.

Project Approach

Much of the activity for this project revolved around the field trials conducted in Kern, Tulare, and Sonoma counties during the 2012-2013 growing seasons. A warmer climate in the lower San Joaquin Valley meant an earlier schedule for laying out field plots and applying insecticide treatments. After completing applications on table grapes in the San Joaquin Valley, project activities would shift to Sonoma county where similar field layout and treatment applications were carried out in wine grapes. Weekly samplings of vineyards at both locations were carried out through the first six weeks following applications and then shifted to biweekly samplings after that. Grapevine tissue and soil samples collected from as many as eight treatments per field site required processing once they were returned to the laboratory. Leaf, petiole, and bark samples were all processed separately by extracting cellular contents with 75% methanol. The extracted contents were then used in analytical assays to determine concentrations of insecticides that had been taken up and translocated within the grapevines. Soil samples, on the other hand, were used to evaluate how much of an application remained in the soil over time, apparently unavailable for uptake by roots. The general findings for all field trials conducted in this project were that a large component of the soil applied insecticides remain in the soil column, or is lost from the soil via leaching. Either way, concentrations in grapevine tissues did not attain levels seen in many herbaceous crops such as leafy vegetables or melons. The single exception was the foliar insecticide spirotetramat that attained concentrations 50- to 100-fold greater than the soil-applied neonicotinoid insecticides. The much greater concentrations of spirotetramat in leaf tissues may help to explain the exceptional control that was recorded for spirotetramat in the previous SCBGP project.

Table and wine grape growers were the only direct beneficiaries from research carried out for this project, but only in the general sense that grapes were the commodity being studied. There are many more environments where grapes are grown that vary in soil texture and moisture, climate, grape variety etc. that were not studied and to which findings from this project would only be generally applicable. In the wider sense, results from this project will contribute to the larger body of results that have been obtained using similar approaches for other specialty crop commodities.

All listed project personnel played essential roles in fulfilling project objectives. The Project Manager and co-P.I. provided coordination of personnel and tasks to be accomplished throughout the project as well as performing much of the analytical work in the laboratory. The UC Cooperative Extension personnel in Sonoma County were extremely effective in carrying out all of the sampling in wine grapes following treatment applications. They were also essential for recruiting grower collaborators and making arrangements for the field trials and insecticide applications. Similarly, the UC cooperator in Kern County made all grower contacts and field arrangements, established field plots, and carried out treatment applications each year. The USDA-ARS cooperator was responsible for collecting samples in Kern County and for conducting much of the laboratory analysis performed on tissue and soil samples.

Goals and Outcomes Achieved

Experimental design - Field trials were carried out in table and wine grapes to develop a clearer understanding of the uptake rate, peak titer, and persistence of four soil-applied systemic insecticides and one foliar-applied insecticide. Research was conducted at different sites embedded within commercial vineyards. Experimental areas varied from 2.2 to 2.8 acres and were configured as replicated complete blocks featuring five treatment regimens replicated four times per site. Individual plots were consistent in size at each site but varied among sites from 0.11 to 0.14 acres.

Insecticide Applications – Water (60-80 gal) was transported to the field in tanks and dispensed into large mixing carboys based on volumes required to treat all four replicate plots within each soil-applied insecticide treatment. Insecticide mixes were carried to the labeled plots in five gallon buckets and 120 ml dispensed to each grapevine using a set-volume ladle dipped into the bucket and filled with solution. The concentration of each bucket solution was set to the top label rate for each insecticide according to the volume dispensed to each grapevine. A spray rig was used to apply the foliar insecticide spirotetramat at a volume of 100 gal/acre.

Tissue Sampling - Samples from three different grapevine tissues were collected through the growing season and analyzed in the laboratory to determine insecticide concentrations. Pretreatment samples were taken at the beginning of each season in order to establish a baseline concentration of each insecticide under study. Carryover residues from previous year's treatments were possible, especially for some of the more persistent soil-applied insecticides, thereby mandating the need to establish a baseline concentration at the start of each season. Tissue samples collected in the field consisted of a single basal leaf taken from a proximal shoot from either cordon and a ⅜" diameter woody plug sample taken from the grapevine trunk. Plug samples were immediately placed into 12-well polystyrene plates on ice within a hand-carry ice chest and transported back to the lab and then placed in a -80°C freezer. Basal leaf samples were held in Ziploc plastic bags, transported back to the lab on ice, and then processed into leaf blade and leaf petiole sections. A ½" diameter punch was taken from each leaf blade and transferred to a 12-well polystyrene plate and then frozen. Leaf petiole samples were cut into two ¾" lengths and also stored frozen in the 12-well plates.

Insecticide Quantification - Concentrations of the soil-applied insecticides (imidacloprid, thiamethoxam, dinotefuran, clothianidin) were determined using commercial ELISA kits available for each insecticide. Contents were extracted from thawed freezer samples by shaking tissue samples in 75% methanol (2 ml) for two hours to draw out the active ingredients. Control samples collected from the untreated control (UTC) plots were tested alongside the treatment plot samples to determine background levels of insecticides in vineyards from previous year's applications. Extracted samples were diluted with water at least 20-fold prior to using in ELISA tests. Insecticide active ingredients were quantifiable to one part per billion by all four ELISA kits. Spirotetramat, the active ingredient in the foliar insecticide spirotetramat, was extracted in a similar manner as the soil-applied insecticides, but quantified on an HPLC-MS instrument to a level of 0.1 ppb.

Insecticide Bioassays – Vine mealybug infestations occurred in one of the table grape vineyards in 2012 and were collected to test for their susceptibility to imidacloprid and thiamethoxam. Petri dish bioassays were conducted by using freshly detached grape leaves grown in a greenhouse and placing the petiole of each leaf in a solution for a 24 hour uptake. A concentration series of five solutions were used to elicit a range of mortality responses from low to high. Following the uptake period, leaf disks were punched from each leaf and placed on a bed of agar in a 60 mm petri dish. Approximately 30-50 vine mealybugs of all stages were brushed onto leaves and enclosed within the petri dishes for 24 h. Mortality was scored and probit analysis conducted to calculate LC_{50} values.

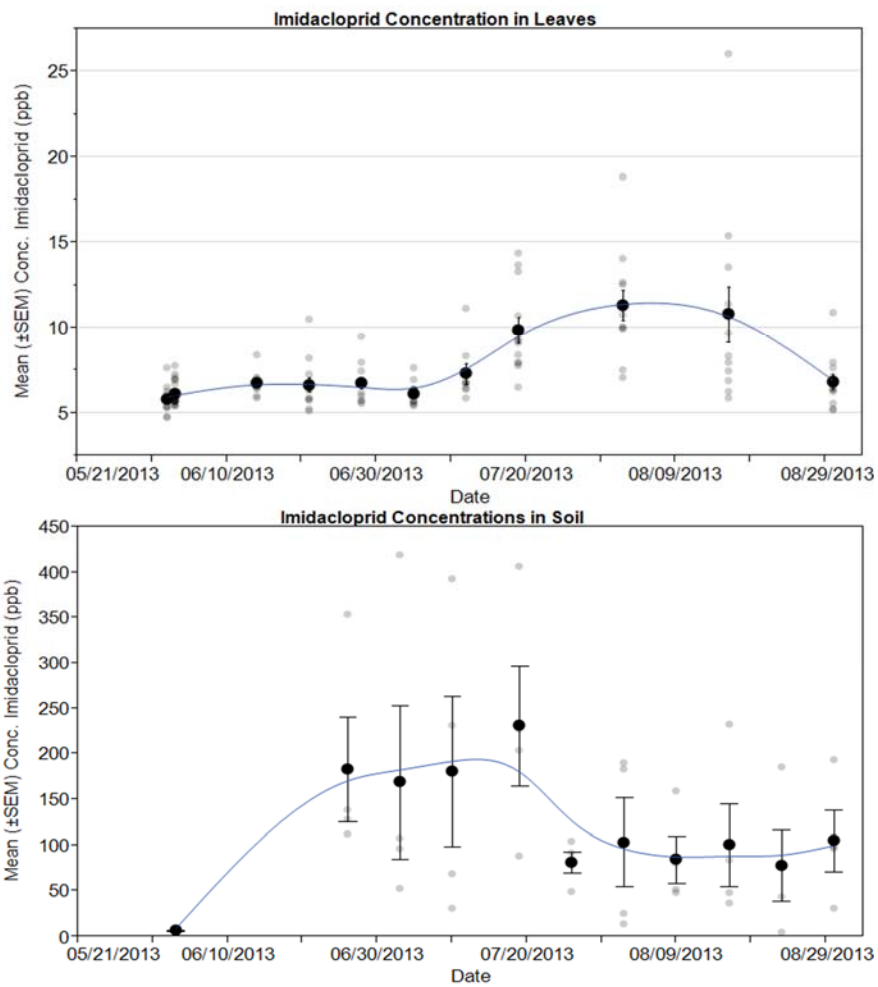
The outcome measures described in the proposal for this project were initially thought to be short term, i.e. attainable soon after completion of this project. This expectation was based on the supposition that the various insecticide treatments would reveal themselves as being better or worse to use under different soil and climate conditions based on concentration differences recovered in grapevine tissues. The first of the performance measures given in the proposal was that higher concentrations of insecticides in grapevine tissues would be observed when used under compatible conditions that would later be described in guidelines that this project had set as a development goal. However, uptake concentrations in grapevines across four field trials all turned out to be disappointingly low. No clear differences in uptake according to conditions in the vineyards were revealed, thereby making it difficult to arrive at a set of recommendations for growers. The remaining performance measures 2-4 are longer term, but are bound to a positive outcome occurring in the first performance measure. Indeed, progress has been made through the realization that the field study approach to identifying critical variables involved with the uptake of soil-applied insecticides can be limited by the inability to control variables that affect soil insecticide uptake, especially in commercial vineyards. However, further progress on longer term outcome measures would require the study of conditions that could be more readily defined and manipulated than what is possible in a commercial vineyard.

All performance goals and work plan activities were carried out on schedule throughout the project, but the data generated falls short of meeting the overall objectives for the project. Why this is so was the original rationale for the project, i.e. to develop a better understanding of the properties of all five systemic insecticides that enable growers to more effectively utilize each one according to their vineyard conditions.

Prior to this project, it was realized that performance of the soil-applied systemic insecticides did not always match expectations, leading to the hypothesis that performance was dependent upon agronomic conditions within each vineyard. Work completed on a prior SCBGP project supported the idea that soil texture differences affected uptake of the insecticides as indicated by direct measure of insecticide concentrations within grapevine tissues. Experimental sites in the present project were selected for differences in soil texture and other agronomic factors, but the resulting data do not clearly identify controlling factors in the performance of soil-applied insecticides. It became clear with this project that many, many different field trials would have to be performed to reach a general understanding of how uptake of soil-applied insecticides is influenced by various agronomic factors. In addition, controlled studies carried out in the greenhouse and laboratory would permit the type of experimental manipulation that could isolate a particular factor such as soil texture or soil moisture and measure its influence on uptake.

Season-long data represented as concentration (in parts per billion) of insecticides in three different grapevine tissues was collected at five vineyard sites during 2012-13. In addition, insecticide residues in soil samples were also analyzed for insight into the relationship between insecticide concentrations in soil and grapevine tissues. A good example of this relationship was generated by the 2013 Sonoma County field trial in Chardonnay grapes. Very little evidence of uptake by grapevine roots was seen in leaf samples collected over the first six weeks after treatment. In contrast, the first soil samples collected on June 23 registered high concentrations of imidacloprid that remained elevated through mid-July. Mean titers of imidacloprid in grape leaves began to increase slowly with samples collected on July 19 and peaked with the August 3 samples before declining to early season levels on August 29. In conjunction with the rise in leaf titers of imidacloprid, concentrations in soil samples declined after the July 19 sample, suggesting that grapevines were uptaking imidacloprid from the soil that was being expressed as higher concentrations in leaf tissue. Although imidacloprid was still registering in soil samples on the August 30 sampling date, the concentrations getting into leaf tissues had dropped off at this point. There are many possible explanations for why soil-applied insecticides do not make it into grapevine tissues despite being present in the soil column, but these all require systematic

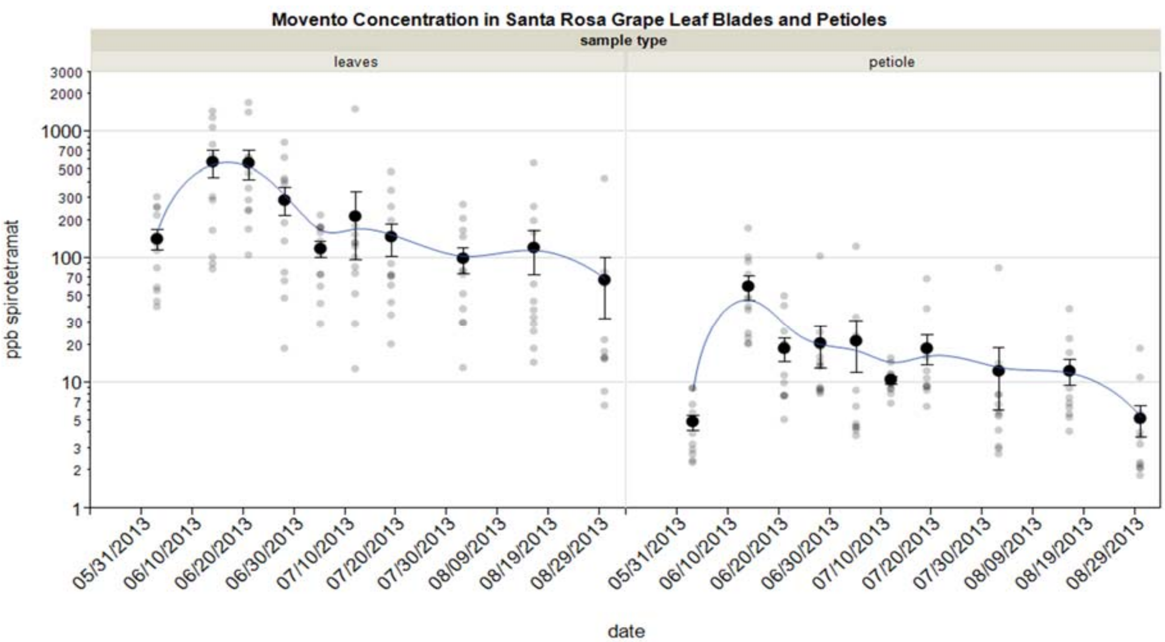
Fig. 1. Concentrations of imidacloprid (ppb) in 2013 Sonoma Co. grapevine leaves and soil where imidacloprid was applied as a drench treatment on May 25.



study in a controlled environment that allows manipulation of experimental variables such as soil texture, soil moisture, grapevine age and variety, evapotranspiration conditions, etc. The long delay at the first six weeks of the sampling period when very little imidacloprid was detected in leaf tissue is another example of the insecticide being present in the soil, but for some reason unavailable for uptake by the grapevine. While the relationship between soil and plant concentrations of imidacloprid seen in Fig. 1 is one of the nicer relationships to come out of this project, it nonetheless illustrates the very low concentrations of imidacloprid that made it into the grapevine tissues that was unfortunately typical of profiles obtained for the other three soil-applied insecticides.

The most important outcome from this project was to confirm that applications of soil-applied systemic insecticides may not attain the concentrations in grapevine tissues required to effectively reduce VMB infestations. This is based on concentration profiles for each insecticide that showed levels similar to those for imidacloprid seen in Fig. 1. In contrast, concentration profiles for the foliar-applied insecticide spirotetramat (Movento) showed high concentrations (Fig. 2) that persisted long after treatment was made.

Fig. 2. Mean titers of spirotetramat in grapevine leaves and petioles sampled through the 2013 season.



Beneficiaries

Vineyard growers and managers may derive benefit from this project by reconsidering the type of insecticide application to make for control of VMB. The findings from this project provide ample support for relying upon spirotetramat as an effective treatment that attains high concentrations in grapevine tissues. In addition, the collective wine and table grape industries benefit by research that can help guide farming and pest management operations that are sustainable over time.

Vineyard growers throughout California and elsewhere may benefit with the publication of findings from this project. There are approximately 475 table grape farming operations in California that account for 99% of table grapes produced in the United States. The winegrape industry of California is the fourth leading wine producer in the world and includes approximately 4,600 growers that supply 2,843 bonded wineries in California. The vine mealybug and other mealybug species are important pests of table and wine grapes that are known to occur in most grape-growing counties of California. It is probable that a majority of growers that have been confronted by mealybug infestations has relied on one or more of the insecticides investigated by this project. Findings from this project have also been reported as oral or poster presentations at scientific meetings that have been viewed by scores of scientists. Other scientists that also evaluate insecticide residues in crops and their impact on insect pests will benefit by adopting methods employed in this study for their own investigations.

Lessons Learned

Discussion has been ongoing throughout this report as to why project outcomes were not achieved. Insufficient differences in uptake of soil-applied insecticides among the vineyard sites precluded identification of soil characteristics most responsible for effective uptake.

In an operational sense, the project worked very well in terms of cooperation among the members and executing the project plan.

Additional Information

Presentation of project results have been made at numerous grower and industry sponsored meetings throughout California and at professional meetings hosted by the Entomological Society of America. Manuscript preparation is underway. The following is a list of all presentations associated with this project:

Talks

11/27/12 "Vine Mealybug Management in Table Grapes: lessons learned from 2012 research" D. Haviland, Tulare, Consolidated Central Valley Table Grape Pest Control District Table Grape Grower/PCA Meeting, 46 attendees

11/30/12 "Status of IPM in CaliforniaTable Grapes" D. Haviland, Tulare, Association of Applied Insect Ecologists Grape Roundtable Meeting. 45 attendees

2/7/13 "Effects of Production Practices on the Nematode and Phylloxera Control Achieved with Spirotetramat". D. Haviland, Delano, Board Meeting of the Consolidated San Joaquin Valley Table Grape Pest and Disease Control District. 9 attendees

2/27/13 “Activity Profiles of Systemic Insecticides in Table Grapes and Impact on Vine Mealybug” S. Castle, San Joaquin Valley Table Grape Seminar, Visalia. 200 attendees

4/4/13 "Evaluation of Spirotetramat Systemicity in Grapevines" D. Haviland, Delano, Table Grape Pest and Disease Control District Research Committee Meeting" Delano. 18 attendees

4/10/13 "Vine Mealybug Managment in California Table Grapes" S. Rill. Reno, Pacific Branch Meeting of the Entomological Society of America. 87 attendees

5/6/13 "Impact of Exotic Pests on IPM Programs for Citrus and Table Grapes in California" D. Haviland, USDA Lunch Seminar Speaker Series, USDA Maricopa, AZ. 24 attendees

8/13/13 "Movento in Table Grapes: Understanding Use Patterns and Expectations". D. Haviland, UC Grape Day, Kearney, 120 attendees

10/13/13 "Effects of Exotic Pests on Integrated Pest Management Programs in California Table Grapes" D. Haviland, International Orgainzation of Biological Control Viticulture Working Group Meeting, Ascona, Switzerland, 110 attendees

10/24/13 "Status of Glassy-winged Sharpshooter Management Programs in Kern County" D. Haviland, Glassy-winged Sharpshooter and Pierce's Disease Field Day. Arvin, 50 attendees

12/2/13 "Recent Advances in Vine Mealybug Management". D. Haviland, Association of Applied IPM Ecologists Grape Roundtable. Tulare, 42 attendees

12/10/13 "2013 Research Update: Management of Mealybugs, Ants, Sharpshooters, and Pierce's Disease" D. Haviland, Table Grape Pest and Disease Control District Grower Meeting, Tulare, 39

Poster Presentations

11/13/12 “Uptake and Persistence of Systemic Insecticides in Table and Wine Grapes” N. Prabhaker, Entomological Society of America National Meeting, Knoxville, TN. 2,000 attendees

4/9/13 “Seasonal Profiles of Neonicotinoid Insecticides in Table Grapes” N. Prabhaker, South Lake Tahoe, Pacific Branch Meeting of the Entomological Society of America. 87 attendees

Publications

Castle, S., N. Prabhaker and D. Haviland. 2013. Activity Profiles of Systemic Insecticides in Table Grapes and Impact on Vine Mealybug. Proceedings of the San Joaquin Valley Table Grape Seminar, Visalia, 27 Feb., 2013, pp 5-13

Ingels, C., D. Haviland and S. Quashnick. Vine Mealybug Management in Wine Grapes in the Northern San Joaquin Valley. CAPCA Advisor, April 2012 Vo. XV, No. 2, pp. 34-36.

Ingels, C., D. Haviland and S. Quashnick. Use of Insecticides in Vine Mealybug Management. San Joaquin County & Delta Water Quality Coalition Watershed News. May 2012, p3-4

Haviland, D., and S. Rill. Movento in Table Grapes: understanding use patterns and expectations. Proceedings of the 2013 UC Grape Day, Kearney Agriculture Center, Aug. 8, 2013

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 60	**Project Title:** Mass Rearing and Identification of Imported Parasitoids of the Asian Citrus Psyllid	
Grant Recipient: The Regents of the University of California, Riverside	**Grant Agreement No.:** SCB11060	**Date Submitted:** December 2014
Recipient Contact: Robert Chan	**Telephone:** (951) 827-7986	**Email:** rchan@ucr.edu

Project Summary

The Asian Citrus Psyllid (ACP) is a new invasive pest on citrus in California (CA). This insect is capable of transmitting a fatal bacterial disease of Citrus, *Liberibacter asiaticus*, also known as HLB (huánglóngbìng). While in California this disease is still of limited distribution, slowing the spread of this disease is essential for the long term survival of the citrus industry. ACP populations in commercial groves can be controlled by insecticide treatments. Such treatments are much more difficult in the urban environment and additional non-insecticidal control measures will need to be undertaken. One such measure is classical biological control, in which the natural enemies from the pest are reunited with the pest in the invaded range. The pest in the invaded range often reaches high population densities simply because the species invades without the natural enemies present in their native range. The native range of the pest includes Pakistan and according to the literature (Hussein & Nath, 1927) nine species of parasitoids were found in association with the ACP in the Punjab. The goal of this project was to maintain populations of the nine species of parasitoids from the Punjab in quarantine and study their systematics, behavior and genetics so that these wasps could be evaluated for potential release against ACP in California. The collection trips to the Punjab were funded separately and were executed by Dr. Hoddle. Two species of parasitoid had previously been considered for release in the US: *Tamarixia radiata* (*T. radiata*) and *Diaphorencyrtus aligarhensis (D.aligarhensis).* The release of more than a single species of parasitoid often results is a better control of the pest.

ACP was first detected in 2008 in California and in 2012 a tree infected with HLB was found in Southern California. ACP is extending its range slowly up north and has not reached high levels yet in the main Citrus growing areas in the state. Slowing down the population growth of ACP is of vital importance to protect the Citrus industry that has a yearly value of $2 billion. Biological control is the most appropriate control method for the urban environment, thus reducing the overflow from urban to commercial citrus.

This project is not built on a previously funded Specialty Crop Block Grant Program (SCBGP) project.

Project Approach

Dr. Hoddle travelled to Pakistan, collected wasps there from ACP populations, allowed the wasps to emerge in the University of California, Riverside (UCR) Quarantine facility and sorted the wasps by morphospecies. Populations of these species were established and their behavior and systematics were studied. For two species it was initially possible to establish populations: *D. aligarhensis* and *T. radiata*. *T. radiata* was allowed out of quarantine after the proper non-target testing was done and 16 isolated populations of these wasps were and still are maintained for the mass rearing of this species, and were released throughout southern California for the control of ACP. Populations of *D. aligarhensis* were also maintained in quarantine, but thus far no permission was received for their release from quarantine. An additional 5 species were found to be hyperparasitoids (=Parasitoids of the primary parasitoids *T. radiata* and *D. aligarhensis*), specifically: *Psyllaphycus diaphorinae, Marietta leopardina, Aprostocetus sp., Chartocerus* sp., and *Pachyneuron crassiculme* (Hoddle *et al* 2013, Triapitsyn *et al* 2013, Blistine-East & Hoddle, 2014). Consequently Hussein and Nath (1927) did not realize that many of the parasitoids associated with ACP appeared not to be primary parasitoids but hyperparasitoids.

All *Tamarixia* populations that left quarantine were tested to make sure that these wasps were not infected with HLB. The genetics of *T. radiata* were studied, though initially as the sequencing of the so called bar code of life (the mitochondrial Cytochrome Oxidase I (COI) sequence), and these sequences have been used to make sure that wasps recovered from the field in California were indeed offspring of the wasps that were released from the UCR mass rearing. Additional genetic analysis of *Tamarixia* populations was done. In this study next generation sequencing methods were used—so called Restriction site Associated DNA sequencing (RAD-Seq)—to sample the genetic variation within the different *Tamarixia* populations. Once analyzed these data will be used to evaluate how well the genetic variation introduced into California was maintained in the field, as well as to estimate how successful the program on maintaining genetic variation was throughout the long process of mass rearing.

Only the citrus industry has benefitted from this work.

Dr. Stouthamer was in charge of the mass rearing of the *Tamarixia* populations once these populations were released from quarantine and of the ACP and plant rearing to assure consistent availability of host material for the different colonies. The genetic work was done by Dr. Rugman-Jones and a graduate student in the project under Dr. Stouthamer's guidance.

Dr. Hoddle collected and successfully established populations of the different species in Quarantine for subsequent studies on their behavior, several papers on the different hyperparasitoids were published from this work.

Dr. Rugman-Jones did the molecular work done in the project, and checked wasps for HLB infection.

Dr. Triapitsyn, was involved in the morphological identification and descriptions of the different species and published papers with Dr. Hoddle on the wasps.

Goals and Outcomes Achieved

Performance measure: collect and describe 6-15 additional parasitoid species of ACP.
Material was collected in the Punjab region of Pakistan during several trips funded by other sources. In the UCR quarantine facility the wasps emerged from the field collected material, were sorted to morphospecies, and their status as primary parasitoid or hyperparasitoid was determined. Unfortunately only 2 primary parasitoids and an additional 5 hyperparasitoids were encountered contrary to what the literature suggested. Consequently the performance measure of 6-15 was not reached. Only 5 additional species were found, and they were all hyperparasitoids.

Performance measure: Maintenance of colonies of all primary parasitoids.
Colonies were maintained of the two primary parasitoids *T. radiata* and *D. aligarhensis*. Of *T. radiata* a total of 16 separate colonies, each originating from a different collection in the Punjab region were maintained in

the UCR insectary. *D. aligarhensis* colonies are still present in the UCR Quarantine, where these colonies will be kept until permission is received for their release.

Performance measure: Reliable genetic markers will be developed for the primary parasitoids showing promise.
For both *T. radiata* and *D. aligarhensis* COI sequences have been determined. For *T. radiata* these have been used to verify that wasps recovered from the field in Southern California are indeed the offspring of the wasps that had been released and not wasps that had come into California from Mexico with the ACP invasion. In addition detailed genetic markers have been developed for *T. radiata* using Rad-Seq.

Goal was to collect and describe 6-15 new species.

- Accomplished: 5 new species

Goal was to maintain quarantine populations of new primary parasitoids.

- Not accomplished: only the two already known species were maintained and no additional new species were found; all 5 additional species that were cultured in Quarantine turned out to be hyperparasitoids.

Goal was to genetically characterize new primary parasitoid species.

- Not accomplished: no new primary parasitoid species were found, the species that was released for biocontrol (*T. radiata*) and the other primary parasitoid *D. aligarhensis* not yet permitted by the United States Department of Agiculture, Animal Plant Health Inspection Service (USDA-APHIS) have been genetically characterized.

Before the project started two primary parasitoid species were known of ACP, but the literature indicated that many more were present. Based on the work done in this project, knowledge has been acquired that only two primary parasitoids are present in the Punjab, and that all additional species reported in the literature either were primary parasitoids of other hosts (not ACP) or were hyperparasitoids.

Before this project all *Tamarixia* populations were kept as single colonies collected from different countries. Now the genetic health of the *T. radiata* population that was released for biological control in California was maintained by keeping different lines from different collection sites within Pakistan. In doing so, the two main problems associated with mass rearing were avoided: 1.) Loss of genetic variation; and 2.) Adaptation to mass rearing conditions.

Before the project started little knowledge existed about the genetic variation present in *T. radiata*. Once the RAD-Seq data have been analyzed many genetic markers will be available to measure genetic variation within the different *Tamarixia* populations. These markers can then be used to discover if field populations of *Tamarixia* in both California and in other states in the US that are genetically impoverished and genetic variation should be added to give such populations the building blocks to better adapt to the local circumstances.

A better understanding of the parasitoid complex existing in the native range was reached. While the literature suggested that many primary parasitoids existed, this project's results show that only two were found and that the additional 5 species discovered were all hyperparasitoids.

Genetic variation is maintained in *Tamarixia radiata* and used for biological control in California. Instead of a single interbreeding population of this wasp, 16 isolated populations were maintained. While each of these isolated populations harbored little genetic variation, the total of all 16 populations allowed the restoration of a large fraction of the original variation that was present in Pakistan, thus giving the released population in California the best chance to become adapted to the California conditions.

Beneficiaries

The biological control effort in California of the ACP has benefitted from the work done in this grant. At this point UCR is supplying all the *Tamarixia* starting material for the mass rearings done by the California Department of Food and Agriculture (CDFA), one private insectary commissioned by the Citrus Research Board (CRB) to produce *Tamarixia* parasitoids, and a cooperative program of the CRB and USDA-APHIS to use field cages for the mass production of *Tamarixia*. Before the different mass rearing programs were operational, the UCR production was the one used to establish *Tamarixia* in California. Therefore, this program benefited the citrus industry by providing material that will reduce or slow down the population growth rate of the ACP and with that hopefully the spread of HLB, thus giving the industry time to come up with potentially more permanent solutions for HLB.

The value of the citrus industry in California is estimated to be ~$2 billion dollars a year with 26,000 jobs associated to this industry. Each year that the spread of the HLB disease can be postponed, results in an obvious benefit to the industry. An economic analysis was conducted of the impacts of HLB on the citrus industry in Florida. Florida has been the largest citrus producer in the US with total cumulative production over the five-year period, 2006/07-2010/11. Production under the "without-HLB" scenario is 951 million boxes, while production under the "with-HLB" scenario is 734 million boxes, or about 23% lower. With California contributing over 80% of the nation's fresh oranges, if HLB was to become widespread through the state, estimated losses in production value are between $2.2 and 2.7 billion over a 20-year period.

Lessons Learned

An obvious lesson that was learned was not to take some of the literature at face value. The expectation was to find a much larger number of primary parasitoids based on the work of Hussein & Nath (1927) which did not happen. The expectation was to find many more species of primary parasitoids in Pakistan based on the literature, and while a substantial number of parasitoids were found to be associated with ACP, the majority were hyperparasitoids.

During this project much was learned about the best practices for the mass production of the host plants, and mass rearing of ACP for the ultimate production of *T. radiata*. Initially plant quality problems interfered with the mass rearing, but once the discovery was made that plant quality could be easily assessed by looking at the roots, the whole mass rearing process became much more reliable.

Additional Information

Triapitsyn, S. V., Hoddle, C. D., Hayat, M., & Hoddle, M. S. (2013). Taxonomic notes on *Psyllaphycus diaphorinae* (Hymenoptera: Encyrtidae) and its host associations in Pakistan. *Florida Entomologist*, *96*(1), 212-218.

Bistline-East, A., & Hoddle, M. S. (2014). *Chartocerus sp.*(Hymenoptera: Signiphoridae) and *Pachyneuron crassiculme* (Hymenoptera: Pteromalidae) are obligate hyperparasitoids of *Diaphorencyrtus* *aligarhensis* (Hymenoptera: Encyrtidae) and possibly *Tamarixia radiata* (Hymenoptera: Eulophidae). *Florida Entomologist*, *97*(2), 562-566.

Hoddle, C. D., Hoddle, M. S., & Triapitsyn, S. V. (2013). *Marietta leopardina* (Hymenoptera: Aphelinidae) and *Aprostocetus (Aprostocetus*) sp.(Hymenoptera: Eulophidae) are obligate hyperparasitoids of *Tamarixia radiata* (Eulophidae) and *Diaphorencyrtus aligarhensis* (Hymenoptera: Encyrtidae).*Florida Entomologist*, *96*(2), 643-646.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 61	**Project Title:** Addressing Urgent Research Needs for Red Palm Weevil in California	
Grant Recipient: The Regents of the University of California, Riverside	**Grant Agreement No.:** SCB11061	**Date Submitted:** December 2012
Recipient Contact: Mark Hoddle	**Telephone:** (951) 827-7986	**Email:** rchan@ucr.edu

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

The red palm weevil (RPW), *Rhynchophorus ferrugineus*, is considered by Food and Agriculture Organization (FAO) to be the world's most destructive palm pest. In 2004, two different colored forms of palm weevil, one being orange with black spots (*R. ferrugineus*), and the second being black with a red stripe and known as *R. vulneratus*, were considered by Canadian scientists to be the same species, *R. ferrugineus*. They concluded that the only difference between these two species was color, and this was insufficient to support two different species names. In August 2010, the red striped form of this weevil was found in Laguna Beach, Orange County California, following reports of unusual palm deaths in this area (4-6 palms killed and about 5 with signs of RPW infestation). This was the first time the red stripe weevil had been found outside of its home range in Southeast (SE) Asia. The orange form is a global invader having been moved out of SE Asia in live coconut palms to Egypt, then from Egypt in exported live date palms throughout the Middle East, the Mediterranean, and into the Caribbean. This weevil has killed millions of ornamental Canary Island and date palms in the more than 20 countries it has invaded.

The detection of the red striped RPW in Laguna Beach was cause for major and immediate concern. California's large ornamental palm industry is worth approximately $70 million per year, dates in the Coachella Valley are a $30 million per year business, and California's desert oases are characterized by native palms that are vulnerable to attack by these weevils. Additionally, the urban landscape of California is dominated by palm trees; they are synonymous with famous and iconic areas in southern California (e.g., Rodeo Drive). Immediate action was needed to mitigate an invasion disaster similar to the Mediterranean (e.g., southern France, Spain, Italy, etc.) The failure of pheromone traps using commercially available RPW aggregation pheromone to trap RPW in Laguna Beach caused major concern because monitoring infestations and weevil spread without this tool would make the development of eradication and control programs extremely difficult. The pheromone issue needed resolving, as did two other questions: (1) are *R. vulneratus* and *R. ferrugineus* really different species, and (2) where in the world did the Laguna weevils come from?

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

As stated in the Scope of Work, this project addressed four primary activities: (1) using DNA analyses, determine if the red striped weevil in Laguna Beach (formerly known as *R. vulneratus*) was a synonym of the orange weevil, *R. ferrugineus*; (2) determine where California's invading population originated; (3) determine if the commercially available aggregation pheromone used globally for control and monitoring of the orange weevil is attractive to the red striped weevil in Laguna and if the pheromone trapping program used in Laguna can be improved; and (4) identify natural enemies of RPW that could be used for biocontrol if eradication efforts are unsuccessful.

In particular, it is important to note that determining if the commercially available aggregation pheromone used globally for control and monitoring was critical because despite more than 2.5 years of pheromone monitoring, just one adult weevil was caught in more than 100 deployed traps in Laguna Beach. Typically, RPW is highly attracted to pheromone traps, and this anomaly needed investigation.

Hoddle, Kabashima, & Alzubaidy with the enhanced RPW trap set up in Laguna Beach

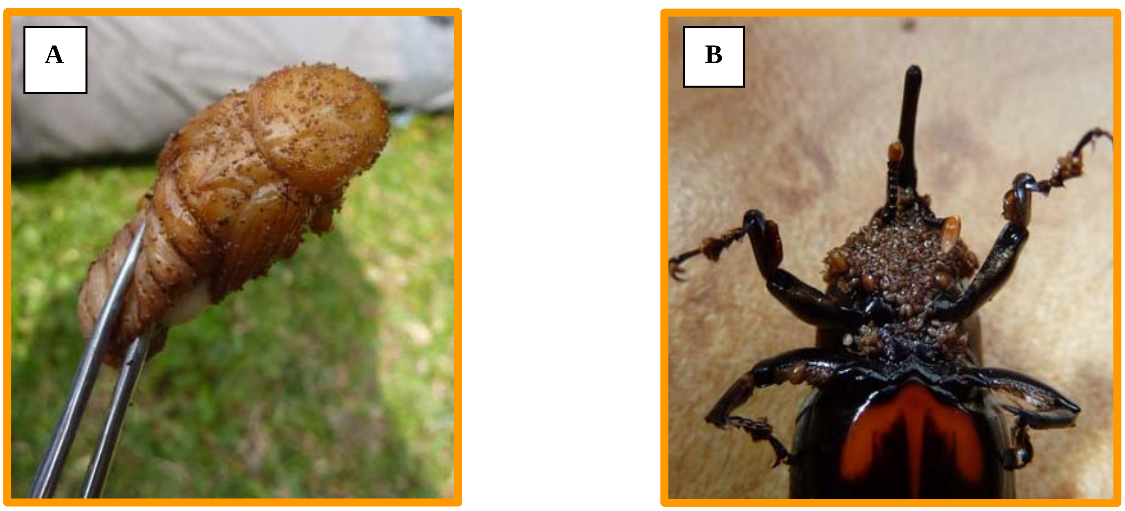
The results of DNA analyses on several hundred orange and red stripe palm weevils collected throughout the native and invaded ranges revealed a very clear result: the red stripe form of the weevil in Laguna Beach is a different species to the invasive orange form. The previous name for the red stripe form, *R. vulneratus*, is valid, and it is not the same species as the global orange invader, *R. ferrugineus*. Further, the DNA studies clearly indicated that *R. vulneratus* can exist in two different color forms in its home range in the southern parts of SE Asia (e.g., the Philippines and Indonesia): either black with a red stripe as seen in Laguna Beach, or orange with black spots, coloration very similar to *R. ferrugineus*. In contrast, *R. ferrugineus* is found only in the northern parts of SE Asia (e.g., India, Vietnam, and Cambodia) and it is always orange with black spots. The DNA work also points to Bali, Indonesia, as the source of California's invading *R. vulneratus* population in Laguna Beach. Studies testing the attractiveness of the commercially available aggregation pheromone clearly demonstrated attractiveness to *R. vulneratus* in Indonesia and the Philippines.

Collections of pheromones from weevils in Sumatra, Indonesia were and analyzed at University of California, Riverside (UCR) conclusively showed that the pheromone was chemically the same as the commercially available pheromone. Studies in the Philippines and Indonesia showed that *R. vulneratus* attraction to pheromone traps is greatly enhanced when deployed with freshly cut coconut palm trunks. This set up, pheromone traps and cut palm logs was replicated at three different sites in Laguna Beach around areas where

RPW had been previously detected in June-July 2012 and again in October-November 2012. Enhanced trapping trials were run for 4 weeks and donated cut date palm trunks and hearts were used for experiments. The set up of the experiments at Laguna were supervised by a team consisting of the PI, a University of California Cooperative Extension (UCCE) Environmental Horticulture Advisor, and Orange County Entomologist and a California Department of Food and Agriculture (CDFA) Senior Environmental Scientist. No RPW were caught with this enhanced trapping set up. The last trap capture of a single RPW was in January 2012. This raised an intriguing possibility; did the pesticide treatments of approximately 6 Canary Islands palms suspected to be infested with RPW based on observations of visual damage unintentionally eradicate *R. vulneratus* from Laguna Beach? This would be a remarkable accomplishment if true.

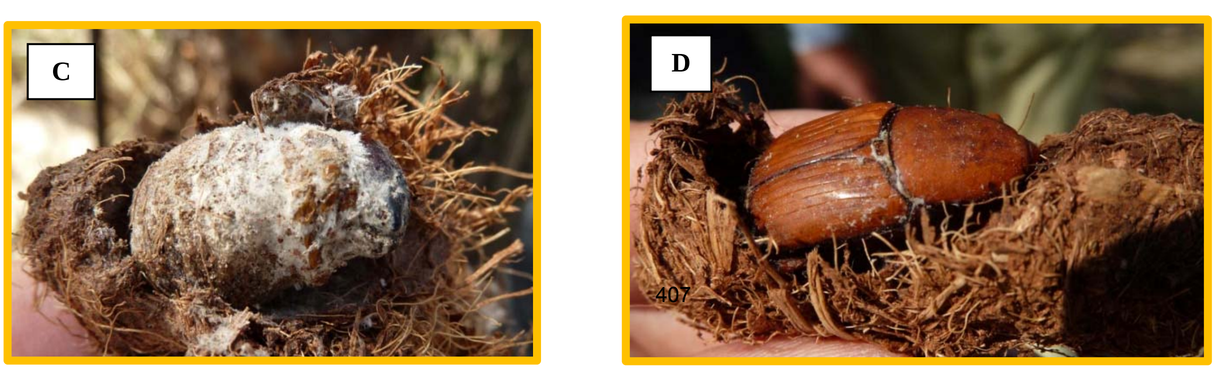
Two types of natural enemies were found attacking red palm weevil. In Indonesia (Figure 1), pupae (A) and adults (B) were heavily infested with mites. It is uncertain as to whether or not these mites are parasitic on red palm weevil, or whether these mites use the weevils to migrate from tree to tree. The biology of these mites is not understood. Some researchers claim mites are parasitic and reduce the longevity and fecundity of red palm weevil (research from Egypt), while workers in Cyprus claim these mites are phoretic and use weevils to emigrate from palm to palm where they feed on decaying palm material.

Figure 1. Red palm weevil pupae (extracted from pupal case) (A) and adult (B) infested with phoretic mites in Indonesia.



In Pakistan (Figure 2), dead pupae (C) and adults (D) were found infested with a fungus. It is uncertain as to whether or not the fungus killed these individuals or whether the fungus opportunistically infested pupae and adults that were already dead.

Figure 2. Dead red palm weevil pupa (C) and adult (D) infested with a fungus in Pakistan



Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

More than 800 RPW adults and larvae were collected from Indonesia, Philippines, Malaysia, north and south Thailand, Sri Lanka, India, Pakistan, Vietnam, Cambodia, Singapore, Papua New Guinea, Israel, Italy, France, Spain, Cyprus, Turkey, Portugal, Egypt, Saudi Arabia, and Aruba. DNA was extracted from approximately 300 representative samples from each of these countries and subjected to analyses to determine genetic relatedness and subsequent species identity and to DNA "finger-printing" to determine where California's invading population originated. The red stripe form in California, of which six specimens have been sequenced, the only six available for the project, consists of a single haplotype. This may be evidence of a single invasion event. Genetically, the California specimens are most similar to material from Bali, Indonesia. The cytochrome oxidase I (COI) sequences of the invasive orange form is about14% divergent from those of the red stripe form, suggesting that these are probably different species (3% divergence is typically inferred to be indicative of species boundaries). This significant divergence in the COI gene is supported by a 2^+ base pair difference in a second gene region, 28sD2, a highly conserved nuclear gene that can be used to separate species. These analyses provide sufficient supporting molecular data for diagnosing *R. vulneratus* and *R. ferrugineus* as different species and synonomization by Canadian scientists may be incorrect. This is the order of activities that enabled the project team to achieve the performance goals and measurable outcomes of this part of the project.

Field collected *R. vulneratus* were used for pheromone aeration trials in Sumatra, Indonesia. RPW with either sugar cane or oil palm hearts (favored food items for RPW adults) were placed inside odorless "oven bags" and a purified air was drawn over the wire cages holding the adults and their food source. Air was pulled through bags using a modified aquarium pump, and through special glass tubes packed with an ultra-fine charcoal filter. This filter trapped any aggregation pheromone released by RPW inside the oven bags. Charcoal filters were shipped from Sumatra to UCR where they were analyzed. The results were clear cut; the aggregation pheromone produced by *R. vulneratus* in Sumatra is exactly the same as the commercially-available RPW aggregation pheromone. Therefore, the pheromone being used in monitoring programs in Laguna Beach should be attractive to RPW. This is the order of activities that enabled the project team to achieve the performance goals and measurable outcomes of this part of the project.

Based on the extensive surveys in the home range of the red palm weevil and a review of the literature regarding detection of natural enemies, it was concluded that effective natural enemies attacking larvae, pupae, and adults likely do not exist. This would suggest that agents targeting these life stages would not be available for use in California as a part of a classical biological control program. However, the eggs of the red palm weevil were not examined for natural enemies. It is possible that this life stage, which is laid inside a hole made by the females on a palm frond, could be attacked by parasitic wasps. No eggs were found in the field to confirm this possibility. To survey for egg parasitoids, it would require additional work to deliberately deploy red palm weevil eggs, and then retrieve them again at set time intervals. However, this work was beyond the scope of this project.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

This work benefited the California date industry, the California nursery and landscaping industries that grow and manage ornamental palms, the millions of home owners and landscape managers with palms on their properties, and managers of native California palm oases. The US Department of Agriculture (USDA) statistics (2007) state that California date production was worth approximately $30 million from 151 farms on 6,315 acres in Riverside and Imperial Counties. An inability to manage, contain, and understand the RPW invasion in Laguna Beach could severely impact California's iconic date industry in the Coachella Valley making it unable to compete with other date producers and possibly decline because of unprofitability. The USDA statistics (2009) indicate that ornamental palms in California were grown by 197 operations producing approximately 1.5 million trees worth around $46 million. Indirect beneficiaries include the California tourism industry that relies on visions of palm-lined beaches and boulevards to attract tourists to California. Managers of natural areas with native palms in desert oases will have few control options should RPW spread from Laguna Beach into these sensitive wilderness areas.

One highly practical aspect of this work enabled the project team to develop enhanced trapping programs for RPW using commercially available pheromones, which was demonstrated to be attractive and identical to the aggregation pheromone produced by *R. vulneratus*. The failure of the enhanced trapping programs in Laguna Beach to capture RPW strengthens greatly the credibility of claims that this weevil is either at densities too low to trap, or the very real possibility, that the invading population has gone extinct, possibly because of pesticide applications to infested palms. Finally, the DNA work indicates Bali, Indonesia is the likely area of origin for the Laguna Beach weevil population. There are no live palm imports from this part of the world into southern California, or the United States in general.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

Many beneficial outcomes have resulted from the project: (1) greatly improved understanding of the taxonomy of giant palm weevils, this knowledge is very important for managing invasions in general, and these weevils in particular. (2) Refinement of technology to collect insect pheromones in the field without the need for complicated laboratory equipment, or to import insects into Quarantine at UCR. (3) An improved ability of staff to recognize and exploit unanticipated research opportunities while working in the field, the enhanced trapping trials resulted from this in the Philippines and were refined in Sumatra. (4) Superior preparation and experience with pheromone trap deployment for the anticipated invasion for the highly destructive *R. ferrugineus*. It is expected that this pest will invade Florida from the Caribbean (it was introduced into Curacao and Aruba in infested date palms imported from Egypt and planted around hotels) and sweep through the southern United States into California. (5) Excellent working relations have been developed with numerous RPW workers overseas, and between UCR staff with CDFA, OC, and UCCE colleagues – these collaborations will be immediately activated should *R. ferrugineus* be detected in southern California.

The major unexpected outcome resulting from this project was the development of enhanced trapping trials that were set up in Laguna Beach over June-July 2012 and again in October-November 2012. These trials resulted from insights that came from field work on RPW in the Philippines and Indonesia (Sumatra).

The project achieved all of its goals and outcome measures; in fact the project team exceeded what was originally planned.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

Web related materials developed over the course of this project:

http://cisr.ucr.edu/red_palm_weevil.html

http://cisr.ucr.edu/blog/uc-riverside/testing-a-new-trapping-program-for-red-palm-weevil-in-laguna-beach-california/

http://cisr.ucr.edu/blog/invasive-species/entomophagy-collecting-and-eating-red-palm-weevil-larvae-from-nipa-palms-in-sumatra-indonesia/

http://cisr.ucr.edu/blog/mark-hoddle/testing-red-palm-weevil-pheromone-traps-in-the-philippines/

http://cisr.ucr.edu/blog/invasive-species/palmaggedon-are-california%e2%80%99s-palms-about-to-face-the-perfect-storm/

http://cisr.ucr.edu/blog/news/red-palm-weevil-in-laguna-beach-dealt-a-second-blow/

http://cisr.ucr.edu/blog/invasive-species/first-move-made-against-red-palm-weevil-in-laguna-beach/

http://cisr.ucr.edu/blog/invasive-species/looking-for-red-palm-weevil-in-indonesia/

http://cisr.ucr.edu/blog/news/red-palm-weevil-outreach-meeting-in-coachella-valley/

http://cisr.ucr.edu/blog/invasive-species/red-palm-weevil-technical-working-group-field-trip-to-laguna-beach/

http://cisr.ucr.edu/blog/invasive-species/red-palm-weevil-infested-palm-at-laguna-beach-removed/

http://cisr.ucr.edu/blog/invasive-species/confirmed-live-red-palm-weevil-found-in-us/

Talks and outreach resulting from this project:

Hoddle, M.S. Three big invasive pest problems for southern California and their incipient biocontrol programs. Essig Museum Seminar, University of California Berkeley, September 2 2011.

Hoddle, M.S. Invasive arthropod threats to California and the role of classical biological control for remediation. Department of Entomology, University of Georgia, Athens. September 19 2011.

Hoddle, M.S. Three big invaders and their biocontrol options. Dow AgroSciences Seminar Series, "The Frontiers of Pest Management" Cal Poly San Luis Obispo, October 10 2011.

Hoddle, M.S. Red palm weevil, biology, invasion history, and IPM practices. New Senate Hall, University of Agriculture, Faisalabad, Pakistan. November 2 2011.

Hoddle, M.S. "What's in your Garden?: Protecting California from Invasive Species." UC Riverside Palm Desert Science and Society Major Issues of the 21st Century Lecture Series. January 11 2012.

<u>Hoddle, C.D.</u>, M.S. Hoddle, J. Millar, P. Rugman-Jones, and R. Stouthamer. The red palm weevil (*Rhynchophorus ferrugineus*), should it have been synonomized? Findings from pheromone molecular, and flight studies. Invited presentation ESA Pacific Branch Symposium: Forest Insect Semiochemistry, Marriott Downtown Waterfront, Portland Oregon, March 27 2012.

Hoddle, M.S. Alien Invasions: California's invasive species problem. Museum Speaker, Bohemian Club, Bohemian Grove, Monte Rio California. July 28 2012.

Hoddle, M.S. Three new pest problems for Southern California. Riverside Master Gardener Class, Western Municipal Water District Office, 14205 Meridian Parkway, Riverside CA.

Hoddle, M.S. Addressing urgent research needs for red palm weevil in California. CDFA site visits, the Large Conference Room, Entomology, University of California, Riverside. August 8 2012.

Hoddle, M.S. The red palm weevil situation in Laguna. UCR-UCCE-CAPCA Entomology Conference. South Coast Winery Resort & Spa, Rancho California Road, Temecula. Sept 19 2012.

Hoddle, M.S. Updates on the red palm weevil situation in Laguna Beach. Environmental Horticulture Team Meeting, South Coast Field Station, Irvine, CA. Oct. 4. 2012 1:00pm.

Hoddle, M.S. Updates on the red palm weevil situation in southern California. PAPA Seminar, 901 Via San Clemente, Montebello, CA. Oct. 16 2012.

Hoddle, M.S. Updates on the red palm weevil situation in southern California. CAPCA, Santa Paula Community Center, Santa Paula, Nov. 14 2012.

<u>Publications resulting from this project:</u> one publication has resulted from this project so far, but 2-3 more are expected as results are fully analyzed (e.g., the genetics work).

Hoddle, M.S. and C.D. Hoddle. 2012. Evaluation of three trapping strategies for red palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) in the Philippines. Pakistan Entomologist 33: 77-80.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 62	**Project Title:** Urban Farmer Training Program	
Grant Recipient: Soil Born Farms	**Grant Agreement No.:** SCB11062	**Date Submitted:** December 2014
Recipient Contact: Shawn Harrison	**Telephone:** 916-363-9685	**Email:** sharrison@soilborn.org

Project Summary

A growing urban population and consumer demand for fresh, local, and often organic food is challenging the capacity of the current food system in Sacramento and other urban communities. Although Sacramento is unique in that it produces an abundance of agricultural products, it is similar to other urban environments in that it imports nearly 98% of its food from other areas (Sacramento Region Local Market Assessment 2008). The food system that has evolved supports large-scale agriculture. Small and midsized farmers producing crops in urban and peri- environments are unable to navigate the system and compete in the agriculture industry. Much of the farmlands adjacent to cities have already been replaced by housing and commercial development. While there is an ample amount of publicly and privately owned land in cities available for production, and a great interest in farming, there is a shortage of skilled and knowledgeable farmers who can meet the unique and challenging issues of urban farming, including knowledge and skills in intensive farming on smaller lands; diverse cropping plans for distribution in urban markets; public engagement; access to markets; secure land tenure, access to distribution and processing facilities. Traditional training programs have not provided the support and experiences needed to address these challenges.

This program is responding to an increasing interest in and need for urban agriculture opportunities by providing direct experience and training for the emerging urban farm sector to grow specialty crops on urban and peri-urban lands and compete in the agriculture industry. While the Center for Land Based Learning (CLBL) has concurrently developed a Beginning Farmer Training and Incubator Program for beginning farmers in the Sacramento Valley, there was no training program designed specifically to address the unique issues of urban farmers, except the work being done at Soil Born Farms (SBF).

The objective of this program is to create a comprehensive and replicable program designed to train “urban farmers” to produce, process, distribute, and market specialty crops to meet the increasing demand for local fruits and vegetables in urban environments. The Urban Farmer Training Program complements the work at CLBL by creating a seamless regional approach to training farmers interested in growing specialty crops in both rural and urban settings. SBF has also worked with partner organizations who can contribute to addressing urban farming issues including University of California Davis, Agricultural Sustainability Institute (UC Davis ASI), Sacramento County Regional Parks, Asian Resources, Sacramento Area Council of Governments, UC Cooperative Extension, CA Farmlink, developers, school districts, and others to address the specific needs of urban farmers.

Despite a growing population and demand for fresh, local, and often organic food, Sacramento and other urban communities import nearly 98% of their food needs from other areas. Bolstered by ample amounts of publicly and privately owned land available for production, an interest in urban farming has emerged to fill this unmet demand for local specialty crops. SBF's Urban Farmer Training Program responds to this increasing interest in and need for urban agriculture opportunities.

Currently, SBF receives over 100 inquiries each year for urban farming training opportunities from new or existing limited resource farmers. Although most of these prospective farmers have a strong interest in farming, they typically do not have the skills, knowledge, experience, or relationships to grow crops for sale in an urban environment and be competitive in the agricultural industry.

The economic impact of this program is significant. Models developed by SBF demonstrate that small urban farmers can generate in excess of $40,000 per acre for specialty crops produced for direct market. Smaller market gardeners can realize modest incomes of $5,000 to $10,000. For diverse communities, increased local production means increased local supply through food box, farm stand or small retail access points. These types of access points impact the supply of fresh fruits and vegetables in low income urban communities. Other impacts of local food production include improved health of consumers; reduced blight associated with vacant lots, and reduced environmental costs associated with food transportation.

Project Approach

Hire Staff: Program Manager, Farmer Educators. Staff was hired, including Program Manager and Farmer Educator's (September 2011-September 2012).

Develop contract agreements with key partners: CLBL, ASI, Asian Resources, California Farmlink, UC Cooperative Extension, and Business Planning Consultant. Contracts were developed with each of the above-mentioned partners. Significant contributions of these partners and more are discussed in section below.

Assemble work team. Between October 2011 and March 2012, SBF assembled a work team comprised of the Executive Director, Program Manager, and Farmer-Educators.

Develop other partners' roles and responsibilities. Relationships with additional partners were developed in order to address class instruction needs. SBF contracted with experts in the field to provide class instruction and curriculum development support, including the Integrated Pest Management Director of the City of Davis, Program Specialists at National Center for Appropriate Technology/National Sustainable Agriculture Information Service (NCAT/ATTRA), Farm-to-Market Director at California Alliance with Family Farmers, Bludog Consulting Services, Two Crows Ecological Design and Consulting, Sustainable Agriculture Agent at the UC Cooperative Extension, Water Efficiency Specialist for the City of Roseville, Farm Manager of Raphael Gardens at the Rudolf Steiner College, Woodleaf Farm in Oroville. In addition, SBF developed a contract with LPC Consulting Associates to develop and implement a comprehensive program evaluation.

Develop curriculum and training program for different tracks: beginning farmers, limited resource farmers, home farmers. The urban farmer training program consists of three different tracks: beginning farmers, home farmers, and limited resource farmers. Beginning farmers participate in an intensive program that includes 20 classes on sustainable, small-scale specialty crop production skills, and business and logistics topics, 1280 + hours of field work at the American River Ranch, 8 farm tours to regional organic specialty crop farms, and one-on-one technical assistance.

The home farmer track includes two sub-tracks: Urban Farmers and Home Gardeners. The Urban Farmer program consists of 14 classes on sustainable, small-scale specialty crop production skills and business and logistics topics, 20 hours of field work at the two Soil Born Farms sites, the American River Ranch and the Farm on Hurley Way, 3 farm tours to regional organic specialty crop farms, and one-on-one technical assistance. The Home Gardener sub-track includes 11 classes on sustainable, garden-scale specialty crop production and includes 11 hours of hands-on field work at the American River Ranch.

Limited resource farmers, most of whom are first-generation Hmong and Mien immigrants, receive training and assistance from program partner Asian Resources. They participate in classes on business and technical topics related to specialty crop production and executed by that agency's staff and contracted instructors using culturally-appropriate supports including native language translation for non-native English speakers. They also receive one-on-one technical assistance in specialty crop production and business and logistics topics.

Working with program partners UC Davis ASI and CA Farmlink, as well as contracted instructors from regional farms and sustainable agriculture agencies, program staff developed course curriculum for twenty-three core and elective classes on specialty crop production, logistical and business planning topics. Learning objectives and lesson plans for each class were developed to standardize the content for the home and beginning farmer tracks. A syllabus was created and a training manual for beginning farmers was assembled, including readings on each class topic.

Present Curriculum at Advisory Committee: Advisory committee members reviewed curriculum as it was developed on an on-going basis. Program partners and advisors UC Davis ASI and CA Farmlink played a critical role in this process.

Develop recruitment, screening, and application materials. A beginning farmer application process was developed to recruit beginning farmers committed to training in sustainable specialty crop production in an urban agricultural setting. Applications are reviewed by the Program Manager and Farmer-Educators, followed by phone interviews and working interviews to identify and select the strongest candidates for the beginning farmer training program.

Identify and develop relationships with limited resource farmers for recruitment in training program.
In partnership with Asian Resources, outreach was conducted and 24 limited resource farmers, the majority of them Hmong and Mien, were identified and supported through technical assistance, individual site visits, and classes on basic business skills development (accounting, marketing, land tenure, food safety) that cater to Southeast Asian farmers with associated translation services.

Begin recruitment for first Urban Farmer Training in May 2012. Over 50 applicants for the beginning farmer track were recruited through regional and national websites, including Ecological Farming Association, ATTRA, GoodFoodJobs.com, and Idealist.org. Additional recruitment for home farmers was done through outreach and educational events onsite at SBF and at off-site events.

Work with developers, institutions, county and city parks, and schools to identify land available for farming. Progress was made to target new land opportunities from a variety of entities. Potential land sites existed with Stonebridge Properties, LandPark West Developers, Sacramento County Parks Department, Sacramento City Unified School District, Capital Public Radio and several private homeowners with larger lots. A land database for vacant lots in South Sacramento, California is currently being developed by SBF and partners. In total, these future land opportunities total several hundred acres.

First year training for beginning farmers and home farmers. The first cadre of beginning farmers participated in 21 classes with 109 total class participants. All of these class participants demonstrated an increase in knowledge of specialty crop production and 36 participants completed the series. Of these beginning farmers, 5 participated in intensive training with over 1280 hours of field hour's experience.

Relationship building and screening of existing limited resource farmers. As mentioned above, program partner Asian Resources provided training and one-on-one technical assistance with 24 limited resource growers focused on specialty crop production, business skills, access to land and access to local markets.

Evaluate training program after year one to identify what worked and challenges, and new opportunities. Program evaluation following the first year concluded a need for the following:

1) the formalization of the program, including a standardized syllabus and components (a set number of classes, educational field hours, and farm visits)
2) a revision in the curriculum, resulting in the addition of some classes including:
a.) a Tractor and Equipment course, organized in partnership with program partner the Center for Land-Based Learning and UC Davis Western Center for Agricultural Equipment;
b.) revised trade skills workshops, including a Small Engine Mechanics workshop and Beginning Welding workshop taught by a Davis High School agriculture teacher, and an expanded Beginning Carpentry Workshop, taught by an independent carpenter;
c.) additional classes covering niche specialty crop topics such as small-scale mushroom cultivation, cut flower production, grape & berry cultivation, and fruit tree propagation;
d.) a three session, small-group business planning workshop with program partners CA Farmlink and UC Davis ASI.
3) In addition, SBF recognized the need for more comprehensive program evaluation. This led to the development of a new contract with LPC Consultant Associates, who, in conjunction with the Program Manager and Executive Director, developed and implemented a comprehensive program evaluation focusing on Year 2 program participants.

Present Year-end findings to Advisory Committee and program revisions. Each year program highlights and adjustments have been shared with the advisory committee.

Begin placement of Year 1 program graduates on available farming sites. Four of the five beginning farmers from Year 1 were placed on farming sites, including one at the American River Ranch in Rancho Cordova, where he worked during the following season to develop higher-level farming and farm management skills, two at the SBF urban farm training site in Sacramento, where they co-managed 1.5 acres of mixed fruit trees and annual vegetables, and one at a vineyard management company in Sonoma County. Three of these four first year program graduates continue growing specialty crops for market as of the end of the grant period.

Assist farmers in developing secure land tenure agreements, loan applications as needed. Program partner CA Farmlink provided one-on-one technical assistance to program participants interested in such assistance.

Provide one-on-one in the field technical assistance to year 1 program graduates. One-on-one field technical assistance was provided to Year 1 Beginning Farmer program graduates on a biweekly or monthly basis, with SBF farm managers providing mentorship and guidance to three Year 1 Beginning Farmers placed on sites in Sacramento and Rancho Cordova. One-on-one assistance for Home Farmers was provided based on grower request.

Assist Year 1 training program graduates with access to potential markets through direct market sales and connections with the Food Hub. SBF assisted three Year 1 beginning farmer program graduates by providing access to markets in Sacramento including two restaurant accounts, a weekly farmers' market, a farm stand and a CSA.

Repeat recruitment, training, evaluation, technical assistance, marketing, etc. for years 2 & 3. In March 2013 (Year 2) an expanded and more comprehensive urban farmer training program was launched with 27 beginning farmers enrolled in the program. 31 classes on small-scale sustainable specialty crop production and business skills were conducted between March and December of 2013 (some topics offered more than once to offer flexibility to program participants) and 8 field trips were scheduled in this same time. Each home farmer participant took between 11 and 14 classes, with beginning farmers taking 20 classes. Field practice for the less intensive home scale beginning farmers totaled 108 hours and scaled upwards from there with the most intensive beginning farmers averaging over 1200 hours each. Guided field training occurred at SBF's 1.5-acre Farm on Hurley Way and 55-acre American River Ranch locations.

In March 2014 (Year 3) 41 total Beginning and Home Farmers participated in the program. 32 of these beginning farmers started in October of 2013 and another 9 joined beginning in March of 2014. Of these students 5 participated in the beginning farmer intensive component. An additional 3 second-year farmers who started the program as Beginning Farmers in March 2013 received advanced training and placement on SBF sites, including the 1.5 –acre training farm (2 second-years) and the 55-acre American River Ranch (1 second-year) As of the end of the grant period, all of the year 3 program participants had completed the program with the exception of the latter 5 participating in the more intensive training track and 4 home farmers. These remaining trainees completed their training between August and October of 2014.

Overall program evaluation. Participant experience, knowledge gain, and program success is evaluated through student evaluations at the end of each class and pre- and post-surveys conducted upon entering and completion of the program. Program partner LPC Consultant Associates also conducted a program evaluation based on the Year 2 program. Their report, compiled from pre- and post-surveys, participant interviews and staff interviews, (attachment 1) includes a host of important information, including program recommendations which will be incorporated into the development of the program moving forward. Key findings include a significant increase in knowledge of sustainable specialty crop production skills, a high degree of satisfaction with the urban farmer training program, and an increase in overall growing space from the beginning of the program to its completion. SBF will continue to utilize the evaluation tools developed to evaluate subsequent program years.

Program recommendations include the following:

1. Revisit the program logic model by conducting a workshop with staff, alumni, and other stakeholders to improve program focus and gain clarity on desired outcomes.

2. Begin to establish the structure for a multiple year program, to support participants in further strengthening their ability to work in the agricultural sector. Provide the option for second-year students to continue to take courses and "round out" their experience.
3. Hire a farmer educator to provide apprentice training, teach a portion of Grow Your Groceries (GYG) classes, and provide technical assistance to participants after program completion.
4. Devote more time to case management of participants. This includes more one-on-one communication, developing an Individual Education Plan (IEP) with each participant, and disseminating information about educational or career opportunities. Strive to create and foster mentor relationships between beginning farmers and established or retired farmers.
5. Support participants and alumni by researching and solidifying land access opportunities for those who need secure land. This includes help with identifying available land, negotiating leases, and navigating strategic opportunities.
6. Establish more farm sites for field instruction, where participants who have already completed courses are able to gain experience in leadership and continue their learning past the first program year. This might include designating additional sites operated by Soil Born Farms, or formalizing relationships with other farms to provide this experience.
7. Consider greater formalization of the home gardener and urban farmer tracks, to ensure the appropriate program intensity based on growing and business goals. Part of this may entail developing a formal application process to determine proper program placement.
8. Offer smaller class packages, such as a business planning module, that would cost less for participants and could increase the number of people who commit to participating in the GYG program.
9. Explore opportunities to collaborate more closely with partner organizations, such as the Center for Land Based Learning and the National Center for Appropriate Technology (NCAT), whose mission and activities overlap with GYG. Consider additional opportunities for representatives from these organizations to serve as instructors for GYG classes.
10. Formalize financial aid policies and procedures for the GYG Program. Explore opportunities to connect applicants to resources and scholarships that may help fund their participation. A fee structure would be implemented in the future, but it has not been applied to date. Any future revenue generated through program fees would be used to help cover staffing costs associated with managing the program, farmer educator and training materials.
11. Establish clear guidelines for provision of technical assistance to participants and alumni. Consider a fixed timeline for follow-up support. Develop a system to track the technical assistance provided, including number of hours and type of assistance by participant.

The overall scope of the project was limited to specialty crops. The mechanisms that were used to ensure this compliance included:

- Recruitment Materials: All program recruitment materials specified that SBF training focus is limited to the production of specialty crops.
- Trainee Application: The trainee application states that the program is limited to specialty crop production, listing allowable and unallowable specialty crops.
- All developed curriculum focused on the production of specialty crops.
- All associated marketing training and assistance focused exclusively on the sale of specialty crops.

The project benefitted greatly from the dedicated involvement of program partners, including the Center for Land-Based Learning, CA Farmlink, NCAT/ATTRA, UC Davis ASI, UC Cooperative Extension, Asian Resources, LPC Consultants and many individual farmers and farmer-educators.

The Center for Land-Based Learning was a key partner in the development of the program, sharing resources throughout the project, including collaboration on individual workshops and the tractor class series, and cross-promotion of programs. CA Farmlink provided significant support in developing the business class series, a three-part business planning workshop, and offering one-on-one technical assistance to program participants. NCAT/ATTRA provided curriculum development and class instruction on topics including marketing, organic systems compliance and soil science. UC Davis ASI supported the development of the curriculum, program management tools, workshop evaluation and improvement, one-one-one and small group marketing and business planning support and general program development advising. UC Cooperative Extension provided instruction on soil science, fruit tree care, and grape and berry growing. Asian Resources conducted outreach, technical assistance and support for immigrant and minority growers. Finally, LPC Consultants carried out a valuable program evaluation to track the impact of the program for the cohort of participants who began the program in March 2013. The evaluation tools developed will be put to use going forward, and the resulting report will inform the progression and improvement of the program in the future.

Goals and Outcomes Achieved

Measurable outcome: 100 people will complete the urban farmer training program.
94 beginning farmers have completed the program by the end of the grant and an additional 9 completed the program between August and October of 2014. 36 beginning farmers and home farmers completed the farmer training program during Year 1. Following program improvements in format, evaluation and curriculum, 58 additional beginning and home farmers had completed the program as of June 2014. In order to maximize the time and expertise of instructors, single class participants were also added to beginning farmer classes. 227 additional students took advantage of this opportunity and attended between 1 to 5 crop production and/or business skills classes during the grant period.

Activities completed in order to achieve this measurable outcome included:
Year 1 included the piloting of 28 classes on specialty crop production and business topics, 1280 + hours of fieldwork experience for five beginning farmers and 8 field trips. Classes were taught by SBF farmer-educator and instructors from program partner CA Farmlink, for the business series. Program recruitment, application and screening process was carried out through the dissemination of recruitment materials by program partners, regional farms, farm agencies and online job posting sites, and review of candidates by the Program Manager, Farmer-Educator, Farm Managers, and Executive Director.

Year 2 & Year 3 included expansion of the program to include a comprehensive structure and requirements for completion, including educational farm visits and field hours for the Home Farmer tracks. Recruitment efforts for participants focused on hosting educational open houses that included classes, farm tours, and presentation by program staff about the farmer training program. Candidates were reviewed by Program Manager, Farmer-Educator, Farm Managers, and Executive Director, and an intake survey was completed by all incoming beginning farmer and home farmer students.

Measurable outcome: 100 trainees will have increased knowledge and skills in intensive urban farming, including diverse cropping plans, public engagement, land tenure, business planning, and marketing.
By the end of the grant period 94 trainees completed the program and demonstrated an increase in knowledge related specialty crop production. Nine additional trainees completed the program by October 2014. An additional 227 participants taking one to five classes demonstrated an increase in knowledge of at least one topic related to specialty crop production. Production and business classes were taught by contracted instructors who are experts in their field, including successful organic farmers, sustainable agriculture program specialists at technical assistance agency NCAT/ATTRA, farm business advisors from UC Davis ASI, CA Farmlink, CAFF, and BluDog Consulting Services, city officials specializing in Integrated Pest Management and irrigation, etc. The recruitment and relationship-building with these highly skilled contracted instructors resulted in high quality instruction. Their instruction received consistent high marks by both instructional evaluators such as UC Davis ASI and class participants. Class instruction in multiple categories, including content relevance, instructor enthusiasm, and organization and presentation, was consistently ranked Very Good or Excellent by class participants, based on end-of-class student evaluations (see example of student evaluation in Attachment 1).

Measurable outcome: Of the 100 participants, 10 limited resource farmers and 5 beginning farmers will grow specialty crops on public and/or private urban lots with secure land tenure, have business and marketing plans, loan applications if needed, and access to distribution channels through the Sacramento Regional Food Hub and local retail outlets.
All of the 24 limited resource Hmong and Mien growers supported during the grant period in partnership with Asian Resources and Cooperative Extension are currently on secure land and are producing for local market. While basic skills and access has been addressed, this grower groups' foothold remains tenuous due to cultural, language and generational business transfer issues. For the beginning farmers who participated in the intensive track of the program, 13 are currently growing specialty crops for market with secure land tenure, crop and marketing plans and diverse local markets. Program partners UC Davis ASI, California Farmlink, and NCAT/ATTRA have been instrumental in providing instruction, guidance, and technical assistance to program participants and graduates looking for land, business planning, and marketing assistance. An additional 13 beginning and home farmers have plans to grow for market in the next 1-5 years. Activities performed to achieve this measurable outcome included the development and implementation of field and classroom training in sustainable specialty crop production skills, trade skills, and business and logistics topics, the incorporation of experts in the field as course instructors and program partners, and the provision of small group and one-on-one technical assistance by SBF and program partners to course participants and graduates.

Measurable outcome: 20 urban residents will grow specialty crops for sale in their home garden and have business and marketing plans, loan applications if needed, and access to distribution channels through the Sacramento Regional Food Hub and local retail outlets.
By the end of the grant period, 7 urban residents are producing specialty crops in their home garden for sale with associated planning tools. Within the next 1 to 5 years an additional 12 home-scale beginning farmers are planning production as well. A significant constraint that affected this outcome is the zoning ordinance in the city of Sacramento under which makes it difficult for urban residents to grow specialty crops for sale from their home gardens. Soil Born Farms plans to continue to support these new and prospective growers with production to technical assistance, business planning tools and market access support as they start their specialty crop businesses in the coming years.

Measurable outcome: Of the 100 participants, 10 limited resource farmers and 5 beginning farmers will grow specialty crops on public and/or private urban lots with secure land tenure, have business and marketing plans, loan applications if needed, and access to distribution channels through the Sacramento Regional Food Hub and local retail outlets.
20 current and past beginning and home farmers (13 beginning farmers, 7 home farmers) are growing specialty crops for market and an additional 12 beginning farmers have expressed interest in farming within the next 1 to 5 years. An additional 24 limited resource farmers supported by the project are also growing for local market. Growers are selling their specialty crops through farm stands, restaurants, farmers' markets, and CSAs. Training received through the farmer training program provides these individuals with the foundational skills and knowledge necessary to grow specialty crops for market. SBF plans to provide support to program graduates as they make progress toward starting specialty crop production businesses in the years following their completion of the program. SBF is currently preparing to add additional training and support for program graduates in their second and third years of growing specialty crops in order to provide a strong support system and increase their likelihood of success. This includes an incubator site for third-year beginning farmers (scheduled to begin in 2015) a series of advanced level workshops for graduates of the current farmer training program, and continued technical assistance on production skills, business and marketing skills, etc.

Goal: Curriculum and training components in place for Year 1 training. Actual Accomplishment: Initial curriculum and training components were in place for Year 1, and pilot program was launched with 28 classes and a total of 109 class participants and 36 participants who completed the training.

Goal: Recruitment, screening, and application materials created and disseminated by staff and partners. Actual Accomplishment: Recruitment, screening and application materials were created and disseminated through channels including program partners, local and regional sustainable agriculture agencies, online sustainable agriculture job posting sites such as Ecological Farming Association, Goodfoodjobs.com, and NCAT/ATTRA. Such efforts resulted in 30-50 applications per year for the Beginning Farmer program. SBF hosted educational events for Year 2 and Year 3 as outreach for the farmer training program; Year 2 educational events had 93 participants, and Year 3 educational events had 72 participants attending.

Goal: 25/year home farmers and 5/year beginning farmers complete training
Actual Accomplishment:
Year 1 - 31 home farmers and 5 beginning farmers completed training, 73 additional participants completed one or more individual classes.
Year 2 – 22 home farmers and 4 beginning farmers completed training, 78 additional participants completed one or more individual classes.
Year 3 – 32 home farmers completed training, 74 additional participants completed one or more individual classes. Five beginning farmers and 4 home farmers completed training by October 2014.

Goal: 5/year limited resource farmers completed training
Actual Accomplishment: Training and technical assistance was provided to 8 limited resource farmers per year by program partner Asian Resources and Soil Born Farms.

Goal: Training program, curriculum, and recruitment materials revised based on results of each year's review.

Actual Accomplishment: Based on Year 1 review, Year 2 training program and curriculum development expanded to incorporate a more comprehensive structure, including expectations for participants regarding number of classes completed, field hours, and farm visits; curriculum development expanded and intensified with the incorporation of UC Davis ASI to evaluate instructor performance and develop learning objectives, and instructor collaboration on development of lesson plans for each workshop.

Based on Year 2 review, Year 3 training program shifted to create separate classes for Home Farmer and Beginning Farmer participants.

Goal: % of farmer trainees with increased knowledge based on pre-post test scores, questionnaires and interviews (100 trainees will have increased knowledge and skills in intensive urban farming, including diverse cropping plans; public engagement; land tenure, business planning, and marketing).
Actual Accomplishment: 94 program graduates (9 still in program) reported increased knowledge on specialty crop production. Detailed program evaluation conducted by LPC Consultants of Year 2 participants (termed "Cohort 1" due to Year 2 being the first year students entered the comprehensive course at the same time), reported increased skill level in all 20 areas of specialty crop production and business topics covered measured. For instance, while only 36 percent of participants felt "very" or "somewhat" skilled in building healthy soil before the program, 100 percent felt "very" or "somewhat" skilled after completing the program. The greatest increases in competence, according to survey results, were in basics of soil science (79% of participants felt more skilled), seed saving (75%), and harvesting, grading, and packing (75%), as shown on page 13 of the attached program evaluation report.

While post-survey data and analysis of Year 3 participants is not yet complete due to the ongoing nature of the program, extrapolation of the data collected in the LPC program evaluation would indicate that at least 100 trainees will have increased knowledge and skills intensive urban farming upon completion of the program in the fall of 2014. Program evaluation is planned to collect this information in order to verify the extrapolation.

Goal: Number of farmers who have business and marketing plans, access to secure land, loan applications & distribution channels (10 limited resource farmers and 5 beginning farmers will grow specialty crops on public and/or private urban lots with secure land tenure, have business and marketing plans, loan applications if needed, and access to distribution channels through the Sacramento Regional Food Hub and local retail outlets).
Actual Accomplishment: As mentioned above, 20 current and past beginning farmers and home farmers, (13 beginning farmers and 7 home farmers), are currently growing specialty crops for market with marketing plans, secure land tenure access to distribution channels including farmers markets, restaurants, farm stands, and CSA. 24 limited resource farmers are currently growing specialty crops for market.

Goal: Contract-end program evaluation report and model replication plan.
Actual Accomplishment: Comprehensive program evaluation report was completed by LPC Consulting Associates in June 2014 (Attachment 1).

This project aimed to increase the number of urban farmers producing specialty crops on urban and peri-urban land for sale to the urban population. The baseline is zero, since the increase in urban farmers was based on the number of people completing the training program and achieving the following:

a. 100 people complete the urban farmer training program.
103 beginning farmers completed the urban farmer training program by October 2014.

b. 100 trainees have increased knowledge and skills in intensive urban farming, including diverse cropping plans; public engagement; land tenure; business planning, and marketing.
94 trainees who have completed the training program demonstrate an increase of knowledge in specialty crop production, as evidenced by verbal and written in-class assessments and self-reporting on the pre- and post-surveys administered at the beginning and end of the program. Early responses from remaining 9 beginning farmers indicate strong increase in knowledge and skill as well in specialty crop production.

Of the 100 participants: c. 10 limited resource farmers and 5 beginning farmers will grow specialty crops on public and/or private urban lots with secure land tenure, have business and marketing plans, loan applications if needed, and access to distribution channels through thee Sacramento Regional Food Hub and local retail outlets.
24 limited resource farmers and 13 beginning farmers are currently growing specialty crops on public and/or private urban lots, and are selling produce through a combination of farm stands, farmers' markets, CSAs, and restaurants.

d. 20 urban residents will grow specialty crops for sale in their home garden and have business and marketing plans, loan applications if needed, and access to distribution channels through the Sacramento Regional Food Hub and local retail outlets.
7 home farmers are currently growing specialty crops for sale in their home garden, and an additional 12 have plans to grow for sale in the next 1-5 years. SBF is continuing to support these existing and future urban farmers through program income reinvested into the project.

SBF considers the project to be a resounding success, with over 100 well-trained individuals growing or prepared to grow for market, and 44 specialty crop growers currently growing for market as a result of the training program. This outcome represents economic benefits to the growers and their families, and increased availability of local, sustainably-grown specialty crops for the region's population.

Beneficiaries

The individuals who participated in the farmer training program are the most direct beneficiaries;
Gender: 70% of the beginning and home farmers who completed the program were female (66 of 94) and 30% were male (28 of 94).

103 beginning and home farmers completed the training program by October 2014, significantly increasing their knowledge in specialty crop production and an additional 227 took one or more classes and exhibited increased knowledge in specialty crop production. 24 limited resource farmers received training, support and technical assistance and are currently growing for market. 20 beginning and home farmers are currently growing specialty crops for market, with an additional 13 planning to grow for market in the next 1-5 years.

Other operations that benefited from the completion of the project's accomplishments include the operations that employ or are run by the graduates of the program, including program partner Woodleaf Farm in Oroville, Enterprise Vineyards in Sonoma, Yisrael Family Farm and Urban Joy Family Farm in Sacramento, Soil Born Farms in Rancho Cordova, West Sacramento Urban Farm Project in West Sacramento, the

Refarmery in Rio Linda, Hillview Farm in Auburn, Amberchella Flower Farm in Mokelumne Hill, Yolo Bulb Farm in Winters, and Burge Organic Farm in Mansfield, Georgia.

In addition, due to the completion of this project's accomplishments, residents of the areas local to these farms, including Sacramento, West Sacramento, Rio Linda, Auburn, and Rancho Cordova, have increased access to fresh organic fruits and vegetables.

Lessons Learned

Lesson 1: Farmer training requires a multi-year, multi-faceted effort: Based on the successes and challenges of this project, including the participation of several individuals with plans to begin growing specialty crops for market in 1-5 years, the evaluation of program participants and graduates and their readiness to start or manage a specialty crop operation after one year of training, and conversations with farm owners and operators regarding their interests and requirements when recruiting farm employees and managers, SBF learned that a successful farmer training program requires an approach that includes multiple years of training, mentorship, technical assistance and support.

Lesson 2: Farmer and gardener trainees require separate course tracks.
In Year 1 and Year 2, the farmer training program was structured in such a way that beginning farmers, home farmers and home gardeners took the same classes. While this enabled more flexibility for the program, it was concluded that farmers and gardeners have different priorities and interests that necessitate separate training tracks.

As a result, in Year 3 the courses were separated into "Urban Farmer" and "Home Gardener" sub-tracks. The "Home Gardener" track focuses on organic horticulture practices for small spaces, while the Urban Farmer track caters to aspiring market gardeners and commercial farmers, including regulatory, logistics, and business and marketing topics, and specialty crop production skills appropriate for commercial-scale operations.

Lesson 3: A significant number of hands-on or field hours are important to a high-quality, comprehensive training experience. In order to offer a flexible program that fits with the schedules of Home Farmers currently working full-time, non-farming jobs, the program had a relatively small field hour's requirement for Home Farmers of 16-20 hours. Based on program evaluation data from LPC Consultant Associates, participants confirmed that the field hour's element was an important component of the education they received in this training program. 91% of respondents in Cohort 1 indicated that the field hours were "Very Useful." With this in mind, plans are to significantly increase the field hour's component beginning in 2015 to 100 hours minimum, and to focus recruitment on individuals receiving field training at regional farms or urban agriculture or gardening agencies concurrently to the program, are in place. Partnerships have been established with Rudolf Steiner College's Raphael Garden and International Rescue Committee (IRC)'s New Roots program, and other farms and agencies targeted for partnership. This strategy will include the incorporation of novice farm workers and interns at regional farms into the farmer training program at SBF. The field hour's portion of the program will be the work experience they obtain at the employer farm, and the workshops, technical assistance and educational farm visits will provide the structured training to increase their skills and knowledge and support their advancement within the field of specialty crop production.

During the course of this project, increased collaboration between Soil Born Farms and other regional farms and agencies has resulted in new recruiting strategies, including partnerships with Farmer-Veteran Coalition and other veterans services organizations to formalize the incorporation of veterans into the farmer training program, and a partnership with International Rescue Committee (IRC) to incorporate refugee participants in that organization's New Roots farming initiative into the SBF farmer training program. Plans are underway to incorporate these new partnerships, with the support of these collaborating agencies, in 2015.

Lessons learned during the grant period include an increased appreciation for the long-term nature of successful farmer training. Making a career transition to a skilled, independent and complex field such as sustainable agriculture can be a long-term process and support for these new growers will be most successful if provided over multiple years as growers plan and then begin their new careers. To address this need, SBF has plans to increase and expand the support for specialty crop growers in their second and third years, including ongoing technical assistance, land placement support, and placement on incubator sites, as well as advanced level workshops.

In addition, several program participants enrolled in the program have longer-term plans to transition to specialty crop production (in 3 or more years). SBF intends for this program to target individuals for whom a career in specialty crop production is a near-term goal. Thus, changes to the recruitment process are planned to further formalize the screening of applicants, selecting those who are currently growing specialty crops and those who express the intention to grow in the near-term (1-2 years). Also, starting in 2015 recruitment will focus on novice specialty crop farm employees at partnering regional farms, and will include an increased field hours component of a minimum of 100 hours during the program, which is anticipated to attract a trainee population with a higher likelihood of transitioning to specialty crop production in the near term.

Additional Information

Attachment 1: Grow Your Groceries Training Program Evaluation Report June 2014

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 63	**Project Title:** Evaluation of sampling protocol to provide science-based metrics for use in identification of Salmonella in irrigation water testing programs in mixed produce farms in the Suwannee River watershed	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB11063	**Date Submitted:** December 2014
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** 530-757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

The goal of this project was to develop knowledge which will allow fruit and vegetable producers who rely on untreated surface sources of irrigation water to effectively address recently proposed FDA rules. These rules may require that all agricultural water, including irrigation water, be safe for its intended use. Although data may be available with which to respond to the FDA proposals on safe agricultural water for some parts of the United States, there are still significant knowledge gaps in many parts of the country that prevent producers from doing so. Before a science-based response can be formulated, this knowledge gap must be closed. Knowing this, project staff developed this project to close the knowledge gap. In the Southeast, where this project took place, a variety of irrigation sources are used by vegetable producers with the most common source a constructed farm pond.

Members of the team participated in a companion CPS-funded study led by the University of Florida cooperator which consistently found measurable concentrations of *Salmonella*, shiga toxin-producing *E. coli* and *Campylobacter jejuni* in water samples collected from near the irrigation system intake of 10 ponds in southern Georgia. The intake is usually 10 to 20 feet from the bank and at a depth of 3 to 6 ft. Collecting samples at the intake typically requires a boat, specialized sampling equipment, and time, all of which make it difficult for vegetable producers to collect samples during the growing season – especially if it is to be done weekly as FDA is proposing. This study developed and evaluated two different producer-friendly sampling strategies designed to reflect *Salmonella* concentrations at the irrigation system intake. Staff also evaluated the effect of storm-driven surface runoff events on the presence of *Salmonella* in irrigation ponds.

This project did not build on a previous SCBCP grant.

Project Approach

The study developed and evaluated two different producer-friendly sampling strategies designed to reflect *Salmonella* concentrations at the irrigation system intake. Strategy 1 consisted of collecting 3 grab samples from the bank near the intake of the irrigation system, approximately 10 feet apart. Strategy 2 consisted of collecting 3 grab samples distributed along the perimeter of the pond. For each strategy, a composite sample was created from the 3 grab samples. Samples were collected from 5 ponds used to irrigate produce and other crops for 19 months beginning March 2012 and ending September 2013. These ponds were a subset of the 10 ponds used in the Wright study. *Salmonella* was found consistently in the ponds but at very low concentrations. Concentrations averaged below 1 MPN/100mL. Of the 507 samples staff analyzed, 217 samples (42.8%) were confirmed positive for *Salmonella* and 290 (57.2%) were negative. There were differences both in average concentrations and percent positive samples between the ponds confirming that each pond acts as its own ecosystem.

Statistically, both sampling strategies represented the intake well. However, also evaluated was how frequently the analytical results from the intake matched the analytical results for each sampling strategy. Overall, there was a 70% match rate between the intake and composite bank samples. In other words, 70% of the time the analytical results for *Salmonella* from the intake matched the analytical results of the composite bank sample (positive intake = positive composite and negative intake = negative composite). However, this also means that the samples did not match about 30% of the time. For individual ponds, the results were more variable – the lowest match rate was 50% while the highest was 89%. These results indicate that sampling from the bank does not reliably represent water near the irrigation system intake.

Effect of storm-driven surface runoff was also evaluated for events on two of the study ponds. For 12 storms (6 per pond) occurring between January and August 2013, 33% of pond water samples collected shortly before rainfall events were positive for *Salmonella* while 58% were positive immediately after rainfall events. Surface runoff samples from agricultural fields were positive 38% of the time, and samples from forested areas were positive 40% of the time. Small streams feeding the ponds were positive 100% of the time. This indicates that hydrologic features which concentrate water from the surrounding landscape and flow into ponds during storm events are more likely sources of contamination than direct surface runoff.

Finally, many of the positive samples were sent for serotyping to the National Veterinary Services Laboratory (NVSL) in Ames, Iowa. Serotyping will allow staff to identify the species of *Salmonella* in the samples and further allow staff to understand if these *Salmonella* species are associated with human illness – something which will make the results more powerful and more meaningful to the produce industry. Also found was that the 235 CFU per 100 mL generic *E. coli* threshold proposed by FDA is not a good indicator of the presence of *Salmonella* in irrigation ponds and surface runoff in the southeastern study region.

This project did not benefit commodities other than specialty crops.

This project provided many challenges ranging from logistical to scientific but resulted in a series of positive outcomes and accomplishments. A strong and dynamic multi-state, multi-institutional team was dedicated to developing knowledge which will allow fruit and vegetable producers who rely on untreated surface sources of irrigation water to effectively address recently proposed FDA rules. The partner institutions include the University of Georgia, Emory University, the University of Florida, the University of California at Davis, and the Western Center for Food Safety. The team consisted of microbiologists, water quality experts, hydrologists and several vegetable producers in southern Georgia. The partnerships and trust staff developed with the vegetable producers will be long-lasting and will allow staff to conduct important on-farm projects in the future. In addition, several young scientists were trained during the project's two years. Two graduate students conducted their M.S. thesis on components of the project while a third student also participated. Two post-doctoral researchers, two undergraduate student workers, a field technician and a lab analyst were also employed.

Innovative analytical techniques for the laboratory and innovative sampling techniques were developed for the field which will make future projects easier, more cost-effective, and more productive. Implementation of a novel cross-streaking method was developed by the collaborator at the University of Florida to isolate, confirm, and enumerate *Salmonella* in laboratories at the University of Georgia and Emory University. The University of Florida collaborator trained the lab analyst and post-doc in her laboratory and then sent her graduate student to the laboratory to help establish the method. For one year, both the University of Florida laboratory and the University of Georgia laboratory analyzed samples from the same ponds using the same methods. The results are being used to quantitatively assess the robustness of the method.

Goals and Outcomes Achieved

Research activities for this project are conducted by the University of Georgia subaward principal investigator.

The goals of this proposal were successfully completed although the experimental approach used for the second objective (surface runoff) was modified from that originally proposed. This allowed staff to better understand the contribution of the landscape to the ponds' *Salmonella* load. A summary of the findings and recommendations is provided below.

- The bank sampling strategies staff evaluated do not consistently represent presence of *Salmonella* in the water near the irrigation system intakes so they are probably not the best approach for weekly sampling used for GAP and other similar protocols.

- Bank sampling can be used to assess longer-term trends in the ponds and to assess the potential risk of using the water for irrigating produce.

- The most representative sample of water entering the irrigation system can be collected by installing a sampling valve in the supply line of the irrigation system. This will allow producers to easily collect samples while the irrigation system is operating. However, this approach does not prevent contaminated irrigation water from being distributed by the irrigation system. In a recently initiated CPS-sponsored study, staff will be installing sampling valves in the supply lines of several irrigation systems and will compare samples collected from near the intake, the sampling valve, and the irrigation system during irrigation events.

- Precipitation driven surface-runoff does increase the concentration of *Salmonella* in the ponds. It is not clear however if this is an effect of inflowing water disturbing pond sediments or an effect of *Salmonella* being added to the ponds directly by runoff and storm-driven stream flow. The concentrations of *Salmonella* in surface runoff and the percentage of runoff samples found positive for *Salmonella* were similar to those found in the ponds during monthly sampling.

- The 235 CFU per 100 mL generic *E. coli* threshold proposed by FDA is not a good indicator of the presence of *Salmonella* in irrigation ponds and surface runoff in the Southeast.

As an alternative to developing an independent survey to track acceptance of research findings, CPS has opted to partner with various commodity and trade groups to disseminate research results. This is a trusted source of information for the fresh produce industry. Two of the larger associations that assist CPS with this endeavor are Western Growers Association and Produce Marketing Association. Western Growers members provide 50% of the nation's fresh fruit vegetables including one-third of the organic fresh produce and 99% of the tree nuts. The Produce Marketing Association represents companies from every segment of the global fresh produce supply chain. Both WGA and PMA have provided staff resources to translate the research results into usable information for use by the fresh produce and dried nut industry. All information is public and available on the Center for Produce Safety's website, www.centerforproducesafety.org as well as offered through research webinars, extension scientists and commodity organizations. All trusted sources for science based information. Resources include; annual symposium, symposium key learnings, CPS 5 Year Key Learnings, and CPS Produce Research Symposium - A Practical Guide to the Scientific Research.

Beneficiaries

The primary beneficiaries of this project are vegetable producers who use ponds as a source of their irrigation water. Although the project was confined to the southern Georgia, many of the lessons learned should apply across the United States. Because of this project, vegetable producers now have a better understanding of the prevalence of *Salmonella* in these ponds and of effective sampling strategies which may assist them to comply with proposed FDA rules.

Beneficiaries are also researchers who now have additional data with which to understand the dynamics of *Salmonella* in the agricultural landscape and better analytical tools and field techniques with which to conduct future research to address problems facing fruit and vegetable producers.

These groups receive information about this research as described below.

There are 42,729 farms of produce crop growers representing $23.9 billion in sales in the state of California according to the 2012 Census (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/index.asp).

Dr. George Vellidis, University of Georgia, presented interim results at the 2013 CPS Produce Research Symposium in Rochester, New York. Final research results were presented in June at the 2014 CPS Produce Research Symposium in Newport Beach, CA. The 2013 symposium had 300 attendees and the 2014 symposium had 245. The participants included California regional and national growers/shippers, retail and food service buyers, scientists, academic, produce industry representatives, and members of regulatory agencies. The symposium provides expert panels to critique research results. This process helps participants evaluate the use of the research results in their respective businesses. Project results will be disseminated at industry meetings and streamed through social media sources.

Final results will also be included in the following:

1.) The Final report can be found at http://www.centerforproducesafety.org/amass/documents/researchproject/329/CPS%20FINAL%20REPORT%20-%20Vellidis%209-22-14.pdf
2.) CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website.
3.) The Center for Produce Safety's Board of Directors and members of the Technical Committee distribute a series of information throughout the year on their websites, and through presentations, meetings and webinars. An example of this would be the "CPS Funded Research - Key Learnings" on the CPS website at the following link:

http://www.centerforproducesafety.org/amass/documents/document/210/CPS%20Key%20Learnings%20May%202014_FINAL2.pdf

The following websites provide additional resources on the final reports and symposium proceedings:

Center for Produce Safety: https://cps.ucdavis.edu/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

Lessons Learned

Although the team encountered many obstacles ranging from establishing and running a completely new and complex analytical method to driving long distances to the sampling sites and sampling in adverse weather conditions, staff not only met the goals, but exceeded them. This was possible due to the development of a very cohesive and professional team with clearly assigned responsibilities and deliverables and leveraging other ongoing related projects to maximize the use of the funding.

Additional Information

Attachment 1: Eleven data and results tables as well as 22 figures containing photos, results, and a variety of other information are included.

A description of the project and a summary of the results will be posted to the PI's webstie – www.vellidis.org under the water quality section.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 64	**Project Title:** Toward a Rapid and Reliable Pathogen Detection System in Produce	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB11064	**Date Submitted:** December 2014
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** 530-757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

Recent outbreaks linked to *Salmonella*- and *E. coli*-contaminated produce pose a significant threat to public health and the produce industry. Rapid, reliable, and robust detection methods are needed to promptly identify contamination risks in the supply chain and better ensure produce safety. However, pathogen detection in produce remains a challenging task. Molecular-based methods such as polymerase chain reaction (PCR) and quantitative real-time polymerase chain reaction (qPCR) have gained wide application in produce testing, often including an enrichment step to increase pathogen cell numbers in produce. However, false-positive and false-negative results are reported and few PCR assays have been validated on a commodity-specific basis. Loop-mediated isothermal amplification (LAMP,) a novel molecular method, has emerged recently as a promising alternative to PCR for pathogen detection.

Through a previous Center for Produce Safety (CPS) project funded by the University of California, Agriculture and Natural Resources, a rapid and accurate LAMP assay for *Salmonella* detection in produce was developed. Subsequently, a suite of LAMP assays for *E. coli* detection was developed. Despite these developments, these LAMP assays have not been evaluated using a large number of bacterial strains or tested in a variety of produce items using conditions mimicking real-world contamination events (e.g., low-level surface spiking, cold storage). There is also a scarcity of data on the effectiveness of sample preparation methods on pathogen detection in produce. The aims of this project were to comprehensively evaluate the *Salmonella* LAMP assay and *E. coli* LAMP suite against qPCR using a large panel of bacterial strains and in various produce items (cantaloupe, lettuce, pepper, spinach, sprouts, and tomato) with conditions mimicking real-world contamination events, and to examine the effect of DNA extraction methods on assay performance. Rapid, reliable, and robust detection of important human pathogens in produce will provide the produce industry an invaluable tool to better control potential microbial contaminants, therefore significantly reducing the number of outbreaks and illnesses associated with fresh produce.

This project did not build on a previous SCBCP grant.

Project Approach

LAMP and qPCR specificity were examined using a large panel of bacterial strains, 168 for *Salmonella* and 156 for *E. coli*. False-positive or false-negative results were not observed for any of the LAMP assays, i.e., LAMP was 100% specific for all targets. The time to positive results ranged from 13.5 to 25 min for LAMP and 12.8 to 20 cycles for qPCR (about 2 min per cycle). However, false-negative results were consistently generated for two *E. coli* strains tested by one qPCR assay.

LAMP and qPCR sensitivity were determined using 10-fold serially diluted bacterial cultures. The detection limits for LAMP and qPCR were 1-20 CFU per reaction and inconsistent results were observed at the lower level. Two *E. coli* LAMP assays were 100-fold less sensitive when testing strains carrying certain target gene subtypes.

A variety of produce items (cantaloupe, lettuce, pepper, spinach, sprouts, and tomato) were spiked on the surface using 10-fold serially diluted bacterial cultures. The samples were aged at the refrigerator temperature for 2 days before testing. A DNA sample preparation kit, PrepMan Ultra was used to prepare samples for detection by LAMP or qPCR. In total, 60 samples per produce item were tested for *Salmonella* and 35 samples per produce were tested for *E. coli*. The detection limits were 10^4 to 10^6 CFU per 25 g produce, approximately 10^2 to 10^4 CFU per g. Lower sensitivity was observed in the three types of sprouts. The abundant natural flora present in sprouts, 2-3 longs higher than other produce items, may account for the discrepancies. Consistent with pure-culture sensitivity data, two *E. coli* LAMP assays were 100-fold less sensitive when testing strains carrying certain target gene subtypes.

A variety of produce items (cantaloupe, lettuce, pepper, spinach, sprouts, and tomato) were spiked on the surface with a low-level (1 to 2 CFU/25 g) of bacterial cultures. The samples were aged at the refrigerator temperature for 2 days before testing. After cold storage, the samples were enriched in microbiological media for up to 24 h. Samples were taken at 6, 8, 10, and 24 h, and subjected to sample preparation followed by LAMP or qPCR testing. With 6 to 8 h of enrichment, LAMP detected such low level pathogen cells in all the produce varieties tested except for sprouts, which required up to 1,000-fold higher bacterial cells and 8-10 h of enrichment.

Six DNA sample preparation methods were compared using produce enrichment broths. Overall, PrepMan Ultra sample preparation yielded the best results, while the five other methods also generated satisfactory results with samples enriched up to 24 h. FTA Elute has the advantage of preserving sample DNAs up to two years and without centrifugation steps; however, the final DNA amount extracted was approximately 100-fold less concentrated than other methods, requiring more cells in the enrichment broth or prolonged enrichment time.

Goals and Outcomes Achieved
Research activities for this project are conducted by the University of Maryland subaward principal investigator.

Objective 1: To develop and evaluate LAMP assays for STEC O157 and top non-O157 serogroups
The successful development of two sets of STEC assays were detailed in two peer-reviewed publications (Wang et al., 2012, Journal of Clinical Microbiology, 50:91-97; Wang et al., 2012, Applied and Environmental Microbiology, 78:2727-2736). Further evaluation of the LAMP assays against qPCR using a large panel of bacterial strains showed that the assays were rapid (10 to 45 min), specific (no false-positive or false-negative results), and sensitive (1-20 cells per reaction). Two assays also observed were 100-fold less sensitive when applied to *E. coli* strains containing certain gene subtypes.

Objective 2: To evaluate the robustness of the LAMP detection system using abusive temperature, pH, and the addition of soil, chlorophyll, and produce enrichment broth
Robustness of the *Salmonella* LAMP assay was evaluated in comparison with PCR. Parameters evaluated included assay preparation temperature, assay running temperature, pH, the addition of culture media, humic acid, plant polysaccharide, soil and produce rinses. The data suggested that humic acid had a strong inhibitory effect against LAMP assays, while the LAMP assays were rather robust under other conditions. In comparison, PCR was found to be less robust than LAMP. Findings from this study were published recently (Yang et al., 2014, Journal of Applied Microbiology, 116:81-88).

Objective 3: To validate the system in complex produce matrices (cantaloupe, lettuce, pepper, spinach, sprouts, and tomato) surface-inoculated with low levels of these pathogens
LAMP and qPCR sensitivity were determined in produce surface-inoculated with high levels of these pathogens first, and found the detection limits to be in the range of 10^4 to 10^6 CFU per 25 g of produce, which was comparable to the sensitivity in pure-culture testing. The effect of six DNA extraction methods was then evaluated on assay performance and identified PrepMan Ultra to be the best method. Finally, the rapid detection of a low level (1-2 CFU/25 g) of pathogen cells in produce was evaluated. With 6 to 8 h of enrichment, the LAMP assays accurately detected such low level pathogen cells, even among *E. coli* strains containing certain gene subtypes of inferior sensitivity. In sprouts varieties, up to 1,000-fold higher bacterial cells and 8-10 h of enrichment were required for accurate detection.

As an alternative to a survey, CPS has opted to partner with various commodity and trade groups to disseminate research results. This is a trusted source of information for the fresh produce industry. Two of the larger associations that assist CPS with this endeavor are Western Growers Association and Produce Marketing Association. Western Growers members provide 50% of the nation's fresh fruit vegetables including one-third of the organic fresh produce and 99% of the tree nuts. The Produce Marketing Association represents companies from every segment of the global fresh produce supply chain. Both WGA and PMA have provided staff resources to translate the research results into usable information for use by the fresh produce and dried nut industry. All information is public and available on the Center for Produce Safety's website, www.centerforproducesafety.org as well as offered through research webinars, extension scientists and commodity organizations. All trusted sources for science based information. Resources include; annual symposium, symposium key learnings, CPS 5 Year Key Learnings, and CPS Produce Research Symposium - A Practical Guide to the Scientific Research.

Beneficiaries
Upon comprehensive evaluation using a large panel of bacterial strains and a variety of produce items, the *Salmonella* LAMP assay and the STEC LAMP suite of 10 assays were demonstrated to be rapid, reliable, and robust. Coupled with an effective DNA extraction method, the assays accurately detected a low level (1-2 CFU/25 g) of these pathogens in all produce items tested (but not sprouts) after 6 to 8 h of enrichment. A similar trend of detection was observed for qPCR.
The availability of such a detection system for routine pathogen testing in produce provides a valuable tool for the specialty crop industry (growers, harvesters, processors, distributors, retailers, and consumers) and regulatory agencies to better identify contamination risks and ensure produce safety, therefore reducing produce-related *Salmonella* or STEC outbreaks and illnesses in the long run. These groups receive information about this research as described below.

The research findings have been presented at the 2012 and 2013 CPS Produce Research Symposium and various other venues, including International Association for Food Protection annual meetings and FDA Annual Foods Program Science and Research Conferences. Feedbacks from the scientific community and the produce industry highlighted the critical importance and timeliness of the research.

There are 42,729 farms of specialty crop growers representing $23.9 billion in sales in the state of California according to the 2012 Census (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/index.asp).

The Project Director presented a poster of interim results at the 2013 CPS Produce Research Symposium in Rochester, New York. Final research results were presented in June at the 2014 CPS Produce Research Symposium in Newport Beach, California. The 2013 symposium had 300 attendees and the 2014 symposium had 245. The participants included California regional and national growers/shippers, retail and food service buyers, scientists, academic, produce industry representatives, and members of regulatory agencies. The symposium provides expert panels to critique research results. This process helps participants evaluate the use of the research results in their respective businesses. Project results will be disseminated at industry meetings and streamed through social media sources.

Final results will also be included in the following:

1. The Final report can be found at http://www.centerforproducesafety.org/amass/documents/researchproject/330/CPS%20Final%20report%20-%20Meng.pdf
2. CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website.
3. The Center for Produce Safety's Board of Directors and members of the Technical Committee distribute a series of information throughout the year on their websites, and through presentations, meetings and webinars. An example of this would be the "CPS Funded Research - Key Learnings" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/210/CPS%20Key%20Learnings%20May%202014_FINAL2.pdf

The following websites provide additional resources on the final reports and symposium proceedings:

Center for Produce Safety: https://cps.ucdavis.edu/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

Lessons Learned

The challenge with sprouts detection by both LAMP and qPCR was unexpected. For sprouts varieties spiked with 1-2 CFU per 25 g *Salmonella* or *E. coli*, both LAMP and qPCR failed to detect with up to 24-h enrichment. The levels were increased spiked by 100- and 1,000 fold, which resulted in positive detection. Project team hypothesized that he abundant natural flora present in sprouts, 2-3 longs higher than other produce items, may account for the discrepancies. Also, natural compounds in sprouts released during processing may affect *Salmonella* and STEC survival during enrichment, resulting in low sensitivity in detection.

Additional Information
Attachment 1: Evaluation of a Loop-Mediated Isothermal Amplification Suite for the Rapid, Reliable, and Robust Detection of Shiga Toxin-Producing Escherichia coli in Produce

Publications:

Wang, F., Q. Yang, Y. qu, J. Meng, and B. Ge. 2014. Evaluation of a loop-mediated isothermal amplification suite for the rapid, reliable, and robust detection of Shiga toxin-producing *Escherichia coli* in produce. Applied and Environmental Microbiology (revision submitted)

Yang, Q., F. Wang, K. L. Jones, J. Meng, W. Prinyawiwatkul, and B. Ge. 2014. Evaluation of loop-mediated isothermal amplification for the rapid, reliable, and robust detection of *Salmonella* in produce. Food Microbiology (under preparation)

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 65	**Project Title:** Sources and mechanisms of transfer of Salmonella in the production and post-harvest tree nut environment	
Grant Recipient: Regents of the University of California, Davis Center for Produce Safety	**Grant Agreement No.:** SCB11065	**Date Submitted:** December 2014
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** 530-757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

Over the past decade, several foodborne disease outbreaks (both salmonellosis and Escherichia coli (E.coli) O157:H7 gastroenteritis)) have been linked to consumption of raw tree nuts grown in California. The primary vectors and transport pathways leading to the contamination of almonds and pistachios by Salmonella and other zoonotic enteric pathogens remain unclear, and may be impacted by production practices, harvest and postharvest handling. However, for both almonds and pistachios, dust and bioaerosols have the potential to be important routes of transmission during production, harvest and, in some cases, post-process handling. Bioaerosols are defined as biological particulates, such as viruses and bacteria suspended in the air, whereas dust comprises mineral particulates that may serve as carriers. Concentrations of livestock may generate bioaerosols and airborne dust that can be transported off-farm to surrounding areas. The purpose of this project was to explore whether contamination of almonds and pistachios with Salmonella bacteria is facilitated by movement of dust in orchards, and during initial post-harvest handling.

In the U.S., California's Central Valley is the sole producer of almonds and the major producer of pistachios. This region is also a home to the largest dairy industry in the nation. An unintended consequence of the growth of the dairy and tree nut industries over the past 20 years is the large concentration of cattle often found in the vicinity of many other agricultural crops, including tree nuts, citrus, and vegetables. The risk of pathogen transport from large dairies and feedlots to surrounding food crops is not well-characterized. Results from *Salmonella* prevalence surveys for California almonds (2001-2007, 2010) suggested that cattle environments, especially dairies, may serve as a source of Salmonella contamination of orchards in the Central Valley.

Thus the objectives were as follows: Objective 1a was to evaluate the microbial composition of bioaerosols and dust originating from livestock operations located in close proximity to almond and pistachio production areas in the California Central Valley. Objective 1b was to evaluate the movement of microorganisms from livestock areas to nearby almond and pistachio orchards compared with control orchards not in the proximity to livestock operations. Standardized and validated bioaerosol collection and analytical techniques were used to measure the occurrence, dispersion, and transport of Salmonella and non-pathogenic indicator E. coli from livestock sources (solid stacks, lagoon, pen floors/bedding) to nearby almond and pistachio crops. Molecular sub-typing approaches were used to compare genetic relatedness and source track movement of strains from livestock operations to tree nut study sites. Culture-independent bacterial community analysis was used on a subset of samples to evaluate the potential of this technique. Objective 2a was to evaluate microbial composition of bioaerosols and dusts at a almond hullers/shellers and 2b was to evaluate microbial composition of bioaerosols and dusts at pistachio hulling/processing facilities.

This project did not build on a previous SCBCP grant.

Project Approach

Samples were collected from two pistachio orchards in close proximity to livestock operations: One orchard was next to a dairy (denoted "Pistachio Dairy") and the other was next to a dairy calf operation ("Pistachio Calf"). In 2012, Pistachio Dairy was sampled twice, before and after the harvest. In 2013, samples were collected three times from Pistachio Dairy, and seven times from Pistachio Calf. Samples were also collected from the adjacent livestock operations upon each visit. In addition, samples were collected from two almond orchards: One orchard was in close proximity to a poultry operation ("Almond Poultry"), and the other served as a control orchard ("Almond Control"), and was not in proximity to any animal operation. In 2012, Almond Poultry was sampled three times (before, during, and after harvest), and eight times in 2013. Samples were collected on five occasions from Almond Control in 2013. Samplings within the poultry operation were not permitted. For Pistachio Calf, Almond Poultry, and Almond Control--the final sampling in 2013 occurred after the trees had been shaken the first time, and the nuts harvested; all other sampling in 2013 occurred before harvest activities.

A significant amount of effort (more than expected) was devoted to evaluating the methodology used to collect data on microbiological populations. Initially, proposed methods for air sampling (pyrosequencing) did not work well (counts were virtually impossible for a vast majority of samples), and molecular sequencing was used instead. While there was a visible gradient in the amount of dust present on leaves at the edge of the orchard, differences in microbial counts could not be demonstrated. However, in year two of this project, weights of adhering dry solid matter were also measured on the leaves and this method did support the observations. Originally planned was the evaluation of the potential of pyrosequencing (on a subset of samples) as a means to evaluate the potential for this culture-independent technique to characterize microbial communities. However, evaluation methods in this area had advanced significantly and the project team instead decided to evaluate Illumina Sequencing.

A total of 1,477 samples were collected in almond and pistachio orchards or adjacent animal operations to evaluate the microbial composition of bioaerosols and dusts near and within almond and pistachio orchards; and to evaluate to what extent microorganisms were able to move from livestock areas to neighboring orchards. The following general observations were made:

1. Microbial populations in air samples as measured by collection on agar were consistent throughout an orchard, but differed with sample date.
2. Harvest amounts of dust were significantly greater on leaves collected from trees that were at the edge of the orchard compared to the leaves from trees further into the orchard. Differences in dust levels on leaves collected throughout the orchards were insignificant after harvest, and likely due to shaking of the trees during the harvest.
3. Generic E. coli was detected in the air, from within the almond and pistachio orchards that were next to animal operations, but not from the almond control orchard.
4. Salmonella was isolated from some, but not all samples of manure collected from the dairy or calf operation. Salmonella was isolated at a single time point from each of the three orchards from pooled drag swabs that pick up material from the surface of the orchard, and never from any of the other samples (air, soil, leaf rinsates). For Almond Poultry and Pistachio Dairy, Salmonella was found during harvest June 2014, in the row closest to the animal operation. Salmonella was isolated from Pistachio Calf, in all three of the rows

examined (next to, 60 and 120 meters into the orchard). The Salmonella identified in the calf manure and lagoon samples (Serovar Give) in February and April of 2013 was the same as that identified in the corresponding pistachio orchard in June of 2013.
5. The microbial communities identified by Illumina sequencing (Originally proposed pyrosequencing) revealed that there were distinct bacterial populations associated with the air, leaf rinsate, and soil collected in the orchards. Bacterial populations in the leaf rinsate and air samples from Almond Poultry were significantly more diverse compared to the leaf rinsate samples from Almond Control. Almond Poultry leaf rinsate samples form unique clusters in Principal Component Analysis (PCA), and different bacterial families were associated with Almond Poultry.

Partners included the two industry organizations (Almond Board of California and Pistachio Research Board) growers. Also, processors that assisted in identifying appropriate collaborators, and especially the farmers that allowed access to their property; support from these partners was greatly appreciated. In many cases, a work-around was needed to various orchard activities (application of agrochemicals, harvesting activities) and the partners were very accommodating.

Goals and Outcomes Achieved

Research activities for this project were conducted by the UC Davis sub-award principal investigator. The goal was to collect approximately 600 total livestock and orchard environmental samples, and approximately 100 processing/kernel samples for Salmonella culture and enumeration of E. coli indicator bacteria. A total of 1,477 samples were collected in almond and pistachio orchards, or adjacent animal operations to evaluate the movement of bacterial populations from nearby animal operations into tree nut orchards. No processing/kernel samples were collected for the reasons stated above.

The long-term goal was to fill a data gap relating to off-orchard sources of Salmonella contamination of almonds and pistachios. Project team wanted to determine the role of bioaerosols and dust generated from nearby livestock operations in the transport and dissemination of Salmonella and indicator bacteria during production, harvest, and processing of tree nuts. The knowledge gained from this study was intended to be used to improve good agriculture practices that protect almond and pistachio nuts from Salmonella contamination.

Collectively, the data generated by this study provided preliminary evidence that microbial populations in tree nut orchards may be altered by proximity to large-scale animal operations. However, further data from paired orchards (next to and at a distance from animal operations) are needed to characterize the significance of these altered microbial communities to the safety of tree nuts. The findings represent an important addition to the ongoing work by the research team and others to elucidate sources and mechanisms of transmission of pathogens where animal and orchard production units coexist. Moreover, specific areas are being discovered where the tree-nut industry and livestock industry can address risk, and promote targeted future research in produce food safety standards.

Of the various measurements evaluated in the study, the following would be recommended should research in this area be continued: Amounts of dust on leaves; pooled drag swabs in the orchards for Salmonella; E. coli in air samples; and microbial communities on leaf rinsates and soil.

Beneficiaries

The primary beneficiaries of the results of this study are almond and pistachio growers with processors as indirect beneficiaries. The long-term goal of this research was to characterize the food safety risk, if any, of co-location of concentrated animal agriculture and tree nut orchards. Collectively, the data suggested that microbial populations in orchards may be impacted by proximity animal agriculture, but the impact on microbial food safety at this point is unclear.

There are more than 6,500 almond growers in California, farming over 800,000 acres of land. California produces nearly 2 billion pounds of kernels each year, which is about 80% of the world production that is handled by 250 huller shellers and 106 processors; the crop is valued at nearly 4 billion dollars. There are more than 950 pistachio growers in California farming over 300,000 acres, and 4,000 in Arizona and New Mexico. There are 24 pistachio processors in the United States, and the seven largest processors are located in California, accounting for over 97% of the total volume produced. The total crop size has increased from 1.5 million pounds in 1976 to an average of nearly 500 million pounds per year over the 2010-2013 crop years, with a value of over 1 billion dollars.

The Center for Produce Safety (CPS) has worked with the industry partners to disseminate and translate research information. In turn, the CPS website has become an industry reference site for produce food safety research information. As an alternative to a survey, CPS has opted to partner with various commodity and trade groups to disseminate research results. This is a trusted source of information for the fresh produce industry.

Two of the larger associations that assist CPS are Western Growers Association (WGA) and Produce Marketing Association (PMA). Western Growers members provide 50% of the nation's fresh fruit vegetables including one-third of the organic fresh produce, and 99% of the tree nuts. The PMA represents companies from every segment of the global fresh produce supply chain. Both WGA and PMA have provided staff resources to translate the research results into usable information for use by the fresh produce and dried nut industry.

All information is public and available on the Center for Produce Safety's website, www.centerforproducesafety.org as well as offered through research webinars, extension scientists and commodity organizations. Resources include; annual symposium, symposium key learnings, CPS 5 Year Key Learnings, and CPS Produce Research Symposium - A Practical Guide to the Scientific Research.

In addition to the support of PMA and WGA, the Almond Board of California was the Partner in Research for this project. The California almond industry includes 1,000 almond growers and over 100 almond handlers that represent about 80% of the global and virtually 100% of the domestic supply. ABC disseminated research finding directly to the almond industry.

Dr. Linda Harris, University of California, Davis, presented a poster of interim results at the 2013 CPS Produce Research Symposium in Rochester, New York. Final research results were presented in June at the 2014 CPS Produce Research Symposium in Newport Beach, CA. The 2013 symposium had 300 attendees and the 2014 symposium had 245. The participants included California regional and national growers/shippers, retail and food service buyers, scientists, academic, produce industry representatives, and members of regulatory agencies. The symposium provides expert panels to critique research results. This process helps participants evaluate the use of the research results in their respective businesses. Project results will be disseminated at industry meetings and streamed through social media sources.

Final results will also be included in the following:

1. The Final report can be found at http://www.centerforproducesafety.org/amass/documents/researchproject/331/CPS%20Final%20report%20Harris%20Sources%20and%20mechanism.pdf
2. CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website.
3. The Center for Produce Safety's Board of Directors and members of the Technical Committee distribute a series of information throughout the year on their websites, and through presentations, meetings and webinars. An example of this would be the "CPS Funded Research - Key Learnings" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/210/CPS%20Key%20Learnings%20May%202014_FINAL2.pdf

Lessons Learned

The goal for objective 1 was to identify almond and pistachio orchards that were next to a collaborating dairy or feedlot, and control orchards that were approximately 0.5 miles and upwind from the nearest livestock operation (preferably surrounded by other orchards). Investigation of two livestock operation orchard units and two control orchards were proposed and would be sampled for two growing seasons, from July through November of 2013, and with greater sampling frequency as those orchards were harvested (objective 1). Unfortunately, collaborating growers were not identified until very late in the first year of the project (2011). Once identified, there were limitations in the choice. Confirmation was made of two pistachio orchards; one next to a dairy feedlot (Identified mid 2012) and the other next to a dairy calf operation (late 2012). Access was permitted to both the diary and dairy calf operations. However, access to control orchards was not given. The orchard next to the dairy feedlot was very small, and for this reason, was sampled in 2012 and the spring of 2013. The only collaborating almond orchard identified was next to a poultry layer operation, rather than a dairy. The manager of the poultry farm acknowledged and did not object to the sampling of the almond orchard, but was uncomfortable with having project team on his property, in part because of his biosecurity program. Therefore, samples were not collected within the layer operation. There was, however, access to a corresponding control almond orchard that was not near domestic animal production. The proposed research was written in direct response to a research area of interest for both the almond and pistachio industries. Despite the collective agreement that the research was of interest, collaborators expected "someone else" to volunteer to give access to appropriate properties to collect samples. Ultimately, after several meetings and phone calls, individuals, in both the almond and pistachio industries, offered to collaborate and help identify appropriate individuals. The extra effort these individuals made to ensure that samples could be collected was very much appreciated, but overall the project would have benefitted from having broader access to properties that were better paired. (Pistachio Calf plus Pistachio controls, almonds near a dairy instead of poultry).

The reluctance to collaborate was most likely, in part, due to the lack of preliminary data and the fact that this project concentrated on looking for Salmonella. Because this was uncharted territory, the challenge was to communicate exactly what the data would reveal and what risk, if any, there would be to the crop or the business on either side of the fence. For those who worked with UC Davis Center for Produce Safety, trust and confidence was gained with a genuine interest and support of the work for this project. If someone were to start this project today, with the data now known, greater success would be achieved in identifying additional collaborators.

For objective 2, it was proposed to follow the harvested almonds and pistachios from the test orchards to the hulling facilities where they are processed; and sample dusts in and around these facilities as corresponding almonds are hulled and shelled or pistachios are hulled and dried. However, despite best efforts and those of collaborating almond and pistachio industry food safety committees, there was no success in identifying either almond or pistachio hulling facilities that were willing to allow the collection of samples. Thus, objective 2 was not accomplished.

Additional Information

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: https://cps.ucdavis.edu/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 66	**Project Title:** Distribution of *Salmonella* in Pistachios and Development of Effective Sampling Strategies	
Grant Recipient: The Regents for the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB11066	**Date Submitted:** December 2014
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** 530-757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

Nuts and other low-moisture foods have generally been considered low risks for foodborne illness because they are consumed in a dry state where water activity (available moisture) is too low to support microbial growth. However, it is increasingly recognized that many foodborne pathogens can cause illness at very low concentrations, such that microbial growth is not required. In the past decade, foodborne illness outbreaks associated with consumption of raw almonds, pine nuts, and hazelnuts have been documented in the U.S. In 2009 there was a large recall of pistachios when *Salmonella* Montevideo was isolated from commercial products and in 2013 a smaller recall was triggered by isolation of *Salmonella* Senftenberg from pistachios that were epidemiologically linked to several illnesses across the U.S. However, with the exception of almonds, very little is known about the prevalence, levels and distribution of *Salmonella* in nut production and processing environments; these data are important to develop robust quantitative microbial risk assessment (QMRA) and for developing scientifically-sound product sampling schemes for verification of food safety plans. One objective of this research was to determine the prevalence, levels and distribution of *Salmonella* in U.S. pistachios over a 2-year period. *Salmonella* isolates were characterized as a means of providing insight into potential routes of contamination with the long-term goal of identifying appropriate mitigation strategies. A second objective was to use these data to evaluate sampling strategies that could be applied by the pistachio industry to evaluate the microbial status of raw pistachios.

The data generated by this project (prevalence, levels and distribution of *Salmonella* in U.S. pistachios) are being used to complete a Quantitative Microbial Risk Assessment (QMRA) for pistachios that was initiated in a previously funded 2009 SCBGP project #54. In addition, on July 17, 2013, the U.S. Food and Drug Administration posted a formal request (in the Federal Register) for raw data that will be used to develop a tree nut risk assessment (risk of salmonellosis associated with eating tree nuts) over the next 1 to 2 years. This QMRA will be very important to evaluating and setting performance standards (appropriate target reductions) for *Salmonella* in pistachios. Determining scientifically-defendable performance standards will be critical once the final rules for the Food Safety Modernization Act are published (in particular the Food and Drug Administration Preventative Controls Rule). The project team worked closely with the pistachio industry to organize the data generated from this grant to include in their formal data submission to the docket that was due December 16, 2013 ((Docket No. FDA-2013-N-0747) Assessment of the Risk of Human Salmonellosis Associated with the Consumption of Tree Nuts; Request for Comments, Scientific Data and Information).

Project Approach
Raw in shell pistachio samples from the 2011 and 2012 harvests were collected within 2 months of harvest and stored at 4°C. Seven collaborating pistachio processors representing the majority of California pistachio production (about 98%) participated in the survey. The number of samples collected from each collaborator roughly corresponded to their proportion of the approximate crop volume. Pistachios were coded to blind the samples, and then stored and processed for *Salmonella* by the American Council for Food Safety and Quality (ACFSQ) (Fresno, California). A total of 2,816 pistachio samples were collected and analyzed in 2011 and 2012. Because the data from a 2010 survey (1,152 samples) funded previously by the pistachio industry were important to the overall evaluation and analysis of the survey data they are included throughout the results and discussion. Immediately after hulling, pistachios are passed through a float tank that separates nuts on the basis of density – nuts that fill the shell are heavier and sink while smaller nuts and those with insect damage or adhering hull float. Nuts that sink are called "sinkers" (~85% of the typical crop), and nuts that float are called "floaters" (~15% of the typical crop). Sinker and floater nuts are handled independently after initial separation and are dried and stored separately. An evaluation of data from a 2010 survey indicated a potentially higher prevalence of *Salmonella* in floater samples. Therefore, the project team chose to analyze a disproportionate number of floaters in 2011 and 2012 (35% and 27% of samples, respectively).

The overall weighted prevalence of *Salmonella* in raw California inshell pistachios in 100-g samples determined for nearly 4,000 samples collected over three harvests (2010, 2011, and 2012) was 0.6%. The overall average level of *Salmonella* determined for positive samples was 0.8 Most Probable Number (MPN)/100 g or 0.008 MPN/g.

There was a significant difference in the overall prevalence of *Salmonella* in sinker (0.4%) and floater pistachios (2%). The average level of *Salmonella* in sinkers (0.2 MPN/100 g) was also significantly lower than that of floaters (1 MPN/100 g). All the positive samples in 2012 came from silos that held pistachios that came from a second shaking of the trees or were mixed (first and second shake).

Two approaches were used to recommend an appropriate sample size for isolation of *Salmonella* from raw pistachios. It is usually recommended that a sampling plan achieve at least a 95% probability of detecting a positive in a positive lot. For floater silos contaminated at levels reported here, a 250 g or greater subsample would provide an estimated 97% likelihood of detecting a positive. For sinker samples, three 375 g samples would be needed to provide a 95% assurance of finding *Salmonella* in a positive lot.

More than one serovar of *Salmonella* was isolated from 14 of the 32 positive samples; three or four different serovars of *Salmonella* were isolated from eight different pistachio samples. All isolates over the 3 years were one of nine different serovars. *Salmonella* Montevideo predominated and was isolated from an average of 66% of the samples (45%, 50%, and 88% of samples in 2010, 2011, and 2012). Pulsed-field Gel Electrophoresis (PFGE) patterns were determined to provide further information on the diversity of the *Salmonella* isolates. There were two PFGE patterns of *Salmonella* Montevideo isolated in each of the 3 years (of 11 isolates evaluated) and two PFGE patterns of *Salmonella* Worthington (of 10 isolates evaluated) over 2 years. *Salmonella* Enteritidis PFGE patterns were the same within each of the three phage types identified (PT9c, PT37, and RDNC). Three different but related *Salmonella* Liverpool PFGE patterns were noted for the eight isolates. Two PFGE patterns that differed by a single band were noted for the eight *Salmonella* Senftenberg isolates.

Taken together these data suggest that the higher prevalence and levels of *Salmonella* in floater pistachios is driven by a subset of silos that are much more contaminated than the rest. Data from 2012 suggest that this contamination is strongly associated with pistachios that are "second shake." For these floater silos the prevalence of *Salmonella* among the samples analyzed ranged from 14 to 100% (average 48% positive 100-g samples from 11 silos). Although the level of *Salmonella* in these silos was the same as the calculated overall average (0.008 MPN/g), these silos each contain 1 to 1.5 million pounds of pistachios. Even though only 25% of the weight is edible product, the amounts are significant. It is not known if the prevalence of *Salmonella* from these silos would be similar after the product was sorted and shelled. While most pistachios are treated by one or more processes that have been validated to reduce *Salmonella*, large volumes of pistachios, even when contaminated at low levels, pose a risk of contaminating the both the equipment and facility in which they are handled. This increases the risk of a post-processing recontamination event.

To maintain optimum quality, pistachio processors target short times between shaking nuts from the tree to the time the hull is removed. Based on data from earlier CPS-funded study *Salmonella* can grow on harvested pistachios under temperatures and humidities that can be achieved in harvest trailers that are held for several hours. Increases in levels of *Salmonella* are significant after 6 hours. *Salmonella* can also multiply in hulled pistachios when there are delays between hulling and drying. Because the prevalence of *Salmonella* was lower in sinker pistachios it is likely that the cause of the higher prevalence in a number of floater silos occurred after the float tank. The association with second shake pistachios may be related to the condition of the hulls that adhere to a greater portion of hulled floaters but also suggests the possibility of delays between hulling and drying.

The isolation of a narrow range of *Salmonella* serovars and PFGE patterns over the 3 years of this study suggests that several strains of *Salmonella* may have established resident and persistent populations at one or more of the pistachio handlers that participated in this study. It is possible that several silos are contaminated with these *Salmonella*. Cleaning and sanitizing silos is challenging and it is possible that the reoccurring contamination of floaters is due to an introduction of *Salmonella* after the pistachios are dried and as they are loaded into these silos. However, this explanation does not explain the strong association of positive samples with second shake pistachios and especially with floaters.

Pistachios were sampled through silo sample ports using a sample trier. The sampling was not supervised by UC Davis but was undertaken by a contract laboratory. Although the triers are sprayed with a 70% ethanol solution between each sample, the construction of each triers are complex making sanitation a challenge. It is possible that the sanitation step was inadequate and resulted in some cross-contamination among samples. This might explain why some of the floater silos had a higher prevalence of *Salmonella* but would not fully explain why the positives were consistently associated with floater samples in each of the 3 years since the same triers were used to collect both floater and sinker samples.

Although all of the pistachios from this survey have already been processed and distributed, it is strongly recommended that the participants in this study closely evaluate their floater stream for future crops. Particular attention should be given to those silos that contain second shake or mixed pistachios. Analyzing a single 250 to 375-g sample of pistachios per silo by enrichment (assuming subsamples are taken from throughout the silo and well mixed) should give a reasonable likelihood of finding *Salmonella* if present at the levels observed in 2012. If positives are found, these facilities should handle pistachios from these silos with caution and they should consider performing a root cause analysis with the goal of developing an action plan to 1) reduce prevalence of *Salmonella* in floater pistachios and 2) eradicate potentially resident populations of *Salmonella*.

The overall results from sinker pistachios provide substantial data demonstrating that production of pistachios with low prevalence and levels of *Salmonella* is possible. By focusing on identifying the root cases for contamination of second shake floater pistachios the U.S. pistachio industry should be able to implement targeted mitigation strategies that will further reduce the overall prevalence of *Salmonella* in this commodity.

California produces 99% of the total domestic production of pistachios (an average of 500 million pounds per year over the 2010-2013 crop years). There are more than 950 pistachio growers and 24 pistachio processors in the U.S. The seven largest processors (all in California) account for over 97% of the total volume produced and these processors participated in the survey by supplying samples of pistachios each year. The data described here were presented to the pistachio industry on a regular basis and feedback from pistachio processors lead to modifications in data collection and analysis that significantly increased the impact of the data collected. For example, in 2012, on the recommendation of one of the industry partners, the project team also made note of whether or not the pistachios were harvested from the first or second shake of the tree. Pistachio trees are not always shaken twice during harvest, but “second shake” nuts often have softer hulls because it is later in the season and the product is more mature. Second shake floater pistachios were ultimately highly associated with isolation of *Salmonella*. This finding provides the pistachio industry with a targeted focus for further reducing overall prevalence of *Salmonella* in this commodity.

Goals and Outcomes Achieved

Research activities for this project are conducted by the UC Davis subaward principal investigator. The target goals were met and exceeded as outlined in the initial grant proposal. Approximately 4,000 sample enrichments were processed for *Salmonella*, over 225 isolates were serotyped, and PFGE patterns were determined for more than 60 of those isolates. The data from these analyses were used to calculate the prevalence, levels and distribution of *Salmonella* for California pistachios harvested in 2010, 2011 and 2012 and to determine sampling protocols for the pistachio industry that are appropriate for detection of *Salmonella* in raw pistachios collected from storage silos.

As an alternative to a survey, CPS has opted to partner with various commodity and trade groups to disseminate research results. This is a trusted source of information for the fresh produce industry. Two of the larger associations that assist CPS with this endeavor are Western Growers Association (WGA) and Produce Marketing Association (PMA). Western Growers members provide 50% of the nation’s fresh fruit and vegetables including one-third of the organic fresh produce and 99% of the tree nuts. The Produce Marketing Association represents companies from every segment of the global fresh produce supply chain. Both WGA and PMA have provided staff resources to translate the research results into usable information for use by the fresh produce and dried nut industry. All information is public and available on the Center for Produce Safety's website, www.centerforproducesafety.org as well as offered through research webinars, extension scientists and commodity organizations. All trusted sources for science based information. Resources include; annual symposium, symposium key learnings, CPS 5 Year Key Learnings, and CPS Produce Research Symposium - A Practical Guide to the Scientific Research.

In addition to the support of the PMA and WG, the California Pistachio Research Board (CPRB) was the Partner in Research for this project. According to CPRB; California produces 98 percent of the nation's pistachios with approximately 1,000 growers and 24 handlers. Seven handlers represent 98 percent of the volume. CPRB directly disseminated research to their pistachio industry.

Beneficiaries

There are more than 950 pistachio growers farming over 300,000 acres (bearing and nonbearing) in California. There are 24 pistachio processors in the U.S. and the seven largest processors are located in California and account for over 97% of the total volume produced. The total crop size has increased from 1.5 million pounds in 1976 to an average of nearly 500 million pounds per year over the 2010-2013 crop years with a value of over one billion dollars. A large portion of the crop (60%) is exported, primarily to China and Europe. The primary beneficiaries of the results of this study are the pistachio processors and users of pistachio nuts, with growers as indirect beneficiaries. These groups receive information about this research as described below.

The Project Director presented a poster of interim results at the 2013 CPS Produce Research Symposium in Rochester, New York. Final research results were presented in June at the 2014 CPS Produce Research Symposium in Newport Beach, CA. The 2013 symposium had 300 attendees and the 2014 symposium had 245. The participants included California regional and national growers/shippers, retail and food service buyers, scientists, academis, produce industry representatives, and members of regulatory agencies. The symposium provides rexpert panels to critique research results. This process helps participants evaluate the use of the research results in their respective businesses. Project results will be disseminated at industry meetings and streamed through social media sources.

Final results will also be included in the following:

1.) The Final report can be found at http://www.centerforproducesafety.org/amass/documents/researchproject/332/CPS%20Final%20report,%20Harris%20-%20Distribution%20of%20Salmonella.pdf

2.) CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website.

3.) The Center for Produce Safety's Board of Directors and members of the Technical Committee distribute a series of information throughout the year on their websites, and through presentations, meetings and webinars. An example of this would be the "CPS Funded Research - Key Learnings" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/210/CPS%20Key%20Learnings%20May%202014_FINAL2.pdf

The following websites provide additional resources on the final reports and symposium proceedings:

Center for Produce Safety: https://cps.ucdavis.edu/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

Lessons Learned
This project made several findings that were not expected:

- Significantly greater prevalence and levels of *Salmonella* were found in floater pistachios than in sinker pistachios.
- Large volumes of floater pistachios (silos) can be contaminated with low levels of *Salmonella*.
- Higher prevalence and levels of *Salmonella* in floater pistachios may be associated with the practice of shaking pistachio trees more than one time during harvest.
- Several strains of *Salmonella* may have established resident and persistent populations at one or more of the pistachio handlers that participated in this study.

The overall results from sinker pistachios provide substantial data that demonstrate that the production of pistachios with low prevalence and levels of *Salmonella* is possible. By focusing on identification of the root cases for contamination of second shake floater pistachios the U.S. pistachio industry should be able to implement targeted mitigation strategies that will further reduce the prevalence of *Salmonella* in this crop.

Additional Information
Attachment 1: Abstract – Distribution of *Salmonella* in pistachios and development of effective sampling strategies

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 67	**Project Title:** Validating *Salmonella* inactivation during thermal processing of the physically heat-treated chicken litter as soil amendment and organic fertilizer	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB11067	**Date Submitted:** December 2014
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** 530-757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

Chicken litter, commonly used as soil amendment and organic fertilizer, may contain human pathogens such as *Salmonella* spp. In order to reduce the microbiological risks associated with the use of animal wastes as a soil amendment or fertilizer, physical heat treatments are recommended to reduce or eliminate potential pathogenic microorganisms. In pelletizing industry, regardless of heat source, temperature, and equipment, pellets leave the die at temperatures of 60~95°C and moisture contents of 12~18%. However, there is no official guideline for processing the pelletized chicken litter. Although the physically heat-treated chicken litter has been recommended and used by produce growers, there is a lack of scientific data to prove if the heating processes in terms of time-temperature combination are adequate to kill *Salmonella*.

Some microorganisms become acclimatized to desiccation stress under dry environment, and induction of desiccation stress response in bacterial cells makes them more resistant to the dry condition they are present. Most importantly, exposure to a single stress is found to be associated with the development of cross-tolerance to multiple unrelated stresses. Under real-world stockpiling conditions for chicken litter, *Salmonella* cells may have been exposed to the dry environment for a long period of time. Therefore, in order to validate if a thermal processing is sufficient to kill the most heat resistant pathogen, various factors such as bacterial physiological stage, type, dryness and freshness of chicken litter affecting thermal resistance of *Salmonella* should be evaluated.

During drying process, moisture in chicken litter can be quickly lost, and consequently the surviving cells become more heat resistance. Numerous studies have demonstrated that the non-spore-forming microorganisms can be inactivated much quicker by moist heat than dry heat. In order to increase the thermal inactivation rate of *Salmonella* in chicken litter, it would be plausible to design a two-step treatment with first step using moist heat to kill large populations of pathogen fast, and then apply dry heat to dry the chicken litter to the desired moisture level.

To reduce foodborne illnesses associated with fresh produce, interventions to control contamination at farm level are critical. Therefore, the project on validating *Salmonella* inactivation during thermal processing of the physically heat-treated chicken litter is urgently needed in order to provide some practical guidelines on time-temperature combination to treat chicken litter of different properties to produce the finished products as *Salmonella*-free.

This project did not build on a previous SCBGP funds.

Project Approach

The following were the activities and tasks project staff performed:

1. Validating the thermal inactivation of *Salmonella* spp. at different temperatures in broiler chicken litter.
2. Evaluating the effect of type and freshness of chicken litter on thermal resistance of *Salmonella* spp.
3. Developing a two-step heat treatment for chicken litter to expedite *Salmonella* inactivation.

The following are the significant findings from the research and the conclusions and recommendations:
Obj. 1. The results demonstrated that the thermal resistance of *Salmonella* in aged chicken litter was increased significantly when the cells were adapted to desiccation or dry chicken litter was heat-treated. In addition, pronounced tailing was also observed in the survival curves of desiccation-adapted *Salmonella* at 70, 75, 80 and 85°C. The observation implies that desiccation-adapted cells from the tailing in survival curves should be considered sufficiently by chicken litter processors when applying thermal treatment to chicken litter during compost processing. Otherwise, inadequate processing would lead to the survival of a few heat-resistant *Salmonella* cells that may contaminate produce in the field. In addition, the use of *Salmonella* Senftenberg, verified as the most heat resistant serotype in this study, as indicator microorganism can assure microbial risk assessment of the 'worst-case scenario' when evaluating the thermal processing of chicken litter in future heat challenge studies. Overall, this work has important implications for the chicken litter processors to validate and modify their heating process depending on the conditions of incoming raw chicken litter in order to eliminate *Salmonella* that may be subjected to dry stress.

Obj. 2. The results revealed that desiccation-adapted *Salmonella* in different types and storage ages of chicken litter displayed different survival profiles during heat treatment, and changes in moisture level, ammonia, electrical conductivity, heavy metals and indigenous microbial community of these samples could contribute to this difference. Overall, the desiccation-adapted *Salmonella* in fresh chicken litter was more susceptible to heat inactivation as compared in aged chicken litter of the same type or different type. Therefore, the recommendation to chicken litter processing industry is to process the chicken litter as soon as possible since the presence of ammonia and moisture in fresh chicken litter can enhance the inactivation rate of *Salmonella* during thermal processing.

Obj. 3. Due to the increased resistance of *Salmonella* in dried chicken litter during thermal processing, a few heat resistant cells may survive current physical heat processing and result in the contamination of the finished products. In order to provide temperature-time recommendations for processing physically heat-treated chicken litter, the most heat-resistant form of *Salmonella*, desiccation-adapted cells, was used to simulate the "worst-case scenario". Staff have demonstrated that a two-step heat treatment by applying moist heat to the contaminated chicken litter first followed by dry heat, can not only ensure the fast inactivation of *Salmonella* but also produce more stable and nutrient dense finished products. Based on the results, a two-step heating technique consisting of a moist-heat treatment for 1 h at 65°C and a sequential dry-heat treatment for 1 h at 85°C can be sufficient for achieving >5.5-log reductions of *Salmonella* in chicken litter with moisture content of ≥40%. Results generated from this study, after actual processing plant validation, will help the chicken litter processors to modify their existing process parameters to produce microbiologically safe organic fertilizers and soil amendment, thereby reducing the possible source of produce contamination on farm.

Goals and Outcomes Achieved
Research activities for this project were conducted by the Clemson University principal investigator.

In this proposed study, first, several recovery media for allowing heat-injured cells to resuscitate fully were evaluted. Then, a procedure to develop desiccation adaptation of *Salmonella* spp. in the finished compost was optimized. Afterwards, the thermal resistance of desiccation-adapted *Salmonella* cells (a mixture of 4 serotypes) in partially composted chicken litter was exposed to heat treatments at 70, 75, 80, 85 and 150°C. Results clearly demonstrated that the thermal resistance of *Salmonella* in aged chicken litter was increased significantly when the cells were adapted to desiccation, and the reduced moisture levels in chicken litter contributed to the better survival of *Salmonella* during heat treatment (Objective 1). The thermal resistance of *Salmonella* in both broiler chicken and egg-laying hen litter was compared, and the change of *Salmonella* heat resistance as affected by different storage ages of the broiler chicken litter collected from the same farm was also determined. Metabolic profiles of chicken litter microflora during long-term storage were analyzed using principal component analysis. The results showed that the desiccation-adapted *Salmonella* survived longer in aged broiler chicken litter than in fresh laying hen litter at 70, 75, 80, and 150ºC. A field study confirmed that the desiccation-adapted cells became increased resistance to lethal temperatures as the storage time was extended. Some changes in moisture level, ammonia, electrical conductivity, heavy metals and indigenous microbial community of aged chicken litter could contribute to this difference in the thermal resistance of *Salmonella* (Objective 2). Furthermore, the effectiveness of a two-step heat treatment for aged chicken litter on elimination of desiccation-adapted *Salmonella* was also evaluated. Based on the results, a two-step heating technique consisting of a moist-heat treatment for 1 h at 65°C and a sequential dry-heat treatment for 1 h at 85°C can be sufficient for achieving >5.5-log reductions of *Salmonella* in chicken litter with moisture content of ≥40%. Moisture contents in the range of 20 to 50% in chicken litter samples were all reduced to <12% after drying process. The increased moisture contents in chicken litter contributed to the better killing effects of *Salmonella* during moist-heat treatment (Objective 3). The results clearly demonstrated that the thermal resistance of *Salmonella* in chicken litter can vary significantly depending on moisture level, types and freshness of chicken litter, physiological stage of the pathogen, and type of heat source. The desiccation-adapted *Salmonella* in fresh chicken litter was more susceptible to heat inactivation as compared in aged chicken litter of the same type or different type. By applying moist heat to the contaminated chicken litter first followed by dry heat, this two-step heat treatment not only ensures the fast inactivation of *Salmonella* but also produce more stable and nutrient dense finished products. Results generated from this study, after actual processing plant validation, will help the chicken litter processors to modify their existing process parameters to produce microbiologically safe organic fertilizers and soil amendments, thereby reducing the possible source of produce contamination on farm.

As an alternative to developing an independent survey to track acceptance of research findings, CPS has opted to partner with various commodity and trade groups to disseminate research results. This is a trusted source of information for the fresh produce industry. Two of the larger associations that assist CPS with this endeavor are Western Growers Association and Produce Marketing Association. Western Growers members provide 50% of the nation's fresh fruit vegetables including one-third of the organic fresh produce and 99% of the tree nuts. The Produce Marketing Association represents companies from every segment of the global fresh produce supply chain. Both WGA and PMA have provided staff resources to translate the research results into usable information for use by the fresh produce and dried nut industry. All information is public and available on the Center for Produce Safety's website, www.centerforproducesafety.org as well as offered through research webinars, extension scientists and commodity organizations. All trusted sources for science based information. Resources include; annual symposium, symposium key learnings, CPS 5 Year Key Learnings, and CPS Produce Research Symposium - A Practical Guide to the Scientific Research.

Beneficiaries
Fresh produce growers, soil amendment processors, and compost suppliers are the primary beneficiaries of this research. The processors of physically heat-treated chicken litter or compost processors can utilize the research findings to identify the critical factors (such as freshness and moisture level of raw chicken litter, physiological stages of pathogen, time and temperature of the physical heat treatment) affecting *Salmonella* survival during thermal processing, and set up the criteria for rapidly destroying the pathogen in the finished products. Farmers will be able to obtain *Salmonella*-free soil amendments or organic fertilizers for growing fresh produce, and thereby able to reduce cross contamination of fresh produce via soil amendment. Ultimate beneficiary will be the U.S. public who will get safe fresh produce for their families, and have increased confidence in consuming fresh produce without fear of foodborne illnesses. These groups receive information about this research as described below.

There are 42,729 farms of produce crop growers representing $23.9 billion in sales in the state of California according to the 2012 Census (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/index.asp). There are nearly 170 businesses in California that produce compost and mulch (http://www.calrecycle.ca.gov/organics/Processors/).

Dr. Xiuping Jiang, Clemson University, presented interim results at the 2013 CPS Produce Research Symposium in Rochester, New York. Final research results were presented in June at the 2014 CPS Produce Research Symposium in Newport Beach, CA. The 2013 symposium had 300 attendees and the 2014 symposium had 245. The participants included California regional and national growers/shippers, retail and food service buyers, scientists, academic, produce industry representatives, and members of regulatory agencies. The symposium provides expert panels to critique research results. This process helps participants evaluate the use of the research results in their respective businesses. Project results will be disseminated at industry meetings and streamed through social media sources.

Final results will also be included in the following:

1.) The Final report can be found at http://www.centerforproducesafety.org/amass/documents/researchproject/333/CPS%20Final%20report%20-%20Jiang.pdf
2.) CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website.
3.) The Center for Produce Safety's Board of Directors and members of the Technical Committee distribute a series of information throughout the year on their websites, and through presentations, meetings and webinars. An example of this would be the "CPS Funded Research - Key Learnings" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/210/CPS%20Key%20Learnings%20May%202014_FINAL2.pdf

The following websites provide additional resources on the final reports and symposium proceedings:

Center for Produce Safety: https://cps.ucdavis.edu/resources.php
Produce Marketing Association: http://pma.com

Western Growers Association: http://www.wga.com/

Lessons Learned
The research is applied science in nature. Therefore any research findings will have direct impact on practices and performance of the soil amendment industry. Early on in the project, CPS connected Clemson University staff to a chicken litter processing company. Many communications and a plant tour enabled them to understand the actual practices in this industry and their concerns about microbiological safety issues surrounding their processes and finished products. These valuable interactions have guided the project design and implementation of this project. Therefore, the most important lessons learned are to get industry involved, and design the research to answer the industry needs.

Additional Information
Chen, Z. and X. Jiang. 2014. Microbiological safety of chicken litter or chicken litter-based organic fertilizers: A Review. Agriculture 4:1-29.

Chen, Z. and X. Jiang. 2014. Developing a two-step heat treatment for inactivating desiccation-adapted *Salmonella* in aged chicken litter. Abs. 101th Annu. Mtg. Intern. Assoc. Food Prot., Indianapolis, IN, Aug. 3-6. (submitted)

Chen, Z. J. Diao, M. Dharmasena, C. Ionita, and X. Jiang. 2013. Thermal inactivation of desiccation-adapted *Salmonella* spp. in aged chicken litter. Appl. Environ. Microbiol. 79:7013-7020.

Chen, Z., J. Diao, C. Ionita, and X. Jiang. 2013. Thermal inactivation of desiccation-adapted *Salmonella* spp. in aged chicken litter. Abs. 100th Annu. Mtg. Intern. Assoc. Food Prot., Charlotte, NC, July 28-31.

Jiang, X. Invited presentation: On-farm produce safety: biological soil amendments. Department of Biology seminar series, Clemson University, Nov. 15, 2013.

Jiang, X. Validating *Salmonella* inactivation during thermal processing of the physically heat-treated chicken litter as soil amendment and organic fertilizer. Produce Safety Symposium, UC Davis Center for Produce Safety, June 26, 2013. Rochester, NY.

Jiang, X. 2012. Invited presentation: Produce Safety. University of Food Technology, Bulgaria, Dec. 15, 2012.

Chen, Z. and X. Jiang. 2012. Thermal inactivation of desiccation-adapted *Salmonella* spp. in aged chicken litter. American Society for Microbiology – South Carolina Branch Meeting, Columbia, SC, October 2012 (Oral presentation).

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 68	**Project Title:** Glucosinolate-derived compounds as a green manure for controlling Escherichia coli O157:H7 and Salmonella in soil	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB11068	**Date Submitted:** December 2014
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

The number of foodborne outbreaks linked to fresh produce has increased in last decades. Increased consumption of fresh produce, a better outbreak surveillance system, and changes in production and distribution of fresh produce have contributed to this increased trend. Trace back investigations in many of these outbreaks have identified contamination at the farm level. As a major source of nutrients for crop productions, soil and soil amendments play a vital role in the safety of fresh produce. *E. coli* O157:H7 has been reported to survive for weeks or months depending upon soil type and soil amendments. *E. coli* O157:H7 has survived greater than (>) 28 days in clay soil to 69 days in manure-amended soil, and > 600 days in sheep manure. Similarly, *Salmonella* Newport and *Salmonella* Enteritidis survived for 332 and 240 days in soil, respectively. These enteric pathogens, which persist in soil for longer durations, may transfer to foliar or fruit surfaces of fresh produce during the splashing of irrigation water or rain, and may survive and grow under the appropriate environmental conditions.

Natural antimicrobials in some plants play key roles in their defense against fungal and bacterial phytopathogens. Plants, such as broccoli from the *Brassica* family, produce glucosinolate (GSL), which is hydrolyzed by enzyme myrosinase present in intact tissue in a number of bioactive hydrolysis products such as isothiocyanates, nitrile, and thiocyanate. The antimicrobial activity of GSL-derived compounds (GDC) such as isothiocyanates has been demonstrated against wide range of phytopathogens.

Interventions to control fresh produce contamination at the farm level will help reduce incidental contamination of finished product (fresh-cut produce) and eventually reduce foodborne illnesses. Less outbreaks and produce recalls will help improve consumers' confidence in produce safety and increase fresh produce consumption which will eventually reduce the obesity problem of the US population.

This project did not build on a previous SCBGP grant.

Project Approach

This project investigated the role of broccoli remnants tilled over after harvest as antimicrobial in reducing enteric pathogens in soil. First, CPS investigated the antimicrobial effect of glucosinolate-derived compounds (GDC) against enteric pathogens *in vitro*. The GDC and their enzymatic derivatives obtained commercially were evaluated for antibacterial activity using a disc diffusion assay on tryptic soy agar (TSA). *Salmonella* were more sensitive to these compounds than *E. coli* O157:H7 or non-pathogenic *E. coli*. Benzyl isothiocyanate exhibited a significantly higher zone of inhibition than other chemicals or Gentamicin (positive control) against *Salmonella* strains. The antibacterial effects of benzyl- and phenethyl isothiocyanate against *E. coli* O157:H7 were comparable to Gentamicin. Three broccoli cultivars: Arcadia, Belstar, and Diplomat were grown in a greenhouse to determine their glucosinolate content. Broccoli was harvested at maturity into three fractions (leaves and stems, roots, and florets). These broccoli fractions were freeze-dried, and then analyzed by high performance liquid chromatography—tandem mass spectrometry (HPLC- MS) for qualitative extraction of intact glucosinolate content. The GSL content of broccoli varied with cultivar and its fraction. Glucotrapaeolin content was up to 10 times higher in roots of the Diplomat cultivar than in roots of Arcadia or Belstar. In general, leaves and stems were rich in sinigrin content and roots were rich in glucotrapaeolin. A field study was conducted to evaluate the survival of surrogate strain O157:H12 in soil tilled over with broccoli. For field study, six-week old broccoli seedlings (Packman cultivar) planted at Beltsville Agricultural Research Farm. After reaching full maturity, broccoli florets were harvested and remaining plants were tilled over with a tiller set at 4" depth. The tilled area was spray inoculated with *E. coli* O157:H12 strain (7 log CFU/ml) followed by an additional treatment of glucosinolate or plant antimicrobials. Soil samples (100 g) were collected for up to 14 weeks from each subplot and analyzed for surviving populations of *E. coli* O157:H12 by direct plating on selective media and 8-block Most Probable Number (MPN) assay. In general, populations of *E. coli* O157:H12 decreased in soil with time irrespective of treatment. *E. coli* O157:H12 populations in BIT-treated soil were not detected by direct plating after seven days, whereas in other treatments populations ranged from 0.9 to 2.0 Log CFU/g of soil. The antimicrobial effect of broccoli plant remnants as well as that of cinnamaldehyde was more pronounced after 28 day from inoculation. Rapid inactivation of *E. coli* O157:H12 in soil could be attributed to glucosinolate derived compounds released from broccoli and additional antimicrobials sprayed in soil. At each sampling time, *E. coli* O157:H12 were found only in control soil samples ranging from 3.08 to 5.52 log MPN/g of soil. The results reveal that the tilling over of the broccoli remnants as a green manure after harvest as well as GDC and natural plant volatiles has the potential in reducing *E. coli* O157:H12 populations in soil. Additionally, five broccoli cultivars (Arcadia, Diplomat, Green Magic, Belstar, and Imperial) grown in a high tunnel were harvested at maturity. Following harvest, soil was tilled over with broccoli remnants and then spray inoculated with nonpathogenic *E. coli* O157:H12 strain as described earlier. Soil plug samples (top and bottom layer of soil) were collected weekly/biweekly from each subplot using a soil sampler and then analyzed for surviving populations of *E. coli* O157:12 using MPN assay. Initial *E. coli* O157:H12 populations were 4-5 log and 2-4 log CFU/g soil for top and bottom layer samples, respectively. The *E. coli* O157:H7 persistence varied with type of broccoli cultivar tilled over in soil. *E. coli* O157:H12 were undetectable after 12 weeks in soil tilled over with Green magic and Imperial broccoli cultivars. However, they were still recovered after 16 weeks in soil tilled over with Arcadia or Belstar broccoli. *E. coli* O157:H12 were reduced by up to 5 log CFU/g in soil within 28 days when soil was tilled-over with Marathon cultivar of broccoli.

The GDC reduced *E. coli* O157:H7 and *Salmonella* serovars *in vitro* without affecting generic *E. coli* populations, which is one of the most favorable developments of this study. One can hypothesize that these compounds would not affect commensal microflora of soil. Further, extremely low concentration of benzyl isothiocyanate (0.039%) can reduce *E. coli* O157:H12 by 6 log CFU/g in soil. The BIT can be used as a potential bio-fumigant to rapidly reduce enteric pathogens in heavily contaminated soil.

Based on the results of this study, it is recommended to plant broccoli as a primary crop or intercropping judiciously for its antimicrobial activity in soil. As the glucosinolate content in broccoli varies with cultivar, maximum benefits could be achieved using broccoli cultivars such as Marathon, Green Magic, or Imperial. It is prudent to consider glucosinolate content of broccoli along with disease resistance and yield when selecting cultivar. The glucosinolate in broccoli is also beneficial to human health, the anti-inflammatory benefits of isothiocyanate in broccoli makes it a unique food in terms of cancer prevention. The antimicrobial effect of other crops from *Brassica* family should be investigated.

Goals and Outcomes Achieved

Research activities for this project were conducted by the United States Department of Agriculture - Agricultural Research Service (USDA-ARS) subaward principal investigator.

The ultimate goal of this study was to evaluate antimicrobial activity of broccoli remnants (stems, leaves, and roots tilled over after harvest) against enteric pathogens in soil. Control of certain plant pathogens by glucosinolate in broccoli has been documented. This was the first investigation on the role of *Brassica* family crop (broccoli) in controlling *E. coli* O157:H12 in soil. Glucosinolate content in different cultivars and its practical impact in soil was studied. Glucosinolate-derived compounds, specifically isothiocyanates exhibited antimicrobial activity against *E. coli* O157:H7 and *Salmonella* strains isolated from produce and environmental samples. *Salmonella* were more sensitive to these compounds than *E. coli* O157:H7; the antibacterial effects of benzyl- and phenethyl isothiocyanate against *E. coli* O157:H7 were comparable to Gentamicin (positive control). Novel HPLC-MS procedure was used to determine glucosinolate content in broccoli. The GSL content of broccoli varied with the cultivar and its fraction (root, stem and leaves, or florets). The glucotropaeolin content was up to 10 times higher in roots of the Diplomat cultivar than in roots of Arcadia or Belstar. Broccoli leaves and stems were rich in sinigrin content and roots were rich in glucotropaeolin. *E. coli* O157:H12 were reduced by 6 log CFU/g in soil tilled over with broccoli remnants and treated with benzyl isothiocyanate. The rate of reduction varied with broccoli cultivar; antimicrobial activity of the Green Magic broccoli cultivar was superior to the antimicrobial activity of the Arcadia or Diplomat cultivar. Up to 5 log reductions in soil tilled over with broccoli remnants of Marathon cultivar were reported after 28 days.

As an alternative to developing an independent survey to track acceptance of research findings, CPS has opted to partner with various commodity and trade groups to disseminate research results. This is a trusted source of information for the fresh produce industry. Two of the larger associations that assist CPS with this endeavor are Western Growers Association and Produce Marketing Association. Western Growers members provide 50% of the nation’s fresh fruit vegetables including one-third of the organic fresh produce and 99% of the tree nuts. The Produce Marketing Association represents companies from every segment of the global fresh produce supply chain. Both WGA and PMA have provided staff resources to translate the research results into usable information for use by the fresh produce and dried nut industry. All information is public and available on the Center for Produce Safety’s website, www.centerforproducesafety.org as well as offered through research webinars, extension scientists and commodity organizations. All trusted sources for science based information. Resources include; annual symposium, symposium key learnings, CPS 5 Year Key Learnings, and CPS Produce Research Symposium - A Practical Guide to the Scientific Research.

Beneficiaries

Fresh produce growers are the primary beneficiaries of the research. Growers will utilize this research data and use broccoli cultivars with higher glucosinolate content as a primary or cover crop. This agricultural practice will reduce potential pathogen contaminants in soil and reduce subsequent transfer of enteric pathogens from soil to fresh produce leaves. Glucosinolate-derived compounds such as benzyl isothiocyanate can be used for bio-fumigation to rapidly reduce pathogens in soil. Consequently, plant breeding will include glucosinolate levels as a factor in selecting broccoli for pathogen reduction in soil. The ultimate beneficiary will be the U.S. consumers who will get safe fresh produce in their homes and will have increased confidence in fresh produce with limited number of food recalls or illnesses.

There are 42,729 farms of specialty crop growers representing $23.9 billion in sales in the state of California according to the 2012 Census. Additionally, there are nearly 170 businesses in California that produce compost and mulch for necessary for specialty growers. These groups receive information about this research as described below.

Dr. Jitu Patel, USDA-Agricultural Research Service, presented interim results at the 2013 CPS Produce Research Symposium in Rochester, New York. A poster of final research results was presented in June at the 2014 CPS Produce Research Symposium in Newport Beach, CA. The 2013 symposium had 300 attendees and the 2014 symposium had 245. The participants included California regional and national growers/shippers, retail and food service buyers, scientists, academic, produce industry representatives, and members of regulatory agencies. The symposium provides expert panels to critique research results. This process helps participants evaluate the use of the research results in their respective businesses. Project results will be disseminated at industry meetings and streamed through social media sources.

Final results will also be included in the following:

1.) The Final report can be found at http://www.centerforproducesafety.org/amass/documents/researchproject/334/CPS%20final%20report%20-%20Patel.pdf

2.) CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website.

3.) The Center for Produce Safety's Board of Directors and members of the Technical Committee distribute a series of information throughout the year on their websites, and through presentations, meetings and webinars. An example of this would be the "CPS Funded Research - Key Learnings" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/210/CPS%20Key%20Learnings%20May%202014_FINAL2.pdf

The following websites provide additional resources on the final reports and symposium proceedings:

- Center for Produce Safety: https://cps.ucdavis.edu/resources.php
- Produce Marketing Association: http://pma.com
- Western Growers Association: http://www.wga.com/

Lessons Learned

Direct plating does not yield clear results as soil is loaded with complex microflora and the target pathogen may be present at a very low level. Selective enrichment of sample is required to suppress background microorganisms while increasing the population of the target pathogen. Sensitive detection procedures such as Most Probable Number (MPN) will be helpful to recover low level of surviving pathogen populations. Additional confirmation with molecular assay is helpful in soil samples as soil microbiota is quite complex.

Soil sampling is an important aspect of study as the pathogen population varied significantly with the depth of soil. Soil microflora is influenced by environmental factors such as rain event and temperature.

Field studies with broccoli cultivar were conducted in high tunnel as broccoli planted in field was destroyed by harsh winter season. High tunnels will be an alternative to continue field studies during harsh weather conditions.

Additional Information

None.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 69	Project Title: Assessment of *E. coli* as an indicator of microbial quality or irrigation water use for produce	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB11069	**Date Submitted:** December 2013
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

The goals of this project were to assess currently used methods for the detection of *Escherichia coli* (*E.coli*) in irrigation waters used in Arizona and Southern California, and to provide guidelines for a revised *E.coli* standard for irrigation waters used for produce. Currently, there is concern that the false positive rate of *E.coli* detection may be high in these waters giving false indications of the level of risk from enteric pathogens. This may result in unnecessary costly interventions (e.g. disinfection of the water, attempts to limit wildlife access, etc) as well as inaccurate perception of risk among consumers. For this reason it is essential to determine the rate of false positive detection of *E.coli* in waters used for produce irrigation. *E.coli* detection methods were originally developed for assessment of treated drinking water quality and not surface/irrigation waters. Recent research by the project team and others has indicated that high temperatures and elevated salinity may result in false positives rates as high as 40% in Arizona and similar climates. The first objective of this project was accomplished by evaluating three commercially available methods for *E.coli* detection to test irrigation waters from three agricultural areas (Yuma and Maricopa, AZ and Imperial Valley, CA) and assessing false positive rates utilizing Polymerase Chain Reaction (PCR) and sequencing of the bacterial isolates. This unique study helped to determine the usefulness of current detection methods for the accurate assessment of *E.coli* contamination in irrigation waters and provides guidance for interpretation of results.

The assessment and confirmation work will; however, have little value without applying these data to the currently proposed *E.coli* guidelines used by the produce industry. Currently, no microbial indicator standards exist for irrigation waters used for produce production in the United States. It has been suggested by the produce industry that the bathing water standard guideline (126 *E.coli* per 100 ml) established by the United States Environmental Protection Agency (U.S. EPA) be used. This guideline was developed from epidemiological studies of bather exposure in recreational waters and has no direct relationship to risk associated with infection or illness rates that might result from produce irrigation waters. Therefore, as a secondary objective to evaluating *E.coli* as a reliable indicator, the project team worked to develop a Quantitative Microbial Risk Assessment (QMRA) to assess the risk from consumption of leafy greens following irrigation with waters containing various levels of *E.coli*. The QMRA considers method of irrigation, irrigation timing from harvest time, and other environmental factors that may influence indicator organism or pathogen. This was accomplished using water quality data collected in the first phase of this project coupled with existing information found in the scientific literature. This effort has resulted in a suggested *E.coli* guideline for irrigation waters, which reflects irrigation and harvesting practices and is based on human health risk.

Ultimately this work offers recommendations towards the most reliable methods to be used by the produce industry to assess irrigation water contamination as well as a scientific risk-based E.coli guideline that growers can use to protect public health.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

Research activities for this project were conducted by University of Arizona subaward principal investigator (PI).

Project Outcomes Phase 1:

1. Determine the best method (most reliable, ease of use, low false positive rate) for *E. coli* detection in irrigation waters based on the comparison of three methods currently available for the detection of *E.coli* in irrigation waters.
2. Determine influence of temperature and salinity (and other environmental factors) on false positive rates of these three methods for accurate *E. coli* detection in irrigation waters.

Project Outcomes Phase 2:

1. Develop an exposure scenario (model) for *E. coli* in irrigation waters taking into consideration the type of irrigation method, the irrigated crop, the transfer rate of *E. coli* to the crop, and the *E. coli* survival post irrigation.
2. Estimate the risk of illness from ingestion of various levels of *E. coli* from the proposed irrigation scenarios.
3. Develop a simple, user friendly guideline (program or graph) for estimating risk of infection from the different irrigation scenarios (e.g., different levels of *E. coli* deposited, different crops irrigated). These guidelines will be compared to risks associated with the current guideline of 126 CFU/100 mL.

Research Activities Phase 1: Three different methods for detection and quantification of *E.coli* in water were evaluated during this study. These methods included: (1) MI Agar (Becton-Dickinson, Franklin Lakes, NJ); (2) IDEXX Colilert Quanti-Tray® (IDEXX Laboratories, Westbrook, ME); and (3) m-ColiBlue24® broth (Hach Co., Loveland, CO).

Samples were collected in three different agricultural areas: Maricopa and Yuma (AZ), and growing regions of Imperial Valley (CA). These three locations represent a significant portion of winter leafy green production in the United States. Sample collection was carried out over the course of one year during the winter growing season and additional select times of year to assess the effects of temperature, salinity and other environmental factors (e. g. sunlight intensity, precipitation) on method variability.

Over the course of the project, a total of 150 1L grab samples were collected at each of the three locations for a total of 450 samples. Sampling sites were determined based on relative distance up-stream from the irrigation practice and each production field. This was done in collaboration with University of Arizona faculty at the Yuma Agricultural Center (YAC), the Maricopa Agricultural Center (MAC), cooperating industry partners and irrigation districts.

A subset of all water samples that were collected and processed to enumerate *E. coli* using cultural techniques were subsequently tracked and processed to verify *E. coli* isolate identification using PCR, sequencing by the project PI and students working to complete the project objectives.

Research Activities Phase 2: The second phase of this project focused on the development of guidelines to estimate risk of illness from different levels of *E.coli* in irrigation waters. Using QMRA, the project team assessed the risk from consumption of leafy greens following irrigation with waters containing various levels of *E.coli*. Factors considered were method of irrigation, irrigation scheduling in relation to harvest time and other environmental factors that may influence survival of the indicator organism or pathogen.

Literature reviews were conducted to develop QMRA scenarios that were applicable to real world conditions of the industry. The development of the scenarios is discussed in detail the Statistical Methods and Analysis, QMRA (See Attachment 1).

A model event tree was completed for this work as well as the three irrigation scenarios were evaluated: subsurface drip, furrow and spray irrigation (See Attachment 2).

Because the data set collected contained an extensive number of samples and was considered robust, it was determined that Monte Carlo simulations were not needed to improve the suitability of the data for the project's analysis. Additionally, it was found that probability of infection for most microbial infections follows either an exponential model or the Beta-Poisson dose-response model (Haas, et al. 1999). To determine which model best fit the experimental data for *E. coli O157:H7*, the Solver routine in Microsoft Excel program was used to determine the best fit. Since the p-value for the Beta-Poisson dose response model showed a stronger fit between the observed and expected values, the Beta-Poisson model was used to determine probability of infection for *E. coli*.

In the project team's evaluation, the maximum E. coli concentrations per 100 ml of irrigation water measured in the field using the three different methods were utilized. Concentrations of 77 *E. coli* per 100 ml recommended by Johnson (2001), 126 E. coli per 100 ml recommended by U.S. EPA (1984) and 10,000 *E. coli* per 100 ml recommended by the World Health Organization (WHO) (2006) were also utilized in calculating the risk of *E. coli* infections.

Under field conditions, Stine et al. (2005) measured the fraction of *E. coli* that is transferred to lettuce when irrigated with water inoculated with *E. coli*. The maximum ratio was found to be 1.1×10^{-4} for furrow irrigation systems and 8.8×10^{-7} for subsurface irrigation systems. Stine et al. (2011) found that the transfer fraction for sprinkler irrigation systems was 1.1×10^{-2}. Stine et al. assumed in both the 2005 and 2011 studies that the adjusted per capita consumption of lettuce in the United States is 4,416.5 grams and that the consumption of lettuce occurs one day after irrigation.

Multiplying each fraction for the respective irrigation system by the maximum concentration of the irrigation water *E. coli* measured in the field in this study yields the annual risk of infection from eating an average of 12.1 grams of fresh lettuce per day under the specific irrigation system scenario.

After completion of the project, the research team created an Excel spreadsheet including the risk assessment results and created a short PowerPoint presentation outlining the process of the risk assessment and the research findings that were the most relevant to stakeholders. These were made available to the industry. Additionally, the project team currently has an Extension publication and book chapter under peer review describing the research results. Once finalized, these publications will be disseminated to industry partners and stakeholders in Arizona and California though hard copy or download online from the University of Arizona Cooperative Extension and Center for Produce Safety websites.

The project team has worked with the local industry in Yuma and California to disseminate research findings to stakeholders. This information dissemination was in the form of lectures, workshops, poster presentations, conference attendance, and personal communication. A list of select events is provided below:

a) Center for Produce Safety, 2012 Produce Research Symposium
June 27, 2012, University of California, Davis, CA

b) Third Annual University of Arizona Food Safety Conference and Poster Session
October 12, 2012, Omni Tucson National, 2727 West Club Drive, Tucson AZ

c) Institute of the Environment Presents: Grad Blitz
November 8, 2012, Tucson Marriott, University Park, Tucson AZ
Audience Choice Best Poster Award

d) Graduate and Professional Student Council Presents: Student Showcase
November 9, 2012, University of Arizona, University Mall, Tucson AZ

e) American Society for Microbiology International Meeting
May 18 – 22, 2013, Denver, CO

f) Western Food Safety Summit (WFSS)
May 9 – 10, 2013, Hartnell College, Salinas, CA

g) Center for Produce Safety, 2013 Produce Research Symposium
June 24 – 27, 2013, Rochester, NY

h) Center for Produce Safety Webcast with Oregon Department of Agriculture
August 13, 2013, Maricopa, AZ

i) University of Arizona Food Safety Research Update
September 11, 2013, Yuma, AZ

Summary of Project Significant Results, Accomplishments, Conclusions and Recommendations:

- Results reveal *E.coli* in irrigation waters in all agricultural areas sampled, including exceedances of the Leafy Green Marketing Agreement (LGMA) guideline of 126 *E.coli* per 100 mL. All three methods have identified *E.coli* in irrigation waters, but methods including MI agar, and IDEXX Colilert Quanti-Tray®, have shown the most straightforward results for interpretation, while blue colonies on m-ColiBlue24® broth plates are typically not well defined, making it difficult to differentiate between a single colony or multiple colonies, which could over- or underestimate the *E. coli* in the sample.

- This study indicated there are significant differences between *E. coli* counts measured using m-ColiBlue24®, those measured using IDEXX Colilert Quanti-Tray® and between those measured using

IDEXX Colilert Quanti-Tray® and MI methods. However, there are no significant differences between *E. coli* counts measured using MI and IDEXX Colilert Quanti-Tray®.

- The IDEXX Colilert Quanti-Tray® performed with the highest rate of accuracy with 49% of the time calling a true positive followed by MI Agar and m-ColiBlue24® broth at 33% and 29% respectively.

- Each of the three methods seemed to have elevated false positive rates indicating the difficulty in accurately assessing *E.coli* concentrations. This could be due heavily to analyst interpretation and points towards the need in methods to be straight forward and user friendly. False positive rates ranged from 53% to 71% with m-ColiBlue24® broth performing the worst.

- According to the QMRA, if irrigation water has *E. coli* density of 126 per 100 ml (or 12.6 *E. coli* per 10 ml), and based on Stine et al. (2005), 0.00011 of the 126 *E. coli* per 100 ml (or 12.6 E. coli per 10 ml) will be transferred to lettuce for furrow irrigation system and 8.8×10^{-7} of the 126 will be transferred to lettuce for subsurface drip irrigation system. That corresponds to a risk of Gastrointestinal (GI) illness of 1.1 in 100,000 for furrows and nine in 100,000,000 for subsurface irrigation system.

- For sprinkler irrigation system and based on Stine et al. (2011), 0.011 of the 126 *E. coli* per 100 ml (or 12.6 *E. coli* per 10 ml) will be transferred to lettuce resulting in a risk of GI illness of 1.1 in 1,000.

- Irrigation water containing 126 *E. coli* per 100 ml for lettuce would appear to present a minimal risk for furrow and subsurface drip. However, further research on contamination of lettuce by spray irrigation appears warranted to reduce uncertainty in the risk estimate.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Overall, the project team was able to evaluate three currently used methods for the accurate assessment of *E.coli* in irrigation waters used for produce. The concluding findings indicate while all three methods are able to detect *E.coli*, the variance between them is great, and that the IDEXX Colilert Quanti-Tray® seems to be the best choice when given an option. However, it is important to note that while the IDEXX Colilert Quanti-Tray® performed well at reducing false positives rates, false negative rates were higher than the two other methods compared. This is important information for the industry and testing labs currently utilizing these methods for *E.coli* assessment.

Additionally, through the comprehensive evaluation conducted, a more robust QMRA analysis was performed using actual *E.coli* data collected throughout the growing region. This is the first study of this kind using actual environmental data and applying it to current regulatory guidelines for irrigation waters used for produce. The results of this risk assessment will be shared industry wide. The project team is currently working to finalize a *Risk Communication Packet* which contains a series "fact sheets" through the University of Arizona Cooperative Extension. This packet summarizes the research results, but also includes sections on frequently asked questions, key message points, definitions regarding what are risk assessments, relative risk, and how water quality and irrigation risks compare to other risks commonly observed by the general population.

As mentioned above, several outreach and education events were conducted with project PIs and stakeholders in the industry to disseminate research findings. Specific recommendations were provided to the industry, based on research findings, related to the performance of each of the cultural methods evaluated in this study as well as the results of the risk assessment analysis conducted. Based on the findings, the project team recommends two of the three cultural methods for *E. coli* assessment in irrigation waters; however, the project team strongly recommends to the industry that individual testing labs currently processing irrigation water samples conduct performance assessments on their own methods using local water sources. This will allow labs to better understand the impact of local water quality on method efficiency, as shown in this study. Additionally, the project team provided very specific data to the industry on the results of this risk assessment. According to the QMRA conducted during this study, if irrigation water has *E. coli* density of 126 per 100 ml (or 12.6 E. coli per 10 ml), and based on Stine et al. (2005), 0.00011 of the 126 E. coli per 100 ml (or 12.6 E. coli per 10 ml) will be transferred to lettuce for furrow irrigation system and 8.8 x 10^{-7} of the 126 will be transferred to lettuce for subsurface drip irrigation system. That corresponds to a risk of GI illness of 1.1 in 100,000 for furrows and nine in 100,000,000 for a subsurface irrigation system. For sprinkler irrigation system and based on Stine et al. (2011), 0.011 of the 126 E. coli per 100 ml (or 12.6 E. coli per 10 ml) will be transferred to lettuce resulting in a risk of GI illness of 1.1 in 1,000. Irrigation water containing 126 *E. coli* per 100 ml for lettuce would appear to present a minimal risk for furrow and subsurface drip. However, further research on contamination of lettuce by spray irrigation appears warranted to reduce uncertainty in the risk estimate.

While the QMRA approach described above can be used to analyze various scenarios and provide accurate risk assessments, it is difficult to use this approach to define a specific regulatory guideline for *E. coli* concentrations “acceptable” in irrigation water used for produce that would “fit” all proposed scenarios. What this research has shown is that the current guidelines used by the industry are very conservative and in many cases are over protective of public health when it comes to subsurface drip or furrow irrigation practices. However, it also demonstrates that when leafy greens are irrigated by spray irrigation, the current regulatory guideline of 126 *E. coli* per 100mL of water may present un-warranted risk to consumers (1.1 in 1,000). The currently acceptable risk level according to the U.S. EPA for full body contact with surface water is eight in 1,000. While this is somewhat concerning, additional research is needed to reduce the uncertainty in this risk estimate and better understand the implications of revised guidelines for additional irrigation scenarios and ranges in water quality.

Dr. Channah Rock, University of Arizona, presented a poster of interim results at the 2012 Center for Produce Safety (CPS) Produce Research Symposium in California, and final research results at the 2013 CPS Produce Research Symposium in New York. The 2012 symposium had 325 attendees and survey respondents rated the relevance of the research as important. The 2013 symposium had 300 attendees and survey respondents rated the relevance of this project to the fresh produce industry as 1.7 (1=very important; 5=very unimportant). The participants included California regional and national growers/shippers, retail and food service buyers, scientists, academic, produce industry representatives, and members of regulatory agencies.

The CPS’s Board of Directors and members of the Technical Committee tracked research findings and distribute a series of information throughout the year on their websites, and through presentations, meetings and webinars. An example of this occurred on July 18, 2013 when Western Growers Association held a webinar for their members. Information discussed at the webinar is now part of the “Key Learnings” on the CPS website:

https://cps.ucdavis.edu/amass/documents/document/186/Key%20Learnings_2013%20CPS%20Symposium.pdf.

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: https://cps.ucdavis.edu/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

A survey was sent to 2013 CPS Produce Research Symposium participants who rated the relevance of the research (see below).

The project results will be posted on the CPS website, disseminated at industry meetings and streamed through social media sources.

Final results are also included in the following:

1.) Final report is posted on the CPS website (https://cps.ucdavis.edu/grant_opportunities_awards.php).
2.) CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website.

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

This is the first study of this kind using actual environmental data and applying it to current regulatory guidelines for irrigation waters used for produce. This project benefits approximately 75% or 31,992 of California growers who irrigate specialty crops grown in the state by providing the most reliable methods to assess irrigation water contamination based on scientific facts.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

It should be noted that while all work was completed within the budgetary limitations of the grant, in the future, the project team recommends including funds dedicated towards travel for sample collection, project meetings with primary investigators and meetings with the industry. A significant amount of time was spent during the onset of the project working with the local industry to establish goals and sampling locations that would benefit not only the project, but also the local industry. Additionally, determining logistically the most feasible plan of action took multiple trips prior to the onset of sample collection.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

See attachments.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 70	**Project Title:** Validation of testing methods for the detection and quantification of *E. coli* O157:H7, *Salmonella* spp., fecal coliforms and non-pathogenic *E. coli* in compost	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB11070	**Date Submitted:** December 2013
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** 530-757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

Compost is well known for many beneficial properties as a soil amendment for both organic and conventional farming systems. Aerobic, thermophilic compost production processes are designed to achieve significant reductions in human and plant pathogens through time-temperature exposures. While compost is generally regarded as a safe product for unrestricted usage, it is gaining recognition as a potential source of foodborne pathogen contamination in the fresh produce industry. Recommended testing for pathogens in compost refer to US Environmental Protection Agency (EPA) methodology (which has not been evaluated for non-biosolids based composts) or other laboratory-certified/accredited methods like U.S. Composting Council Test Methods for the Examination of Composting and Compost (TMECC). Neither EPA nor TMECC microbiological testing procedures have been evaluated for the recovery of pathogens from non-biosolids based compost that produce growers utilize across the United States. Identifying the most sensitive and accurate method to determine the presence of pathogens in compost will provide certainty with regard to microbiological testing for compost producers, and provide produce growers another tool to ensure produce safety. This study compared these two methods for their recovery efficiency of fecal coliforms, *Escherichia coli*, and *Salmonella* (Objective 1). In addition, the use of two different immunomagnetic separation (IMS)-based methods for the detection of *E. coli* O157:H7 in composts were evaluated. Our study included 29 different 'point of sale' mature composts, made from manure (n=4), biosolids (n=10), and yardwaste (n=15) feedstocks, collected from across the United States. The use of a non-microbiological indicator in finished compost may also have some benefit. Chemical or physical determinants in compost may indicate the presence of pathogens in point of sale material (Objective 2). Some of these parameters (moisture, water activity, electrical conductivity, soluble carbon, pH and carbon: nitrogen ratios) have been previously associated with pathogen re-growth potential in biosolids-based and dairy manure compost. Further investigation is needed, however, to determine which of these parameters are important for pathogen re-growth in finished compost products from a variety of feedstocks and locations across the U.S.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

Research activities for this project are conducted by the USDA ARS subaward principal investigator.

Methods. Twenty-nine compost samples were obtained from across the U.S. Samples of compost were tested for microbial background and physicochemical properties. Compost samples (400g) were inoculated simultaneously with non-pathogenic *E. coli*, *Salmonella* spp., and *E. coli* O157:H7. All strains were inoculated at between 1 -2 $\log_{10}$ CFU/g and homogenized thoroughly to disperse the inoculum throughout each compost sample. Inoculated compost was then hand massaged for 2 min to thoroughly mix bacterial inoculum. Thereafter, inoculated compost samples were analyzed by standardized EPA, TMECC, or novel immunomagnetic separation methods with minor modifications. Regrowth of pathogens over three days was also determined. For the comparison of EPA and TMECC methods for the recovery of fecal coliforms, *E. coli* and *Salmonella*, a two-way analysis of variance (ANOVA) based on a beta-distribution of the recovery percentages of each pathogen in each compost type was used at an alpha level of 0.10. For objective 2, a linear regression model was constructed to predict regrowth of *Salmonella* spp. or *E. coli* O157:H7 based on total organic carbon or the carbon/nitrogen ratio.
Results. EPA methods recovered significantly ($p < 0.10$) greater levels of fecal coliforms and *E. coli* when compared TMECC methods ($p = 0.0003$) for all compost type (biosolids, manure, and yardwaste). EPA methods also recovered significantly greater levels of *E. coli* from compost made from biosolids and manure feedstocks compared to TMECC methods. Both methods showed equivalent recoveries of *Salmonella*; however, EPA methods recovered significantly higher ($p = 0.0596$) *Salmonella* levels from compost made with a biosolid feedstock compared to TMECC methods. Both immunomagnetic separation methods (direct plating and automated recirculating) were equally effective in recovering low population of *E. coli* O157:H7 from inoculated compost samples. Levels of total organic carbon and carbon / nitrogen ratios were not correlated to the regret of *Salmonella* spp. and *E. coli* O157:H7 in point of sale finished composts, indicating that pathogen regrowth cannot be predicted by either of these chemical parameters. However, composts containing biosolids feedstocks were more likely to have maturity levels less > 5, potentially indicating that they may require longer times to reach suitable maturity.

Significance and Findings
1.EPA method 1680 recovered a significantly higher percentage of fecal coliforms than TMECC method 7.01B from inoculated composts.
2.EPA method 1682 and TMECC method 7.02 were statistically equivalent in the percentage of *Salmonella* spp. recovered from inoculated composts.
3.EPA methods seem to recover higher or equivalent percentages of fecal coliforms and *Salmonella* spp. compared to TMECC methods.
4.Immunomagnetic methods – either direct plating or automated recirculation – are effective and relatively rapid in recovering low levels of *E. coli* O157:H7 from compost.

5.Total organic carbon and the carbon/nitrogen ratio were not correlated to the ability of *Salmonella* spp. and *E. coli* O157:H7 to regroup in point of sale finished composts; however the interaction of all physicochemical factors evaluated and their effect on pathogen regret deserves more attention.
6.Composts made from biosolids feedstocks were significantly more likely to score lower on the maturity index compared to composts made from yard waste and manure; it is unclear from the data gathered in this study how this finding may be related to pathogen regrowth in finished composts.
7.When possible, the greater volumes of sample used in the analysis of primary dilutions in the MPN series outline in the EPA methods 1680 and 1682 should be used to recover fecal coliforms and *Salmonella* spp. from compost.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Objective 1 and Objective 2 were fully completed.

Objective 1: Compare a) TMECC and USEPA methods for detecting and quantifying fecal coliforms, *Escherichia coli*, and *Salmonella* in 'point of sale' compost to determine which method should be utilized by the compost industry as well as on-farm practitioners; b) compare two immunomagnetic separation techniques – automated recirculation (AR) and Direct Plating (DP) for the detection of *E. coli* O157:H7 in same point of sale composts.
Objective 2: Determine whether soluble carbon profiles in finished compost samples can accurately predict the re-growth potential of *E. coli* O157:H7 and *Salmonella* in mature, finished 'point of sale' composts that have been inoculated with low population levels.
Data was collected on the recovery of fecal coliforms and *E. coli* in compost by EPA 1680 and TMECC 7.01b and 7.01c methods; data was also collected on the recovery of *Salmonella* in compost by EPA 1682 and TMECC 7.02, respectively. Data was also collected on the recovery of *E. coli* O157:H7 by direct plating and automated recirculation. Regrowth of *E. coli* O157:H7 and *Salmonella* in compost was also collected over 3 days. Three replicate experiments for each analysis were performed.
Background microflora and physicochemical parameters (pH, electrical conductivity, compost maturity, total organic carbon, carbon: nitrogen ratio, % moisture, and % ash) were also collected and attempted to be correlated to pathogen regrowth.
Foremost among the findings from this study was the EPA methods recovered significantly higher percentages of *E. coli* than TMECC methods, likely due to the large volumes used in serial dilutions. EPA and TMECC methods were equivalent in recovering *Salmonella* over all compost types. Two specific chemical parameters (total organic carbon and carbon: nitrogen) were unable to be used to predict the regrowth of *Salmonella* and *E. coli* O157:H7 in point of sale finished composts. From the project's data it is unclear what the relationship is between the maturity of compost and the ability of pathogens to regrow in finished composts. Finally, EPA methods were shown to be effective as TMECC methods in recovery *E. coli* and *Salmonella* from composts made from non-biosolids based composts.

Results were presented or included in the following:

1.) 2013 IAFP – International Association of Food Protection
2.) Final report posted on the CPS website (https://cps.ucdavis.edu/grant_opportunities_awards.php)
3.) 2013 CPS Produce Research Symposium – Key Learning's (https://cps.ucdavis.edu/resources.php; see attached)
4.) 2013 CPS Produce Research Symposium – A Practical Guide to the Scientific Research (available September 2013)

Dr. Manan Sharma, USDA-Agricultural Research Service, presented a poster of interim results at the 2012 CPS Produce Research Symposium in California, and final research results at the 2013 CPS Produce Research Symposium in New York. The 2012 symposium had 325 attendees and survey respondents rated the relevance of the research as important. The 2013 symposium had 300 attendees and survey respondents rated the relevance of this project to the fresh produce industry as 1.8 (1=very important; 5=very unimportant).

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

These results provide compost producers, produce crops growers, testing laboratories and certifying organizations with data and findings that will increase efficiency and cost-savings at these respective operations. Findings that EPA methods are more efficient or equivalent to TMECC methods in recovering *E. coli* and *Salmonella* will provide clarity to compost producers on which microbiological analyses to use to accurately test point of sale finished composts. Produce crop growers will also benefit from more accurate and sensitive testing of finished composts used to fertilize soils. The relatively rapid detection of *E. coli* O157:H7 by immunomagnetic separation combined with direct plating or real time PCR also provides a reliable method to detect the pathogen in finished composts. Testing laboratories will benefit from the understanding that the larger volumes of dilutions used in EPA methods may lead to higher recoveries of fecal coliforms and *Salmonella*, and may rely on these methods to provide more accurate detection of these pathogens.

According to the US Composting Council http://compostingcouncil.org/, there are 1,000 plus licensed compost producers in the U.S. Of these, there are nearly 170 businesses in California that produce compost and mulch http://www.calrecycle.ca.gov/organics/processors/. There are 41,992 farms representing produce crop growers in California according to the 2007 Census, http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/California/st06_1_040_040.pdf.

The above groups receive information about this research in the following ways:

The project results are posted on the CPS website, disseminated at industry meetings and streamed through social media sources. CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website https://cps.ucdavis.edu/.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

Complying with both EPA and TMECC methods requires redundant and tremendous expense in purchasing different microbiological media, buffers, glassware, and homogenization equipment. Determining that a single method (EPA) is efficient in recovering both fecal coliforms and *Salmonella* will reduce capital expenses of those testing compost. With regard to the automatic recirculating method of immunomagnetic separation of detecting *E. coli* O157:H7, extraction of DNA should involve a purification step which involves the removal of polymerase chain reaction (PCR) inhibitors like polyphenols, humic acids, etc.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 71	Project Title: Comparative assessment of field survival of *Salmonella enterica* and *Escherichia coli* O157:H7 on cilantro (*Coriandrum sativum*) in relation to sequential cutting and re-growth	
Grant Recipient: University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB11071	**Date Submitted:** December 2013
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** 530-757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.
- If the project built on a previously funded SCBGP project, describe how this project complimented and enhanced previously completed work.

Cilantro, parsley, basil, and other herbaceous culinary herbs have been implicated in several notable outbreaks and surveillance-initiated recalls since 1998. In the specific case of cilantro, since 2004, FDA has confirmed the presence of Salmonella spp. in 28 samples of cilantro in the market, from both U. S. and non-U. S. origins.

Cilantro is a widely enjoyed culinary herb commonly consumed in its raw state without a terminal kill step. Cilantro has become a popular fresh produce item in the United States for its usage in diverse ethnic cooking including Chinese, Southeast Asian, Mexican, Middle Eastern, Indian, and California Fusion styles. From November 2010 to February 2011, more than 8 brands and over 20 SKU's (Stock Keeping Unit) containing cilantro were recalled by major retailers in the US and Canada. In addition to the direct cost of implementing a recall, growers and shippers are typically required to remunerate their customers for a recall which may be thousands of dollars in administrative fees, and hundreds of dollars in restocking fees per distribution center, SKU, and outlet store. Further indirect costs in lost reputation and continued erosion of consumer confidence are also of great concern to individual operations, the category, and the produce industry.

In March 2011, the FDA expressed concerns about positive sample findings for human pathogens on fresh cilantro in a guidance letter to companies that grow, harvest, sort, pack, or ship fresh cilantro. In this letter, the FDA recommends that the produce industry segment take action at three levels: 1) Review the current cilantro operations in the context of GAPs Guide, as well as other available information regarding reducing pathogens in fresh produce; 2) Assess hazards that are unique of the cilantro production and; 3) Develop commodity-specific preventive control strategies that would identify potential hazards that may be specific to fresh cilantro production and distribution, as it was previously done with tomatoes and leafy greens. As one component of the response to the industry and public health concern, the Commodity Specific Food Safety Guidelines for the Production, Harvest, Post-Harvest, and Processing Unit Operations of Fresh Culinary Herbs (CSG Herbs 2013) was recently released.

Current research on survival and fitness of human pathogens on plants has been mostly assessed on detached leaves to simulate postharvest operations. Limited studies have been conducted in growth chamber settings but their survival under natural conditions of produce production is mostly unexplored. In the particular case of culinary herbs, cilantro was linked to an outbreak of *Salmonella* serotype Thompson in California producing 41 cases of salmonellosis. Additionally, in a broader survey of produce grown within or exported to the United States, 1.6% and 9% of analyzed cilantro samples were contaminated with *Salmonella* for domestic and import sources, respectively (http://www.cfsan.fda.gov). Among selected culinary herbs including parsley, basil and rosemary, recovery of *Salmonella* under refrigerated conditions was most pronounced on cilantro leaves suggesting an elevated risk of this pathogen to reach consumers following distribution and point of purchase or consumption on this host plant. Previous research on cilantro, has demonstrated the ability of *Salmonella* to colonize the surface of cilantro leaves at high densities under permissive temperature and moisture conditions.

Notable consolidation and shifts in production and postharvest handling among suppliers has resulted in an increase in large-scale block production and machine harvesting, much like baby-leaf spinach and spring mix. Wide seedbeds and overhead irrigation close to the timing of harvest have become a common production management format. Postharvest washing and cooling has, in parallel, shifted significantly from field bunching and palletized hydrocooling to loose bulk-harvest and flume washing with additional spray washes prior to packaging. As the production and process flow has responded to increasing demand, there exists a clear need to evaluate the root cause and contributing factors to an apparent rising issue with food safety associated with cilantro consumption.

This research proposal aimed to assess the comparative post-contamination consequences on cilantro, in model commercial settings, with attenuated isolates of *Salmonella enterica* and *Escherichia coli* O157:H7 during open-field production, sequential harvest and re-growth, and in pilot plant postharvest operations. The goal was to begin to address some of the key concerns and questions raised by suppliers, handlers, and buyers of cilantro. The longer, but still near-term, goal was to develop risk reduction and control strategies, including microbiological and pathogen testing Best Practices, along the supply-chain for this important culinary herb.

Project Approach

- Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
- Present the significant contributions and role of project partners in the project.

Research activities are conducted by the UC Davis subaward principal investigator.

Objective 1. To determine the quantitative and qualitative survival of *Salmonella enterica* and *Escherichia coli* O157:H7 on cilantro leaves after foliar applied contamination during pre-harvest production.

A controlled (fenced, bare soil buffered, and posted for restricted access) open field trial was conducted during fall 2011 at the UC Davis Plant Sciences Research Farm, as specified in the materials and methods section. Two cultivars of cilantro cv. Santo and cv. Leisure; three cultivars of Parsley cv. Moss Curled, cv. Alizira and cv. Green Forest; and a cultivar of basil cv. Genovese were seeded. Due to technical complications, weather conditions and a severe weed problem, parsley and basil seeds did not develop a useable stand for research purposes. Thus, this field trial was carried out only with cilantro cultivars.

Population dynamics of *E. coli* O157:H7 and *Salmonella* in the phyllosphere of cilantro during field production, postharvest washing and storage are presented in Table 1. The initial *E. coli* O157:H7 population was in the range of 3.80 – 3.81 and 1.84 – 1.97 log CFU/g after 12 hours of the inoculation event for the high (log 6) and the low (log 4) inoculum dose, respectively. No significant difference of attached *E. coli* O157:H7 in cilantro foliage samples was observed as a function of the cultivar. *E. coli* O157:H7 populations for all cultivars declined rapidly below the limit of quantitative detection (LOD) and no culturable bacteria were recovered by direct plating after 6 and 12 days post-inoculation. The viability of the bacterium was demonstrated 12 days post-inoculation, but significant differences among initial inoculum doses were observed. Staff determined that 100% of the samples (15/15) which were inoculated with the high dose were positive after selective enrichment for *E. coli* O157:H7, while only one sample out of 15 (6.7%) was positive for those samples inoculated with the low dose. For both inoculum doses, no differences in *E. coli* O157:H7 viability among cilantro cultivars were found. Statistical analysis of main factors showed that there was a significant effect of the dose ($p=0.0031$), as it refers to the day of harvest after 12 hours of inoculation, however no significant difference in survival was detected between days 6 or 12 post-inoculation ($p=0.4047$).

Objective 2. To determine the degree of persistence and dispersal of *Salmonella enterica* and *Escherichia coli* O157:H7 in sequential harvest and re-growth intervals.

The persistence of *E. coli* O157:H7 and *Salmonella* in sequential harvest and re-grow intervals of cilantro was determined to be of greatest risk for contamination events associated with foliar contact closest to harvest and not as likely due to re-growth during pre-harvest intervals between cuts. Overall, no culturable bacteria were recovered by direct plating for all cilantro samples 2 days after an inoculation event with a single dose of log 4 CFU/mL of *a*PTVS155 or PTVS177.

For *E. coli* O157:H7, only one out of 9 samples (11%) was positive 2 days post-inoculation when plants were not re-inoculated after the first cut, this was observed for both cilantro cultivars. In general, for cilantro samples that were not inoculated after the 1^{st} cut or 4 days after the 1^{st} cut, no applied bacteria were recovered at the 22 day re-growing period. For the rest of the treatment conditions (inoculation event 14 and 20 days after the 1^{st} cut), the presence of *E. coli* O157:H7 was confirmed in the 11 and 22% of the samples for both cultivars.

In contrast, a greater viability and survival of *Salmonella* in comparison with *E. coli* O157:H7 under similar conditions was observed. Overall, no applied Salmonella was recovered after the 22 day re-growing period for cilantro samples that were not re-inoculated after the 1^{st} cut. For the remainder of the treatments, the presence of Salmonella was confirmed in 11, 43 and 100% of cilantro samples that were inoculated 4, 14 and 20 days after the 1^{st} cut respectively. No significant variability of attached *Salmonella* and *E. coli* O157:H7 was observed as a function of the cultivar.

Objective 3. Determine the impact of delays to cooling, specific temperature thresholds, and postharvest washing on growth potential and cross-contamination of applied pathogen-surrogates, including simulated industrial pilot-plant processing and simulated retail distribution.

Overall for both surrogates, the role of limited delays to cooling during postharvest handling does not seem to promote their growth or survival. This study only evaluated a maximum time of 120 min of cooling delay, based on industry input for initiating studies considering commercial conditions, within the field environment, however other factors including humidity, free moisture during harvest, temperatures at harvest and transport, and extended periods of cooling delay temperature abuse should also be explored in future studies.

No significant variability of attached *E. coli* O157:H7 and *Salmonella* was observed depending on the cilantro cultivar. *Salmonella* and *E. coli* O157:H7 populations declined after inoculation below the limit of quantitative detection, but still detected after 12 dpi by selective enrichment. The minimal processing with 50 mg/L of NaClO was not sufficient to disinfect inoculated cilantro (log 6) prior to refrigerated storage. Viable populations of both pathogens were confirmed throughout storage, including the final time point. In relation to the potential for re-growth on field cultivated cilantro, no culturable bacteria were detected 22 days after the first cut.

In addition, a wash water process control project was conducted in collaboration with SmartWash Solutions at their pilot plant facilities in Salinas, CA. A substantial in-kind funding, through technical and operational staff time and experimental materials, was generously contributed to the execution of this objective and was essential to obtaining the data and results reported. This part of the project aimed to evaluate the removal and extent of cross-contamination control efficacy between cilantro and parsley inoculated with PTVS177 under pilot plant wash process operations. Four trials with pallet-load scale plant material were conducted with varying conditions of challenge Salmonella dose on cilantro and sodium hypochlorite dose, with either citric acid or SmartWash (T-128) as the additional process water treatment aide. In brief summary of results, increase of chlorine dose to 15 ppm did not have an effect in further log reduction of Salmonella on contaminated cilantro compared to 4 or 10 ppm or in eliminating cross-contamination to non-inoculated and co-process washed parsley. The use of T-128 was observed to completely mitigate the presence of detectable levels of Salmonella in process wash water when contamination on cilantro was log 4 CFU/g or lower, but cross contamination due to plant to plant and plant to equipment contact needs to be considered for setting minimal dose thresholds.

This study provides a science-based approach to supply chain management that will be useful for the development and adoption of Best Practices in food safety management among cilantro growers and processors.

The participation of industry research collaborators and partners was instrumental in the execution of the pilot plant studies conducted during the project period. Part of this volunteered generosity was in response to the crop failure associated with planned grow-out plots of cilantro and parsley in Salinas, intended to supply the field contaminated product for wash water optimization. The technical staff jointly designed and implemented the pilot plant studies developing valuable information for the industry as a whole.

Goals and Outcomes Achieved

- Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
- If outcome measures were long term, summarize the progress that has been made towards achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Overall, between the two field trials, laboratory studies, and four pilot plant wash process studies that were completed, staff feel that significant science-based contributions to food safety system design, implementation, and industry standards were accomplished. Many but not all of the originally proposed goals were met. The most significant obstacle encountered was weather-related delays or impacts on establishing field plots with adequate plants of acceptable horticultural quality to allow for comparative field persistence studies and sufficient mass to properly supply the pilot plant wash volume needed with stress-adapted “contamination”. Despite these limitations, staff conducted detailed data gathering on preharvest survival and postharvest wash disinfection optimization and prevention of cross-contamination.

Research outcomes demonstrating the important interaction between contamination levels and disinfectant dose in preventing lot to lot cross-contamination, presented at several industry meetings such as the Produce Marketing Association special session on Wash Water Management at their annual meeting, are already part of the on-going dialogue for setting Best Practices for cilantro, other culinary herbs, and fresh produce in general.

Dr. Trevor Suslow, University of California, Davis, presented a poster of interim results at the 2012 CPS Produce Research Symposium in California, and final research results at the 2013 CPS Produce Research Symposium in New York. The 2012 symposium had 325 attendees and survey respondents rated the relevance of the research as important. The 2013 symposium had 300 attendees and survey respondents rated the relevance of this project to the fresh produce industry as 1.8 (1=very important; 5=very unimportant).

Beneficiaries

- Provide a description of the groups and other operations that benefited from the completion of this project’s accomplishments.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project’s accomplishments and/or the potential economic impact of the project.

Consistent with the extension and outreach program of PI, the general principles and commodity-specific information generated within this project has been broadly communicated to grower groups, produce associations, fresh processors, UC Cooperative Extension, professional society meetings involving food safety, CA Farm Bureau Federation, state and federal public health officials, and work groups developing Commodity Specific Guidance documents and On-farm Audit Checklists. Though hard to specifically quantify, the greatest potential impact is on prevention of recalls and reducing the burden of food-borne illness at all scales of production and handling across the supply-chain.

There are 81,033 producers in the state of California. Out of these, 41,992 represent produce crop growers and other specialty crops according to the 2007 Census (http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/California/st06_1_040_040.pdf). This project has potential to benefit all 41,992 specialty crop growers.

The above groups receive information about this research in the following ways:

The project results are posted on the CPS website, disseminated at industry meetings and streamed through social media sources. CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website http://centerforproducesafety.org.

Lessons Learned

- Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
- Provide unexpected outcomes or results that were an effect of implementing this project.
- If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

Although field research can be encumbered by difficult or impossible to prevent circumstances including bad weather, pests, and crop management errors, it is clear that the planned research managed to encounter contributions from each of these obstacles to success. The initial field trial at UC Davis was largely successful for cilantro studies but not parsley and basil. However, the anticipated trials in Salinas were a complete failure. From the staff's perspective, one possible Lesson Learned after two years of challenging field research on food safety objectives with different commodities is that one-year research award plans are very risky in achieving projected results if anything approaching a major barrier to execution is experienced. Food safety field research is often limited by sensitivity and restrictions to conducting large-scale field evaluations with applied pathogen surrogates, or any research restricted to a dedicated research field station, especially where crop growth and quality are sensitive to a narrow climatic condition (such as cool season for duration of experiment). Although staff had enjoyed several years of success in conducting such trials, the 2012 season was not a favorable one and fell short of expectations. In the absence of having sufficient funds and time, there were few options to salvage securing as many of the goals and objectives as possible.

A somewhat unexpected outcome was the observed inability to prevent cross-contamination of the applied Salmonella in wash water, even at 10 mg/L hypochlorite at pH 6.5. Prior work, funded by CPS, using attenuated *E. coli* O157:H7 and shredded lettuce established that this dose resulted in no detection of viable populations in the water or transfer to non-inoculated lettuce in the same lot. Staff did not find this to be the case with the Salmonella and cilantro/parsley system of this study. While 15 mg/L prevented detectable levels of applied bacteria in the water system, transfer to no-inoculated parsley from cilantro was observed. Additional system optimization will be necessary to fully achieve the desired commercial operating outcomes.

Additional Information

- Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

See attached

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 72	Project Title: The Role of Riparian Zones in Bacteria Dispersal to Produce Farms	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB11072	**Date Submitted:** December 2014
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 757-5777	**Email:** bfernandez@cps.ucdavis.edu

Project Summary

Riparian buffer zones provide essential ecosystem services and increase species diversity and habitat connectivity for wildlife and plants. Unfortunately, improved wildlife habitat adjacent to crop production areas may increase risk for contamination of fruits and vegetables. Because riparian buffer zones not only increase the movement of water across that landscape but also increase the movement of animal hosts, buffer zones could serve as transport pathways across landscapes for foodborne pathogens. This project measured the movement of fecal bacteria through riparian zones and onto produce fields by detecting the movement of genes from those bacteria. The measured movement of genes from field sampling was compared to models that represent competing ideas about how the bacteria move. For example, models used can compare the likelihood that dispersal of fecal bacteria is primarily driven by water networks or primarily driven by movement of wild-ruminants or avian scavengers.

These models can be used to produce maps for farms and surrounding lands that tell us how bacteria move across the land in a manner similar to what roadmaps tell us about the movement of cars. The maps that agree best with the movement patterns of fecal bacteria will be used to advise growers about when, where and how riparian zones increase risk of foodborne pathogen dispersal onto produce. Ultimately, these models can be used to help the produce industry evaluate crop planting decisions, pre-harvest surveillance practices and harvest practices to prevent product contamination. This project's analyses: (i) support that dispersal and persistence of *E. coli* is complex and that dispersal patterns differ by landscape; and (ii) indicate that terrestrial wildlife likely played a role in the movements of *E. coli* among the produce fields and landscapes evaluated in the study. This suggests that future studies should evaluate the effects, on *E. coli* dispersal, of barriers that reduce terrestrial wildlife movement. Future studies on other landscapes are also needed to determine the reproducibility of fecal bacteria dispersal patterns.

This project did not build on a previous SCBGP grant.

Project Approach

Project activities, accomplishments and results.

An innovative approach, using techniques that have been pioneered in the emerging field of landscape genetics to systematically answer questions about pathogen movement, sources, and sinks within agricultural landscapes, was applied. Two distinct produce growing areas in New York were specifically selected to: (i) collect data on *E. coli* prevalence and genetic diversity in produce fields and adjacent riparian zones; and to (ii) perform modeling of the effect of riparian zone and produce field qualities on the movement of fecal bacteria across agricultural landscapes, using the data collected in these two areas (see Table 1). Specifically, 571 samples (fecal, soil, drag and water) were collected from a total of 23 produce field sites and 17 forest sites, including 294 samples collected from the Flint Creek watershed and 277 collected from the Hoosic

River watershed. A total of 2,871 *E. coli* isolates were obtained from these samples. While the proportion of fecal samples yielding *E. coli* was somewhat similar at 74% in Flint Creek and 78% in the Hoosic River area, there was a pronounced difference in the proportion of positive soil samples between the two riparian areas: 35% of soils in the Flint Creek area and 72% of soils in the Hoosic River area were positive for *E. coli*.

Table 1. Summary of findings for both produce producing area sampled

	Flint Creek	**Hoosic River**
Description	Intensive vegetable and livestock production region that is sparsely forested	Heavily forested areas interspersed between sporadic production regions
E. coli prevalence	35% of soil samples positive for *E. coli* 74% of fecal samples positive for *E. coli*	72% of soil samples positive for *E. coli* 78% of fecal samples positive for *E. coli*
E. coil dispersal patterns	<u>Decreased dispersal as compared to Hoosic River</u> Forested sites shared sequence types with an average of 5.5 other sites (min=1, max=9, n=15) Vegetable fields shared sequence types with an average of 3.6 other sites (min=0, max=8, n=15).	<u>Increased dispersal as compared to Flint Creek</u> Forested sites shared sequence types with an average of 11 other sites (min=8, max=15, n=19). Vegetable fields shared sequence types with an average of 14 other sites (min=8, max=17, n=19)
Dispersal models with best fit	Dispersal was detectable almost exclusively in the riparian area	Widespread dispersal which correlated with riparian effect models only slightly better than with non-riparian models
Summary	Landscape with sparse forestation shows (i) lower *E. coli* prevalence in soil samples, (ii) decreased *E. coli* dispersal; and (iii) dispersal almost exclusively in the riparian area	Landscape that has heavily forested areas interspersed between sporadic production regions shows (i) higher *E. coli* prevalence in soil samples , (ii) increased *E. coli* dispersal; and (iii) widespread dispersal not confined to riparian area

In general, soil samples obtained from riparian forest soils were more likely to yield *E. coli* (with 70% of these samples positive) than soil samples from produce field (with 48% of these samples positive for *E. coli*). Moreover, samples collected from boundaries between fields and forests were somewhat more likely than samples from the produce fields proper (sampling sites located at least 25 m from the forest-field boundary) to yield *E. coli*. These results indicate that forest habitats harbor *E. coli* in extra-host environments with greater prevalence, and likely abundance, than produce fields. Hence forest habitats may act as environmental sources for *E. coli* dispersal to produce fields. In particular, the observation that soil samples from the sparsely forested Flint Creek area showed considerably lower *E. coli* prevalence than soil samples from the more forested Hoosic River indicate that local density of forest cover (i.e., percent land cover of forest) likely correlates with the presence of *E. coli* in environmental samples.

The *E. coli* isolates were characterized using a 7-gene multi-locus typing scheme to identify unique genetic types ("sequence types") within each sample. More than 570 unique sequence types were identified with this approach. This comprehensive set of sequence data was used to estimate the rates and distance of movement of *E. coli* isolates among produce field and forest sites. These data allowed CPS to classify *E. coli* into ECOR groups A, B1, B2, D, E and F, which differ in their presence in different environments. For example, ECOR B1 is thought to be the dominant type in wild and domestic animals.

Competing models were formulated using remotely-sensed and field-collected data, e.g. vegetation density and type, buffer width, soil habitat quality, produce type, and infiltration rate of host animal feces. These models were used to predict produce contamination risk in the landscape context and to produce maps of the most efficient dispersal paths for fecal bacteria across the landscape. The predictions from these maps were then compared to genetic data for the *E. coli* isolates collected in the field to identify the models that best fit the observed data. The set of models producing the best fit to the genetic data defines landscape attributes that promote pathogen dispersal. Analyses showed that models that contained absolute or porous barriers (e.g. major rivers or roads) for dispersal best fit the actual dispersal data, which indicates that terrestrial transport, likely wild animals, is important for transmission of *E. coli*.

Significant conclusions and recommendations.
Overall, this project developed new data indicating that, in the areas sampled in New York, density of forest cover correlates with the percent of *E. coli* positive environmental samples and riparian zones may play a role as a dispersal corridor for the transmission of enteric bacteria between and towards produce fields, especially where forest cover is very limited (Table 1). Importantly, data indicates that the transmission of fecal bacteria is not uniform across the agricultural landscape, rather it may be shaped by local landscape features. In the Flint Creek area, which is characterized by sparse forestation, dispersal was detectable almost exclusively in the riparian area. Whereas, the Hoosic River landscape, which is more forested, exhibited widespread dispersal that correlated with riparian effect models only slightly better than with non-riparian models. Specifically, modeling data indicate that dispersal of *E. coli* follows a pattern that suggests dispersal by terrestrial animals. Importantly, this project developed the methodology and tools that can be used to perform similar analyses in other landscapes, which will further enhance the understanding of the roles of riparian zones in bacterial dispersal to produce fields.

The data supports that co-management of riparian zones to manage both ecological benefits and potential food safety impacts is needed. Importantly, this project represents a key first step towards the development of data and methodologies that can be used to quantify the contributions of riparian zones and wildlife movement to dispersal of *E. coli*, and by extension enteric pathogens. Use of these data to develop co-management practices for riparian zones will likely represent an important step in pre-harvest food safety, though validation of the results generated here in other areas as well as in different seasons will be necessary.

The Center for Produce Safety staff understands the mission of Specialty Crop Block Grant Program funds and adheres strictly to the CDFA-SCBGP Grants Management Procedures Manual. The CPS staff is in constant communication with both the California industry and the scientist working on this project and is unaware of any benefit to commodities other than specialty crops.

Significant contributions by project partners.
The subaward principal investigator (PI) (Cornell University) devoted his supervision and his expertise in food safety microbiology to the project. Data management and formulation of dispersal models was performed by a cooperator, who is now an assistant professor at North Dakota State University. Environmental sampling was conducted by six members of the Food Safety Lab. Isolation and identification of *E. coli* and nucleotide sequencing were carried out by a postdoctoral associate, and an experienced

technician. The cooperator at Cornell University, provided support for establishing working relationships with growers and invaluable advice about farm management practices.

Goals and Outcomes Achieved

Research activities for this project are conducted by the Cornell University subaward PI.

Project goals.
This project developed causal models of fecal bacteria dispersal through riparian buffer zones onto produce farms. These models provide data to predict produce contamination risk in the landscape context and serve as the first attempt at a quantitative or qualitative model for bacteria transport between forests and farms. The success of the project will be measured by citations of publications and grower implementation of recommendations.

Measurable outcomes.
The results from this study were disseminated to the larger scientific community, industry and growers. Results from this project were presented at the 2013 Annual Meeting of the International Association for Food Protection, the 2013 CPS Symposium, the 98th General Meeting of the Ecological Society of America, the International Association of Food Protection 2013 Annual Meeting, and the 112th General Meeting American Society for Microbiology. CPS anticipates publication in a peer-reviewed journal in 2014. Results will also be disseminated to growers through the Good Agricultural Practices program at Cornell.

Table 1 includes a summary of findings for the sampled areas.

As an alternative to developing an independent survey to track acceptance of research findings, CPS has opted to partner with various commodity and trade groups to disseminate research results. This is a trusted source of information for the fresh produce industry. Two of the larger associations that assist CPS with this endeavor are Western Growers Association and Produce Marketing Association. Western Growers members provide 50% of the nation's fresh fruit vegetables including one-third of the organic fresh produce and 99% of the tree nuts. The Produce Marketing Association represents companies from every segment of the global fresh produce supply chain. Both WGA and PMA have provided staff resources to translate the research results into usable information for use by the fresh produce and dried nut industry. All information is public and available on the Center for Produce Safety's website, www.centerforproducesafety.org as well as offered through research webinars, extension scientists and commodity organizations. All trusted sources for science based information. Resources include; annual symposium, symposium key learnings, CPS 5 Year Key Learnings, and CPS Produce Research Symposium - A Practical Guide to the Scientific Research.

Beneficiaries

The findings from this project specifically support the produce industry, by providing scientific data and tools that can be used to predict and assess the risk of produce contamination on lands impacted by riparian zones. Ultimately, the data and models produced here will also benefit agencies that make decisions on conservation issues, particularly in areas where riparian zones and produce production areas co-exist. The potential economic impact of CPS' results centers around the availability of tools to make rational decisions with regard to selection of food safety related management practices (e.g., our data suggest that management practices that control spread by terrestrial animals are more important than management practices that would control spread by birds). Another key benefit will be that the data are providing a path towards the development of geographic information systems (GIS) tools that will assist growers in developing and implementing individualized science-based food safety measures on produce farms. This has the potential to replace the one-size-fits-all approaches that carry considerable costs.

There are 42,729 farms of specialty crop growers representing $23.9 billion in sales in the state of California according to the 2012 Census. Information about the research is disseminated in the following manner:

Dr. Martin Wiedmann, Cornell University, presented interim results at the 2013 CPS Produce Research Symposium in Rochester, New York. Final research results were presented in June at the 2014 CPS Produce Research Symposium in Newport Beach, CA. The 2013 symposium had 300 attendees and the 2014 symposium had 245. The participants included California regional and national growers/shippers, retail and food service buyers, scientists, academic, produce industry representatives, and members of regulatory agencies. The symposium provides expert panels to critique research results. This process helps participants evaluate the use of the research results in their respective businesses. Project results will be disseminated at industry meetings and streamed through social media sources.

Final results will also be included in the following:

1.) The Final report can be found at http://www.centerforproducesafety.org/amass/documents/researchproject/338/033114%20SCB11072%20CPS%20Final%20report%20Wiedmann.pdf
2.) CPS also works with scientists to publish results in scientific journals. Publication dates occur after the project is completed. Awards and abstracts can be found on the CPS website.
3.) The Center for Produce Safety's Board of Directors and members of the Technical Committee distribute a series of information throughout the year on their websites, and through presentations, meetings and webinars. An example of this would be the "CPS Funded Research - Key Learnings" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/210/CPS%20Key%20Learnings%20May%202014_FINAL2.pdf

The following websites provide additional resources on the final reports and symposium proceedings:

- Center for Produce Safety: https://cps.ucdavis.edu/resources.php
- Produce Marketing Association: http://pma.com
- Western Growers Association: http://www.wga.com/

Lessons Learned

The following lessons were learned as a result of completing this project:

- The dispersal dynamics of *E. coli* varies by landscape (with the landscapes studied differing by the proportion of forest land). Forested areas may act as a reservoir of extrahost *E. coli*.
- Different dispersal behaviors were exhibited by different *E. coli* groups. Group B1A was frequently isolated and exhibited a relatively strong signal of dispersal with some preference for riparian corridors. Future attempts to understand *E. coli* dispersal might do better if the studies focus on *E. coli* groups B1, B1A and E, which are closely related to the *E. coli* pathogens of greatest concern and exhibit the best correlation to wildlife-based dispersal models.
- Riparian forests played a role in the overland movement of *E. coli*. In less forested landscapes, detectable dispersal is largely limited to riparian forests.

- While the dispersal and persistence of *E. coli* is complex, CPS' analyses indicate that terrestrial wildlife likely played a role in the movements of *E. coli* among produce fields. This suggests that future projects should further evaluate the effects, in *E. coli* dispersal, of barriers that reduce terrestrial wildlife movement.
- The observation that dispersal dynamics of *E. coli* varied by landscape suggests that generalization from studies in a specific landscape to other landscapes may provide potentially misleading information on *E. coli* and pathogen dispersal.
- GIS-based tools are also applicable to understanding the effects of serious natural flooding disasters on bacterial contamination of produce fields. These tools were employed to investigate the extent of bacterial contamination of spinach fields after flooding by Hurricane Irene in 2009 and were used to inform farming practices for remediation and replanting of fields.

Additional Information

Publications and Presentations:

Bergholz, P.W., T. K. Chapin, R.C. Pfuntner, L. K. Strawn, and M. Wiedmann. 2012. Quantifying environmental reservoir quality and landscape connectivity for foodborne pathogen transmission to produce fields. 112th General Meeting American Society for Microbiology. June 16-19, 2012, San Francisco, CA

Ryan, G., S. Warchocki, L. Strawn, M. Wiedmann, and P. Bergholz. 2013. Impacts of riparian forests on the prevalence of non-pathogenic *Escherichia coli* contamination in produce fields. International Association of Food Protection Annual Meeting, Charlotte, NC, July 18-31, 2013

Bergholz, P. W., G. T. Ryan, L. K. Strawn, S. Warchocki, and M. Wiedmann. 2013. The potential role of riparian corridors in overland dispersal of bacteria among vegetable farms. Ecological Society of America Annual Meeting, Minneapolis, MN, August 4 - 9, 2013

Wiedmann, M. 2013. The role of riparian corridors in bacteria dispersal to produce farms. CPS 2013 Produce Research Symposium, Rochester, NY, June 25 – 26, 2013

USDA Project No.: 73	Project Title: Solving Housing and Transportation Barriers faced by the Specialty Crop Workforce	
Grant Recipient: Ag Innovations Network	**Grant Agreement No.:** SCB11073	**Date Submitted:** December 2014
Recipient Contact: Dan Schurman	**Telephone:** 707-823-6111 x 120	**Email:** dan@aginnovations.org

Project Summary

Farm worker communities are critical to the specialty crop industry. California specialty crop growers consistently rank availability of production and harvest labor as a critical risk factor for profitability and long-term viability.

The project brought together stakeholders from the agriculture, labor, housing, and transportation sectors to examine barriers and community issues that make it difficult to house and transport the workers required by specialty crop producers. The outcome of this effort is a set of actionable recommendations that businesses, communities and non-governmental organizations can act upon to increase worker access to jobs within the specialty crop sector.

This issue is important and timely because of the workforce availability challenges faced by the specialty crop industry during the current harvest season – a trend that is anticipated to continue in coming years, particularly without the prospect of immigration policy reform.

This was a new project and did not build on previously funded Specialty Crop Block Grant projects, nor did it apply for or receive funding from other state or federal grant programs.

Project Approach

- Identified key stakeholders from across the state with knowledge of agricultural labor and transportation issues and the influence to make the recommendations developed become a blueprint for action. A group of 50 stakeholders was assembled.

- Interviewed 40 of the identified stakeholders and created a baseline data set of the issues and opportunities in both housing and transportation for specialty crop workers.

- Conducted a kick-off summit of all 50 stakeholders where the group reviewed the results of the interviews, committed to a 12-month work plan for the project, and began the process of agreeing on the nature and scope of the issues.

- Broke into two workgroups, housing and transportation, charged with creating a comprehensive statement of the issues and a list of recommendations for government (without lobbying), business, and the general public that has broad support from the workgroup. These workgroups worked both in-person and virtually for 6-8 months to accomplish their goals.

- Synthesized the work product of the two groups into a comprehensive set of recommendations and gained full stakeholder committee support for the proposals.

- Published a report of the recommendations entitled "Shelter + Mobility: Recommendations for California's Specialty Crop Workforce" (attached). Released the report to the public during an appearance before the California State Board of Food and Agriculture.

- Held a final summit attended by 30 of the stakeholders to provide closure to the project and generate interest in and commitment to working further to implement the recommendations.

- Used a networked marketing and outreach methodology to involve stakeholders in identifying the key audiences for the recommendations. Distributed the report to approximately 300 additional stakeholders statewide. Posted the report on the AIN and CDFA websites.

- Evaluated the effectiveness of the effort with members and created a summary of these evaluation findings (attached).

While the recommendations developed in the project, if they were to be implemented across the board, would benefit all agricultural workers in California, the efforts taken to ensure specialty crop competitiveness was solely enhanced included the inclusion of specialty crop growers and specialty crop grower organizations in the project and the specific focus of the recommendations in the final report on specialty crop workers.

As a multi-stakeholder initiative, the project was almost entirely partner-driven. The partners (listing included in the attached final report publication) worked directly in identifying the issues to be addressed, developing the recommendations to be presented, and crafting the final document.

Goals and Outcomes Achieved

This project was originally written with a much larger budget and time frame. However, the award was less than the original budget and as work began on the project it was clear that the project deliverables needed to be changed to acknowledge the budget and time frame change. Instead of having actual on-the-ground increases in worker availability due to decreasing housing and transportation barriers, as was originally envisioned, it was clear that the more realistic goal was of getting stakeholders to first agree on what needed to be done. This was challenging in and of itself, and the original outcome of actually implementing those changes and piloting them in a specific number of communities was unrealistic.

A change was made to the project's Expected Measurable Outcomes and was reported in the second annual report. Instead of focusing on implementation in a few select counties, the project instead focused on developing a strong set of recommendations from a broad statewide representation of stakeholders that could be delivered and distributed throughout the entirety of the state. The report was disseminated to at least 960 stakeholders including various businesses, communities, and non-governmental organizations.

The following are activities that were completed in order to achieve the performance goals and measurable outcomes:

1. A universe of potential stakeholders was identified to involve in the process of developing recommendations.
2. 50 stakeholders were recruited and 40 of these were interviewed to develop an overview of the issues, problems, and potential solutions

3. Stakeholders were convened and a process was organized to yield desired outcomes (recommendations).
4. A final report was published and disseminated to a wide range of stakeholders to educate and inform them on the issues, challenges, and recommendations.
5. A final survey of stakeholders was conducted to evaluate project effectiveness and identify next steps.

The outcomes were very specific and time-limited, so there were no long-term outcomes with only partial achievement or progress to report. The major successful outcome of the project was the development of a consensus-based set of recommendations to improve the housing and transportation options for California's specialty crop workforce.

Beneficiaries

To the extent that the recommendations developed in the project are acted upon and result in increased access to housing and transportation resources for specialty crop workers in California, the beneficiaries of this project will be specialty crop workers and their families, the specialty crop producer employers of these workers, and the communities in which they live and do business.

California specialty crop agriculture employs more than 150,000 farm workers in communities across the state. A national sample survey of agricultural employers indicated that the negative economic impact resulting from the inability or delay in getting agricultural workers was approximately $316 million among 1,444 sampled operations. California currently has more than 81,000 farming operations and the economic impact resulting from the delay or inability in obtaining agricultural workforce is significant, especially among specialty crop producers with a limited harvest window.

Direct beneficiaries of this project are suburban and rural agricultural communities (growers/processors) that experience agricultural workforce availability challenges due to housing and transportation constraints. This represents communities throughout the state and all specialty crop producers. Developing actionable recommendations for urban and rural communities that address the inability and delay in getting agricultural workers will directly benefit specialty crop growers through higher production yields in short harvest windows (less product wasted by the lack of labor to harvest). If this project improves labor availability and reduces delays in finding labor for five percent of California's 81,000 farming operations, this project has the potential economic impact of $882 million benefiting specialty crop growers. This estimate is based on results of the national sample survey referenced above.

Lessons Learned

There is more consensus on the issue than anticipated, which encourages AIN to believe that there is real potential for a powerful coalition to form to further the work of the project and implement the recommendations. Additional time and budget is required to move the stakeholders to the next level of required specificity and involvement on implementation to make actual changes on the ground. AIN remains committed to accomplishing that larger goal in a subsequent phase of the project in which staff would work to implement the recommendations that emerged from this project.

The high degree of consensus on the issue among stakeholders was unexpected, as was the degree to which certain stakeholders representing employer and labor interests were able to overcome their historic and usual opposition on many topics to work together on this project and in pursuit of common benefits for both specialty crop employers and workers.

Additional Information

Attachment 1: Shelter + Mobility: Recommendations for California's Specialty Crop Ag Workforce
Attachment 2: Project Evaluation: Synthesis

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 74	Project Title: Specialty Crop Trade Mission to China	
Grant Recipient: Center for International Trade Development	**Grant Agreement No:** SCB11074	**Date Submitted:** December 2014
Recipient Contact: Alicia Rios	**Telephone:** 559-324-6401	**Email:** Alicia.rios@scccd.edu

Project Summary
In April 2013, the Center for International Trade Development (CITD), in coordination with California Department of Food and Agriculture (CDFA) facilitated a specialty crop trade mission to China. The delegation consisted of 10 specialty crop company representatives and two government officials.

The purpose of this project was to increase specialty crop awareness among importers, distributors and retailers in Beijing, Shanghai, and Guangzhou. California specialty crop products have significant market competition from domestic production (Chinese) and other specialty crop imports from foreign markets (Southeast Asia, Europe, etc.) Increased awareness among the targeted trade sector on product quality/safety, use, and nutritional benefits improves the likeliness of purchases of California specialty crop products.

This trade mission was important and timely to maintain the visibility of California specialty crop products in China among increased market competition and price competiveness.

This project did build upon the previous Specialty Crop Trade Mission to Asia (2008 Farm Bill). The focus of the September 2010 mission was to increase market visibility in three foreign markets - China, Japan and South Korea through direct business meetings, promotional outcomes and media visibility. This activity also followed the previous format (meetings, promotional outcomes, etc.) but focused on one country market (China) and will build upon market visibility and awareness through continued trade sector servicing – market maintenance activities to continue product visibility in a highly competitive market sector.

Project Approach
The trade mission focused on raising the visibility of California specialty crop products within the trade sector through direct meetings with importers/distributors as well as meetings with Chinese governmental representatives to inform and educate on the prospects of represented products with the market. The trade mission activity was closely coordinated with the USDA's Foreign Agricultural Service and activities/programs were implemented by a contracted firm within market specializing in representing agricultural organizations.

The trade mission resulted in more than 20 group meeting opportunities with trade sector and government representatives. Meeting overview: in Beijing, four governmental and two trade sector meetings occurred; in Shanghai, one governmental and seven trade sector meetings/visits occurred; in Guangzhou, one governmental meeting and three trade sector meetings/visits occurred. Overall the agricultural specific meetings were combined with additional business meetings/events organized by the main trade delegation. The agricultural meetings provided a forum by which participating specialty crop representatives could engage with foreign counterparts to help maintain the visibility and business connections for the specialty crop industry within the trade sector. In preparation for the trade mission, participants were asked (through an informal survey) to provide a list of important issues, specific meeting requests, as well as if they were interested in participating in promotional opportunities. This information was used by the contractor in market and U.S. government officials in determining the schedule for the agricultural delegation.

Direct business and governmental engagement by participating companies helped to support the continued growth of California agricultural exports to China as well as to encourage further trade and business relations. By demonstrating the business intent and desire by specialty crop companies to conduct business with China, a foundation of cooperation is being built to help further facilitate trade relations. The project approach was to establish business relationships with the trade sector and to invite these business entities back to California to further promote business and export sales by California specialty crop companies.

Project activities were not associated with lobbying, nor were grant funds utilized towards lobbying. The Specialty Crop Trade Mission to China was solely to enhance the competitiveness of specialty crops. The project funds were strictly spent on approved project activities. Additionally, the trade mission provided the opportunity to specifically highlight and promote California specialty crop items only, to agriculture trade and business leaders. This mission raised awareness of the diversity and availability of California specialty crops within a highly competitive market.

Goals and Outcomes Achieved

With more than 20 business and governmental meetings– several of these meetings representing the largest food trading groups in the market – the prospects are strong for export sales to result from long-term outcomes identified within project.

As identified in the project approach, this activity provided the foundation by which Chinese trade organizations could lead reciprocal meetings to California. This approach has been successful and with the following results:

On February 25, 2014, the CITD and the CDFA hosted TMall (leading Chinese online retailer) for business meetings with California specialty crop companies. TMall had a group business meeting with five USDA MAP cooperatives, conducted an informational webinar of which more than 30 companies attended, and had separate meetings with three large specialty crop cooperator organizations.

On February 27, 2014, the CITD and CDFA hosted a delegation from China Chamber of Commerce for Import and Export of Foodstuffs, Native Produce and Animal By-Products (CFNA) the largest agricultural/food trade organization in China. The leadership delegation met with CDFA to inform them on upcoming trade events focusing on specialty crops and the prospects for future trade development.

On June 10, 2014 the Shanghai Municipal Government visited California and had an agricultural forum with representatives from the Driscoll's, the Buy California Marketing Agreement, the Almond Board of California, California Citrus Quality Council, Lodi Winegrape Commission, and World Food Center at UC Davis. The meeting resulted in an opportunity for agricultural groups to address trade barriers and cooperation with Shanghai Municipal Government.

On June 11-14, 2014, the USDA Agricultural Trade Office Shanghai presented a nut buying mission to California that consisted of site visits and tabletop one-on-one meetings. During this mission, there were 6 buyers that were introduced to 19 California exporters. Initial exporter company evaluations indicate a projected $1.8 million in sales will take place over the next 12 months as a direct result of this mission.

On June 16-18, 2014, the USDA Agricultural Trade Office Shanghai presented a consumer oriented buying mission to California that consisted of site visits and tabletop one-on-one meetings. During this mission, there were 7 buyers that were introduced to 16 California exporters. Initial exporter company evaluations indicate a projected $585,000 in sales will take place over the next 12 months as a direct result of this mission.

Communications are currently ongoing with the Subcommittee on Roasted Seed and Nuts of the Association (CRSN) of the China National Food Industry Association for a meeting in California in August 2014. The meeting will potentially include representatives from the Almond Board of California, American Pistachio Growers and the California Walnut Commission.

As measurable outcomes have been identified as long-term, the CITD remains in contact with USDA Foreign Agricultural Service in China as well as in-market representatives to continue outcome development and progress. The CITD is well facilitated to achieve the targeted outcomes based on its experience and expertise in facilitating a variety of trade delegation requests from U.S. Agricultural Trade Offices and other agricultural organizations.

Beneficiaries

Beneficiaries of this project include the following: 102 growers/shippers of the Almond Board of California, over 2,700 farms/processors/traders of the California Certified Organic Farmers, 36 growers of the California Strawberry Commission, 35 packers/dehydrators of the Raisin Administrative Committee, 65 growers of the California Citrus Quality Council, and over 800 wineries of the Wine Institute.

By participating in the trade mission, these organizations had direct engagement with trade sector representatives, importers and distributors, as well as governmental representatives. The Chinese market is very relationship based and continued visibility of products, representatives is critical to future success.

In addition to the organizations represented on the mission, the reciprocal trade mission activities generated by this project will provide broad-based individual business opportunities for specialty crop companies. By participating in direct business to business meetings, these companies will have an opportunity to increase trade relationships and potential export sales to the market.

Lessons Learned

The trade mission was successful in the meeting the objectives of increasing market visibility and awareness within the market. The post trade mission activities to date have largely been governmental focusing on expanding trade cooperation between California and China. Three activities have occurred that have focused on business-to business opportunities, including the meeting with TMall and buying mission organized in conjunction with the Agricultural Trade Office with over $2,385,000 in projected sales. Post activity surveys will be distributed in 2015.

Overall the approach of the project, using high-level meetings with trade organizations, businesses and government officials to reinforce specialty crop awareness did achieve the goals of the participants. Long term outcomes of the project appear to be in line with the activity plan and projected sales outcomes are anticipated following the survey. This assumption is made based on a historic activity data from annual reverse trade missions conducted by the CITD.

China is a very difficult and a relationship based market. Trade activities, like trade missions, that engage with trade and governmental sector are essential not only to expand but to maintain market visibility and sales.

In specific terms of the activity – direct coordination with the USDA's Foreign Agricultural Service is essential. These offices help to facilitate trade and government meeting access and provide important and vital market information on the market. In each location the delegation visited, a briefing with the local U.S. Agricultural Trade Office occurred.

Further, engagement with trade organizations and local government officials is also needed to maintain visibility of the products within the market.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 75	**Project Title:** Mobile Agriculture Education Exhibit	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SCB11075	**Date Submitted:** December 2014
Recipient Contact: John Quiroz	**Telephone:** 916-900-5025	**Email:** John.quiroz@cdfa.ca.gov

Project Summary

The purpose of this project was to develop grower-consumer connections and encourage increased consumption of California-grown specialty crops by introducing 20,000 urban and suburban visitors at four urban California district agriculture association fairs to local specialty crop growers, farmers' markets, CSA programs, farm stands, and agritourism operations in their region. Additional initial purposes of the project were to increase income to the promoted growers, increase local sales of California specialty crops, and demonstrate interactive agricultural education in the fair environment, leading to future replication of the project exhibits by other California fairs.

Most urban and suburban Californians do not know any farmers or ranchers and are not aware of the huge variety of specialty crops grown in California, but are increasingly interested in knowing where their food comes from. Personal connection with growers has been shown to help build loyalty and increase sales of California specialty crops. California's urban district fairs and county fairs are visited by a large cross-section of urban and suburban consumers. Although specialty crop education and promotion is part of some California fairs, the different agricultural vendors and organizations conducting these activities do not usually collaborate within each individual fair to maximize their impact. This project created a user-friendly guide for fair organizers and communities to use in implementing collaborative specialty crop education at a time when there is public interest in local agriculture and local food access.

This project built on 2010 SCBGP Project 65: *California Fairs: a Portal for Growing Agritourism and Celebrating California Grown Food*. This project complemented and enhanced that previously completed work by continuing to develop the educational exhibits planned in that project, and by testing some of the approaches to agricultural education suggested by participants in the earlier project. Approaches that were tested in this project include situating the agricultural exhibit close to the fair entrance, combining education with product sales, and collaboration among local agricultural organizations in planning and operating the exhibits. The guide for collaborative agricultural education at California fairs, created through this project, reports on challenges and best practices learned through both projects.

Project Approach

- UC Small Farm Program staff gathered and mapped information about all farmers' markets, CSAs, farm stands, U-Pick farms and agritourism associations in Contra Costa, San Joaquin, Riverside and Santa Barbara Counties. Staff also invited winery associations in each of these counties to promote themselves at their county's "Discover California Farms" exhibit. In Contra Costa County, 54 specialty crop growers and 34 weekly farmers' markets were mapped and promoted. In San Joaquin County, 21 specialty crop growers and 12 weekly farmers' markets were mapped and promoted. In Riverside County, 17 specialty crop growers and 17 weekly farmers' markets were mapped and promoted. In Santa Barbara County, 47 specialty crop growers and 13 weekly farmers' markets were mapped and promoted. In addition, the 70 wineries of the Lodi Wine Trail map were promoted in San Joaquin County and the 31 wineries of the Temecula Winery Association were promoted in Riverside County. A total of at least 240 specialty crop growers and 76 weekly farmers' markets were promoted at the exhibits created by this project.

- UC Small Farm Program staff and CDFA staff worked with local committees in each of Contra Costa, San Joaquin, Riverside and Santa Barbara Counties to plan, design and build display elements, to gather materials and supplies for display and interactive activities, and to schedule staffing, tastings, demonstrations and other activities at each of four "Discover California Farms" fair exhibits. Participating in the planning or operations of the exhibits were the following organizations and specialty crop producers: UC Cooperative Extension Master Gardeners and Nutrition Educators, County Farm Bureaus in Contra Costa, San Joaquin, Riverside and Santa Barbara Counties, County Department of Agriculture staff, beekeepers associations in each county, Network for a Healthy California's Latino Campaign, farmers' market associations in each county, individual specialty crop growers, farm stand and CSA operators from each county, Molena Healthcare, Riverside Unified School District Nutrition Services, San Joaquin Historical Museum, California Women for Agriculture, 4H leaders and members, high school student volunteers, fair board members and fair staff in each county.
- UC Small Farm Program staff and CDFA staff coordinated set-up, operations and break-down of "Discover California Farms" exhibits at the Contra Costa County Fair in May 2013, the San Joaquin County Fair in June 2013, the Southern California Farm in Perris in October 2013, and the Santa Barbara Fair and Expo in April 2014.
- UC Small Farm Program staff documented the entire process, consulted with planning team participants about their experiences, and created a guide for specialty crop promotion and education at California district and county fairs. The guide is available online at http://sfp.ucdavis.edu/files/196702.pdf and is included as an attachment to this report.
- UC Small Farm Program staff contacted, by phone and email, 129 specialty crop producers and 29 farmers' market organizations that were promoted at the four exhibits created by this project, asking about the results of fair event participation on their businesses. Responses were received from 41 specialty crop producers and 10 farmers' market organizations; response rates were 32% and 35% respectively. The responses are summarized below in the "Goals and Outcomes Achieved" section.
- Gathering email addresses from fair attendees and obtaining permission to contact them in the future was difficult. At the four fair exhibits, staff were only able to collect a total of 185 valid email addresses from fair attendees who gave permission for contact. UC Small Farm Program staff created four different informational email newsletters, each targeted to fair attendees from one of the counties and containing news about farmers' markets, farm tours and other opportunities to connect with farmers. Each newsletter contained an invitation to participate in a very short survey asking about changes in purchases of California specialty crops since attending the fair exhibit. Of the 185 email newsletters sent, 47 were opened; 8 people clicked on the survey; only 3 answered the survey. Those that answered reported that they had learned something at the exhibit and were now more likely to attend farmers' markets and purchase local specialty crops.

Project staff made sure that the exhibits, including all displays, educational activities, sales, demonstrations and handouts, only mentioned, pictured and promoted specialty crops and specialty crop growers.

Project Partners:

- At the Contra Costa County Fair: Beekeepers from the Diablo Valley Beekeepers Association, with demonstration beehives, were the biggest draws to the booth; thousands of free begonia plugs handed out by the Contra Costa County Farm Bureau were very popular; Master Gardeners contributed multiple shifts of knowledgeable experts, keeping a table staffed for most of the fair, and a jam tasting by 3 French Hens was enjoyed by Saturday visitors. On Sunday, a team of Spanish speaking nutrition educators working with the Network for a Healthy California's Latino Campaign from the Health Education Council distributed cookbooks, aprons and other goodies and lent the use of a nutrition education spinner-wheel for the duration of the fair. Ongoing activities included colorful wooden photo-opportunity cut-outs from the California Farmers' Market Association.
- At the San Joaquin County Fair: The San Joaquin Historical Museum loaned a large photo of a historical grape harvest. On Saturday, California Women for Agriculture helped staff the exhibit and distributed water cycle bracelets. On Sunday, a team of Spanish-speaking nutrition educators from the Network for a Healthy California's Latino Campaign distributed cookbooks and other goodies.
- At the Southern California Fair in Riverside County: Riverside Unified School District Nutrition Services provided a display and education about their pioneering school salad bar program which purchases produce from local farmers. Molena Health Care organization educators provided nutrition education to the exhibit, as well as lending their blender bicycle for use at the Southern California Fair exhibit. UC Cooperative Extension nutrition educators provided staff to assist with children's activities and lent their nutrition education spin wheel for the duration of the exhibit. Local beekeepers brought demonstration hives, which were a big attraction and great education. Farmer Brian Griffith contributed by acting as farmers' market manager for the on-site certified farmers' market set up at the Southern California Fair.
- At the Santa Barbara Fair and Expo: Rancho Olivos Olive Oil conducted olive oil tastings every day except Sunday. Forbidden Fruit Orchards gave out blueberry samples on Thursday evening and sold jams, syrup and fresh blueberries and mulberries. On Saturday afternoon Classic Organic Farms gave away fresh carrots, which were very popular with both adults and children. The UCCE Nutrition Educators were present on Thursday morning for the school tours, and all day on Saturday (Senior Day) and Sunday (Hispanic Day), giving out cookbooks and educational materials in English and Spanish and engaging the children with the spinning wheel activity. The Santa Barbara Beekeepers Guild was present at all times, and their demonstration beehive was very popular.

Goals and Outcomes Achieved

- The target was for approximately 20 percent of attendees at the first two days of each fair event, or 20,000 people to visit the mobile exhibit. To achieve this goal staff mounted large colorful banners and signs, included multiple engaging activities, displays, handouts, tastes, demos and raffle prizes (non-grant funds) in each exhibit, located inviting activities and staff at the front of the exhibit, and trained all staff to engage all potential visitors in a friendly manner. In order to measure achievement of this goal, staff counted with a hand-held click-counter all individual fair attendees who engaged in any of the exhibit activities or displays.
- In order to later contact attendees about their changes in consumption of California specialty crops, staff gathered email addresses by inviting raffle entries and including a check-box on the raffle entry to give permission for contacting the attendee at a later time.

- To increase attendance at regional certified farmers' markets, staff distributed maps and lists of recently verified locations and times for all certified farmers' markets in the county where the exhibit was located. Some participating farmers' market organizations distributed coupons.
- To increase memberships in CSA programs, staff distributed information about CSA programs in general, with specific verified contact information for all CSA programs serving the county where the exhibit was located.
- To increase sales at farm stands and agritourism operations, staff distributed maps, lists and promotional materials from local agritourism operators and organizations in each county.

The Guide to Specialty Crop Promotion and Education at California Fairs, published online at http://sfp.ucdavis.edu/files/196702.pdf and attached to this report, will help fairs work with their agricultural community to create collaborative opportunities for specialty crop promotion and education at fairs. This guide will be promoted by CDFA Fairs and Expositions staff to the California fair community, and will be promoted by the UC Small Farm Program to the California agricultural community.

Actual accomplishments compared with the goals established:

1. The objective - increased public understanding and appreciation of California regional specialty crops - had a goal of reaching a total of 20,000 visitors or 20% of fair attendees at the first two days of each fair event. The project actually counted 13,083 visitors to the exhibits, or about 7% of fair attendees, achieved by keeping the exhibit open for 4 or 5 days at each fair event.
2. The objective - increased California consumption of California-grown specialty crops - had a goal of 10 percent of fair attendees reporting in an email survey that they had increased their purchases of California specialty crops since the fair. It was not measureable by the measurement method used. Gathering email addresses from fair attendees and obtaining permission to contact them in the future was difficult. At the four fair exhibits, staff were only able to collect a total of 185 valid email addresses from fair attendees who gave permission for contact. UC Small Farm Program staff created four different informational email newsletters, each targeted to fair attendees from one of the counties and containing news about farmers' markets, farm tours and other opportunities to connect with farmers. Each newsletter contained an invitation to participate in a very short survey asking about changes in purchases of California specialty crops since attending the fair exhibit. Of the 185 email newsletters sent, 47 were opened; 8 people clicked on the survey; only 3 answered the survey. Those that answered reported that they had learned something at the exhibit and were now more likely to attend farmers' markets and purchase local specialty crops.
3. The objective - increased attendance at regional certified farmers' markets - was achieved, based on telephone interviews with representatives of 10 of the 29 farmers' market organizations promoted by the fair exhibits. However, many other factors besides the fair exhibits also contributed to this increase. UC Small Farm Program staff attempted to contact all 29 farmers' market organizations, representing the 76 weekly farmers' markets promoted by the exhibits, but did not receive response from representatives of all of the 17 markets included in the June 2012 baseline sample. Of the 10 farmers' market organizations interviewed, 1 reported farmers' market attendance increases of 25% to 50%; 4 reported farmers' market attendance increases of 10% to 25%; 4 reported no change in market attendance; 1 reported a decrease in market attendance of 10% to 25%.
4. The objective - increased memberships in Community Supported Agriculture (CSA) programs operated by specialty crop growers - had a target for 200 new CSA memberships in CSA programs promoted by the fair exhibits. It was not achieved, based on telephone interviews with promoted CSA operators. UC Small

Farm Program staff interviewed operators of 7 of the 25 CSA programs promoted at the exhibits. Of these CSA operators, 4 reported no new members signing up as a result of learning about the CSA at the fair, and the other 3 reported 1 or 2 new memberships as a result of the fair exhibit. This is much less than the goal of 5 new memberships for each of 40 promoted CSA programs.

5. The objective - increased sales of specialty crops at farm stands, farmers' market stalls and agritourism operations promoted by the exhibits - was achieved, based on telephone interviews with 32 specialty crop producers promoted by the exhibits. However, the target goal of an increase of 10 percent in sales of specialty crops by the majority of those promoting or participating was not achieved, based on these 32 interviews. 25 percent of those interviewed, rather than the goal of 50 percent, reported increases in revenue of more than 10 percent; 44 percent reported no change; and only one respondent, or 3 percent of those interviewed, reported a decrease in revenue of more than 10 percent.

Outcomes quantified:

- More than 13,000 attendees at four California Agricultural District fairs learned about local specialty crops and specialty crop growers, received tastes, gardening advice, cookbooks and other nutrition education in English and Spanish, watched bees in a hive, and learned to find local farmers' markets, farm stands, CSA programs and agritourism operations.
- More than 240 direct-marketing specialty crop producers in four California counties were promoted to fair visitors with maps, posters, brochures, coupons and informational handouts, contributing to increases in revenue by many.
- 76 weekly farmers' markets in four California counties were promoted to fair visitors, contributing to increased attendance of more than 10 percent at about half of the markets.
- Diverse specialty crop producers, farmers' market managers, agricultural organizations, community organizations and educators worked together with fair management in four California counties to create collaborative specialty crop educational and promotional exhibits. The project introduced groups and individuals to the potential of future collaborative specialty crop promotion.
- Four California District fairs received needed revenue from this project, and received gratitude and support from the local agricultural community and the larger community for including the "Discover California Farms" exhibit in their fairs.
- The California fair community has a new model for specialty crop education and promotion.
- The experiences and lessons learned in organizing this project allowed project staff to create a guide to specialty crop promotion and education at California District and County Fairs that will be useful for fair managements and communities.

Beneficiaries

1. Fair attendees
   A cross-section of urban, suburban and rural families attend district and county fairs in California. Fairs are particularly family-friendly environments, so many project beneficiaries were in family groups. In addition, three of the four of the district fairs participating in this project offered school groups and other youth groups a special time at the fair for education and activities before the normal opening time, so many project beneficiaries were children and teachers in school groups.
2. Direct-marketing specialty crop growers who participated in the project
   Specialty crop growers who participated in the exhibits in person had the opportunity to make direct contact with potential customers, give them samples, sell them products, and invite fair attendees to be

repeat customers at their farm stands, CSA operations and farmers' market booths. Direct-marketing specialty crop growers who were promoted with posters, maps, coupons and exhibit handouts benefited from increased awareness of their operations by local potential customers.

3. Specialty crop growers selling at local farmers' markets
   Several hundred specialty crop growers selling at certified farmers' markets close to the fair events benefited from increased sales at farmers' markets resulting from promotion of local farmers' markets in fair displays.
4. The California Specialty Crop industry in general
   California specialty crop growers benefited by increased understanding of locally-grown specialty crops and increased public support due to the 2013-14 promotional exhibits at the fairs and will continue to benefit from future fair exhibits based on this project.
5. The California Fair Industry
   The California Fair industry (78 fairs) benefits from use of a guide that will assist fairs in replicating the project. The California fair industry benefits through increased collaborations with specialty crop growers who will support the fairs, and through public appreciation of a community-based and enjoyable display, leading to increased attendance at fairs.
6. Agricultural organizations and community organizations
   Agricultural and community organizations who participated in the project benefited by making new connections with each other and with the fair, through increased awareness by fair attendees of their programs, and from use of the guide that will assist them in working with their local fair to replicate the project's exhibits.

- Fair attendees – 13,083 people
- Direct-marketing specialty crop growers participating in or directly promoted by the project – 240
- Weekly farmers' markets promoted by the project exhibits – 76
- The California specialty crop industry in general – unknown numbers or economic impact
- The California fair industry – 78 district and county fairs
- Agricultural and community organizations – 22 groups directly involved on the planning teams and/or participating in the exhibits, not counting farmers' market organizations

Lessons Learned

- Many California district and county fairs already include specialty crop education and promotion in their fair events, but the organizations operating these booths, activities and exhibits are not usually working together. By organizing collaborative specialty crop promotion and education, this project provided opportunities for diverse local groups to multiply their impact and plan together for future collaboration.
- The location of an exhibit is a very important consideration in a fair environment. The best location for agricultural education and specialty crop product sales is probably not between the front gate and the carnival, even though many fair attendees walk from the front gate to the carnival. For this project, staff tested setting up a freestanding 20 x 40 foot pavilion tent close to the front gate of the fairs, based on a suggestion received from multiple farmers and agricultural organizations at workshops in a previous project. The farmers in those earlier workshops said that they were not visible to most visitors when they set up displays and exhibits further to the back of the fair sites, closer to animal agriculture and other farm exhibits. In this project staff learned that being visible to more fair attendees when they enter the fair does not necessarily mean that those fair attendees are ready or interested in visiting the exhibit. Staff watched

waves of people enter the fair gates and walk past the "Discover California Farms" exhibit tent without entering. However, when the exhibit was situated, at one fair, just inside the front door of a large commercial pavilion toward the center of the fair, people who entered the building were ready and interested in engaging in exhibit activities.

- People like to participate, and to look at bees. In this project, the most popular activities were children pedaling the blender bike or spinning the nutrition wheel, everyone tasting samples of smoothies, fruit and jam, and watching the bees in the beekeepers' observation hives. Staff had the most luck engaging visitors when they could offer them something to taste or something to do.
- Trying to measure the results of the education of fair visitors by collecting their emails and expecting them to answer a survey that was emailed to them did not work. A better measurement of the number of people using promotional information might be to get agreement from all exhibit participants to distribute and redeem marked coupons and request the redemption number from all participating specialty crop producers and farmers' markets after the event. Staff doesn't recommend trying to measure the impact of brief fair environment interactions with visitors by attempting to contact them.
- Selling produce in a fair environment is not usually as profitable for farmers as selling produce at a farmers' market, and can be discouraging for many individual farmers. Honey, jam and other processed products that people can easily carry are more likely to sell than greens and bunches of carrots. Setting up, and promoting, a farmers' market area with multiple vendors and products, at the fair or within a larger exhibit, and putting this close to activities such as a wine garden, can help with on-site sales of specialty crops such as fruits, flowers, nursery plants and processed products.

Unexpected Outcomes:

- This project generated interest from fair management and from project participants in organizing new collaborative specialty crop promotional and educational activities at two of the four fairs involved in the project
  - The Contra Costa County Fair Manager organized an event in October, 2013 (5 months after the project exhibit in his fair) called "Bounty of the County" in partnership with the Contra Costa County Wine Growers Association. The public was invited to "Celebrate all that Contra Costa County has to offer. One day event featuring local growers, producers, wineries, businesses, and the finest restaurants our County has to offer." Williamson told project staff that "You were a good influence. The Ag exhibit helped rebuild relationships."
  - In Riverside County, a former fair exhibit superintendent who volunteered with the "Discover California Farms" exhibit in 2013 is organizing a similar collaborative exhibit for the Southern California Fair in 2014. She will be able to use banners created by this project.
- Posters created by this project have been included for two years in the Contra Costa County exhibit at the California State Fair and used for other educational events. In other counties participating in the project, posters created by the project were given to county agricultural commissioners for future educational use.

Goals and Outcomes not achieved:

- The goal of attracting 5,000 visitors to each "Discover California Farms" exhibit in two days was not achieved. The lesson learned: The location of an exhibit is a very important consideration in a fair environment, and the best location for agricultural education and specialty crop product sales is probably not between the front gate and the carnival, even though many fair attendees walk from the front gate to the carnival. For this project, staff tested setting up a freestanding 20 x 40 foot pavilion tent close to the front gate of the fairs, based on a suggestion received from multiple farmers and agricultural organizations at workshops in a previous project. The farmers in those earlier workshops said that they were not visible to most visitors when they set up displays and exhibits further to the back of the fair sites, closer to animal agriculture and other farm exhibits. In this project staff learned that being visible to more fair attendees when they enter the fair does not necessarily mean that those fair attendees are ready or interested in visiting the exhibit. Staff watched waves of people enter the fair gates and walk past the "Discover California Farms" exhibit tent without entering. However, when the exhibit was situated, at one fair, just inside the front door of a large commercial pavilion toward the center of the fair, people who entered the building were ready and interested in engaging in exhibit activities.

- The goal of signing up 200 new customers for Community Supported Agriculture (CSA) programs was not achieved, although staff did provide information about CSA programs. In talking with CSA operators during follow-up interviews, staff learned that word-of-mouth referrals from current CSA customers are generally the most successful promotion methods for these programs. The lesson learned: Promotion of CSA programs by posters and handouts leads to general understanding about the concept of community supported agriculture, but a more personal approach is needed to actually sign up customers for an individual CSA program.
- The outcome measure of 10 percent of fair attendees reporting increased purchases of local specialty crops several months after visiting the "Discover California Farms" exhibit was not measurable. The lesson learned: Trying to measure the results of education of fair visitors by collecting their emails and expecting them to answer a survey that was emailed to them did not work. A better measurement of the number of people using promotional information might be to get agreement from all exhibit participants to distribute and redeem marked coupons and request the redemption number from all participating specialty crop producers and farmers' markets after the event. Staff doesn't recommend trying to measure the impact of brief fair environment interactions with visitors by attempting to contact them.

Additional Information

The Guide for Specialty Crop Promotion and Education at California Fairs, created by this project, is available online at http://sfp.ucdavis.edu/files/196702.pdf

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 76	**Project Title:** Statewide Plant Pest Prevention and Management Program Environmental Impact Report	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SCB11076	**Date Submitted:** December 2014
Recipient Contact: Michele Dias Laura Petro	**Telephone:** (916) 403-6727 (916) 403-6628	**Email:** Michele.Dias@cdfa.ca.gov Laura.Petro@cdfa.ca.gov

Project Summary

This project was to further the Ecological Risk Assessment and a Human Health Risk Assessment (RA) by developing the draft Program Environmental Impact Report (PEIR) document and incorporate the RA findings of the 2010 Specialty Crop Block Grant Program (SCBGP) Project 68 into the draft PEIR.

The project used the services of an environmental consulting firm to prepare a PEIR. The firm assisted CDFA in developing a comprehensive, coordinated, and consistent PEIR. The PEIR will provide California Environmental Quality Act (CEQA) coverage for the statewide Pest Prevention System, which incorporates Professional Identification, Pest Rating, Exclusion, Pest Detection and Emergency Projects. The PEIR will address the use of pesticides necessary to eliminate, suppress and/or control harmful invasive pests by providing technical information in the form of an Ecological Risk Assessment and a Human Health Risk Assessment. Incorporating the findings of these two Risk Assessments into the draft PEIR was the purpose of this project.

This project was necessary to effectively and efficiently address the growing threat of invasive pests coming into California that affect the varied specialty crops grown throughout the State. The PEIR will allow for a process that will provide a rapid response to invasive pests that have a destructive potential to affect commercial specialty crops both economically and environmentally. It is critical to be in compliance with CEQA, and convey how pesticides may impact humans and the environment. The PEIR will provide information on the Plant Health Division and Pierce’s Disease Control Programs and consideration of a wide variety of treatment methods, including cultural, physical, biological and chemical options that are used to control, suppress, and/or eradicate pests.

The project was important and timely due to the export value of California’s unique specialty crops. Protecting all specialty crops nationally is a major effort, as California is the largest specialty crop producer. Protecting specialty crops from invasive pests ensures protection of the food supply not only in California but throughout the world. The PEIR will facilitate rapid and effective prevention, eradication, and control of pest infestations that have the potential to severely impact specialty crops statewide. The PEIR will educate the public regarding the benefits of invasive pest emergency programs both at home, in horticulture, in nurseries, and in the fields and orchards.

This project built upon 2010 SCBGP Project 68: *Statewide Plant Pest Prevention and Management Program Environmental Impact Report: Human Health and Ecological Risk Assessment*.

Project Approach

Key components of the PEIR were prepared, including: development of a Standardized Pest Rating System according to international protocols; completion of a comprehensive Draft Risk Assessment incorporating both Human Health Risk and Ecological Risk data that was collected and organized; integration of the risk assessment results into the PEIR; completion of the draft PEIR. The draft PEIR was published on CDFA's website and a public comment period commenced.

Two of the most important partners in the Risk Assessment project have been the Office of Environment Health Hazard Assessment (OEHHA) and California Department of Pesticide Regulation (CDPR). Both of these agencies have expertise in the assessment of human health and ecological risk and as a result, have regularly and consistently offered valuable feedback. Meetings were jointly held every six weeks with OEHHA, CDPR, CDFA and the consultant staff to review the risk assessment approach and to establish future review processes. This feedback was valuable and informative to completing the risk assessment. On multiple occasions, additional intervening meetings were held to promptly address topics that needed immediate attention.

Goals and Outcomes Achieved

The goals established for this grant were to complete the standardized pest rating system, complete the Draft Human Health and Ecological risk Assessment, incorporate results of the risk assessment into the PEIR, and publish the draft PEIR on CDFA's website. All goals have been accomplished, and represent progress toward the long-term outcome.

The long-term outcome is certification of a final PEIR resulting in complete compliance with California Environmental Quality Act for all pest prevention programs, and facilitating a timely response to prevention of invasive pests, thereby protecting California's specialty crop industry. A comprehensive PEIR did not exist prior to this undertaking, and the Final PEIR will become part of a properly functioning pest prevention system and provide flexibility for years to come by building on its basic framework.

The RA was completed in early 2014, and the Draft PEIR was published on the California Department of Food and Agriculture's (CDFA) website at http://www.cdfa.ca.gov/plant/peir/ for public comment. Public comments received are currently being reviewed for response and incorporation into the Final PEIR, and Public Hearing will be held prior to certification of the Final PEIR.

Beneficiaries

There are 45,626 specialty crop farms in California, producing over 400 specialty crops. California produces 99 percent of several specialty crop commodities that are enjoyed throughout the United States, including artichokes, dates, kiwifruit, olives, pomegranates, and pistachios. The PEIR will benefit all specialty crop growers in California by facilitating a timely response to prevention of invasive pests, thereby protecting California's specialty crop industry.

Without the EIR, the impacts on export would affect specialty growers when trade partners refuse to accept a crop unless appropriate treatments are initiated. Another consequence from the spread of invasive pests occurs when commodities are unacceptable to the consumer due to blemishes, size, etc. Additionally, production costs of specialty crops should be reduced as those costs increase when invasive pests proliferate.

The PEIR will also mitigate the unintended negative effects of the regulatory process on the specialty crop industry so that specialty growers will be able to grow and market their product in a timely fashion. Additionally, an extensive review of all the approaches necessary to address the invasive species problems was completed through the PEIR process, and will enable coordination with partners to provide a unified response that will ensure protection for California's specialty crop industry for future generations. Upon completion of the PEIR, this project is also expected to increase the interest in research activities concerning invasive pests associated with specialty crops, and will hopefully result in effective and efficient eradication and/or control strategies.

Lessons Learned

Many aspects of the risk assessment were challenging due to the large amount of information, and in certain cases, a lack of generally accepted methodologies that dealt with specific pest management scenarios (e.g., no acceptable models exist for evaluating temporary short term programs such as quarantines). Integrating the results of the risk assessment into a CEQA framework was challenging, as CEQA has different benchmarks and criteria for determining impacts. Coordination between CDPR, OEHHA and CDFA was highly productive and increased capacity and coordination between these agencies. The benefits of DPR/OEHHA/CDFA coordination are anticipated to extend well beyond the scope of this project.

Additional Information

The certification of the PEIR for the Specialty Crop Protection Program is supported by the growers and handlers of specialty crops across the state. Included on this list, but not limited to these supporting entities are: California Invasive Plant Council, California Apple Commission, California Blueberry Commission, California Cut Flower Commission, California Date Commission, California Farm Bureau, California Grape and Tree Fruit League, California Nurseries and Garden Centers, California State Floral Association, California Strawberry Commission, California Tomato Growers Association, Nisei Farmers League, Western Growers Association, Western Pistachio Association, and Wine Institute.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 77	**Project Title:** Public Relations: California Grown Brand Development and Consumer Engagement, Phase II	
Grant Recipient: Buy California Marketing Agreement	**Grant Agreement No.:** SCB11077	**Date Submitted:** December 2014
Recipient Contact: Nick Matteis	**Telephone:** 916-441-5302	**Email:** nick@agamsi.com

Project Summary

Consumer interest in the food supply continues to increase. Consumers are interested in how their Food is produced, where it is grown, and who is growing it. Consumer trends concerning organic, local farmers' markets and community-supported agriculture (CSAs) have redefined retail marketing and sales. Traditional promotional activities by agricultural marketing programs (Cherry Board, Asparagus, etc.) are finding fewer acceptances with the marketplace. As a result, a stronger, sustainable, and effective marketing connection between consumers and California growers has become more important. This project supports the value-added marketing of California specialty crops within the domestic market through a focused consumer engagement campaign that drives interest and attention toward "CA Grown" brand products. This promotional program was developed and implemented to focus on the diversity, innovation, and sustainability of specialty crop growers and the values they represent.

This project was important and timely because of increased consumer interest in food supply trends and how their purchasing decisions are affected. Improved marketing and messaging of specialty crop products improves their competitiveness and long-term sales within the retail sector.

This project builds on a 2010 Specialty Crop Block Grant Program (SCBGP) funded Project 71. Project 71 focused on the development of the value- added marketing platform through consumer and trade research and stakeholder feedback. This project is the second phase of the promotional efforts of the California specialty crop industry, which began in September 2013. This project launched a consumer-facing promotion and messaging campaign based on the results of Project 71.

Project Approach

The project developed/finalized a social media campaign proposal for the BCMA board. The proposal included: campaign development components (website, etc.), an online membership management system, and drafts of BCMA membership packets.

An online audit of the various social media platforms utilized by BCMA was performed to establish a baseline of current performance. The key finding of the audit revealed there are small pockets of organized farm-to-farm and farm-to-consumer communities who have congregated on social media. These communities are small, have limited reach and have fairly modest engagement amongst the community. These small consumer communities are using the more visual social platforms like Facebook, Pinterest and Instagram to express their locally grown values by sharing lifestyle content and visuals. Influencers and media are using social media platforms that are more text based, like Twitter and blogging, to share news and frequent updates. A social media plan was developed and all of the BCMA social media platforms including: Pinterest; Facebook; Twitter and Instagram were refreshed and populated with new consumer facing content starting January 30,

2014. Further, an audit was conducted on the BCMA website and a revision of the site was completed which included: editing of content making navigation more efficient; creating new copy where needed, integration of the new BCMA social media platforms to create an updated more consumer facing website.

For membership development several candidates were considered for a contract position to function as a Community Builder. The contract position was filled to implement a social media outreach program. A candidate was identified to develop the online consumer membership campaign development/finalization, but the candidate could not perform the work desired and a contract was not set up. The funds allocated to the consumer facing membership campaign was reallocated to further consumer facing social media and direct consumer outreach efforts. A BCMA membership one-sheet talking piece was developed for outreach to potential stakeholder members. The remainder of the funding allocated to development and printing of a BCMA membership packet was reallocated to hosting a stakeholder media event in Fresno California. The event included presenting the current specialty crop promotional activities of BCMA and the benefits of BCMA membership to potential stakeholder members.

The overall scope of the project did not benefit commodities other than specialty crops. BCMA ensured this through constant oversight as well as by specifying, within vendor contracts, that only California specialty crop products could be promoted/highlighted.

Goals and Outcomes Achieved

The BCMA Facebook page was refreshed and redesigned to have greater visual appeal. Likes have increased by 36% and the reach of the Facebook page increased from less than 10 to 25,838 per week. New Twitter: https://twitter.com/cagrownofficial, Pinterest: http://www.pinterest.com/cagrown/ and Instagram: http://instagram.com/cagrownofficial/ accounts were established. A schedule of daily social media posts was implemented by the new social media/PR director in March, as there was no established plan in place and little to no activity prior to implementation of the social media plan and negligible reach from January and February posts. The March to June social media activity continued with daily social media posts and all relevant platforms.

A weekly consumer facing blog was launched and BCMA has a resident blogger with a reach of 80,000 subscribers http://cagrownblog.com/. As of June 30, 2014 the BCMA blog has had 3,473 page views and has 2,130 users. A member newsletter was also launched in order to keep current members apprised of BCMA promotional activities. Additionally, a consumer newsletter has been launched and featured on the new BCMA blog. A membership mailer was sent to prospective stakeholders. Approximately, 30 stakeholder meetings were held including a BCMA media event held in Fresno, CA where the current BCMA promotional efforts and the benefit of BCMA membership were presented to stakeholders.

Event Participation

In lieu of the consumer membership contractor being selected to create a consumer membership campaign, BCMA participated in Sunset Magazine's, Celebration Weekend. Over 22,000 consumers attended the event and BCMA had incorporated a farmer advice table, a consumer newsletter sign up opportunity and an almond recipe sample which offered the recipe the next day on the BCMA Facebook page all to drive traffic to the BCMA social media platforms to achieve the goal of direct consumer outreach.

A media event in Fresno, California, the number one agricultural production region in the state, was organized to engage specialty crop stakeholders in Fresno County to educate them on the opportunities of BCMA membership and highlight the current specialty crop promotional efforts being conducted by BCMA.

Through a partnership with one BCMA's new stakeholder members, the Certified Farmers Markets of Sacramento, BCMA was able to have a presence at the California State Fair at a minimal cost and had the opportunity to continue building the BCMA social media fan base to 750,000 fair attendees.

The goal of the project was to leverage social media marketing to increase specialty crop competitiveness and sales through a consumer engagement campaign that incorporates consumer expectations and the marketing objectives of specialty crop growers. Performance measures included: 1) Increase the number of social media fans on "CA Grown" social media platforms (Facebook, Twitter, etc); 2) Number of social media fan conversions (number of consumers enrolling in "CA Grown" campaign); 3) Increase the number of social media fan engagements (shares, posts, etc.) outside of the "CA Grown" social platform (i.e., social media activity independently generated by fans concerning featured content).

The target number of social media fans set in the expected measurable outcomes was 5,000 Facebook Fans; 1,000 Twitter followers and 1,000 Pinterest followers. Further a target was 10 percent of social media fan base becoming members and 25% of the social media fan base was to be engaged with social media content.

- Number of Facebook fans as of June 30, 2014: 3,217.
- Number of Twitter followers as of June 30, 2014: 502
- Number of Instagram followers as of June 30, 2014: 964
- Number of Pinterest followers as of June 30, 2014: 273
- Total Impressions as of June 30, 2014: FB - 4,951,414; Twitter – 4,217,589
- Total number of consumer newsletter subscribers as of June 30, 2014: 13,968

As noted above, the target number of social media fans set in the expected measurable outcomes was 5,000 Facebook Fans; 1,000 Twitter followers 1,000 Pinterest followers, and 1,000,000 impressions. Further a target of 10 percent of was social media fan base becoming members and 25% of the social media fan base was to be engaged with social media content.

The targets set in the grant proposal were not met largely due to the later than expected hire of the social media/PR director in March 2014 and the fact that the consumer membership campaign contractor was not able to perform the work to develop a consumer membership campaign. However, from the March 2014 to June 2014 period the number of Facebook likes has increased by 36% and continues and the number of likes continues to grow. Over 35 specialty crops had been featured during the March to June period. Facebook likes increased from 2,028 to 3,217; Twitter followers increased from 72 to 354 and Instagram followers increased from 0-964. The target of 1,000,000 impressions was exceeded by a multiple of 4+. The goal to convert 10% of the social media fan base to consumer membership was not achieved. The goal of 25% of the social media fan base engaging with the social media content was exceed as engagement from March 2014 to June 30, 2014 was 38%. All of the above metrics indicate that the content developed through the social media campaign was extremely effective with an average weekly reach of 25,838 followers.

Major successful outcomes include a 36% increase in Facebook likes; 4,951,414 total Facebook impressions; 4,217,589 total Twitter impressions; 38% engagement of social media fan base; addition of 11 stakeholder members to BCMA membership; interaction with over 22,000 consumers at Sunset Celebration Weekend which included: 300,000 reached on social media, 907,900,000 Facebook impressions (nearly the entire target set by the proposal), a Facebook reach of 37,500, a total number of Facebook likes of 503 and a total of 314,800 twitter impressions. Participation in this one event generated significant growth in our social media reach and building of the BCMA fan base.

Beneficiaries

Over 35 specialty crops were featured in the social media campaign. The beneficiaries include the California: pear, cherry, fig, table olive, blueberry, raspberry, strawberry, blackberry, asparagus, nursery, tomato, almond, walnut, pistachio, watermelon, sweet pepper, garlic, fresh herb, dried plum, organic crop, tree fruit, table grapes, cut flowers, leafy greens, broccoli, citrus, vegetable, artichoke, kiwifruit, avocado, and raisin industries. An average weekly reach of 25,838 followers and an engagement of 38% of the social media fan base which indicates that the BCMA social media content that is promoting California specialty crops is impactful and raising awareness for California specialty crops. The BCMA social media content is largely consumed by females age 25 to 47, who are the primary household shoppers.

Lessons Learned

Lessons learned were that there were not many experts/contractors to select from in pursuing the goal of developing the consumer membership campaign. However, the opportunity to engage consumers directly at the Sunset Event was effective in building the BCMA social media fan base and CA GROWN community. Additionally, staff learned that a complex printed membership packet was not necessary to convey membership benefits to stakeholders. The essential information was covered in the development of the membership one-sheet and the remainder of the funds was put to better use in organizing an in-person media event where the benefits of BCMA membership to key specialty crop stakeholder groups was presented, and had a much more significant impact on building awareness of current BCMA promotional efforts and opportunities for those stakeholders to become members and get involved.

Consumer and stakeholder event participation was significant in building BCMA membership and the BCMA social media fan base/community. Having a significant social media platform to direct stakeholders and consumers toward both online and at events helped to create a mutually beneficial relationship in further growing and establishing the BCMA social media presence.

The goals set for Facebook, Twitter and Pinterest followers weren't met largely due to the social media program not having significant activity until March 2014. Also, building a social media following was slower than expected. Additionally, the rules for advertising on social media are changing rapidly and it can be more costly to ensure that social media content has the most extended reach possible. Further the consumer membership campaign goals of converting 10% of BCMA fans to consumer membership was not achieved. The contractor that was identified by BCMA was not able to perform the work of developing the plan for the consumer membership campaign. Fortunately, BCMA was able to reallocate funds to other consumer outreach efforts i.e. BCMA's participation in the Sunset Magazine Celebration Weekend which resulted in significant increase in the BCMA social media followers and increased the reach of BCMA social media platforms.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 78	**Project Title:** Education and Skill-Building for Beginning Specialty Crop Farmers	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SCB11078	**Date Submitted:** December 2014
Recipient Contact: Jeff Cesca	**Telephone:** (916) 900-5093	**Email:** jeff.cesca@cdfa.ca.gov

Project Summary

The Education and Skill-Building Project was designed to assist California specialty crop producers - including new and beginning producers and limited resource farmers – to improve their farming and business practices through educational programs on issues of production, marketing, resource conservation and management. The educational topics were selected for the project based upon input from specialty crop farmers, alignment with the Specialty Crop Block Grant Program (SCBGP) goals and objectives, and alignment with the CDFA Ag Vision.

As the Education and Skill-Building Project was getting underway it was clear that the state of California was in a severe and pervasive drought. Small scale specialty crop farmers were facing significant increases in costs to purchase water or to access groundwater to which they had legal rights. In addition to the production, resource conservation, and business management education that had already been planned for the conference, it became a priority to connect specialty crop farmers with resources that could help them to use existing water resources more efficiently, plan alternate crop plantings to reduce water needs, and to adjust business plans to account for the higher cost of inputs and potentially lower sales due to the need to charge higher prices for their harvest to cover these increased costs. Therefore, a session to address the resources available to farmers to help mitigate the impact of the drought upon their farm businesses was added.

Educational content was developed for the 2013 California Small Farm Conference in Fresno in March 2013 under 2010 SCBGP Project 64. While this project was separate and distinct, with unique educational content developed and delivered, all of the educational programs initiated by the Farm Conference build off of the lessons of past successful implementations of the Farm Conference's education model.

The 2014 conference in Rohnert Park, California, for which content was developed by this grant, served a different base of farmers than the 2013 conference in Fresno, California.

Project Approach

The following activities were completed:

Formation and utilization of a Local Planning Committee to help guide the conference planning process: The Local Planning Committee, which ultimately had 15 active members, met three times in person and provided telephone and email support between the in-person meetings. The Local Planning Committee provided suggestions for educational topics, speakers to address selected educational topics, and sites for field course stops.

Providing educational opportunities through off-site field courses, focused workshops, and general sessions with well-known speakers:
The conference organized and offered five off-site field courses that each addressed a different topic of importance to specialty crop farmers, such as agri-tourism opportunities and transitioning to organic production. There was one specifically targeting Specialty Crops and Products, developed by Paul Vossen, UCCE Sonoma County, where attendees could see the most innovative producers and marketers in the Sonoma area. The conference organized 29, 90-minutes workshops, each focused on a different educational topic. Twenty of the workshops were targeted specifically towards specialty crop farmers and included, whenever possible, specialty crop farmers among the workshop speakers.

To determine the effectiveness of the educational offering, the conference surveyed 470 attendees and there was a 25% survey response rate (119 responses):

- 67% of farmers grew fruit crops
- 70% of farmers grew vegetable crops
- 40% of farmers grew herbs
- 28% of all respondents said they learned one new skill from the conference to help their business and 66% of all respondents said they learned two or more new skills.

The annual California Small Farm Conference is a public event, open to anyone who wishes to participate. While small-scale California specialty crop farmers are the primary audience that the Farm Conference seeks to attract, the conference also serves small-scale California ranchers and operators of California's certified farmers' markets. In addition to these groups, the conference also attracts a large number of academics who study California agriculture or provide research or extension services to California farmers. Many of them attend the conference to present on a single topic but will attend other educational sessions to further their exposure to the field and to continue to network with the California farmers that they serve.

In order to ensure the project's funds were used to solely enhance the competitiveness of specialty crops, surveys were distributed to all conference participants and collected at the end of the conference. From those surveys, it was determined that 54.5% of the conference participants were specialty crop farmers. (2.7% were farmers or ranchers not growing specialty crops, 19.1% were farmers' market managers or operators, and 23.7% were academics, government agencies or other participants). The percentage of specialty crop farmers participating in the project was applied to core project costs such as the contract for the Conference Coordinator and payment to the conference host hotel for audio visual equipment for general sessions.

The volunteer members of the Farm Conference Board of Directors provided significant contributions towards designing the educational content delivered at the conference.

Goals and Outcomes Achieved

The long term goal of the project was that at least 50% of specialty crop farmers who reported learning new skills at the conference would report they were be able to implement one or more of the new skills within 12 months. If successful, the fiscal impact of the increased revenue or decreased costs would be between $83,000 and $95,000, averaging $830-$950 per participating specialty crop producer. The long term impacts of the project would be found in improved business practices, increased production and sales, reduced costs, and new hiring by California specialty crop farmers as they utilize the skills learned through this project to improve their farm business operations.

Capturing the long term impact of a short term project is challenging, especially for a volunteer-run organization like the Farm Conference. The Farm Conference is considering how best to capture this information on an on-going basis in order to better assess its impact and provide inspiration to other specialty crop farmers of the types of improvements to their farm production and business practices that are possible if they are willing to invest in building new skills and knowledge.

Proposed project grant goal	**Actual project accomplishments**
Develop unique educational content for specialty crop farmers in areas of production, marketing, natural resource conservation, farm management and business planning.	Of the 29 workshops offered, 21 were specifically designed for specialty crop farmers. The other workshops were designed to appeal to farmers' market managers and small scale ranchers.
Develop content through Field Courses at small farms with opportunities for hands-on learning, focused workshops featuring issue experts and small farmers as speakers, and general sessions with nationally-known speakers.	Four of the five Field Courses were designed specifically for specialty crop farmers and all five Field Courses has specialty crop farmers participate. Surveys were given to all 237 participants and 177 were received (74% return rate). Of those, 47% (83) reported to be specialty crop farmers. All reported that knowledge was gained from the field course they attended. 29 workshops were presented with 88 presenters, 34 of which were farmers.
Directly support up to 100 beginning specialty crop farmers who will participate in the educational sessions.	Of the 470 attendees, 57% reported to be specialty crop farmers.
Assess the effectiveness of the educational program delivery and the potential economic impact on participating specialty crop farmers.	Through the survey responses, 45.9% rated the conference as "excellent" and 36.5% rated it as "good." 27.7% of conference participants reported learning one new skill while 66.3% reported learning two or more new skills at the conference. 57.5% of respondents reported that they expected to see new revenues or cost savings as a result of the skills they learned at the conference.

The nature of the Farm Conference education delivery model does not allow for collection of baseline data. Instead, results from the 2013 California Small Farm Conference were used as a benchmark upon which current results were compared. Progress is measured towards benchmarks as shown below.

Benchmark from 2013	Results
7% of specialty crop farmers learn one new skill	25% of specialty crop farmers reported learning one new skill
93% of specialty crop farmers learn two or more new skills	66.7% of specialty crop farmers reported learning two or more new skills
76 specialty crop farmers project increased revenue or decreased costs as a result of the conference	170 specialty crop farmers expect to see increased revenue or decreased costs as a result of the conference.
The average increased revenue or decreased cost per specialty crop farmer is $833.	The average increased revenue or decreased costs per specialty crop farmers is estimated at $3,170

Goal for 2014	Results
95% of specialty crop farmers will indicate they learned at least one new skill.	92% of specialty crop farmers indicated they learned at least one new skill
Those who learned new skills will report an average of 2.75 new skills	Phrasing of question to participant did not allow for an estimate of this figure.
Those who learned new skills will report they learned skills in an average of 2 different areas.	Those who learned new skills reported they learned skills in an average of 2.76 different areas.
At least 50% of specialty crop farmers will report they will be able to implement one or more of the new skills within 12 months.	90% of specialty crop farmers reported they expected to be able to implement one or more of the skills within 12 months.

Successful outcomes include:

- 470 persons participated.
- 70 hours of continuing education offered over 2 ½ days of the conference.
- 237 participants in Field Courses with 111 (47%) specialty crop farmers.
- 450 participants in workshops with 256 (55%) specialty crop farmers.

Beneficiaries

The direct beneficiaries of this project were the small scale California specialty crop farmers who attended the conference and whose farm business operations were improved by the new skills learned and new contacts that were made with other farmers, with farmers' market operators', and with agricultural experts from the University of California Cooperative Extension, USDA, and CDFA.

57.5% of all conference participants and 67.6% of specialty crop farmers reported that they expected to generate new revenue or create cost savings as a result of the educational content they received at the conference. The estimated economic impact upon specialty crop farmers is over $530,000, while the total economic impact of the conference is estimated at over $740,000

	Specialty Crop Farmers
No economic impact	32.4% | $0.00
$1-$500	8.1% | $5,185
$501-$1,000	13.5% | $25,945
$1,001-$5,000	32.4% | $249,080
$5,001-$10,000	13.3% | $259,455
More than $10,000	0.0% | $0.00
Total	100.0% | $539,665

Lessons Learned

The original project goals relied upon results from the 2013 California Small Farm Conference as the baseline and not all goals were successfully met. In 2013, 100% of specialty crop farmers indicated they learned one or more new skills. For 2014, the goal was set that 95% of specialty crop farmers would learn one or more new skills. The results from 2014 showed 92% of specialty crop farmers learned one or more new skills.

This more in-depth assessment of skills learned and expectations to utilization of skills is a new type of assessment for the Farm Conference. The data from 2013, which was used as the baseline for 2014, could have been an anomaly. Additional years of data will be required to accurately determine a reasonable baseline for setting of clear and achievable goals in the future.

The Farm Conference will look closely at the responses from specialty crop farmers who indicated they did not learn new skills. As the post-conference surveys are anonymous, it is impossible to follow-up directly with those participants to learn more about their conference experience, but a review of their post-conference surveys may suggest ways to improve the development and delivery of educational content in the future.

Also the post-conference assessment did not collect sufficient data to allow an estimate of the new number of new skills acquired. Instead, participants were only able to indicate that they learned “no new skills,” “one new skill,” or “two or more new skills.” The tools for measurement will be assessed to ensure that in the future they are capable of collecting all of the data required to measure progress towards the project goals.

Additional Information

Attachment 1: Survey Summary

USDA Project No.: 79	**Project Title:** Growing California Video Series	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SCB11079	**Date Submitted:** December 2014
Recipient Contact: Josh Eddy	**Telephone:** 916-654-0462	**Email:** Josh.Eddy@cdfa.ca.gov

Project Summary

This project branded the image of California specialty crops within the social media sector to raise awareness on the diversity, innovation and scope of the state's food system. Specifically, this project addressed increased consumer interest in the food system (regional, local, and organic) and leveraged that interest to educate the consumer and market California specialty crops.

This video series was designed to raise consumer awareness on the diversity of the state's specialty crop industry to address the growing interest among consumers about their food supply. The overall objective of this project was to increase the favorable disposition of consumers to California specialty crop farmers and their products, enhancing the overall competitiveness of the industry.

The motivation for this project was prompted by the increase in consumer advocacy concerning the food system and the opportunity to provide further information to consumers about the diversity and innovations within the specialty crop sector.

This project continues to be important and timely because consumer advocacy concerning the food system has increased dramatically over the last few years. Social media is shifting control of messaging away from organizations and companies to that of individuals and communities. This project helps to balance misconceptions about California specialty crop farmers and create a story of California agriculture to engage all consumers. The overall objective is to increase the favorable disposition of consumers to California specialty crop farmers and their products, enhancing the overall competitiveness of the industry.

This project built upon 2010 SCBGP Project 11: *Engaging Social Media – The Voice of California's Specialty Crops*. This project complemented the 2010 project by continuing to engage consumers through social media messaging through the development and distribution of Growing California specialty crop videos.

Project Approach

The project focused on video production and social media implementation. Videos were filmed from January 2014 to September 2014 and a social media program was launched in May 2014. A total of 10 Growing California videos were completed within the project timeline.

By developing videos prior to a social media release, the video series was able to be rolled out on a bi-monthly basis beginning in May 2014 to generate a larger social media impact. The social media release of completed videos will be completed by January 2015. A delayed release of videos provides opportunities to leverage consumer social media engagement and interest to help achieve the overall objectives of the program.

Video production was facilitated by California State University, Sacramento – Academic Technology and Creative Services along with CDFA staff. The social media program is coordinated by CDFA staff and the Buy California Marketing Agreement.

Project team meetings were held on a consistent basis and covered pre/post production of videos along with the social media program.

The focus of each Growing California video was on an individual/multiple specialty crop(s) or program that specifically focused on eligible specialty crops.

The Buy California Marketing Agreement (BCMA) assisted with video topic selection and social media messaging. For each posted video, BCMA also promoted the release of the videos and incorporated them into overall social media messaging.

Goals and Outcomes Achieved

	Videos	Activity Completed:	Social Media Publication:
1.	Heritage Harvesters	May 2014	May 2014
2.	Wine Connections	July 2014	August 2014
3.	Water Wise	July 2014	September 2014
4.	Ag in the Classroom	August 2014	September 2014
5.	Finley Farms	August 2014	Fall/Winter 2014*
6.	Fairview Gardens	August 2014	Fall/Winter 2014*
7.	Acres of Learning	September 2014	Fall/Winter 2014*
8.	Compton Food Access	September 2014	Fall/Winter 2014*
9.	Farm Dinner	September 2014	Fall/Winter 2014*
10.	California Grown	September 2014	Fall/Winter 2014*

* Grant activity completed September 2014, social media publication reflective of long-term outcome measures

The target of the project is to increase by up to15 percent the number of views/likes generated by the video series. With four videos currently released on social media the respected results are as follows:

Growing California Viewership: (May – September 2014) – 4 videos

Planting Seeds Blog:	1,319 views	(Per video average – 329 views)
Buy California YouTube:	805 views	(Per video average – 201 views)
CDFA YouTube:	1,001 views	(Per video average – 250 views)
Facebook:	346 views	(Per vide average – 86 views)

Total views: 3,471 views – (per video average – 867 views)

Based on the 2014 target of generating a 15 percent increased of total viewership of the Growing California series the following results indicated current status. Please note that social media aspects of the program are still in progress.

2015 Target: 15 percent increase viewership – (1,304 views per video)
2015 Results to date: 867 views per video – (10 percent decrease for 2012 benchmark)

Based on the 2012 benchmark of 28,355 views (per video average – 1,134), the current social media program has a decreased viewership of 23 percent on average. Adjusting for changing metrics on Facebook (removing Facebook from viewership calculations), video views decreased by 10 percent.

2012 Benchmark: 28,355 views (per video average – 1,134 views)
2014 Results to Date: 3,471 views (per video average – 867 views)*

* Social media campaign is still in progress with completion targeted for Q1 2015. A final social media report will be developed and made publically available to quantify and document the projects benefits and outcomes.

The video production aspects of the program have been completed showcasing the diversity, innovation and scope of the state's food system in relation to specialty crops. While targeted benchmarks have not been achieved to date, final social media metrics are anticipated in Q1 2015. The project continues to provide awareness on California's diverse specialty crop industry and the farmers that grow food. This awareness does provide a favorable disposition of consumers to California specialty crop farmers and their products, enhancing the overall competitiveness of the industry. Produced videos have been shared by agricultural organizations, outside of current social media tracking, that also expands outreach to the public.

Beneficiaries

California's 45,626 specialty crop farms (2007 Census of Agriculture) are the direct beneficiary of this project. Statewide more than 38,500 farms or 47 percent (including specialty crop) have less than $10,000 in sales (market value). By increasing the visibility and awareness of California specialty crop products, this project is increasing the potential for consumer purchases.

Lessons Learned

The Growing California video series provided an opportunity to highlight the diversity of specialty crops within the state.

<u>Positive Results of Program:</u>

- An increase in consumer awareness concerning California specialty crops. This awareness will further improve the competitiveness of the specialty crop sector.
- More than 3,400 views of the Growing California video series with an addition 10,000 views (anticipated) upon completion of social media campaign in Q1 2015.

Observations/Recommendations:

- Social media marketing is an effective means to increase consumer awareness. Improved social media performance (metrics, tracking and promotion) can be achieved through contractual activity and should be considered for future projects to maximum the visibility and consumer reach.
- Metrics for a consumer awareness campaign are difficult to achieve without significant investment in pre/post research. This further validates the need for professional social media marketing services.
- The variety, scope and level of video production increased video costs above initial estimates. A baseline has now been established for future video projects and staffing.
- Project implementation delays limited video production of certain specialty crops. A longer project timeline (2 years) will provide opportunity to capture more diverse aspects of specialty crop production.
- Cooperation with agricultural organizations was highly successful in determining video subjects and focus. Any future or similar projects should include joint cooperation with agricultural stakeholders.
- Complete outsourcing of video production is not recommended because of the complexity, diversity and uniqueness of the agricultural sector.

Unanticipated video production delays impacted social media program roll-out and deadlines. Future projects should be developed as two separate timelines that do not run concurrently. For example, all video production should be complete prior to beginning a social media campaign. The primary objective of the project (10 videos) was achieved – however the social media program remains in progress.

Additional Information

Growing California Videos can be seen/referenced on the following websites:

- CDFA Website - http://www.cdfa.ca.gov/
- CDFA Planting Seeds Blog - http://plantingseedsblog.cdfa.ca.gov/wordpress/
- Buy California Marketing Agreement - http://www.californiagrown.org/growing-california/
- Youtube (CDFA) - https://www.youtube.com/channel/UC96Fqn_OMC907uCEd_23f5A
- Youtube (BCMA) - https://www.youtube.com/channel/UCDmo1-rMeWcwNX10P_41Duw

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 80	**Project Title:** Specialty Crop Trade Mission to Mexico	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SCB11080	**Date Submitted:** December 2014
Recipient Contact: Josh Eddy	**Telephone:** (916) 654-0462	**Email:** Josh.eddy@cdfa.ca.gov

Project Summary

The California Department of Food and Agriculture (CDFA) led a Specialty Crop Trade Mission to Mexico in July 2014. This trade mission addressed specific interests of California's specialty crop sector to increase market visibility and sales of specialty crop products in Mexico.

The purpose of this project was to increase specialty crop awareness among importers, distributors, and retailers in Mexico City. California specialty crop products have significant market competition from domestic production (Mexico) and other specialty crop imports from foreign markets (South America). Increased awareness among the targeted trade sector on product quality/safety, use, and nutritional benefits improves the likeliness of purchases of California specialty crop products.

The trade mission was important and timely to maintain the visibility of California specialty crop products in Mexico among increased market competition and price competiveness.

This project was not funded by another state or federal grant program and did not build upon a previously funded SCBGP.

Project Approach

In development and preparation for the trade mission to Mexico, close collaboration occurred between the project managers and the trade mission participants. The U.S. Embassy in Mexico City and the in-market contractor were some of the collaborators in this mission. One of the first items, prior to preparation of the trade mission itinerary, was to informally survey specialty crop trade participants to determine key interests and meeting requests to arrange during the trip.

Once completed, official government meeting requests were coordinated with the U.S. Foreign Agricultural Service and non-governmental business activities were coordinated by the in-market contractor. Further, promotional activities were coordinated with the California Travel and Tourism Commission, allowing opportunities for the incorporation and promotion of specialty crop products to key trade and business leaders.

The trade mission resulted in a combination of market visits (central produce market, flower market, supermarkets), government meetings (Ministry of Agriculture and USDA Foreign Agriculture Service), and business meetings (business roundtable, ANTAD and Wal-Mart). Overall, 12 specialty crop focused meetings/visits were arranged in conjunction with trade delegation organized by the California Chamber of Commerce.

All meetings/visits connected to the Specialty Crop Trade Mission to Mexico were focused on specialty crop issues. Specific activities/meetings were not developed for non-specialty crop items. Promotional activities only benefited specialty crops with oversight by the project managers. Participation by non-specialty crop members in the trade mission, were not benefited by specialty crop funds.

The project partners were essential to a successful mission. The Center for International Trade Development (CITD) served as the primary organizer and manger for the project. CITD was the direct manager of the in-market representative and developed the overall itinerary for specialty crop participants. The in-market representative, Imalinx was essential for the coordination and implementation of activities within Mexico City – transportation, meeting logistics and confirmations.

The specialty crop trade mission would not be successful without the participation of: American Pistachio Growers; Sierra Orchards; Iron Horse Vineyards; California Certified Organic Farms; Paramount Farming Company; Harris Farms; Driscoll’s; Raisin Administrative Committee; Wine Institute; and the California Grape and Tree Fruit League/California Fresh Fruit Association.

Goals and Outcomes Achieved

The trade mission addressed specific interests of California’s specialty crop sector to increase market visibility and sales of specialty crop products in Mexico. The performance goals identified as part of the project were to encourage a reverse trade mission to California to expand export sales of specialty crop products. During the trade mission, specific outreach was provided to produce importers, retailers and trade associations to provide progress on this goal. The targets and goals are long term, and further detail is provided below.

The outcome measures of the project were identified as long-term (within one year of project completion). The project managers continue dialogue with the Mexican Ministry of Agriculture (SAGARPA) to host a meeting along the border focusing on improving produce trade (delays, inspections, etc.). The meeting will be attended by representatives of the produce trade (California exporters/Mexican importers) to further expand trade opportunities.

Project managers are currently working on a trade visit by Mexican organic certifiers to the California to evaluate the current organic certification process for U.S. organic products. Mexico and the U.S. currently do not have organic equivalency and an education mission focusing on organic produce certification has the potential to expand the trade in organic specialty crop products to Mexico.

An outcome that was achieved through this Trade Mission was that CDFA Secretary Karen Ross signed a landmark agreement with Mexican Ministry of Agriculture to further enhance trade. The agreement helps to address cross-border trade delays, enhance the opportunities for organic specialty crop trade, other technical and agricultural cooperative outreach. Please see Attachment 3 for more information on the agreement.

Further, communication continues among the in-market contractor, project managers and businesses that the delegation had the opportunity to have direct business meetings with. Opportunities for further trade visits are being explored.

Also, discussion continues among program participants and project managers regarding industry specific focused issues.

Actual accomplishments were identified to occur with the one-year of program activity – outside of the grant reporting period. It was anticipated, that between August-December 2014, that up to 10 inquiries would result from the trade mission. To date, three inquiries have resulted. The project team is currently working with a national retail chain to develop a mission in the spring/summer of 2015; the organic sector is planning to host a delegation of organic certifiers in spring/summer 2015; and further information was provided to cut flower importers concerning the California Cut Flower Commission.

Baseline data is currently unavailable to illustrate progress towards achieving goals because it will take more time than anticipated. As noted above, the following progress has been made toward achieving set targets:

The outcome measures of the project were identified as long-term (within one year of project completion). The project managers continue dialogue with the Mexican Ministry of Agriculture (SAGARPA) to host a meeting along the border focusing on improving produce trade (delays, inspections, etc.). The meeting will be attended by representatives of the produce trade (California exporters/Mexican importers) to further expand trade opportunities.

Another effort being worked on by the project managers is a trade visit by Mexican organic certifiers to the California to evaluate the current organic certification process for U.S. organic products. Mexico and the U.S. currently do not have organic equivalency and an education mission focusing on organic produce certification has the potential to expand the trade in organic specialty crop products to Mexico.

The trade mission provided the opportunity for 12 representatives of the specialty crop sector to educate and raise awareness on the California's specialty crop industry. The California Department of Food and Agriculture conducted follow-up activities with the Mexican Ministry of Agriculture in October 2014 in a meeting at the Produce Marketing Association. A follow-up meeting was planned for December 2014 in which an agreement was signed committing both organizations to conduct activities mentioned within this report – a meeting of the produce industry on the U.S./Mexico border to improve produce trade and the coordination of a Mexico organic certification.

Further the trade mission provided the opportunity to highlight and promote California specialty crop items to the agricultural trade and business leaders, raising awareness of the diversity and availability of product within a highly competitive market. Promotional opportunities were provided to specialty crop trade mission participants at events connected to the main trade delegation organized by the California Chamber of Commerce.

Beneficiaries

Direct participation within the specialty crop trade mission included five trade organizations and four specialty crop companies. The trade organization represents a diverse number of specialty crop growers within the organic, fresh fruit, pistachio, wine and raisin sectors. The participation of these trade organizations generically raised the visibility of the specific California specialty crop commodity and not an individual company. Of the four specialty crop companies that participated, the companies represent a diverse portfolio of specialty crop products.

The overall beneficiaries of this project are suppliers of specialty crop products to Mexico and those specialty crop companies interested in exporting to Mexico.

California agricultural exports to Mexico are valued at approximately $888 million, the fifth largest destination market for the state. California's agricultural exports to Mexico have had double digit growth for the last seven years, with average growth of about 13 percent. Eleven products to this market experienced growth at over 25 percent – including almonds, pistachios, figs, dried plums, strawberries and apricots. Mexico is the majority destination for a variety of California agricultural exports – Mexico represents 26 percent of the California's stone fruit exports, 42 percent of cut flower exports and 38 percent of fig exports.

This trade mission increased the awareness and visibility of California products among key foreign buyers and will help to develop long term trade opportunities for California businesses.

Lessons Learned

Close coordination among project participants and partners is critical in developing a comprehensive project that meets the expectations of individual participants while also meeting the objectives of the overall program.

On the operation side two key factors stand out. The first is that scheduling is dependent on confirmations of major appointments – Ministry of Agriculture (for example). Delays in scheduling can result in concerns by participants and other partners that can impact overall participation as well as limit additional scheduling priorities. The second, the facilitation of international financial payments, can be significantly delayed for a variety of reasons and all project partners need to be aware of potential issues associated with this.

As previously noted, actual accomplishments were identified to occur with the one-year of program activity – outside of the grant reporting period. The project is currently on course to achieve expected outcomes as a result of continuing dialogue and cooperation among the project partners.

Additional Information

Project activities were not associated with lobbying, nor were grant funds utilized towards lobbying. The Specialty Crop Trade Mission to Mexico was solely to enhance the competitiveness of specialty crops. The project funds were strictly spent on approved project activities. Additionally, the trade mission provided the opportunity to specifically highlight and promote California specialty crop items only, to agriculture trade and business leaders. This mission raised awareness of the diversity and availability of California specialty crops within a highly competitive market.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 81	Enhancing Diagnostic Capabilities for Plant Pathogenic Bacteria at the Plant Pest Diagnostics Center (PPDC) to Improve Trade	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SCB11081	**Date Submitted:** December 2014
Recipient Contact: Cheryl Blomquist	**Telephone:** (916) 262-1870	**Email:** Cheryl.Blomquist@cdfa.ca.gov

Project Summary

Plant pathogenic bacteria cause a significant number of important diseases of critical regulatory and phytosanitary significance in specialty crops. Testing for these important diseases are required for shipment of California's specialty crop commodities and nursery stock to other states and overseas locations as well as for seed crop plants to ensure the health of the exported seed. Testing of strawberries for shipment to Australia as well as testing of Prunus species, such as nectarines and apricots, grapes and small berry nursery stock for diseases of concern to overseas markets are just a few examples of specialty crops the Plant Pest Diagnostics Center tests to support trade of California specialty crops. The Biolog GEN III MicroStation and integrated GEN III Data Collection Software will expand and enhance the efficiency, capability, speed, and capacity of the laboratory to diagnose bacterial plant pathogens, which is critical to increasing exports of California specialty crops

Specialty crop fruit and nursery stock, such as strawberries and Prunus, are required to be tested by a government laboratory to fulfill the phytosanitary requirements of the receiving country prior to being shipped internationally. The dramatic increase of overseas sales of specialty crop commodities and nursery stock has made the need for a faster way to diagnose bacterial diseases vital. In addition, the presence of certain bacterial diseases prevents shipment of product to certain countries. The requested piece of equipment will enhance the speed and accuracy of the detection and identification of bacterial plant pathogens for specialty crop fruit and nursery stock and vegetable seed crops and improve California growers' ability to access international markets.

This project does not build upon a previously funded SCBGP project, nor has this project been submitted to or funded by another state or federal grant program.

Project Approach

Once the equipment was received, the staff was trained in the use of the Biolog Gen III and software. The machine is fully operational in the lab and being used to diagnose plant diseases caused by bacteria in specialty crops.

Crop species that were not specialty crops were separated out, and another machine used to perform traditional bacterial analysis on these non-specialty crops.

Goals and Outcomes Achieved

The Biolog Gen III system was received in September of 2014. Training was scheduled and on October 20, 2014, four lab staff received training (one Agricultural Biological Technician, two Agricultural Technician IIs, and one Senior Plant Pathologist). Since October 21, 2014, 51 strains of bacteria were tested from eight different specialty crops:

Host	Number of strains tested	Significant ID
Hydrangea	6	Pseudomonas marginalis
Lillium sp	2	None
alder	3	Pseudomonas marginalis
yellow eyed grass	9	Pantoea sp.
tomato	2	Clavibacter michiganensis subsp. michiganensis
tomato	2	Clavibacter michiganensis subsp. michiganensis
tomato	2	Clavibacter michiganensis subsp. michiganensis
tomato	1	Clavibacter michiganensis subsp. michiganensis
tomato	3	Clavibacter michiganensis subsp. michiganensis
Grape S4	4	Rhizobium (=Agrobacterium) vitis
Grape S5	5	Rhizobium (=Agrobacterium) vitis
Grape S6	2	Rhizobium (=Agrobacterium) vitis
Lillium sp	2	None
Prunus sp.	1	Agrobacterium tumefaciens
Prunus sp.	1	None
Prunus sp.	3	Agrobacterium tumefaciens
Day Lily	3	None
Total	**51**	

The machine has enabled the lab to analyze more bacterial strains using this machine than would have been analyzed without this tool. This has increased the efficiency of the diagnosis of bacterial plant pathogens on specialty crops in the laboratory. Analysis of bacterial diseases on specialty crops is ongoing.

Beneficiaries

This project has already benefitted the grape and *Prunus* nursery industry, tomato seed producers and bulb growers by allowing faster processing of unknown bacterial isolates to allow for faster clearance for overseas shipping. Although strawberry samples have not yet been received, a direct benefit to strawberry plant producers is expected as well.

Beneficiaries include the strawberry, grape, fruit tree nursery, specialty crop seed, and citrus industries. The strawberry industry (berries and nursery stock), which must demonstrate their commodities are free from angular leaf spot. The grape and fruit tree nursery stock growers are required to have their stock tested for crown gall. Most specialty crop seed growers ship seed internationally. Their fields must be inspected prior to harvest for many seed borne diseases caused by bacteria. For example, tomato seed production plants are tested for bacterial canker, pepper and tomato plants for spot and speck, carrot plants for bacterial leaf blight, bean plants are tested for common and halo blight, and crucifer crops for black rot. Citrus growers will also benefit by the detection of intercepted citrus canker using this equipment. The machine has been in use only since October 21, 2014 in our lab and it has already been used for a total of 51 analyses for bacteria including Prunus sp. and grape phytosanitary testing.

Lessons Learned

The machine is being used more frequently than expected, has enabled the lab to analyze more bacterial strains from specialty crops using this machine than would have been analyzed without this tool, and has already increased the efficiency of the diagnosis of bacterial plant pathogens on specialty crops.

Additional Information

None.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 82	**Project Title:** Improving the Capability and Data Defensibility of Specialty Crop Pesticide Residues Analysis	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SCB11082	**Date Submitted:** December 2014
Recipient Contact: Tiffany Tu	**Telephone:** 916-228-6830	**Email:** tiffany.tu@cdfa.ca.gov

Project Summary

The purpose of this proposal is to enhance the efficiency and capacity of the Pesticide Residue laboratory in Southern California. There are two Pesticide Residue (PR) laboratories in California Department of Food and Agriculture's Food Safety program, located in Sacramento with the satellite lab located in Anaheim, adjacent to the port of Los Angeles, the busiest container port in the United States and the major gateway for U.S.-Asian trade.

The Food Safety laboratories screen domestic and imported specialty crop produce for all classes of pesticides and herbicides and in cooperation with enforcement agencies, assuring the quality and safety of California's food supply. This information enhances the competitiveness of California's specialty crops as data clearly demonstrates the safety of California grown produce.

The PR laboratories have a 24-hour turnaround obligation for the specialty crop samples. To be effective in our goal of providing timely, accurate and relevant results to enforcement and surveillance agencies, PR laboratories must rely on rugged and sophisticated instrumentation. Enforcement agencies require timely submission of analytical results so they can quarantine crops that contain presumptive tolerance violation (PTV) or would pose a health risk for consumers. If a violation is detected during the normal screen, the sample(s) must be reanalyzed to confirm the finding.

This project has not been submitted to nor funded by another Federal or state grant program.

The Anaheim laboratory utilizes an older model of LC-MS/MS instruments to monitor for 220 pesticides, which is due to be phased out in early 2015. The new generation of mass spectrometer instrumentations, the Quantiva LC-MS/MS, with its modernized and redesigned electronic components, allows for faster scanning speed and offers better sensitivity. The fast scan feature enables shorter assay time, and lab staff will be able to reduce run-time from 20 minutes down to14 minutes resulting in faster turn-around time. Better sensitivity means greater detectability of agrochemicals and improved quantitative accuracy. Most importantly, having the new instrument allows for the expansion of the current screening method to detect more analytes, particularly the more difficult to detect pesticides. The Anaheim laboratory potentially could add 50 more chemicals to the screen list. The new equipment will further expand the total program's monitoring list to more than 350 chemicals.

Faster turn-around time, accurate results, greater ability to detect agrochemicals and the capability to widen the scope of the detection method mean total improvement of the PR program's quality system.

The use of the instrument would be monitored by the Food Safety-Pesticide Residue Program to ensure it is used solely for screening pesticides and other agrochemicals on specialty crops.

This project built upon 2010 SCBGP Project 77 which allowed the Sacramento laboratory to acquire a LC-MS/MS and Anaheim PR laboratory to acquire a Gas Chromatograph-Mass Spectrometer (GCMS/MS) instrument to expand the laboratories' capabilities to detect many chemicals on specialty crops that were not possible to detect with traditional equipment while decreasing the amount of time to perform the analysis. The Sacramento and Anaheim scientists developed methods that screened for 126 pesticides, an increase of more than 20 analytes over the old method. Most importantly, using the additional instruments allowed staff to conduct assays, analyze data and perform violation confirmation concurrently for uninterrupted laboratory operation which translates to saving up to eight hours for each set. The LC-MS/MS equipment allowed the Sacramento PR laboratory to screen for and detect the more difficult-to-detect pesticides, increasing the Sacramento PR laboratory's detection accuracy.

Project Approach

While the procurement process to acquire the instruments was completed on September 15, 2014, the equipment has not yet been installed.

The equipment will be used solely for specialty crops samples. The use of the instrument will be monitored by the Food Safety-Pesticide Residue Program to ensure it is used solely for screening pesticides and other agrochemicals on specialty crops.

Goals and Outcomes Achieved

Delays in installation have occurred and since the equipment has not been installed, performance goals and outcomes have not been achieved yet. The expectation is the scientists will validate new analytical methods and implement those methods shortly after installation.

In addition, although the instrument has not arrived, the Anaheim team has started collaborating with Sacramento PR team on the method expansion process. The new generation of LC-MS/MS system will enable the team to add another 55 agrochemicals to the screen list which translates to 17% increase in detection capability.

Before any data generated from the instrument can be used, the instrument must be validated. Sacramento PR has the same type of instrument and has started the method and instrument validation process. This head start saves Anaheim PR lab time doing research and development. As soon as Anaheim PR lab receives the Quantiva LCMSMS, it can perform the verification module and start analyzing samples right away. It is now expected that theAnaheim should be able to use the new instrument by March 2015.

The Anaheim laboratory underwent minor upgrades to bring more electrical power to the lab to prepare for instrument installation. The site preparation is complete and the Quantiva is scheduled to ship on February 23, 2015.

The Sacramento Pesticide Residue (PR) laboratory has completed the method development and validation on the same Quantiva model and will transfer the analytical method to the Anaheim lab as soon as the instrument is installed. Preliminary data from Sacramento PR laboratory show that the instrument is capable of screening for more agrochemicals of interest and at a faster rate. An unexpected positive feature of the new system is the capability of the associated software. The new software allows analysts to develop an automated data review functionality that reduces data review time by 75%. Currently, a supervisor spends up to two hours reviewing data results before releasing to enforcement agencies. The newly developed software-assisted data review program uses established criteria to assess data and tabulates any deficiency. This software program helps the supervisor or quality assurance officer reduce review time and focus on the issues of the whole analytical package. With the new software, the entire review process takes less than thirty minutes.

The Sacramento PR laboratory was successful in adding approximately 50 agrochemicals to its screening list using the Quantiva. Some of the newly added compounds are pesticides with new chemistry that would not have been detected using the traditional detectors. The Sacramento PR team noticed that the Quantiva, with its special accessories, can potentially shorten analysis time more than 50%. The team sets the new analysis time at 70% current rate (14 minutes per cycle vs. 20 minutes). For the future, PR team will develop a 10 minute analytical run on this new instrument system; this will decrease sample turnaround time.

The results realized at the Sacramento PR laboratory are expected for this project and the Anaheim PR laboratory. With full implementation of the new Quantiva instrument and software system, the Anaheim PR laboratory will increase its effectiveness and efficiency in monitoring for chemicals to better serve the California specialty crop industry and enhance the competitiveness of California specialty crops.

Beneficiaries

The specialty crop industry will benefit greatly from the project as laboratories' surveillance data clearly demonstrate that California products are safe. This information enhances the value of California's specialty crops as our data clearly demonstrate that California grown produce are the safest in the world. There are 45,646 farms in California producing specialty crops with a market value of $30,451,932,000 [2012 Census of the Agriculture, Specialty Crops] that will potentially benefit from this project. The California consumers also benefit as they can be assured their food supply is being monitored for harmful agrochemicals such as pesticides.

Lessons Learned

It is difficult to know whether scientific equipment will be available quickly or whether there will be a delay, in both shipment and installation. Additional delay occurred upon discovery that electrical upgrades are necessary to provide the power necessary to utilize the instrument. Upgrades, installation and training are expected to be fully completed by March 2015, and use of the instrument will begin immediately after that. Delay in receiving and installing the equipment prevented meeting the targets.

Additional Information

None.

2011
Specialty Crop Block Grant Program – Farm Bill (SCBGP-FB)
FINAL REPORT ATTACHMENTS

USDA, AMS Agreement No:
Specialty Crop Agreement No. 12-25-B-1215

State of California
Department of Food and Agriculture
1220 N Street
Sacramento, CA 95814

Contacts:

Crystal Myers, Manager
Federal Funds Management Office
Email: crystal.myers@cdfa.ca.gov
Phone: (916) 657-3231
Fax: (916) 653-0206

Susan Ichiho, SCBGP Manager
Federal Funds Management Office
Email: susan.ichiho@cdfa.ca.gov
Phone: (916) 657-3231
Fax: (916) 653-0206

California Department of Food and Agriculture
2011 Specialty Crop Block Grant Program –Farm Bill
CFDA # 10.170
Final Report Attachments

TABLE OF CONTENTS

SPECIALTY CROP BLOCK GRANT PROJECTS

Project 4	The Centennial Farm Foundation	1
Project 5	Community Alliance with Family Farmers	5
Project 11	San Benito County Ag in the Classroom	25
Project 13	The Regents of the University of California, Davis	31
Project 14	Ag Innovations Network	46
Project 16	University Corporation at Monterey Bay	132
Project 17	The Regents of the University of California, Davis	137
Project 20	The Regents of the University of California, Davis	139
Project 22	San Luis Obispo Bee Company	165
Project 23	Wine Institute	188
Project 28	The Regents of the University of California, Davis	271
Project 34	California Blueberry Commission	281
Project 36	Solano County	353
Project 37	Northern California Regional Land Trust	357
Project 39	Sacramento Area Council of Governments	397
Project 45	Central Coast Ag Network	664
Project 50	Ceres Community Project	669
Project 53	The Regents of the University of California, Berkeley	721
Project 55	The Regents of the University of California, Davis	722
Project 57	The Regents of the University of California, Davis	767
Project 58	The Regents of the University of California, Davis	769
Project 62	Soil Born Farms	775
Project 63	The Regents of the University of California, Davis, Center for Produce Safety	828
Project 64	The Regents of the University of California, Davis, Center for Produce Safety	848
Project 66	The Regents of the University of California, Davis, Center for Produce Safety	859
Project 73	California Department of Food and Agriculture	868
Project 78	California Department of Food and Agriculture	895

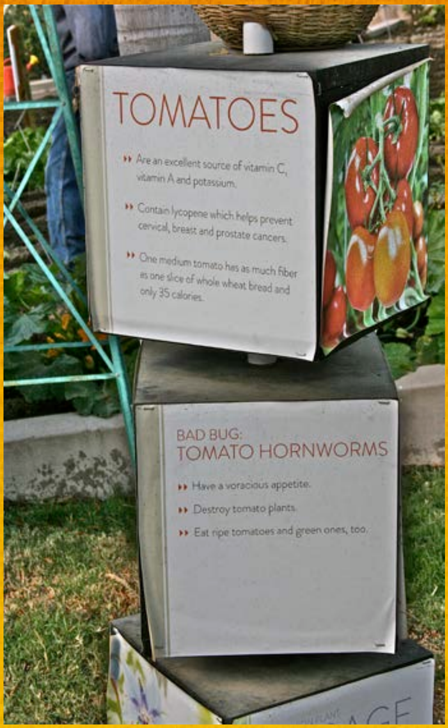
Signage

Signage was a key component of the CA Specialty Crop Block Grant Implementation. Featured Specialty Crops were highlighted with signage (similar to Oranges Sign to left) and other exhibits highlighted nutritional, growing or other information about the crops.

Specialty Crop Exhibits: Specialized Gardens

Specialized Gardens help teach children and adults about Specialty Crops and ways to grow them in urban/ Southern California settings. For instance Square Foot Gardening (above), a Water Conservation Garden (bottom left) and an Aquaponics Exhibit (bottom right)

Specialty Crop Exhibits: Forms of Growing



Other exhibits feature forms of growing such as Companion Growing and Successive Growing.

Interactive Exhibits

Interactive exhibits at the Centennial Farm get children involved and hands-on learning, for example the Vermi-Composting Exhibit (top left)that they can see or the Radish Seed Planting Station – which the students love to take home.

A FARMER'S GUIDE TO FOOD SAFETY AND CONSERVATION:

FACTS, TIPS & FREQUENTLY ASKED QUESTIONS

October 2013

Background

It seems every few months headlines like these make breaking news: "*E. coli* Fears Prompt Romaine Lettuce Recall," "Spinach Recalled in 39 States," "Cantaloupe *Listeria* Outbreak Deadliest in a Decade." These dramatic headlines reflect the attention given to food-borne illness outbreaks associated with contaminated fruits and vegetables. Taking sound, science-based steps to reduce the risk of contaminating produce with pathogens makes sense, but some misguided food-safety standards and interpretation of audit checklists have encouraged or required the removal of on-farm conservation plantings such as hedgerows, windbreaks and grassed-waterways, and the destruction of riparian areas and wetlands. Conservation-minded farmers know that conserving these areas on the farm helps protect water and air quality, supports pollinators, and reduces erosion and greenhouse gases. In a climate of food-safety angst, knowing the basics of managing crops and conservation practices to address food safety can go a long way in maintaining on-farm conservation plantings while reducing the risk of pathogen contamination.

It is highly unlikely that farmers would ever intentionally sell contaminated produce. In the past, it was long held that common sense approaches were sufficient to ensure produce did not have food-borne pathogens. Animals were discouraged from production areas because they damaged crops. The potential for animal manures applied as fertilizers and soil amendments to result in water and crop contamination with human pathogens was well recognized. However, in 2006, everything changed when an outbreak of *E. coli* O157:H7 was traced back to a farm on California's Central coast, the center of the state's fresh-cut salad industry. While it was never unequivocally determined how the spinach became contaminated, non-native feral pigs, contaminated irrigation water, and adjacent cattle operations were all considered as possible sources. All wildlife and the habitat they occupied became scrutinized by public health, academia, and especially the leafy greens industry.

Beneficial natural processes, such as Integrated Pest Management (IPM), help to control rodents.

Periodically monitoring for animal damage or feces in the production field ensures a safe harvest.

Ironically, research conducted in response to this and related leafy greens recall incidents has, so far, indicated that native wildlife in the U.S. have a low relative prevalence of carrying human pathogens. The broad risk appears low; however, the combination of low localized prevalence of wildlife pathogen shedding and changing seasonal conditions remain a concern. Non-native feral pigs were first introduced to California during colonization by Spain and later in the 1920s as a game animal. Particularly where their range intermingles and overlaps with cattle, feral pigs do have a higher prevalence of shedding and now pose a risk to leafy crops. Industry buyers purchasing fresh-cut leafy greens from growers often refuse to buy lettuce or spinach that comes within a certain distance of wildlife habitat because large mechanized harvesters do not exclude picking up hidden fecal matter or even small animals with the crop, as manual harvesting does. To avoid losing production area, many growers are pressured into removing conservation plantings and other non-crop vegetation, such as riparian vegetation, immediately adjacent to their land. In effect, these buyers require 'sterile' or 'scorched-earth' environments; no grass in the drainage ditches, no bushes next to fields—just dirt and lettuce. This aversion to wildlife and its habitat, driven by the uncertainties of risk, has unfortunately transferred to other crops even though their harvests don't accidentally take small animals.

Government agencies are becoming more involved in the produce safety area as well. In 2011 the Food Safety Modernization Act (FSMA) was passed by Congress. When it goes into effect, it will require the implementation of certain on-farm food safety measures. While the legislation has yet to be fully enacted, things are moving forward. In January 2013 the Food and Drug Administration (FDA) published the first draft of the rules that translate the act into on-the-ground regulation. Before the rules officially go into effect, they must be reviewed and commented on by the public and then revised and published in their final form by the FDA. Forward thinking farmers will be learning about the food-safety and conservation issue before FSMA becomes implemented, taking steps to ensure that they are reducing food safety risks while still maintaining the conservation areas important to their operations. Understanding how pathogens move onto crops and having management tools to reduce the risk of this movement are essential knowledge for every produce grower.

How Pathogens Get on the Farm

To put it bluntly, poop contains pathogens. That said, not all poop contains pathogens that make humans sick, but caution should be used to reduce the risk of contaminating crops with feces and the pathogens it may contain. Understanding the pathways in which feces/pathogens come to contaminate crops can aid farmers in preventing contamination from happening, and in identifying potentially contaminated produce before it goes to market.


USDA NRCS

Animal feces can contain pathogens that make humans sick.

Livestock, Wildlife and Human Pathways

Animals intruding onto fields may contaminate a water source or the crops with their feces. Such intruders include wildlife, free-range animals (such as chickens), escaped livestock and companion animals (e.g. dogs, cats). Farmers who use animal traction may also run the risk of having their work animals defecate on crops in the field.

Improper management of raw manure from livestock may increase the risk of pathogen contamination. When used as a soil amendment, raw manure may contaminate crops with pathogens if an appropriate waiting period is not practiced between the application of the raw manure and the harvesting of the crop. Similarly, livestock grazing (and defecating) in harvested fields may potentially contaminate future crops, if an appropriate waiting period is not allowed between grazing and planting/

Washing boots after working with animals, properly composting manure, and keeping livestock out of produce fields can help reduce the risk of contaminating produce with pathogens.

harvesting of crops. Composting or heat-treating manure greatly reduces the number of pathogens in the manure, thus reducing the risk of crop contamination when it is applied as a soil amendment.

Humans may contaminate produce if appropriate sanitary measures such as properly washing hands after using the restroom, changing or washing boots after working with animals, or cleaning farm equipment between non-crop and crop uses, are not taken before harvesting or handling produce. All produce handling surfaces and equipment, including pickup truck beds for local transport, should be managed to prevent cross-contamination from prior uses of the same equipment.

Airborne Pathways

Pathogens that cause human illness can be transported in the air attached to soil and organic particulates and to water droplets. Manure-laden dust blowing off of small or large livestock operations may contaminate surface water sources or produce growing down wind. The pathogen prevalence in the livestock, and the presence of vegetation or the use of other measures that reduce the spread of the dust, determine the extent of the risk.

Waterborne Pathways

Water can become contaminated with pathogens in a number of ways. When water runs off feedlots, pastures, animal loafing areas, manure stockpiles or composting yards, it may pick up feces and pathogens along the way, eventually contaminating the streams, rivers, ponds, and canals to which it flows. Animals may also contaminate water bodies by defecating into the water directly or on banks and levees, leading to pathogen increases during rain events. Poorly managed sewers, septic systems, or portable toilets can contaminate surface water with human feces. Ground water may be contaminated by improperly managed septic systems or by poorly sealed well-heads that allow contaminated surface water to flow into the well. In times of heavy rainfall, very porous sandy soil, soil with macropores from former root penetration, or soil with cracks in its profile may direct pathogens into shallow groundwater and eventually back to surface water.

If contaminated surface or groundwater is used for irrigation, it may lead to persistent crop contamination. Pathogen-laden water during a storm or flood event can also contaminate crops.

As water runs off areas where livestock congregate, it may pick up feces and pathogens along the way.

Sunlight helps kill pathogens through its destructive UV radiation.

Factors that Affect Survival of Human Pathogens

Temperature, Moisture and Diversity
Pathogen survival in soil, water and on plants depends on the temperature, moisture, the nature of the plant surface characteristics, and diversity of the microbial populations present. The sun and desiccation help to kill pathogens. In the summer, when the days are warm and long, direct sunlight, with its destructive UV radiation and its ability to dehydrate pathogens, can help to decrease the survival of pathogens on plant and soil surfaces.

Pathogens tend to persist longest in cooler times of the year when cloud cover and moist conditions are more constant and pathogens, such as *E. coli* and *Salmonella,* are less active. Another bacterial pathogen of concern in minimally processed foods, *Listeria monocytogenes*, actually does better under cool moist conditions but the primary control point is not on the farm. Freezing by itself does not completely kill pathogens. A caveat to that is when rapid freeze-thaw cycles of weather occur, they can cause rapid death of pathogens in soil.

Microbial diversity helps to reduce pathogen survival. Non-pathogenic beneficial microbes usually prevail if diverse populations are present, by outcompeting the pathogens for food, water, and space; by killing and consuming the pathogens; and/or by generally making conditions unfavorable to the pathogens by tying up critical growth nutrients such as soluble iron.

Fumigation studies reinforce that microbial diversity is important. Soil fumigation can foster human pathogens because conditions become more favorable for the survival and growth of the few pathogens that weren't killed or that are re-introduced. Most fumigation is done on conventional farms. Glucosinolate compounds, found in high concentrations in some of the seeds of the *Brassica* plant family, are being applied as mustard meal to decrease organic strawberry plant pathogens, and separate lab studies show that it kills *E. coli* and *Salmonella*. Whether mustard meal will be useful in the field for human pathogens is yet to be determined — the same principle probably applies that if diversity is eliminated, pathogens can persist.

While some microbes may kill pathogens, others may help them survive. In nature, nothing is absolute, and this is the case with biological control of pathogens. While many types of microbes — bacteria, viruses and protozoa — cause harm to human pathogens, not all do. Some protozoa harbor pathogens by consuming but not killing them. Bacterial communities can also surround themselves with a matrix of complex carbohydrates called biofilms. These biofilms sometimes shield pathogens from predators and harsh environmental conditions, while at other times make them more susceptible. Biofilms can form on soil particles and plant roots, in water on aquatic plants and irrigation systems, and on plant leaves.

Soil
Pathogens, like most plants, prefer soils in the range of a neutral pH, with low salts, and with available nutrients, especially carbon and nitrates. Concentrated nutrients exuded by growing root tips, and by diseased plant parts, are especially attractive to microbes. Unlike most plants that can live in many types of soil, pathogens prefer heavier clay soils that can hold water better than sandy soils.

Manure and Antimicrobial Resistance
Pathogenic *E. coli* populations tend to be lower in cattle when the animals graze on forage, than compared

to a grain diet. Similarly, when manure comes from a barnyard it tends to have fewer nutrients readily available for pathogens than when it comes from a slurry. Many confined animal feeding operations administer antibiotics and similar drugs, together called antimicrobial agents. When manure from these confined animal feeding operations is spread on a production field, some of the pathogens, as well as other microbes, typically have genetic traits for antimicrobial resistance. This resistance can be transferred among many types of soil microbes, and can increase the risk of non-pathogenic *E. coli*, *Salmonella*, and other bacteria becoming a health hazard, especially for people with compromised immune systems. Microbes that do not infect healthy people can sicken people with weak immune systems, and the antimicrobial resistance makes it more difficult to treat. Pathogens with antimicrobial resistance are not only found in those carried by livestock and in soils with manure, but have also spread to wildlife.

USDA NRCS

Algae blooms, like the one in this lake, may increase pathogens in the water.

Sediments and Algae in Water

Sediments have been shown to be a key site for pathogen persistence in water bodies. When sediments are stirred up in water, pathogens are brought back into the water column or flow. The reasons for increased pathogens in sediments are not well understood, but the lack of UV radiation and presence of biofilms may be responsible. UV is not able to penetrate sediments at the bottom of creeks, streams, ponds and lakes. Biofilms may provide protection from environmental stress and from predation by other microbes.

USDA NRCS

Vegetative buffers, like this grassed waterway, help filter out pathogens in runoff water before they reach a pond or stream.

Nutrient pollution in surface water can cause algae blooms or mats. Some kinds of pathogenic bacteria survive longer when attached to algae. UV penetration in water, important in reducing pathogens, is diminished with the presence of algae. Therefore, reducing nutrient runoff from fields and blending tailwater with ground water in ponds may aid in reducing both algae and pathogens in irrigation surface water.

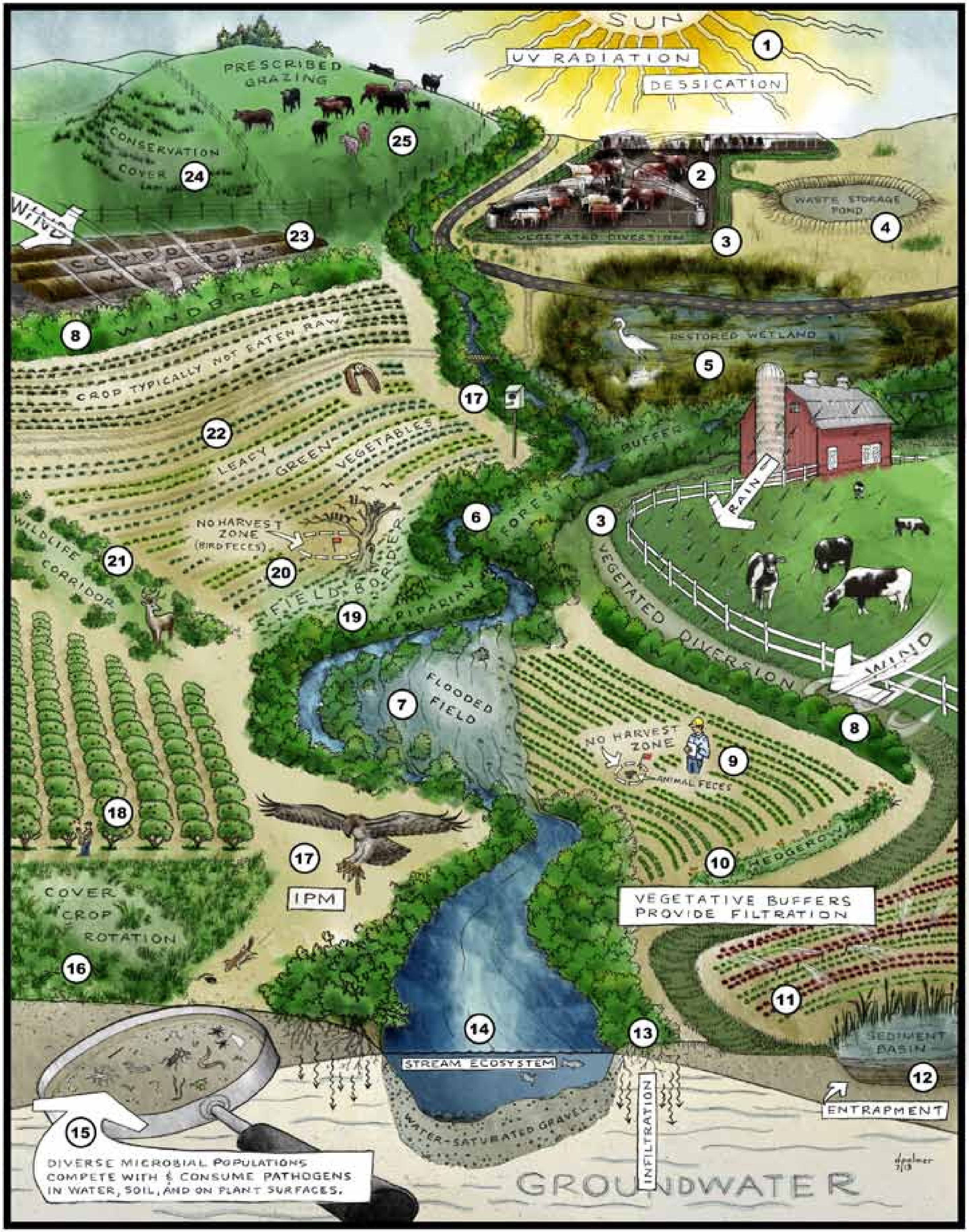
Vegetation

Vegetation can help reduce the movement of pathogens across the farm by filtering pathogens, increasing infiltration of water into the soil, and serving as a structure for biological competition to take place. Grasses and other types of vegetative buffers filter pathogens in runoff before they reach a pond or stream. The vegetation also slows surface water flow which allows for increase infiltration rates.

Wetlands decrease pathogen levels due to increased oxygen levels in the water, antagonistic root exudates, and the fostering of antagonism in biofilms. These processes that act to reduce pathogens in water work best when the water has a long residence time—it moves slowly through the vegetation—a proper hydraulic loading rate—the volume of water flowing through is suited to the size of the planted vegetation, and appropriate settling rates of suspended sediments.

Windbreaks can intercept dust that may be carrying pathogens. When dust trapped on the leaves of a windbreak is exposed to sunlight and other desiccation effects, pathogens can be destroyed.

Healthy Diverse Ecosystems Help to Keep Pathogens in Check



Not to Scale

Illustration Key

Note: The Healthy, Diverse Ecosystems Help Keep Pathogens in Check *illustration* ***is not drawn to scale****; it serves as a visual summary of the conservation practices and food safety actions used to address food safety referenced in this document. These practices and actions do not provide complete and conclusive protection against food-borne pathogens on a given farm/ranch, and some vegetative conservation practices may attract wildlife that can vector pathogens. When implementing in-field practices to address food safety, one should take into account the conditions present on the farm/ranch and use this information to assess the effectiveness of a given practice in* ***reducing the risk of food-borne pathogen contamination of crops.***

1. Sun: UV radiation from the sun may inactivate recently deposited pathogens on the surfaces of soil and leaves, as well as in clear water. The sun also facilitates the desiccation of pathogens, which leads to pathogen reduction.

2. Dust from animal activity is reduced with the application of water by sprinklers and with manure harvesting. Reducing emissions and removing manure proactively are cost-effective means of mitigating pathogen transfer.

3. Diversions redirect water running off of confined animal feeding operations to waste treatment and sedimentation lagoons, preventing the movement of waterborne pathogens to nearby farm traffic areas, fields and waterways. Vegetated diversions also intercept organic matter and soil carrying pathogens running off pasture, and divert potentially contaminated water away from specialty crop fields. The diversions slow pathogen dispersal and provide a matrix for beneficial bacteria and protozoa that compete with and consume pathogens. Plants should be selected for low-flow filtering capacity and the ability for high flows to flow through the vegetation. Selection criteria should also consider how well air and sunlight are able to penetrate into the vegetation, as the cool, moist, shaded interior vegetation may provide favorable habitat for pathogen survival. Otherwise additional maintenance will be required that regularly harvests and removes excess vegetation.

4. Waste storage pond temporarily stores waste, such as manure runoff from confined animal feeding operations, thereby reducing pollution potential in the landscape. The waste storage pond should be properly designed and maintained so that it does not overflow. Food safety Good Agricultural Practices (GAPs) recommend that the effluent from the ponds not be used on crops typically eaten raw. Monitoring of animal movement around the pond and between waste handling areas and crop fields should be a scheduled activity.

5. Restored wetlands can considerably reduce pathogen transport by slowing the water, which increases the interaction time, and providing a matrix for beneficial microbes. The diverse plant and microbial community establishes desirable interactions that serve to limit pathogen persistence. Use of vegetation and designs that facilitate slow moving water over long periods in the wetland allow the best chance for pathogen reduction in water draining from the wetland. The vegetation in the wetland may decrease the ability of UV light to reach the pathogens, which may increase survival. However, pathogens may be retained on vegetation. As water recedes, the pathogens that are retained on the vegetation may be exposed to sunlight and desiccation.

6. Riparian forest buffers are vegetated areas along bodies of surface water, including streams, wetlands and lakes. They may trap wind-borne pathogens on their vegetation and filter waterborne pathogens attached to suspended organic-soil particulates and other solids. The diverse plant and microbial community in the buffers encourages interactions limiting pathogen persistence.

7. Flooded field: Food safety GAPs recommend that crops typically eaten raw are not planted on lands that often flood. If and when a flood occurs, it may take time for pathogens present in the soil to die off. Depending on the frequency of floods, the field could be fallowed for a period, replanted to a cover crop, or possibly, permanently taken out of production with the restoration of riparian habitat.

8. Windbreaks can trap dust containing pathogens and prevent it from entering specialty crop fields. Plants should be selected with foliar and structural characteristics to optimize dust/pathogen interception. If interior vegetation is too dense, it may provide a cooler, moister and shadier environment, which may create a favorable conditions for temporary pathogen survival.

9. Evidence of animal intrusion in a crop field should be monitored. Food safety GAPs recommend that farmers monitor for animal feces and signs of feeding, and when found, a no-harvest buffer is placed around the contaminated source, or other measures are taken to reduce risk of harvesting the contaminated crop. The following considerations all factor into determining the appropriate risk reduction actions taken: the type and number of animals; whether they are present intermittently or continually; if they are there because of food, a movement corridor, or live next to the crop; and if they are seen initially before planting or right before harvesting.

10. Hedgerows may trap waterborne pathogens in their root systems, and wind-borne pathogens on their vegetation. Shaded interior of the vegetation may provide favorable conditions for temporary survival of pathogen if too dense.

11. Irrigation: Food safety GAPs recommend using sources of irrigation water that are adequately free of contamination. Management techniques that promote infiltration of the water into the soil can reduce runoff and may aid in reducing the movement of pathogens already present in the field. Techniques that aid in infiltration include soil quality management that increases porosity and improves structure, and irrigation management that keeps soil from becoming saturated.

12. Sediment basins capture and detain sediment-laden runoff that may contain pathogens. Correctly designed, basins allow sufficient time for the sediment to settle out of the water. With moist, cool conditions, the basin may support the survival of pathogens. Having a sediment basin that dries down as rapidly as possible helps to alleviate these moist conditions and helps reduce pathogen survival. Moist sediment that is removed from the basin and put on cropland should be treated as contaminated and a time period similar to non-composted soil amendments between its application and the next crop's harvest should be established.

13. Riparian forest root zone: The roots of the riparian forest promote water infiltration and provide biological activity. This helps divert pathogens from surface water, and encourages interactions with other soil microorganisms that can limit pathogen persistence.

14. Stream ecosystem: In a stream ecosystem where diverse microbial communities exist, they are thought to reduce pathogens by competition, parasitism, and predation. Clear water allows light to reach pathogens, which can lead to their reduction. Flowing water dilutes pathogen populations. Some algae and protozoa may serve as an alternate host for pathogens, allowing pathogens to survive even when environmental conditions are unfavorable.

15. Diverse microbial populations compete with and consume pathogens in water, soil and on plant surfaces. When diverse microbial populations are present, beneficial microbes compete with pathogens for carbon and nitrogen, while others kill and consume them. Diverse microbial communities in water and on plants also compete for resources and/or consume pathogens. In some instances, biofilms¾a matrix of bacteria and carbohydrates¾can harbor pathogens.

16. Cover crops: Rotating with cover crops increases soil organic matter and supports soil microbial communities that may aid in suppressing pathogens. Cover crops may also reduce the movement of pathogens in water run-off by trapping pathogens in their roots and leaves. They can be used as part of a 'waiting-period' between events that might pose contamination risk (e.g. grazing, flooding) and the planting of a crop typically eaten raw. Cover crops also reduce open soil, which helps reduce dust transmission problems.

17. Integrated pest management (IPM) of vertebrates such as mice and squirrels can be used as a means of control for pest animals that enter crop fields. Having a few predatory animals, such as hawks or owls, on the farm is less of a risk than numerous prey species. A crop should not be planted directly under a raptor nest box or a roost, so that it is not contaminated with raptor feces. Farm traffic should not carry fecal droppings into the cropped area or equipment and storage yard.

18. Harvesting orchard fruit from the tree, not the ground, is recommended by Food Safety GAPs when it will be consumed fresh. Fallen fruit may have come in contact with animal feces.

19. Field borders can intercept and reduce waterborne pathogens moving in overland flow from the field. This planting encourages infiltration and serves as a buffer between the field and the riparian vegetation.

20. Tree bird roost: Food safety GAPs recommend that a no-harvest zone is established under branches that hang over the field to ensure bird feces will not touch the crop.

21. Wildlife corridors allow wildlife to access resources (water, food and cover) without having to walk across crop fields or leave their preferred habitat.

22. Crop placement: Food safety GAPs recommend that leafy green vegetables or other crops typically eaten raw not be planted near manure stockpiles or composting facilities and windrows, or other areas of contamination, as pathogens may transfer to the field via water or wind.

23. Compost: Properly managed compost windrows heat up to a temperature that results in significant pathogen reduction. Compost itself supports beneficial organisms that compete with, inactivate, and consume pathogens. Compost that has been allowed to be re-contaminated, or compost that is unfinished could be a source of pathogens; thus, measures should be taken to prevent these below par composts from moving onto adjacent fields through wind or water. For information on proper compost management practices refer to 'Chapter 2: Composting' in Part 637 of the USDA, NRCS National Engineering Handbook.

24. Conservation cover is used to establish and maintain perennial vegetative cover to protect soil and water resources on land retired from agricultural production or on other lands needing permanent protective cover that will not be used for forage production. Perennial plants may trap wind borne pathogens on the vegetation and waterborne pathogens in the root system.

25. Prescribed grazing uses animals to manage vegetation. It also helps to increase water infiltration, reduce runoff and prevent erosion. This aids in stopping the movement of pathogens in water runoff. Grazing animals are a reasonably foreseeable source of pathogens; thus, measures should be taken to prevent pathogens from the animals' feces from moving onto adjacent fields through wind or water.

Note to User: *Details on the design, dimensions, spacing and maintenance specifications of many of the conservation practices represented here can be found on the NRCS website: http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/?cid=nrcs143_026849.*

Frequently Asked Questions

Questions related to the co-management of food safety and conservation are listed first and followed with general questions that small and mid-sized farmers may have. Answers to these questions are based on common sense, science, and a mix of requirements from third party auditors. While FDA's produce rules are in process, you can visit the WFA website to learn what is being proposed (see www.wildfarmalliance.org).

Co-management Questions

A1. Are there natural processes a farmer can encourage that reduce pathogens on the farm?

Sunlight

Allowing time for sunlight to hit feces left by grazing animals in row crop fields before tilling it in, and managing orchard canopies to let sunlight in on feces will help desiccate and reduce survival of pathogens. The degree of effectiveness depends on how well the pathogens are directly exposed to UV light and how well they dry out. For larger animals, such as cattle grazing un-harvested crops, a light disking to break up partially dried pats may accelerate pathogen die-off. It is important to minimize the potential for manures left on the surface to be carried to surface water during a significant rain or irrigation event, prior to incorporation.

USDA NRCS

Clear water allows UV radiation from the sun to enter the water, which helps kill off pathogens.

Clear Water

When UV radiation is allowed to penetrate clear water, pathogens won't survive long. If there is sediment in the water or nutrients causing algal blooms, UV radiation isn't as effective. Proactively protect water quality by ensuring irrigation water infiltrates the soil well, and excess fertilizers and eroded soils are not causing pollution and murky water. UV penetration can then effectively foster pathogen reduction.

Vegetation Intercepts Pathogens

Using nature's vegetative filtering systems by planting or conserving non-crop vegetation in appropriate areas on the farm can help intercept airborne and waterborne pathogens and other pollutants, and keep the water clean (see #s 3, 5, 6, 8, 10, 16, 19, 21, and 24 in illustration).

Proper Composting

Pathogens are reduced by high temperatures and antibacterial compounds found in compost processes that purposely generate alternate cycles of high heat through the correct mix of carbon and nitrogen, moisture, and aeration by turning. Then the curing process at cooler temperatures can allow the growth of suppressant microorganisms that tie-up nutrients and can limit or outcompete pathogen re-growth or growth following accidental re-contamination.

Encouraging Soil Microbe Diversity

Farming practices that increase the native soil microbial community, such as high organic matter inputs of compost, cover crop rotations (see #s 16 and 23 in illustration), and reduced tillage, promote competition, predation and antagonism of pathogens.

B1. Do some animals pose a higher risk of contaminating produce with food borne pathogens than others?

Humans and Livestock Have Pathogens in Common

Livestock and companion animals can carry human pathogens, such as *E. coli*, *Salmonella*, *Campylobacte*r, *Listeria* and *Cryptosporidium*. Some pathogens are more common in some animals than in others. Cattle often host *E. coli* pathogens, while poultry and pigs are common carriers of *Salmonella*. Poultry may also carry *Campylobacte*r. Small ruminants, such as sheep and goats, are infected with *Listeria* more than other animals.

Animals can be carriers of human pathogens, such as *E. coli* O157:H7, that do not make them ill but can cause very severe human diseases. The age of the animal and season of the year may influence the level of pathogens an animal

Young livestock are likely to carry higher levels of pathogens than adults.

Wildlife living near areas with high levels of pathogens, such as these landfill-dwelling seagulls, may pose a greater risk of transferring pathogens than wildlife not associated with such areas.

Vern Wilkins, Indiana University, Bugwood

Seeing rodent-eating raptors, like this Short-Eared Owl, in habitat near a produce field is good for food safety.

carries. Young animals tend to carry higher levels of pathogens than adults. Seasonal stress may also result in higher pathogen levels. Cattle, for example, shed more *E. coli* in their manure during the summer than during the winter. Individual animals can be 'super-shedders' in a herd that has an overall low prevalence of shedding.

Since livestock can be contained, the risk of contaminating crops with livestock manure depends on whether the manure is inadvertently being transported into the produce fields via wind, water, wildlife or people; or whether it has been applied directly on the field as a soil amendment without adequate composting, aging, or time period before planting and harvest.

Native Wildlife Pose a Low Risk of Carrying Human Pathogens
Thus far, studies have shown that native wildlife have a low prevalence of carrying pathogens that cause human illness. The risk of extensive crop contamination from wildlife is small; however, it will never be zero. Within a given population, the number of individual wildlife carrying pathogens, such as *E. coli* O157:H7 or *Salmonella*, is generally less than three percent, based on the fairly limited snapshots of research around the country and the world.

Where wildlife live and what they feed on may influence the level of pathogens they carry. Birds, rodents and feral pigs that live near areas with high levels of pathogens, such as landfills, feedlots, dairies, cattle ranches, or pig farms, may pose a greater risk of transferring pathogens, than wildlife not associated with such areas. Some research shows that non-native feral pigs, which frequently share rangeland with cattle and eat cattle feces, carry food-borne pathogens at a higher rate than native wildlife does.

Unlike livestock, wildlife cannot be contained or completely excluded from produce growing areas, so depending on the circumstances they may pose a risk when in the production field. In writing the 'first draft' of the proposed rules for the Food Safety Modernization Act (FSMA), FDA suggests that the presence of wildlife in a production field is, in and of itself, not a significant food safety risk, though action needs to be taken if evidence of feeding or feces are found in a crop field.

C1. What should I do if I see wildlife in habitat near my produce field?
Seeing wildlife in habitat is usually good, since the habitat is often planted or conserved to support pollinators, migrating predators that eat rodents and other types of wildlife. There is only a potential for a problem when and if wildlife enter a field and damage the crop, and/or leave feces behind that can contaminate the crop. Monitoring the production field next to

the habitat for damage and feces can help determine if the wildlife are coming in, thereby increasing the risk (see #9 in illustration). By monitoring at a scheduled time, preferably in conjunction with other tasks such as during insect pest scouting or before an irrigation, and keeping records of the monitoring, the farmer can both reduce risk and have simple documents that support their farm safety program.

Jason Wade

Predators like bobcats help keep rodent populations down in produce fields.

D1. What steps do I take if I see wildlife or their evidence in the production fields?

Assess the production field for crop damage or animal feces that can contaminate the crop. If found, cordon off a specified area—the damaged/contaminated area plus a small percentage—so the risk of cross contamination is removed from the growing area (see #9 in illustration). The size of the cordoned-off area depends on the amount of feces, splash that could occur from irrigation or rain, and how close the crop is growing to the soil. A five-foot radius for overhead-irrigated crops is typically felt to be sufficient; for drip-irrigated crops in a dry season the contaminated plant and its nearest two neighbors are often cited as sufficient buffering. Dispose of feces and the contaminated product away from the crop, sanitize the shovel or other equipment, and wash hands afterwards. Keep records of all actions taken. Further crop assessments may be required to determine if there are repeat visits by individuals or many wildlife, and if they were feeding or just passing through. The number of wildlife in the crop is important to notice—more intrusion equals higher contamination risk. In writing the 'first draft' of the proposed FSMA rules, FDA's perspective about crop contamination is that if the crop does not come in contact with manure, or in this case with wildlife feces, then it would not be covered in the rule. Hence, deer droppings in an apple orchard would not be covered. Of course, the apples should not be picked up from the ground.

E1. Are predators of rodents okay to have on the farm?

It is better to have a few predators, such as hawks or bobcats, on the farm that help keep the rodent population in check, than numerous rodents that could cause much more contamination (see #17 in illustration). Hawks and owls can be attracted to the farm with hawk perches and owl boxes, but do not plant directly under them. If four-footed predators are present near the production field, monitoring for feces should be conducted periodically.

F1. Can I plant a conservation practice such as a hedgerow, or leave wildlife habitat next to a crop and still be able to pass a food safety audit?

The OnFarmFoodSafety.org self audit, the USDA food safety audit, and several other audit programs allow for non-crop vegetation on the farm without losing certification or audit points. Global GAPs encourages habitat restoration. In writing the 'first draft' of the proposed FSMA rules, FDA's perspective about wildlife habitat is that they do not expect farmers to destroy habitat or otherwise clear farm borders around outdoor growing areas or drainages.

Sam Earnshaw

Many food safety audits allow non-crop vegetation on the farm. Some even encourage habitat restoration.

Jo Ann Baumgartner

As a last resort, fences around fields can discourage wildlife from entering production areas.

G1. What are some ways I can discourage unwanted wildlife?
In some situations, conserving habitat in wildlife corridors along waterways or other established routes may keep wildlife from crossing through the crop (see #21 in illustration). If wildlife, their crop damage or feces are continually found in the produce field, corrective actions are warranted. Removal of animal attractants such as feed (culls or spilled grain) and standing water may reduce intrusion; or use of hazing techniques such as loud noises, raptor or distressed bird sounds, and visual deterrents may also work.

Fencing may be necessary as a last, expensive resort. The type of fencing used depends on the animals that need to be excluded. Short silt fencing can be effective for smaller animals, such as ground squirrels that tend not to climb something they cannot see over. Rabbit fencing is a bit more involved but functions on the same visual barrier principle tied to their natural avoidance behavior. Silt fencing is inconsistent in discouraging movement of frogs into fields and tends to be less effective in irrigated fields when immediately adjacent natural waterways dry up. Short, moveable electric fencing can temporally keep less determined feral pigs out of a field, whereas more permanent short hog wire fencing keeps those more persistent out. Tall permanent fencing, especially when electrified, can keep out deer. By fencing just the production fields, instead of the whole property, room is left for wildlife to move through the farm for food and cover in neighboring lands. In writing the 'first draft' of proposed FSMA rules, FDA's perspective about fencing out wildlife is that they do not expect farmers to fence or otherwise exclude animals from outdoor growing areas.

H1. Is it okay to grow produce next to a compost pile?
When compost includes raw manure as a feedstock, extra steps should be taken to ensure crop contamination does not occur. Taking into account wind direction and speed, locate the compost pile a safe distance away from the production field so that unfinished compost cannot blow onto the crop and contaminate it. Consider planting a windbreak to reduce the distance needed between the compost pile and the production field (see #23 in illustration). The location of the compost should also be chosen so that water running off the site is both contained and diverted away from traffic routes to the crop. When wildlife are attracted to compost feedstock such as produce culls, they may explore or inadvertently step in raw manure and then move through the production field, so keeping culls out of their reach can reduce contamination risk. Ensure that any heavy equipment and hand implements used for making or handling the compost are cleaned and sanitized before being used in the crop. Personnel involved in both compost and crop management should be trained in proper prevention and cross-contamination measures.

I1. Are some fields more suited than others to grow certain types of produce?
Since wind, water, wildlife and people may transport pathogens from contaminated areas such as dairy, livestock, or fowl production facilities, dumps, and compost piles to the crop, it is better to plant low risk crops near these areas, and to install a barrier between them (see #23 in illustration). The Center for Disease Control reports that leafy vegetables, tomatoes, and melons are associated with a high number of food-borne illness outbreaks. FDA has

USDA NRCS

USDA NRCS


Produce contaminated by flood water is considered 'adultered' by the FDA. Converting sections of fields that flood often into permanent field borders reduces the movement of pathogens by intercepting overland water flow.

published guidance's on leafy greens, tomatoes and melon to help growers reduce risk. Depending on the method by which these crops are grown and harvested, they may or may not be higher risk. However, almost every year new commodities not previously recognized as vehicles for food borne outbreaks are identified. Therefore, the prudent approach is to consider all crops as potentially vulnerable to risk although many have naturally risk-minimizing traits of growth habit and cropping practices.

FDA considers the edible portion of produce that has been flooded "adulterated," so fields subject to frequent flooding are better planted to crops not consumed by humans (see #7 in illustration). The best management for areas that often flood may be to covert them to conservation plantings, such as permanent field borders (see # 19 in illustration) or riparian forest buffers (see # 6 in illustration) that intercept pathogens in overland flow and encourage infiltration. The forest root zone along a river, stream, wetland or water body helps reduce the movement of pathogens by slowing subsurface flow of contaminated water and providing for biological activity that can reduce pathogens (see # 13 in illustration). For fields that don't often flood, a waiting period should be instituted to allow pathogen reduction to occur before planting another cash crop. Cover crops can be a temporary solution.

Funding and technical assistance for on-farm conservation projects can be found through the USDA Natural Resources Conservation Service.

J1. What are the safety precautions I should take when growing produce and raising livestock on the same farm?

In order to reduce the risk of livestock manure unintentionally contaminating the crop, the livestock should be located downhill from the production fields, or runoff should be diverted away from the livestock yards with the use of a berm or diversion ditch (see # 3 in illustration). Depending on the contamination of the diverted water, it may need to be contained in a waste storage pond or sediment basin (see #s 4 and 12 in illustration). Windbreaks and tall hedgerows can be used to reduce dust blowing from livestock areas (see #s 8 and 10 in illustration). If wild birds are eating extra grain, placing the grain in a covered area where the birds don't feel safe entering it can discourage them.

Testing your irrigation water for pathogens is a good food safety practice.

K1. Does prescribed grazing help to reduce pathogens in the environment?

Prescribed grazing helps to disperse animal feces on the grazing lands where healthy stands of grass can help to filter pathogens (see # 25 in illustration). While cattle both in confined operations (fed grain) and out on pasture (eating forage) can test positive for *E. coli* pathogens, a USDA comprehensive review indicates that populations of these pathogens are higher in cattle fed grain diets. Additionally, confined operations concentrate feces and often increase animal vector occurrence, thereby increasing risk.

L1. Where can I get assistance with installing conservation practices?

The USDA Natural Resources Conservation Service offers technical assistance and Farm Bill cost-share funds for farmers interested in implementing conservation practices. It is important to note that they are not a regulatory body of government. Please visit www.nrcs.usda.gov for further information.

Small- and Mid- Size Farm Questions

A2. Do I need to test my irrigation water?

The Produce GAPs Harmonized Food Safety Standards offered by USDA suggests that testing may not be warranted if past testing showed no high levels of fecal indicators, the crop will be not be eaten fresh, the harvest will not occur soon, and the water will not touch the crop. On the other hand, if any of these conditions do occur, initial baseline testing is recommended, along with the establishment of a routine testing regime. Others recommend testing the water source at the beginning of the growing season for generic *E. coli*. If the water source is found to have high bacterial counts (eg. > 500 *E. coli* /100 ml), advice should be sought from local university extension personnel or farm consultants since recommendations can vary depending on the situation. The quality of the water should conform to prevailing regulations.

B2. Can I still use raw manure?

Pathogens that pose a serious food safety risk may be contained in raw manure. Some standards, such as those in the USDA National Organic Program (NOP), require that raw manure be incorporated into the soil not less than 120 days prior to the harvest of a product whose edible portion has direct contact with the soil, or not less than 90 days prior to the harvest of a product whose edible portion does not have direct contact with the soil. An intermediate recommendation from the USDA GAPs states that when raw manure is applied, it is incorporated at least two weeks prior to planting, and a minimum of 120 days prior to harvest. Some marketing agreements, such as the one for leafy greens, suggest a one-year waiting period between application of soil amendments with raw manure and production of the next crop. It is best to keep records of the composition of the manure and the time and method of application, and to conform with prevailing regulations. If the suggested waiting periods are not feasible, use only properly composted manure.

C2. Is manure-based compost okay to use?

Composting is a treatment process that reduces the microbial hazards of raw manure. When done correctly, the composting process can kill most pathogens in manure. Some standards do not suggest a time period between application and other farming practices, while others recommend it be used only before planting, or only applied at least 45 days before harvest. In all cases, it is a good idea to record the dates that the compost is applied to the field. If not completely composted, it should be treated like raw manure.

Using a waiting period between grazing livestock in orchards or produce fields and the harvest of the subsequent crop helps reduce the risk of pathogens in the livestock manure contaminating produce.

D2. Is it still okay to make my own compost, or should I purchase it?

Manure-based compost can be made safely on the farm when methodical management of the decomposing process is done. *Farming with Food Safety and Conservation in Mind* (see www.wildfarmalliance.org) lists details to be considered when making compost. USDA National Organic Program requires a specified carbon to nitrogen ratio of the compost feedstock, a temperature be reached for a set number of days depending on if it is a static pile or in a windrow, and a specified number of times of turning when in a windrow. Besides recording the compost's composition and the dates and methods of the compost treatment, some standards also recommend that farmers obtain residual fecal indicator and pathogen analyses of the compost. In all cases, care must be taken to ensure composts aren't re-contaminated with pathogens, and the composting process should conform to applicable federal, state, and local regulations.

Compost made solely with vegetative feedstock (i.e. no animal products) has fewer restrictions. The source of the feedstock should not come from situations where hazards such as glass or heavy metals are introduced.

Accepting off-site or purchasing commercial compost should be done only when a letter of guarantee or certificate of pathogen analysis from the compost maker can be obtained. It is also beneficial to find out what the compost was made from (e.g., cattle or horse manure; spent mushroom compost; vegetable culls) and that it was produced under conditions that are not a hazard.

E2. Is aged manure okay to use?
Using aged manure that relies primarily on the passage of time can reduce pathogens. During this aging period, natural temperature and moisture fluctuations and UV radiation from sunlight will decrease the number of pathogens. The time needed to reduce the pathogens will vary depending on the weather and on the type and source of manure. Growers who rely on the passage of time should ensure manure is well aged and decomposed before applying to fields, in order to minimize microbial hazards. Most food safety standards treat aged manure the same as raw manure.

F2. Are there other ways to treat raw manure?
Some standards approve of thermally or chemically processed manure. For instance, steam, ammonia, stabilized lime, and more recently biochars (a by-product of biomass conversion) are used to reduce pathogens in the manure. Care must be taken not to accidentally re-contaminate sterilized manure with pathogens since beneficial microorganisms that are antagonistic to pathogens will be absent.


USDA NRCS

Ask U-Pick customers to sign-in at the entrance of the farm and agree to farm hygiene practices.

G2. Can I allow my livestock to graze under a fruit orchard, and in produce fields after the crops have been harvested?
Yes. Grazing should be scheduled so that there is time for pathogens in the feces to be significantly reduced by sunlight and other environmental factors. When ladders are used, harvesters may inadvertently walk in feces or contaminated soil or vegetated cover and then climb up and down their ladders contaminating their gloves, or they may accidentally place harvest containers on contaminated areas of the ground. While some standards do not address this issue, others suggest that a waiting period of 120 days takes place between grazing and harvest. An assessment to determine if any feces are seen should be done between five and seven days before harvest. It is a good policy to never pick fruit up off the ground since the fruit may have come in contact with animal feces (see #18 in illustration).

H2. Can Community Supported Agriculture (CSA) members and U-Pick customers be on the farm?
Yes. Before walking the fields, have members and customers review a food safety Fact Sheet and sign-in on an agreement form to comply with farm hygiene practices that are addressed in the farm's food safety plan.

I2. Can school children visit the farm and pick produce?
Because children don't always follow directions, it is best to have a distinct learning area or garden just for them that is separate from the production fields. Instructing kids about food safety, and requiring them to wash their hands before picking and eating produce are good policies.

J2. How can I have cats and dogs on the farm and still grow food safely?
USDA GAP standards suggest that dogs can be in production fields when the harvest is more than 120 days away or the planting is more than two weeks away. As the time becomes closer, the dogs are leashed and any feces are picked up and disposed of properly. Since cats cannot be controlled like dogs, their presence in the production fields is not recommended. In writing the 'first draft' of the proposed FSMA rules, FDA's perspective about crop contamination is that if the crop does not come in contact with manure, or in this case with pet feces, then it would not be covered in the rule. Hence, dog or cat feces in a fruit orchard would not be covered. Again, the fruit should not be picked up from the ground.

K2. Do I need a food safety plan?
There are currently no federal regulations requiring a food safety plan. Several states may create their own food safety requirements. To get ahead of the curve, and to make your customers happy, consider creating your own food safety plan using the step-by-step process on the onfarmfoodsafety.org website, or contact CAFF for individual assistance.

USDA NRCS

Food Safety Plans

Most often, a farmer's buyer triggers the need for a food safety plan. This is especially true for anyone looking to sell to government institutional food programs, such as the USDA National School Lunch Program or correctional facilities. That plan typically covers personal hygiene of people on the farm, water testing, use of soil amendments, land use history, neighboring issues, wild and domestic animals, and harvesting. For assistance with creating a food safety plan, contact CAFF.

Food Safety Auditors

Sometimes the buyer requires a third party audit of the farm. If that is the case, they will either request a specific food safety auditor(s) be used, or will let the farmer choose the auditor. A third party audit can be mandatory if the farmer opts to sell to a handler who is part of a USDA recognized commodity group such as the Leafy Green Marketing Agreement. The USDA Agricultural Marketing Service offers food safety audits, as do some states, and there are many private auditing companies. They usually have a very specific checklist and make general observations. The purpose of the auditor's visit is to verify that your written food safety plan "says what you do – and you do what you say."

Food Safety Inspection

The FDA or State health enforcement officer may appear on your farm, but the chances of this occurring are small, unless you are growing a crop considered by them to be risky, or your produce is linked to a food borne illness.

Tips on How to Have a Successful Food Safety Audit or Inspection While Advocating for Farm Conservation Practices

When a food safety visitor comes to inspect a farm operation—be it a third party auditor, the local or state health department, or the Food and Drug Administration (FDA)—it may be helpful to follow the 'Co-management Principles', 'General Rules of Thumb', 'Do's and Don'ts,' and 'Follow-Up' outlined below. The farmer will have a more successful food safety audit or inspection and the food safety visitor will benefit from the farmer being prepared. If at the end of the visit, a recommendation is made to which the farmer does not agree, having a conversation with the inspector's/auditor's supervisor may be helpful in correcting the issue.

Addressing Co-management Principles

Farmers can address food safety without sacrificing responsible on-farm conservation measures. According to the Produce Safety Alliance (run by Cornell University, FDA and USDA), farmers can more effectively advocate for their farming practices with food safety auditors by using risk assessment strategies that help identify risks, and by explaining their rationale for management decisions that address those risks. This risk-assessment approach can be used for conservation measures included in a farming operation, such as maintaining streamside habitat or other non-crop vegetation.

Determine risk reduction protocols that address risk identified for your farm's situation. Assess risk such as pathogens coming from a livestock area; conduct necessary corrective actions that address the problem such as installing a diversion as shown in #3 of the illustration; monitor periodically and write down changes in risk; and implement any other corrective actions if necessary, such as using a cover crop as part of a waiting period between a flooding event and planting the next crop, as shown in #16.

Explain rationale for management decisions. Use descriptions of practices in the key to the illustration above to help craft co-management rationale for decisions made.

General Rules of Thumb

Have a written policy for inspections by food safety auditors and government enforcement officers visiting the farm.

• There should be a clear and concise written policy (program) following the farm's food safety plan while auditors and enforcement officers are on the farm. Everyone in the organization should review this policy in its entirety.

• Official food safety auditors and enforcement officers should be "guided" through your farm operation, but you should not impede them in going where they need to go.

What To Do During the Audit or Inspection

Treat food safety auditors and enforcement officers professionally:

• Consider every visit from them as official.
• Always be courteous to them, such as asking if they would like water, coffee or use of the restroom, but keep a professional distance.
• Recognize that they are not paid to be consultants or to assist you with your food safety management.

Require identification and ask for the reason of the visit:

• Have the auditor or enforcement officer sign in on the visitor's sheet.
• Ask that the auditor or enforcement officer provide appropriate credentials and identification, including their business card.
• Ask for their supervisor's name and contact information.
• Ask the auditor or enforcement officer if the inspection is routine or if there is a specific reason for the inspection.
• Require the auditor or enforcement officer to state his/her specific intentions, and in the case of a FDA inspection, to provide Form FD 482-Notice of Inspection.
• Ask the auditor or enforcement officer what s/he wants to see or do, how long it might take, and what resources s/he might need to assist with the inspection.

Take charge of the visit:

• Provide the auditor or enforcement officer with an overview of your farm, including risk assessment strategies for co-managing food safety with conservation and other issues. These practices can be described in detail as part of your food safety plan.
• Escort the auditor or enforcement officer at all times and proactively explain rationale for co-management and other food safety decisions. If possible have two people from your farm present during the inspection.
• Have all policy, management contacts, and standard information records in organized and clearly labeled binders to facilitate and set a positive tone for the inspection.
• If the auditor or enforcement officer asks for records, provide them with a photocopy while you retain the original.
• If the auditor or enforcement officer asks for a produce sample, ask them to make a duplicate one for you and ask what they intend to specifically test for with the sample. Also ask for the expected time to obtain test results so the physical quarantine of the impacted harvested lot may be anticipated. Send the duplicate to a qualified lab of your choice for the same tests.

Strive for clear communication:

• Listen well and ask lots of questions.
• Answer all questions honestly and take time to fully explain each of your answers.
• Stay focused on questions that are asked and only volunteer information when it is related to specific inspection criteria.
• Ask if any minor infractions can be fixed immediately. Don't necessarily accept any advice or recommendations, orders, directions, or instructions without appropriate justification.

Conditions Under Which an Automatic "Unsatisfactory" Will be Assessed in an Audit or Inspection

• An immediate food safety risk that has or would reasonably cause the produce to become contaminated.
• The presence or evidence of general unsanitary conditions, chemical or allergen hazards, rodents, or excessive pests in the produce.
• Personal hygiene has jeopardized the safety of the produce.
• Falsification of records.
• Not having a written and established food safety plan.
• Not having a designated, qualified person on the far to implement and oversee an established food safety plan.

Training Scenarios for USDA and Third Party Auditors on the Co-management of Food Safety and Conservation as well as Small Farm Concerns

Before a food safety auditor comes to your farm, suggest that they first review training scenarios on co-management and small farm issues posted at www.wildfarmalliance.org. The materials are presented in the accepted food safety industry format of the USDA Harmonized Standards for Field Operations. If the auditor works for, or is accredited by USDA, they can receive continuing education units. By having them learn about co-management and small- and mid-size farm issues, they will be better informed when they arrive at your farm. Farmers may also find value in reviewing these training scenarios, and may want to reference them, if a food safety auditor who has not seen these materials is already on the farm and needs further clarification.

• Ask for references (book, paragraph and line number) to all inspection findings.
• An exit briefing will occur at the end of the audit or inspection, but if one is not done, ask for it, taking good notes. During this debriefing, the auditor or enforcement officer will describe what may be a concern. This will be helpful to know, in case they plan on taking future actions. If the official also asks you to sign a paper with the alleged concern outlined, you may want to defer until you can have your attorney review it.

What Not To Do During the Audit or Inspection (Unless required by proper legal authority)
• Do not admit to any fault or deficiency or sign any forms admitting to fault, without proper legal advice.
• Do not volunteer the following information: recipes, formulas, any item that is strictly proprietary, financial records, research data, customer lists, sales information, pricing information, personnel records, accident data, distribution records, or inventories of products.

Follow-Up Right After the Audit or Inspection
When agreement is not reached:
• If for any reason you do not agree with the auditor or enforcement officer, absolutely have them make complete notes of your objections in their report or provide them (before they leave the farm) with a statement explaining the situation and all facts of the matter.
• At this point it is also recommended that you immediately contact this individual's supervisor and state your concerns. The supervisor wants to talk to you and correct the issues.

Follow-Up Some Time After the Audit or Inspection
Audit results:
• Once the audit is processed, either a final copy of the passing audit, or a letter describing what corrective actions are need to be implemented within a designated period of time will be sent.
Inspection results:
• You should be provided with an inspection report (this can take some months). Respond to any deficiencies noted in the report by making corrective actions in a timely manner (FDA requires 15 days) and telling them you did it. If you do not hear back from the inspecting agency, call them on the phone number they provided to you during the initial visit.
• If you do not agree with the findings, contest them with the advice of an attorney.
• If a warning letter is received, check with your attorney before responding.

Sam Earnshaw

USDA NRCS

By using risk assessment strategies that help identify risk as well as explaining the rationale for management decisions that address that risk, farmers can effectively advocate for their conservation-based farming practices including cover crops and wetlands.

Selected Resources

Co-management Materials

• Farming with Food Safety and Conservation in Mind authored by Jo Ann Baumgartner and Dave Runsten; published by Wild Farm Alliance and Community Alliance with Family Farmers. Updated 2013.
• Co-Management of Food Safety and Sustainability authored by Mary Bianchi and published by UC Davis. 2012.
• Safe and Sustainable: Co-Managing for Food Safety and Ecological Health in California's Central Coast Region authored by Karen Lowell, Jeff Langholz, and Diana Stuart; published by The Nature Conservancy of California and the Georgetown University Produce Safety Project. 2011.

Small and Mid-Size Farm Websites with Food Safety Information

• Community Alliance with Family Farmers (http://caff.org/programs/foodsafety/)
• Wild Farm Alliance (www.wildfarmalliance.org)
• Carolina Farm Stewardship Association (http://www.carolinafarmstewards.org/tag/food-safety/)
• Northeast Organic Farming Association (http://www.nofa.org/advocacy.php)
• National Sustainable Agriculture Coalition (http://sustainableagriculture.net/category/food-safety/)
• Maine Organic Farmers and Gardeners Association (http://www.mofga.org/)

Good Agricultural Practices (GAPs) Websites

• On Farm Food Safety Project has a free online tool, based on a comprehensive risk-based framework, which generates customized on-farm food safety plans based on user input (http://onfarmfoodsafety.org/).
• Produce Safety Alliance is developing a nationwide curriculum to increase understanding of the principles of Good Agricultural Practices (GAPs) and to facilitate the implementation of food safety practices on fresh fruit and vegetable farms and in packinghouses (http://producesafetyalliance.cornell.edu/psa.html).
• Global GAP certifies safe, sustainable production of food, flowers, and ornamentals. They work with more than 140 independent and accredited certification bodies to carry out certification worldwide (http://www.globalgap.org/uk_en/for-producers/crops/).
• USDA GAPs is a voluntary program by USDA Agricultural Marketing Service that provides independent audits of produce suppliers throughout the production and supply chain (http://www.ams.usda.gov/AMSv1.0/HarmonizedGAP).
• Produce GAPs Harmonized Food Safety Standard Field Operation and Harvesting offered by USDA is another independent audit that was created by United Fresh with input from the produce industry (http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5102511).
• California Leafy Green Marketing Agreement (LGMA) membership requires verification of compliance with the accepted food safety practices through mandatory audits conducted by USDA trained auditors (http://www.caleafygreens.ca.gov/).

User's Note: This publication provides guidelines and practical tools for use by family farmers. It was supported by The California Department of Food and Agriculture (Specialty Crop Block Grant #SCB11005), Columbia Foundation, Farm Aid, Gaia Fund, Newman's Own Foundation, Organic Farming Research Foundation, True North Foundation, and the Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture, under number 69-3A75-10177. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture. The information provided herein is offered by Wild Farm Alliance and the Community Alliance with Family Farmers in good faith and believed to be reliable, but is made without warranty, express or implied, as to merchantability, fitness for a particular purpose, or any other matter. It is intended as an educational resource and not as technical advice tailored to a specific farming operation or as a substitute for actual regulations and guidance from FDA or other regulatory agencies. It is also not intended as legal advice. We will not be responsible or liable, directly or indirectly, for any consequences resulting from use of this document or any resources identified in this document.

This guide was written by Jo Ann Baumgartner of Wild Farm Alliance, and edited and co-published by Community Alliance with Family Farmers, October 2013.

Community Alliance with Family Farmers
PO Box 363
Davis, CA 95617

Non-Profit Org.
U.S. Postage
PAID
Permit No. 25
Auburn, CA

A FARMER'S GUIDE TO FOOD SAFETY AND CONSERVATION: FACTS, TIPS & FREQUENTLY ASKED QUESTIONS

WILD FARM ALLIANCE

CAFF
COMMUNITY ALLIANCE WITH FAMILY FARMERS

ag in the classroom
San Benito County Farm Bureau

Harvest of the Month

Nutrition Facts

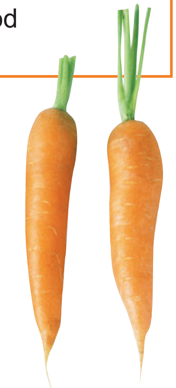
Serving Size: ½ cup carrots, sliced (61g)

Calories 25	Calories from Fat 0
	% Daily Value
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 45mg	2%
Total Carbohydrate 6g	2%
Dietary Fiber 2g	7%
Sugars 3g	
Protein 1g	
Vitamin A 204%	Calcium 2%
Vitamin C 6%	Iron 1%

CARROTS

Health and Learning Success Go Hand-In-Hand

School gardening presents a great opportunity to teach students about fruits and vegetables and actively engage them in physical activity. Studies have shown that school-based nutrition education promoting healthful eating and physical activity can improve academic performance. *Harvest of the Month* connects with core curricula to give students the chance to explore, taste, and learn about the importance of eating fruits and vegetables. It links the classroom, cafeteria, home, and community to motivate and support students to make healthy food choices and be physically active every day.



Exploring California Carrots: Taste Testing

What You Will Need (per student group):

- Raw carrots, peeled and sliced into sticks; one stick per student
- Canned carrots; enough to provide each student with a taste
- Paper and pencils
- Printed Nutrition Facts labels for fresh and canned carrots*

*Download labels from **www.harvestofthemonth.com**.

Activity:

- Taste raw carrots and note the color, texture, smell, flavor, and sound.
- Repeat activity with the canned carrots.
- Compare and contrast the similarities and differences, including the nutrition information.
- Using information from observations and research, apply in a writing activity.
- Compare ideas and observations of carrot taste testing with previous taste testings.

For more ideas, reference:
School Foodservice Guide – Successful Implementation Models for Increased Fruit and Vegetable Consumption, Produce for Better Health Foundation, 2005, pp. 39-42.

Cooking in Class: Vegetable Medley with Salsa Dip

Makes 32 tastes at ¼ cup vegetables and 2 tablespoons dip each

Ingredients:

- 4 carrots, cut into 3-inch sticks
- 4 celery stalks, cut into 3-inch sticks
- 1 jicama, peeled and cut into 3-inch sticks
- 1 bunch radishes, trimmed
- 12 green onions, trimmed
- 1 (16-ounce) container fat free sour cream
- 2 cups pico de gallo (salsa)
- Small paper plates and napkins

1. Arrange vegetables on a platter.
2. In medium bowl, mix sour cream and pico de gallo.
3. Spoon 2 tablespoons dip and 1 of each vegetable on small plate. Serve.

Nutrition information per serving:
Calories 25, Carbohydrate 5 g, Dietary Fiber 2 g, Protein 1 g, Total Fat 0 g, Saturated Fat 0 g, Trans Fat 0 g, Cholesterol 1 mg, Sodium 77 mg

Adapted from: *Healthy Latino Recipes Made With Love, Network for a Healthy California*, 2008.

For more ideas, reference:
Kids Cook Farm-Fresh Food, CDE, 2002.

Reasons to Eat Carrots

A ½ cup of fresh or cooked carrots is:

- An excellent source of vitamin A, providing more than 200% of the recommended Daily Value.
- A good source of vitamin K.
- A source of vitamin C, fiber, and potassium.

*Learn more about vitamin A on page 2.

Champion Sources of Vitamin A*:

- Cantaloupe
- Carrots
- Cooked greens
- Red bell peppers
- Sweet potatoes
- Winter squash

*Champion sources provide an excellent source of vitamin A (at least 20% Daily Value).

For more information, visit:
www.nal.usda.gov/fnic/foodcomp/search/
(NDB No.: 11124, 11125, 11131)

What is Vitamin A?

- Vitamin A is a fat-soluble vitamin, which means it can be stored for long periods of time in your body.
- Vitamin A is an antioxidant that helps to keep the body safe from free radicals. Among Americans, toxic consumption levels of vitamin A are more of a concern than deficiencies.
- Vitamin A is required for the proper development and functioning of our eyes, skin, and many other parts of our bodies.
- Individuals who have low levels vitamin A may develop night blindness.
- Vitamin A is required for normal functioning of the immune system.
- Vitamin A that is found in colorful fruits and vegetables, like carrots, is called provitamin A carotenoid. It can be made into retinol in the body. Some carotenoids (like beta carotene, alpha carotene, and beta cryptoxanthin) can be made into vitamin A by the body.

Sources:
http://lpi.oregonstate.edu/infocenter/vitamins/vitaminA/
http://jn.nutrition.org/
http://ods.od.nih.gov/factsheets/vitamina.asp

How Do Carrots Grow?

Carrots are biennial, meaning they have a two-year life cycle. In the first year, the edible root is formed, followed by production of the flower and seeds in the second year. Carrots can be grown most anywhere. The ideal temperature range is 60 to 70 F. For this reason, carrots are grown year-round in California. They require a growing season of 110 to 160 days and need deep, loose, well-drained soils.

Prior to planting, the soil is plowed deep and disked to avoid clods; a compaction layer also helps keep the roots from becoming forked or rough. Germination of the seedlings may be advanced by sowing them in V-shaped furrows. Seeds are then covered with a quarter-inch layer of sand or sifted compost. Most fields are sprinkler-irrigated during the entire growing season. Carrots are mechanically harvested with self-propelled multi-row harvesters that can harvest up to 1,000 tons per day.

Carrot varieties vary only slightly in taste, shape, or size, so most consumers are unable to tell one variety from another. Varieties are actually grown in particular growing regions or for specific uses. For example, carrots found in supermarkets that are packaged in cello bags are grown specifically larger and for the supermarket.

Baby-cut carrots are made from full-grown, small diameter carrots by peeling and cutting them to the desired length. They are planted closer together so the roots stay slim and there is less waste when the carrots are cut to their small size. True baby carrots are removed from the ground early and actually look like miniature carrots.

For more information, visit:
www.botany.org

How Much Do I Need?

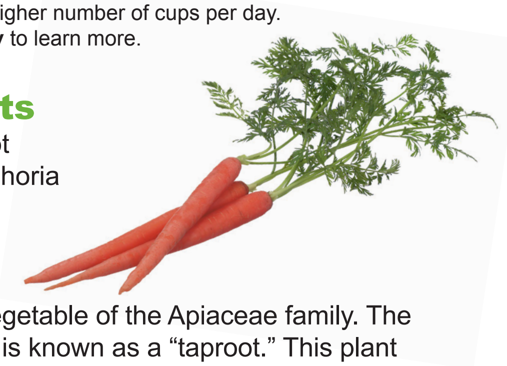
A ½ cup of sliced carrots is about one medium carrot or four baby carrots. This is the same as about one cupped handful. The amount of fruits and vegetables that each person needs depends on age, gender, and physical activity level. Have students visit **www.mypyramid.gov/kids** to find out how much they need to eat from each group in MyPyramid. Have them write down their goals and track them each week.

Recommended Daily Amount of Fruits and Vegetables*

	Kids, Ages 5-12	Teens and Adults, Ages 13 and up
Males	2½ - 5 cups per day	4½ - 6½ cups per day
Females	2½ - 5 cups per day	3½ - 5 cups per day

*If you are active, eat the higher number of cups per day.
Visit **www.mypyramid.gov** to learn more.

Botanical Facts



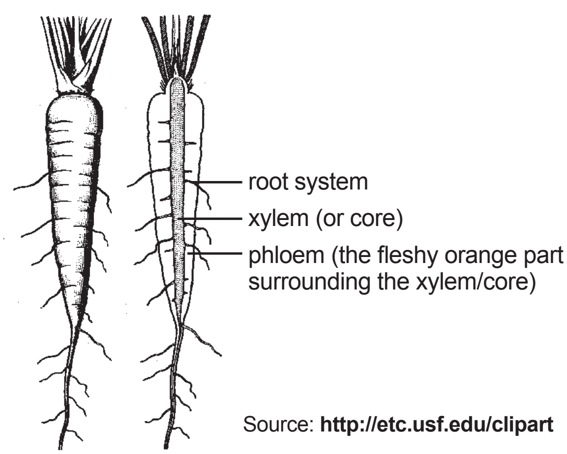
Pronunciation: kăr´ət
Spanish name: zanahoria
Family: Apiaceae
Genus: *Daucus*
Species: *D. carota*

The carrot is a root vegetable of the Apiaceae family. The edible part of a carrot is known as a "taproot." This plant is cultivated for its enlarged edible root and its foliage is fine and lacy. In fact, the wild carrot is actually a familiar wildflower known as "Queen Anne's lace."

Carrots are commonly grouped into two main varieties: eastern and western. Eastern carrots are the original cultivar and are usually purple or yellow in color and have fewer branched roots. The purple color stems from an anthocyanin pigment lost in later varieties. (See *The Roots of Carrot History* on page 3 for details.) Western carrots emerged in the Netherlands in the 15th or 16th century. Their orange color made them popular among countries associated with the House of Orange and the Dutch struggle for independence.

Carrots contain plant pigments called *carotenoids,* of which beta carotene is a member. These pigments were first identified in carrots (giving them their orange color) and their name was thus derived from the word *carrot*.

For more information, visit:
www.caes.uga.edu/publications/pubDetail.cfm?pk_id=7429



Source: **http://etc.usf.edu/clipart**

The Roots of Carrot History

- Carrots originated in central Asia, near Afghanistan, several thousand years ago.
- Ancient ancestors of the modern carrot were not yellow-orange, but of purplish colors ranging from lavender to almost black. The yellow-orange root came from a mutant variety that lacked the purple pigment.
- Purple and yellow-orange varieties spread west to the Mediterranean, where ancient Greeks and Romans used them for medicinal purposes.
- In the 14th century, carrots arrived in China, which is now the world's leading carrot producer.
- Around the 1600s, the purple variety nearly became extinct, and the yellow-orange variety was introduced to America and Japan.
- The high beta carotene content of carrots was discovered in the 19th century. During World War II, the British worked to develop a variety of higher beta carotene carrots to help their aviators see better at night.

For more information, visit:
www.cfaitc.org/factsheets/pdf/FreshCarrots.pdf

Student Sleuths

1. Name three specific functions that vitamin A provides for the body.
2. What are some of the signs of vitamin A deficiency?
3. The percent Daily Value (%DV) tells you how much of a nutrient you get in a serving of a food item and is based on a 2,000-calorie diet. Vitamin A is measured in International Units (IU). Look up the IU for vitamin A that your body needs based on your gender and age. Compile a list of foods you eat and find the %DV for vitamin A in these foods. Determine if you are getting an adequate amount of vitamin A in your diet.
4. Map the different commercial carrot-producing regions in the world.
5. Identify and compare the peak harvest times for carrots in each California region.

For information, visit:
www.fruitsandveggiesmatter.gov/month/carrot.html
www.ipmcenters.org/cropprofiles/docs/cacarrots.html
http://ohioline.osu.edu/hyg-fact/5000/5551.html
http://lpi.oregonstate.edu/infocenter/vitamins/vitaminA/

Student Champions

Encourage students to come up with a slogan for healthy eating. Students can design promotional inserts, pins, and posters that display the slogan and fun facts about healthy eating. Students can distribute these materials to customers at local farmers' markets, grocery stores, restaurants, and hospitals to show support for healthy eating habits.

School Garden: From Seed to Life

If your school has a garden, here is an activity you may want to implement. Look for donations to cover the cost of seeds, tools, irrigation systems, electric pumps, and any salary incurred by garden educators or others.

Students who work directly with plants or in a garden are more likely to understand the important role plants and agriculture play in our lives. Discuss how plants contribute to our society and health. Students can then plant a "container garden" to give to a person or organization, such as a children's hospital, nursing home, neighbor, or take home to their family.

What You Will Need:

- Small plant containers
- Variety of plants
- Bagged soil mix*
- Basin for moistening soil

*Note: Garden soil is too heavy for small containers and often contains weed seeds.

Activity:

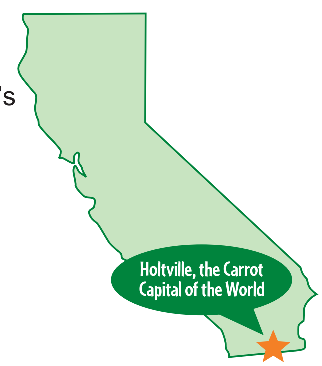
- Fill container with moistened soil mix.
- Loosen plant from its original pot by gently squeezing the bottom of the container or gently tapping it on the ground to loosen the root ball.
- Carefully move to new container and plant at same depth as it was in the old pot.
- Gently firm the soil in around the plant.
- Place container in a spot where it can drain, such as a sink basin or on the ground outside.
- Use a watering can to water the soil very gently, being careful not to create pockets around settled soil.
- Create plant labels and decorate note cards with care instructions to accompany each plant container.

Adapted from: www.kidsgardening.com/Dig/dig.asp?act=t

For more ideas, reference:
Nutrition to Grow On, CDE, 2004.

Home Grown Facts

- California ranks first nationally in the production of carrots.
- Carrots rank among California's top 25 agricultural exports and top three among vegetables.
- Baby-cut peeled carrots account for more than 35% of California's carrot production and 70% of the total acreage.
- Holtville, California is known as the "Carrot Capital of the World."



Source: **www.fsa.usda.gov/ca/**

- Kern County is the state's largest producer of carrots with 75% of the state's acreage.
- There are four main carrot-producing regions in California: Southern San Joaquin Valley/Cuyama Valley, Southern Desert, Central Coast, and High Desert.

For more information, visit:
www.ipmcenters.org/cropprofiles/docs/cacarrots.html
www.cdfa.ca.gov

Physical Activity Corner

Students need to get at least 60 minutes of physical activity each day to help them stay healthy and fit, both mentally and physically. Take time to play a different game or activity each week in or out of the classroom.

Objective:

Develop hand-eye coordination and fast-twitch reflexes.

What You Will Need:

- Frisbee®
- Four bases
- Slide

Activity: *(similar to baseball)*

- Separate students into two teams.
- Set up four bases on playground near slide.
- "Batter" goes down the slide and takes Frisbee® at home plate and throws it.
- If it's "fair" and no one catches the Frisbee®, then "batter" runs the bases.
- Tagging is done with the Frisbee® and someone must be holding it.
- After three outs, the teams switch.
- Play as many rounds as time allows.

For more ideas, visit:
www.sparkpe.org

Adventurous Activities

Creative Writing:

- Based on the *School Garden* discussion (page 3), ask students to write an essay about how carrots (or their favorite fruit or vegetable) contribute to our health and the state's economy.

Science Investigation:

- Demonstrate the water content of carrots.
- Fill a glass of water with ink or food coloring and then put a carrot in the glass.
- Remove carrot after one day and cut it in half, separating the top and bottom halves.
- Ask students questions about what they see and compare it with a raw, cut carrot.
- Cut the halves lengthwise to study the "veins" in a carrot.

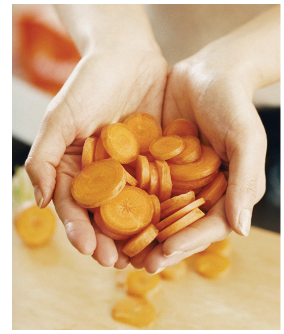
Nutrient Analysis:

- Distribute *Fresh Fruit and Vegetable Photo Cards** (CDE, 1997) for carrots, sweet potatoes, beets, and turnips.
- For each item, calculate the number of grams of the nutrients in the graphs by using the percentages shown in the graph and daily values.

*Download from **www.harvestofthemonth.com**.

For more ideas, visit:
www.hhs.gov/kids

Cafeteria Connections



Work with school nutrition staff to find out which form of raw and/or cooked carrots students prefer.

- Conduct taste tests during lunch.
- Older students or a math class may be interested in conducting the taste test and determining cost, student preference, and nutrient analysis.
- Students can taste test the various ways in which raw carrots may be served, such as whole, sticks, baby, mini, sliced, and shredded. Students can also test cooked carrots.
- After the taste tests, feature the school's "choice" on the school lunch menu. On the same day, fill a jar with the "favorite carrot choice" and ask students to guess how many carrots it took to fill the jar. Provide incentives and/or awards as appropriate for your school site.

For more ideas, reference:
Fruits and Vegetables Galore, USDA, 2004.
www.schoolnutrition.org

Just the Facts

- The average person eats 17 pounds of carrots per year.
- Carrots contain about 90% water.
- Most baby-cut carrots are made from large carrots that have been peeled and trimmed. The trimmings are used in salad mixes, juices, and other carrot products.
- The carrot was one of the first vegetables to be canned in the early 1800s.
- Carrots, or "skirrets," were originally purple, white, and yellow. The orange carrot was developed in Holland as a tribute to William I of Orange during the Dutch fight for independence from Spain in the 16th century.

For more information, visit:
www.cfaitc.org/factsheets/pdf/FreshCarrots.pdf

Literature Links

- **Primary:** *The Carrot Seed* by Ruth Kraus (available in Spanish), *Carrot Soup* by John Segal, Curious George, *The Perfect Carrot* by Marcy Goldberg Sacks, *The Giant Carrot* by Jan Peck, *Just Enough Carrots* by Stuart Murphy, *The Life Cycle of a Carrot* by Linda Tagliaferro, and *Tops and Bottoms* by Janet Stevens.

For more ideas, visit:
www.cfaitc.org/books

CDPH California Department of Public Health

This material was produced by the California Department of Public Health's *Network for a Healthy California* with funding from USDA SNAP, known in California as *CalFresh* (formerly Food Stamps). These institutions are equal opportunity providers and employers. *CalFresh* provides assistance to low-income households and can help buy nutritious foods for better health. For *CalFresh* information, call 1-877-847-3663. For important nutrition information, visit www.cachampionsforchange.net.

CHAMPIONS for CHANGE
Network for a Healthy California


WALNUTS
ag in the CLASSROOM
BERTUCCIO
ORCHARDS

APPENDIX— SCB11013

Instrumentation pattern:

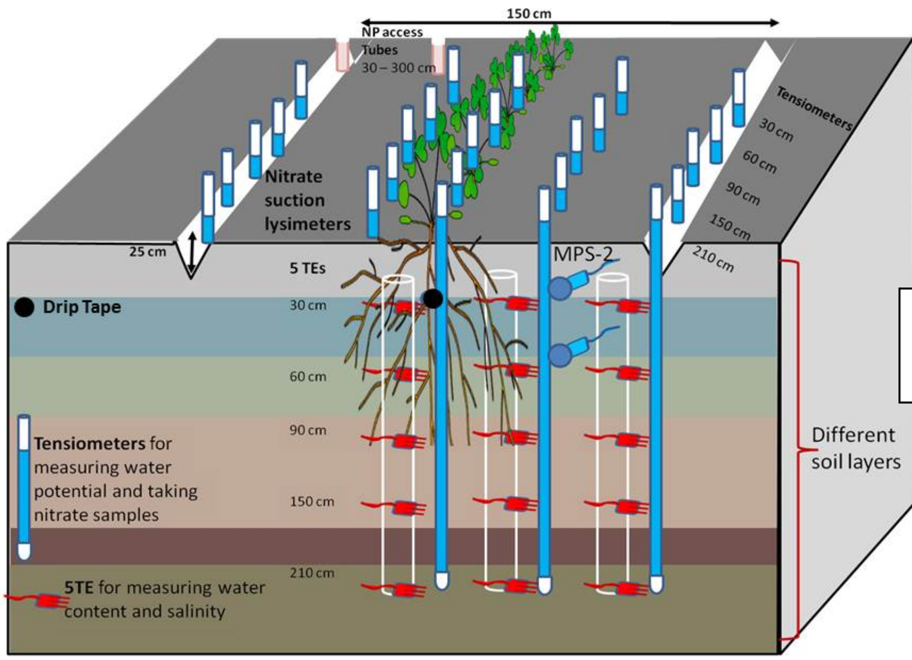


Fig. A1. Instrument layout in one of the three instrumented plots

Instruments list and functions:

1. **Tensiometers**: measures soil matric potential, range: 850 - 0 mbar, individually-calibrated pressure transducers
2. **Decagon 5TE sensors**: measures soil water content, electrical conductivity, temperature
3. **Decagon MPS-2 sensors**: measures soil matric potentials, range -4000 mbar – 0
4. **Neutron Probe**: measures soil water content, large representative soil volume
5. **Nitrate Suction Lysimeters** : is used to collect soil solution for nitrate analysis
6. **Equilibrium-Tension Lysimeters**: measures drainage below the root zone and collect soil solution samples for nitrate analysis

• Multiple sensors at various depths and locations for each treatment plot

Fig. A2. Photos and descriptions of the six instruments installed

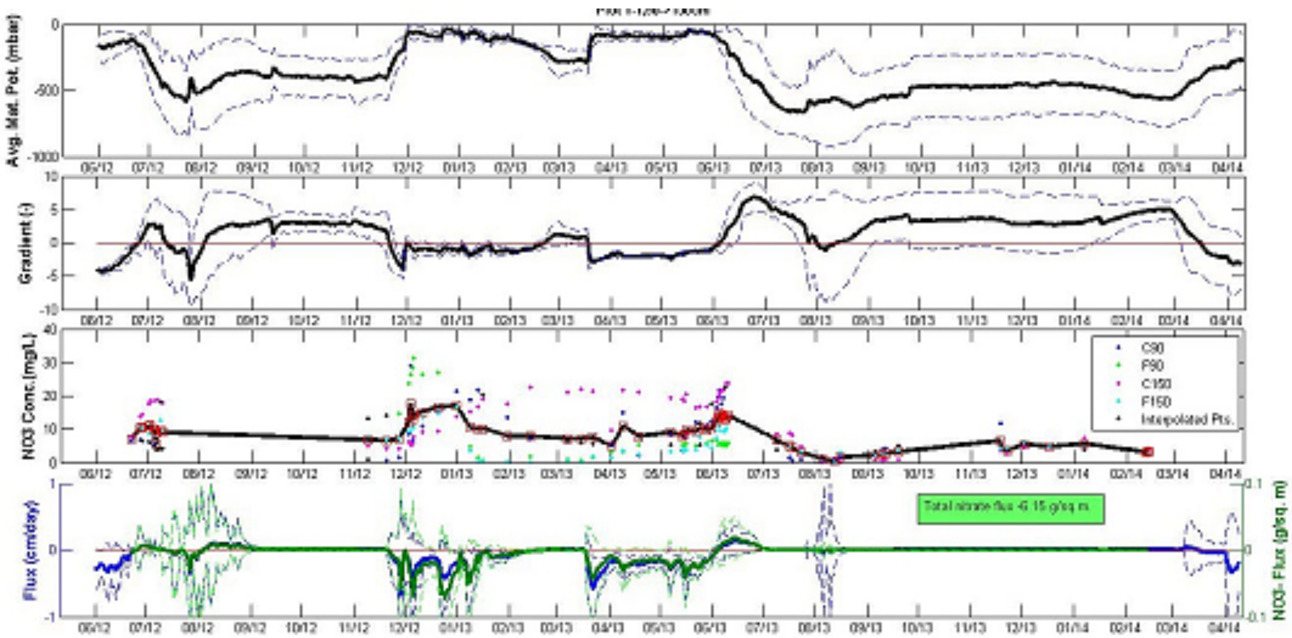


Fig A3. Components for water and nitrate flux computations: soil matric potential, vertical ψ gradient, nitrate concentration, and computed water and nitrate flux in sample plot. Dashed lines show error bars.

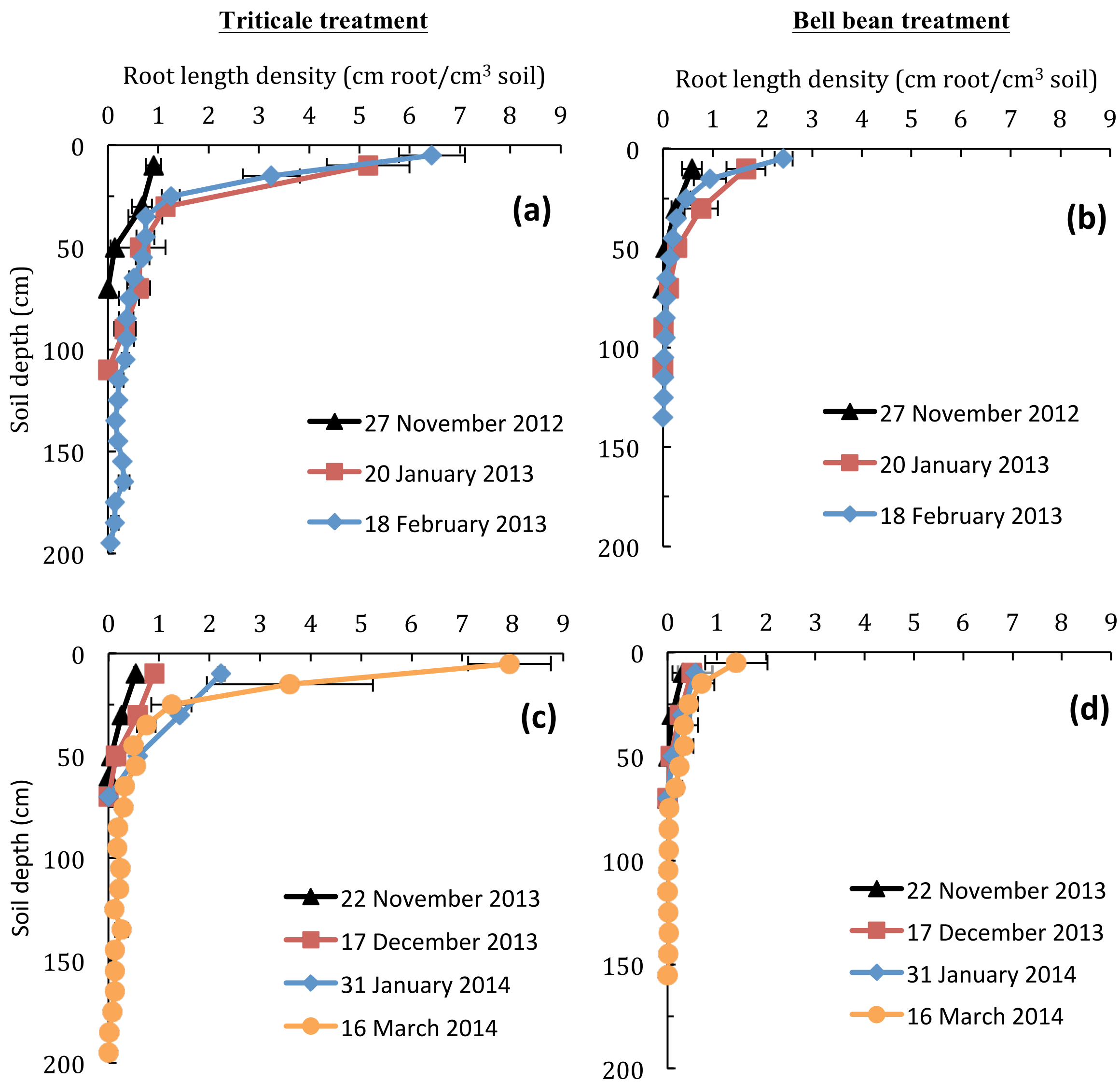


Figure A4. Root length density (cm root / cm^3 soil) with depth for triticale (a and c) and bell bean (b and d) treatments. Bell bean treatment includes both bell bean and weed roots. Each data point is mean ± standard error with n=6-10.

Figure A5. Triticale (a) and bell bean (b) root systems grown in clear boxes in a climate controlled growth chamber. Images were taken after 19 days (427 growing degree-days) in the growth chamber, at which point roots had reached the bottom of the box. This length of time corresponds to approximately 2.5-3 months in the field during the winter cover crop season.

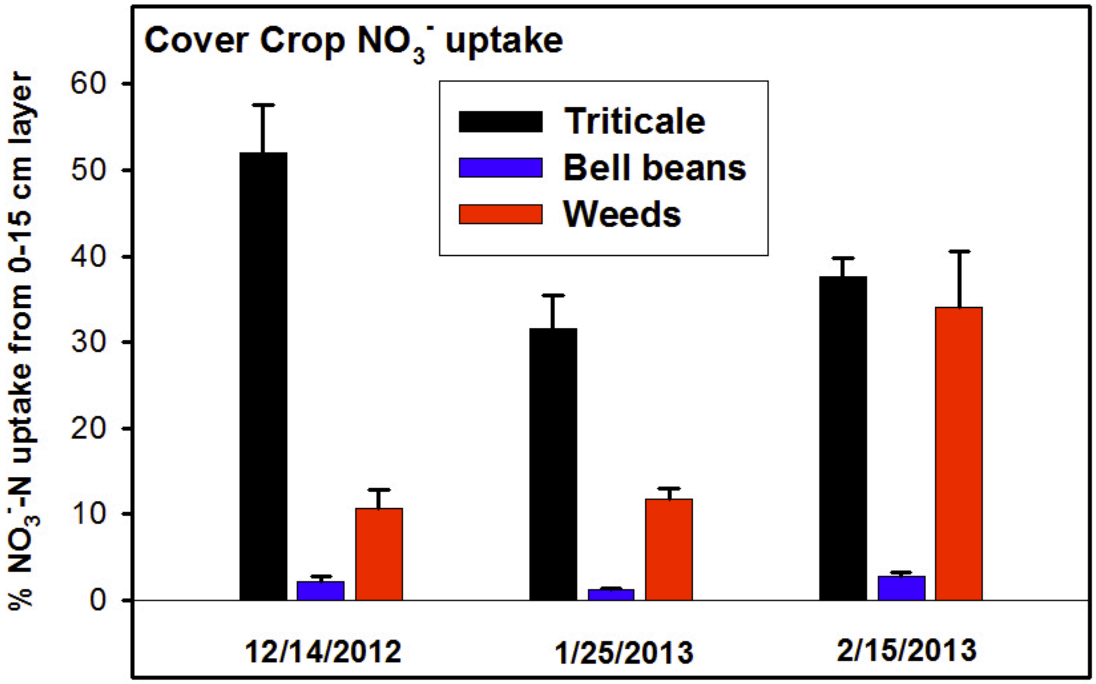


Figure A6. Nitrate uptake by Triticale, bell beans, and weeds during 2012-13 rainy season.

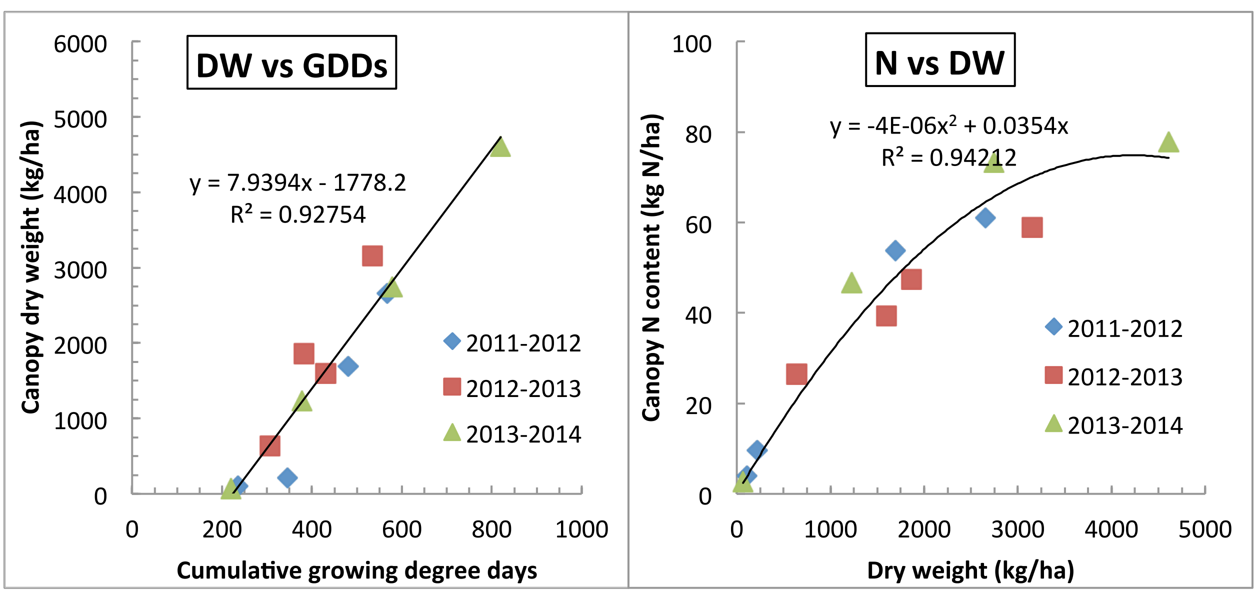
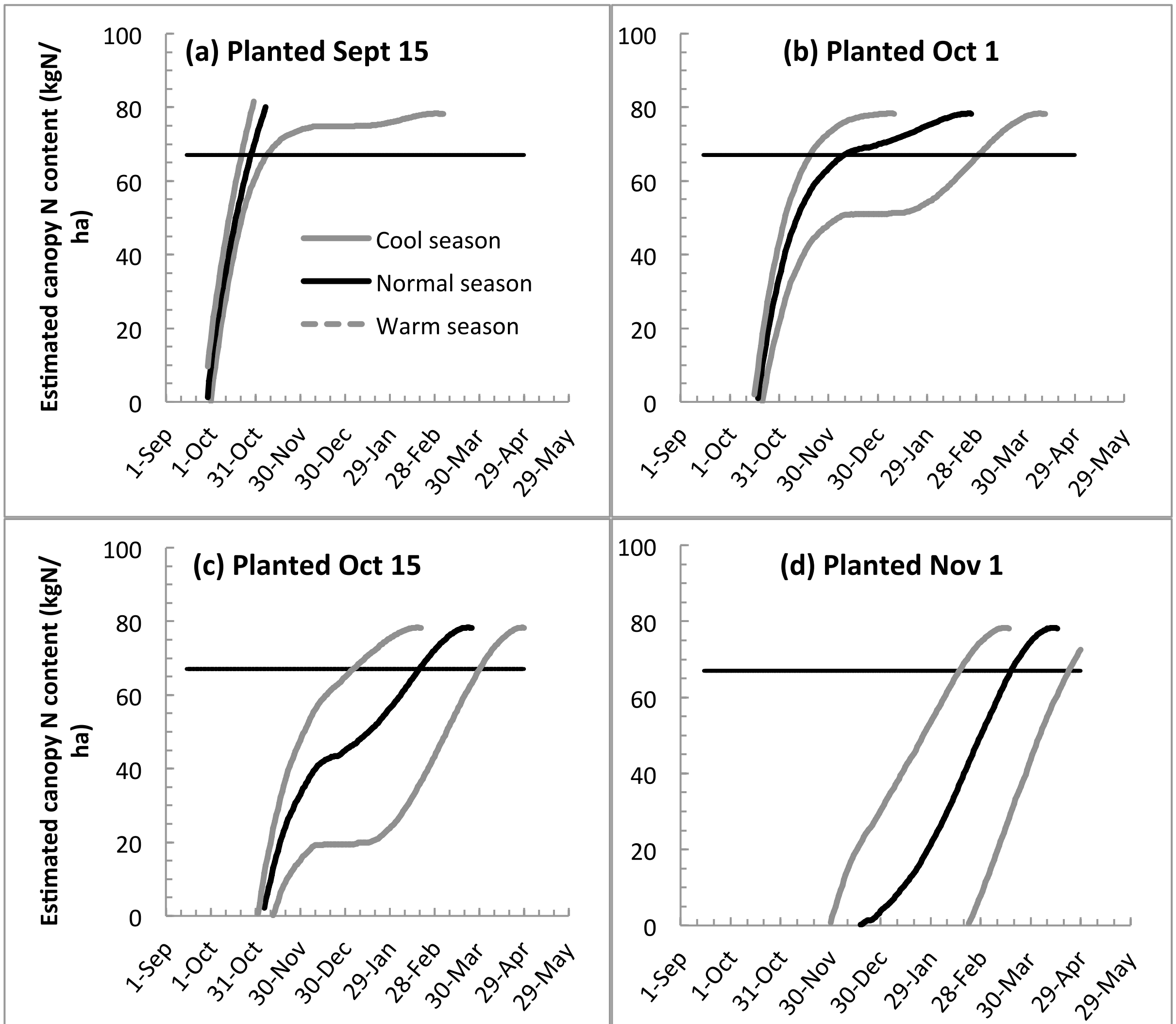


Figure A7. Accumulated temperature (growing degree-days) is a good predictor of triticale dry weight and canopy N content. Relationships are shown for data collected during the previous three cover crop seasons.



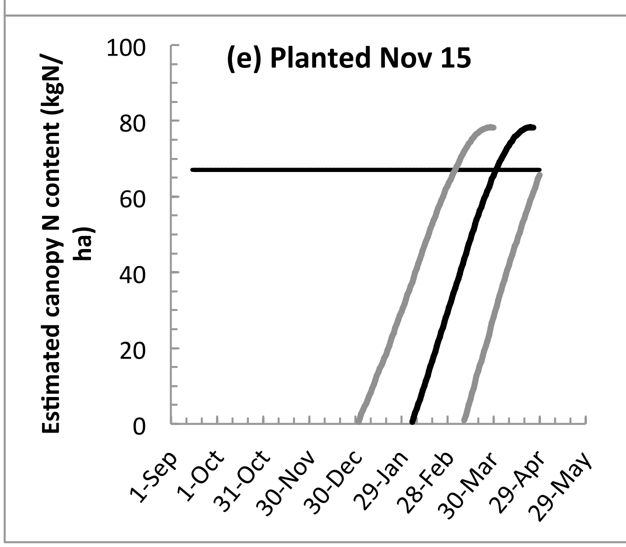


Figure A8. Effect of planting date on N uptake by triticale in normal, warmer than average and colder than average years. Normal temperature trends for the cover crop season were estimated by calculating the average temperature for each day using data from 1982 - 2014. Warmer and colder seasons were created by calculating the temperature that corresponds to the 75th and 25th percentile, respectively, for each day. Each set of temperatures were then used to calculate growing degree-days and N content in the canopy.

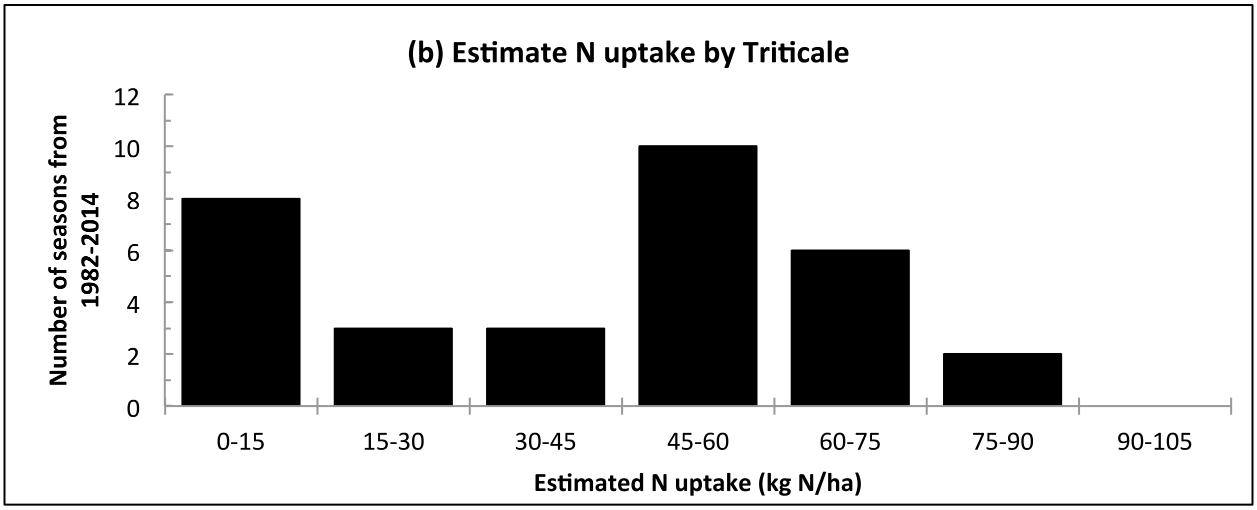


Figure A9. Estimated triticale N uptake if planted immediately prior to the first rains and terminated on February 28. Estimates are based on weather data from 1982-2014 for Davis, CA.

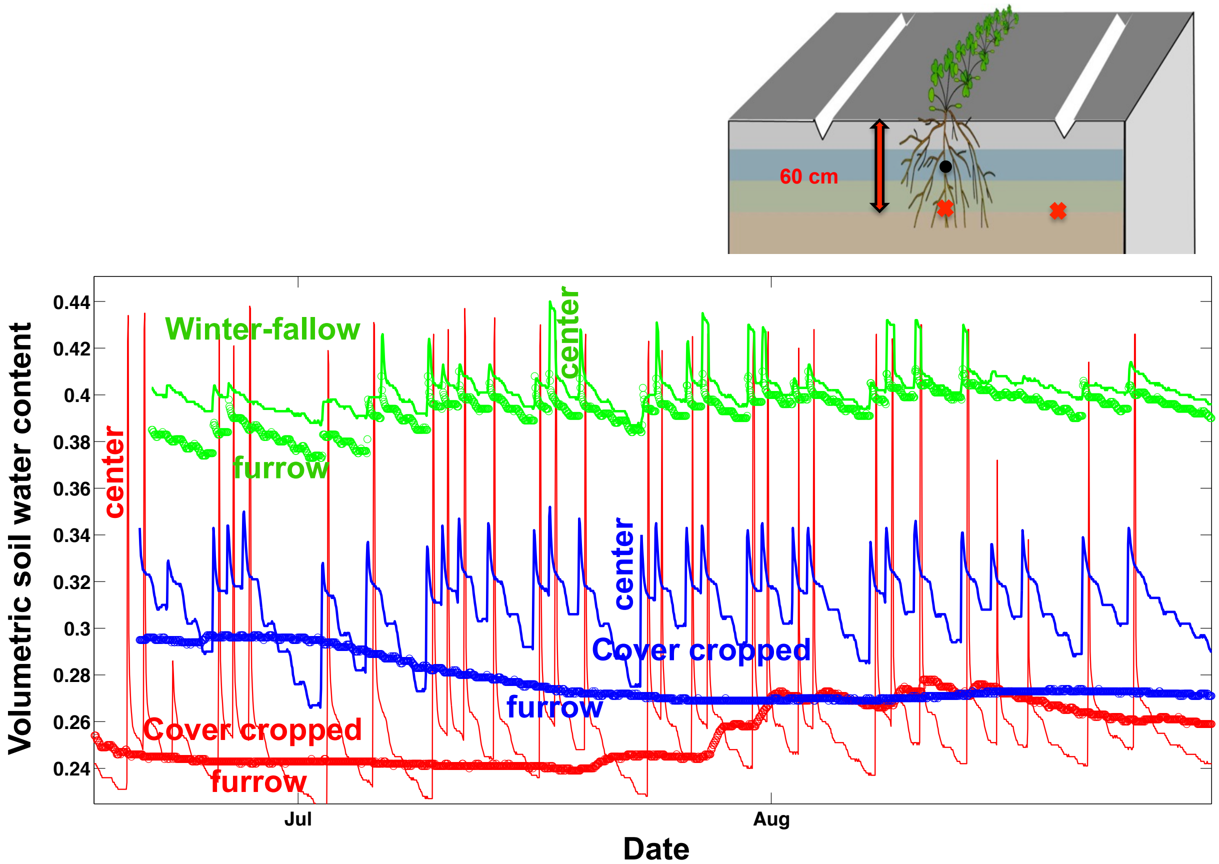


Figure A10. Soil moisture at 60 cm depth underneath the drip tape and furrow locations (see diagram above) in winter-fallow (green), bell bean cover-cropped (red), and Triticale cover-cropped soil during the tomato growing season 2012. The thick lines represent soil moisture underneath the furrow, the thin lines depict soil moisture underneath the drip tape.

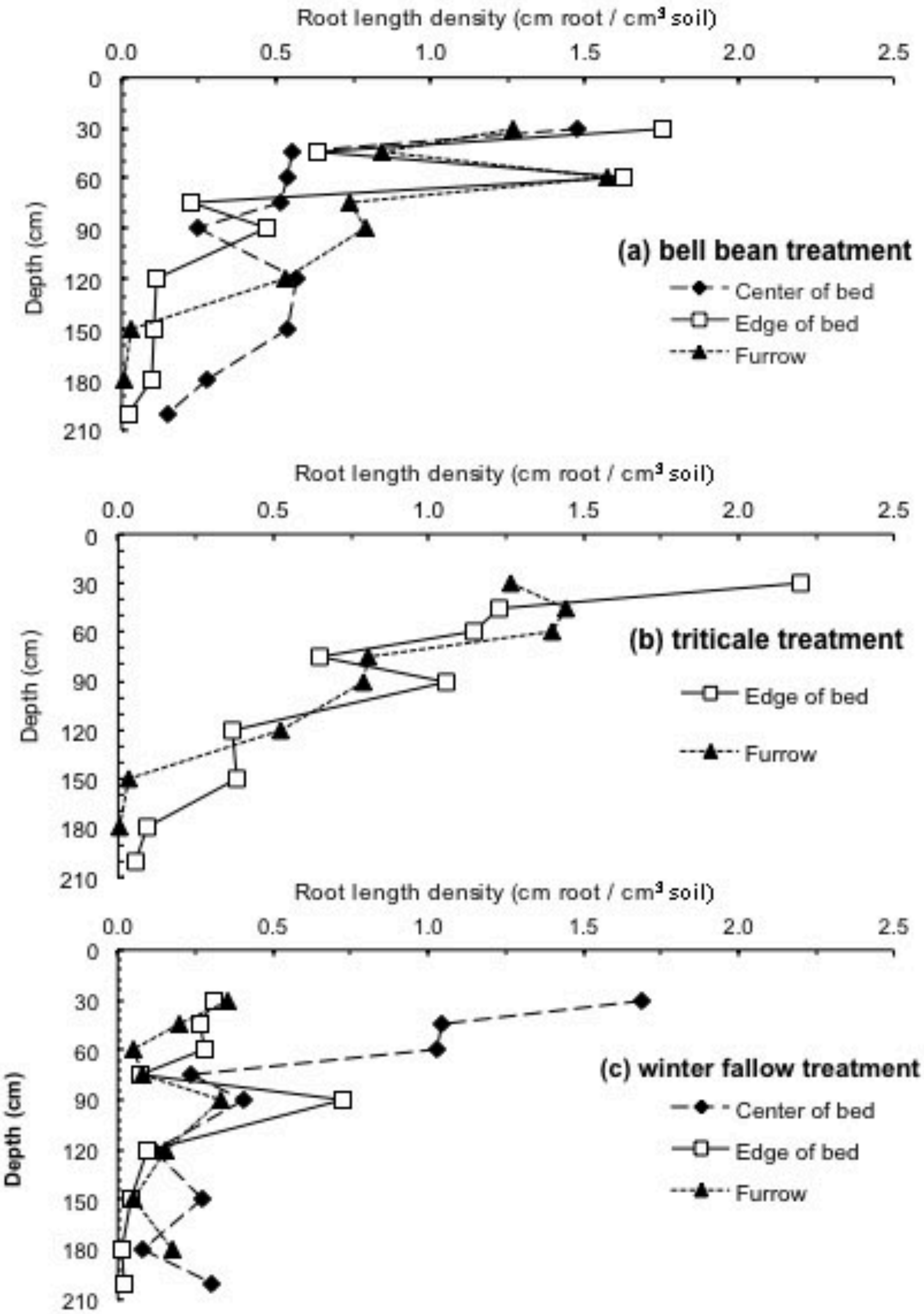


Figure A11. Tomato root length density distribution with depth for (a) bell bean, (b) triticale, and (c) winter fallow treatments. Roots were sampled on 23 July 2012.

BY SUSAN MORAN

The Nitrogen Underground

Scientists trace nitrogen through the soil in a quest to tame pollution from agriculture.

With the assistance of microbes, a nitrogen-fixing soybean seedling helps to enhance soil quality.

ON THIS GRAY, DRIZZLY WINTER morning, the California coastal mountains in the distance look like a mirage hovering over a flat swath of fields at Russell Ranch, a 300-acre experimental farm in the Sacramento Valley. One of the researchers in charge is Martin Burger, an angular, intense-looking Swiss ecologist. He steps out of his Ford F-150 pickup and leads me down a gravely path to a field covered in neat rows of lime-green triticale — a cereal grain — and bean shoots.

Above ground, the scene looks orderly and static. But Burger and his colleagues at the University of California at Davis are interested in what lies hidden below the surface. Down there, it's a highly dynamic and far-from-predictable scene. To get a glimpse, they have buried an array of instruments that can trace the trajectory of nitrogen. They are trying to help solve the many ecological and human health problems caused by this troublesome element while helping farmers grow crops more efficiently.

On average, crops use less than half of the nitrogen that farmers apply to the soil.

Nitrogen has many faces. It is an essential element on the periodic table. No organism, plant or human, can survive without it. Yet there is a short supply of accessible nitrogen in the world. In fact, had scientists not created synthetic, mostly natural-gas-based fertilizer decades ago to improve nature's method of "fixing" nitrogen — a process of breaking nitrogen molecules apart to make them available to plants — neither you nor I, nor most of the 7 billion people crowding the planet, would be here today.

But here's the rub: Chemical companies turn nitrogen found naturally in the atmosphere into ammonium and nitrate compounds that make up fertilizer. Soil microbes eventually transform the ammonium into more nitrate. This water-soluble form of nitrogen is a source of food for plants, but it makes a Jekyll-and-Hyde-like transformation when excess leaks into lakes and streams or groundwater. Nitrate can go from helpful to harmful, choking fish and their habitat by stealing oxygen, and contaminating human drinking water. Exposure to high levels of nitrate in groundwater has been linked to "blue baby syndrome," which can kill by blocking the blood's ability to carry oxygen. The EPA also has linked nitrate in drinking water with thyroid cancer, respiratory tract infections, birth defects and premature births.

To make matters worse, some of those excess nitrate molecules in the soil undergo another chemical change: Microbes help turn nitrate into gaseous nitrous oxide, which has roughly 300 times the global warming potential of carbon dioxide. In the end, crops use less than half of the nitrogen that farmers apply to the soil, on average.

Back at the Ranch

At Russell Ranch, scientists are uncovering how nitrate migrates. To start, they are studying how commercial crops, including tomatoes, wheat and almonds, can use nitrogen more efficiently without leaving excess nitrate to percolate into aquifers or run off fields. What makes nitrate such a vexing subject is that so many variables — including crop type, soil characteristics, field gradient and precipitation — dictate the speed, flow and amount that escapes. Sometimes it can take decades, even centuries, for it to move from a farm to a

MARK THIESSEN/GETTY IMAGES

An aerial view of Russell Ranch, an experimental farm in California's Sacramento Valley.

Ecologist Martin Burger checks on instruments that help measure water flow and nitrogen concentration underground.

distant well used for drinking water, making it hard to pinpoint exactly which farm is a source of nitrate pollution.

In fall 2011, Burger and UC Davis hydrologist Jan Hopmans started a three-year experiment, comparing how different cover crops, which are seasonally rotated with cash crops such as tomatoes, can be used to improve soil quality and reduce fertilizer use. Some cover crops, such as fava beans, "fix" atmospheric nitrogen. They help the soil stockpile nitrate, allowing farmers, in theory, to apply less nitrogen fertilizer on the next set of crops planted in that field. Other types of cover crops bring excess nitrate to the surface, keeping it away from groundwater.

There is also the issue of irrigation. When Burger and Hopmans started, they knew tomatoes weren't capturing a lot of nitrogen, especially when they were watered with furrow irrigation. That is when water runs through channels alongside each raised row. The researchers suspected different, more targeted, irrigation methods would help reduce nitrate runoff and improve plant efficiency.

With new insight about potential cover crop benefits and irrigation pitfalls, what still eluded the UC Davis nitrogen sleuths was precisely how nitrate travels once it flows into the soil and through the root zone of various crops.

To answer this question, they took their previous research to new depths, literally. They designed instruments that would accurately and continuously measure nitrate concentration and water flow farther down into the soil than what had been measured before. Their machinery is spread out over six one-acre plots scattered across 70 acres. Several thousand units of data pour wirelessly into a computer in Burger's lab from the field's central nervous system. Burger unlatches the door of a solar-powered metal cabinet perched on a pole at the edge of a field. A spaghetti of multicolored wires is inside. Some of the wires are connected to sensors under the crops. "Too much information," he quips, shaking his head. He will enter it all into a computer model that simulates water flow and nitrogen transport under various irrigation and weather conditions, so that researchers can get the full picture of what is happening underground.

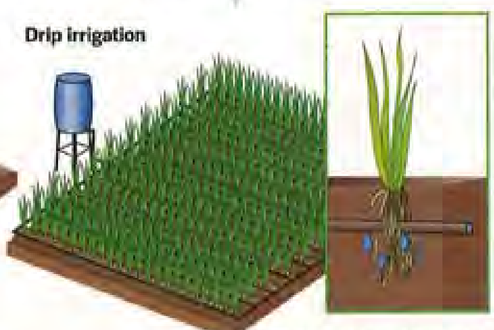
Soil moisture sensors show, over time, how much water has gone into the ground, and how much has left, either from drainage or in the form of evapotranspiration from plants. Burger points out some small red flags among the triticale in one of his plots. They mark where instruments called lysimeters, ceramic plates about 1 foot in diameter, are buried at various depths down to about 47 inches. They measure the amount of water flowing past.

Another set of sensors measure electrical conductivity, which Burger says can be used as a proxy for measuring nitrate. (Nitrate increases electrical conductivity.) The researchers can trace the nitrate using stable (non-radioactive) isotopes, which are essentially unique atomic signatures for nitrate from different sources. They grab water samples by applying suction to ceramic cups buried at various levels in the soil. Each sample is brought to the surface, analyzed for its nitrate concentration and labeled with an isotopic signature. Nitrate sitting on the fields at the beginning of the rainy season is also labeled. Much of this has been left over from last year's fertilizer use. Later in the spring, they can measure how much of the leftover nitrate on the surface ended up in cover crops and how much made its way into each soil layer.

Furrow irrigation

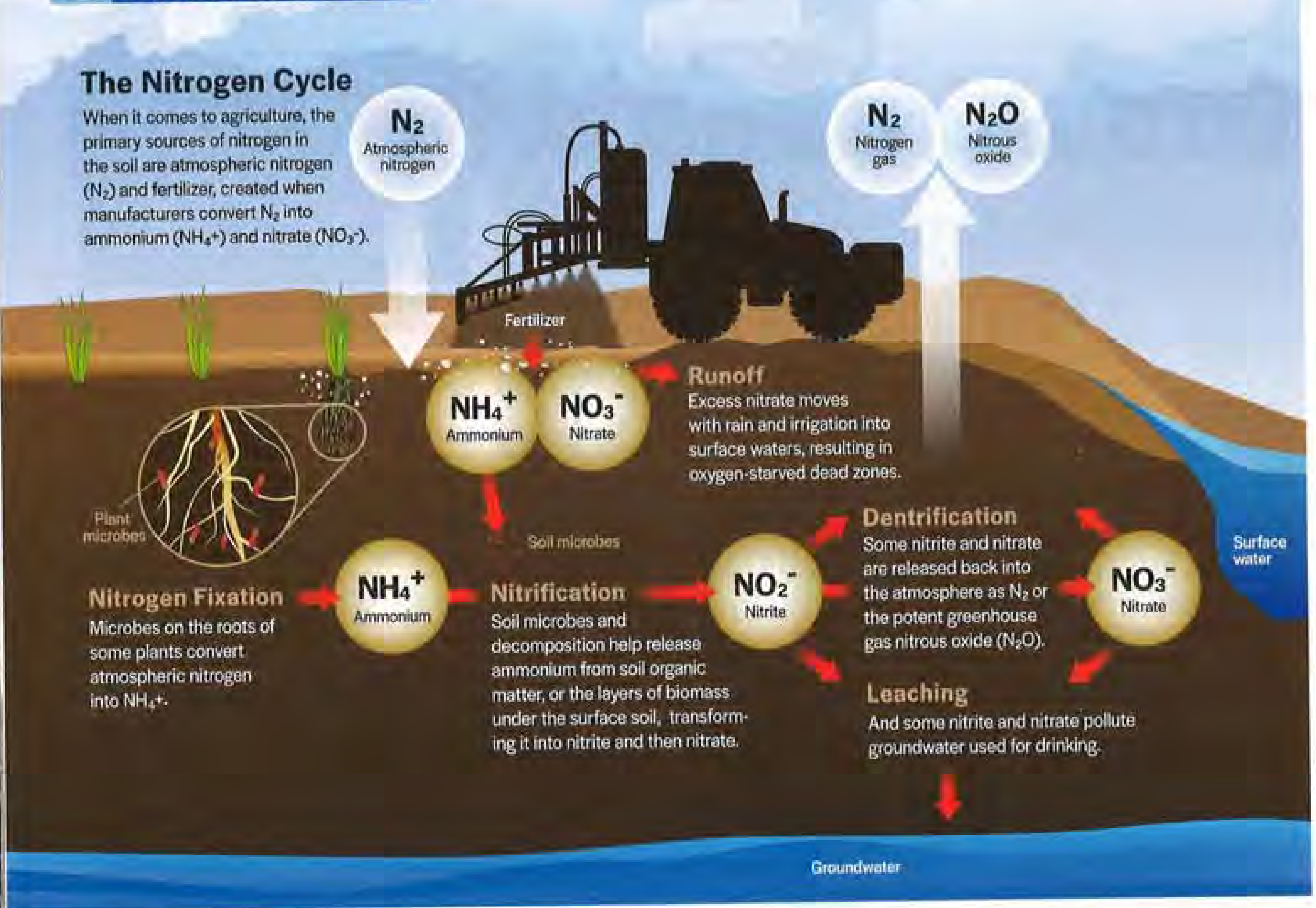
Water is poured into furrows between plants

Drip irrigation



Water is dripped through a series of underground pipes

CLOCKWISE FROM UPPER LEFT: FORD DENISON/RUSSELL RANCH; SUSAN MORAN; JAY SMITH/DISCOVER



Burger gazes across his plot to the south toward the nearby creek that feeds into the Sacramento River and finally into the Pacific Ocean. "From the label, you can see how far the nitrate is traveling," he says.

Sowing Solutions

As he strokes a slim triticale shoot at his feet, Burger talks about his experiment's initial results. "We do know that nitrate is leaching past the root zone during the tomato growing season," even though applying fertilizer and irrigation water together has helped reduce runoff, he says. What has surprised Burger is that triticale has deeper roots — about two feet deeper — than fava beans. So, despite not being nitrogen-fixing, triticale may be better at capturing leftover nitrate.

Burger hopes his research can apply to farmers and scientists facing similar challenges as far away as Chesapeake Bay and the Mississippi River Basin, where there are enormous dead zones. Based on the results, Burger and Hopmans will ultimately be able to offer recommendations for irrigation methods, fertilizer use and cover-crop plantings that help curb nitrate contamination and increase yields.

Hydrologist Thomas Harter, also from UC Davis, posits that even these best-management practices can only go so far. For many crops that need a lot of nitrogen, such as vegetables, corn and nuts, "we don't know today whether farming practices will ever be good enough to produce drinking water quality recharge," he says. (Recharge refers to water that escapes from fields into groundwater.) But farmers can learn to contain nitrate within their systems more carefully, he says. And regulators can step in. He has recommended that California lawmakers consider imposing economic penalties and incentives for farmers, such as excise fees on nitrogen fertilizer applications, with higher rates applied to areas declared to be at risk for nitrate contamination.

In recent years, some growers already have dramatically reduced the amount of water and synthetic fertilizer they use by practicing precision farming techniques, such as drip irrigation, which reduces the overall amount of water used and therefore nitrate runoff. They have managed to achieve these reductions without sacrificing profits. Despite facing what seems like a challenge made for Sisyphus, Harter harbors far more hope than dread for the future. "If we can get the worse half (of growers) to operate like the best half over five years, and then do it again, in 10 years everyone will operate as the best, and we'll have come a long way," he says.

Back at Russell Ranch, Burger continually contemplates the connection between farming practices and distant households. "It would be great if we made a contribution toward safer drinking water," he says. ◗

Susan Moran is a Colorado-based journalist covering agriculture, energy and climate science.

JAY SMITH AND ALISON MACKEY/DISCOVER

CALIFORNIA

VEGETABLES®

A SPECIAL GROWERS' REPORT OF AG ALERT®

oto/Bob Johnson

Buried sensors track nitrogen movement

By Bob Johnson

In a processing tomato research plot at Russell Ranch outside Davis, a battery of sensors buried in the ground at depths ranging from a foot to nearly seven feet transmits highly detailed information on how much water and nitrogen travels below the root zone, and when.

Researchers are using this data to develop management strategies for growers to save on fertilizer costs and reduce leaching losses.

"We have two periods when we see downward movement of water and nitrates. One is in the winter, right after the rains in October and November. The other is in the summer, during the growth period of the crop," said Ahmad Moradi, University of California, Davis, project scientist in the Department of Land, Air and Water Resources.

These are the two times during the year when there are not roots in the ground able to take up the nitrogen before water carries it deeper.

"Both nitrate leaching periods are worst before the crop or cover crop roots are established," said Moradi.

Moradi talked as he showed the tomato study plots to the farmers and researchers who came to Russell Ranch for the UC Davis Agricultural Sustainability Institute's annual field day.

Researchers have closely monitored the movement of nitrates in the soil over the course of a two-year rotation of tomatoes then corn, with the ground either left fallow in the winter or planted with a triticale or bell bean cover crop.

Sensors that transmit soil moisture data from different locations in the ground to nearby data loggers, and also collect water samples for nitrate testing, make possible precision in understanding when nitrates leach.

"We have multiple soil sensors at multiple depths and multiple distances from the drip line," Moradi said.

Nitrate leaching spikes early in the corn or tomato season because water and nitrogen quickly travel below the shallow crop roots with every irrigation.

"We are trying to see if we could do something with the irrigation to manage leaching early in the season," Moradi said.

A promising strategy is to spoon-feed water to the crop early in the season, to minimize the amount of nitrogen carried below the roots.

See TOMATOES, Page 8

Tomatoes

Continued from Page 7

"We're trying high frequency, low volume irrigation to see if it improves the situation," said Warren Burger, UC Davis project scientist in the Department of Land, Air and Water Resources.

Another strategy is to test the soil for nitrates before deciding how much, if any, fertilizer to apply before planting.

"We sampled the soil and found 50 pounds of pre-plant nitrogen in the soil in Yolo County, and about 200 pounds in Fresno and San Joaquin counties. We're encouraging growers to sample the soil early," Burger said.

Managing soil nitrogen levels before irrigation is essential to reduce leaching losses.

"I like to think of it as sharing a checking account with someone who likes to shop. You know to not have a lot of money in the account when a sale is coming up," said Marsha Campbell Mathews, UC Cooperative Extension farm advisor. "You want to deplete soil nitrate before a leaching event."

Mathews did studies and found that in the sandy soils near Stockton, half or more of the nitrates can leave the root zone of a field crop with a single irrigation.

"In San Joaquin County, we need to do strategic timing so there is a minimum of nitrate in the soil when we irrigate," she said.

Photo/Bob Johnson

Ahmad Moradi, University of California, Davis, project scientist, checks out a solar-powered device that tracks data fed to it by underground sensors.

Mathews has developed software that lets her calculate how much nitrogen the crop needs before an irrigation, how much will mineralize and how much will leach below the root zone over the course of the season.

Farmers can use the software to develop nitrogen budgets, make in-season adjustments, and see how much nitrogen will leach using different management plans, she said.

"It is designed to be used by the person who is in charge of the fertilizer program," said Mathews.

This software will be one of the programs posted on the Sustainable Agriculture Research and Education Program Solution Centers Internet site (www.sarep.ucdavis.edu/sarep-solution-centers).

Nitrates also leach after the crop is removed, and developing a cover crop root system as early in the rainy season as possible is an essential part of managing these losses.

"It's important to get the cover crop established early. It's going to be important to capture the nitrates before the winter rains," said Matt Dumlao, a UC Davis graduate student.

His study comparing growth of triticale and bell bean roots shows the grain is far more effective than the legume in capturing nitrates.

"Triticale grew deeper and had a denser root system than bell bean. Triticale seems to be better at growing deeper and scavenging the nitrogen in the soil," said Dumlao.

This more robust root system puts an end to leaching before the heaviest winter rains.

"Once the triticale cover crop establishes, the leaching stops. It stops in January. With bell bean, we have a lot of nitrogen that moves down, continuing into the corn season," Moradi said.

In past Russell Ranch studies, cover crops came with the cost of greater water demands, but advances in irrigation technology have solved that problem.

"With furrow irrigation, there used to be a huge difference in the amount of water used with a cover crop, but with drip irrigation, that difference has disappeared," Burger said.

(Bob Johnson is a reporter in Santa Cruz. He may be contacted at bjohn11135@aol.com.)

REGULATING FOR AGRICULTURAL AND PUBLIC OUTCOMES

Perspectives and Recommendations

Ag Innovations Network

JANUARY 2014

ABOUT AIN Ag Innovations Network (AIN) is a nonprofit, nonpartisan organization dedicated to helping stakeholders solve problems in the food system through effective collaboration. Since 1999, AIN has been designing, organizing, facilitating and managing multi-stakeholder efforts to improve the performance of the food system for producers, consumers, and participants in local, regional, and global food supply chains. These efforts focus on both policy changes and direct improvements on farms, processing sites, and food outlets. AIN combines deep expertise in the challenges of the global food system, from production through food access, with an approach to problem solving that gives groups the tools they need to deliver outcomes in meetings, conferences, and multi-stakeholder collaborations.

ACKNOWLEDGEMENTS

This effort would not have been possible without the generous contributions of time and perspective from farmers and agricultural advocates, environmental and conservation representatives, government agency staff at all levels, and others who have taken an interest in this project. We are particularly grateful to the members of the California Roundtable on Agriculture and the Environment and the California Food System Alliance Network for their vision and participation. The entire Ag Innovations Network staff has participated in this project, with special thanks to Joseph McIntyre, Katy Mamen, Serena Coltrane-Briscoe, Miriam Volat, Tim Griffin, Eric Cárdenas, Helen McGrath, and interns Katherine Schugren-Meyer and Erica Gross. Consultant Jovita Pajarillo also provided critical project support.

Serena Coltrane-Briscoe, Joseph McIntyre, and Katy Mamen of Ag Innovations Network coordinated the production of this publication.

Design was provided by notion:creative | www.notioncreative.com

We are grateful for project funding from a United States Department of Agriculture (USDA) Agricultural Marketing Service Specialty Crop Block Grant, administered by the California Department of Food and Agriculture.

REPORT HIGHLIGHTS

The Project

In an effort to address increasing frustration about the complexity and effectiveness of the regulatory system affecting agriculture, Ag Innovations Network held focused listening sessions with agricultural, conservation, and government agency representatives to build a better understanding of the experiences, challenges, and recommended solutions of each stakeholder group.

This report summarizes the perspectives conveyed by each stakeholder group, identifies areas of agreement among the groups, and presents recommendations for constructively addressing key regulatory challenges in both the short and long term.

The Perspectives

- **Specialty crop farmers** are much more concerned about the cumulative impact of navigating, comprehending, and complying with myriad regulatory requirements than they are with specific legislative statutes, regulations, or agencies. They report frustration with the lack of transparency in the regulatory system, which is also thought to be unreasonably costly and time-consuming, as well as deterring implementation of innovative projects.

- **Conservation** representatives report concern that existing regulations do not achieve a sufficient level of environmental protection and express that the current system does not adequately distinguish projects of public benefit, inadvertently impeding or even preventing their completion.

- **Regulators** acknowledge many of the problems conveyed by the agricultural and conservation communities. However, the static nature of current laws and regulations does not provide the flexibility or adaptability needed to address the dynamic problems society faces today. Regulators explain that the statutory or traditional agency structure and culture, limited funding and staff, and competing mandates compromise their ability to proactively address many of the challenges. They also report the need for greater cooperation and collaboration with those they regulate.

The static nature of current laws and regulations does not provide the flexibility or adaptability needed to address the dynamic problems society faces today.

The Recommendations

NEAR-TERM ADJUSTMENTS TO THE CURRENT REGULATORY SYSTEM

Reduce conflict and increase innovation by building understanding among stakeholder groups

- Increase productive interaction between stakeholders dealing with regulatory issues
- Increase the flow of critical information between regulators and the regulated
- Better accommodate innovative on-farm practices through research and outreach
- Engage stakeholders early and effectively in rule making and implementation planning

Reduce regulatory "friction" by improving interagency coordination

- Create effective coordination programs that include both state and local government
- Encourage a team approach to align regulatory goals and actions

Reduce the cost of complying with regulations by creating vehicles to easily discover and navigate regulatory requirements

- Improve efficiency and coordination of permitting processes
- Provide a regulatory roadmap for common agricultural business activities to easily learn the requirements for project implementation
- Establish one-stop-shops for permit assistance
- Improve the technical support capacity of agencies and others to assist farmers in meeting regulatory requirements
- Develop a web portal for consolidation of crucial information

ENVISIONING A "MODERN" REGULATORY SYSTEM

While significant relief can be achieved through information exchange, reducing regulatory friction, and easing navigation of the regulatory process, stakeholders also identified the need to begin considering what a modern regulatory system for agriculture would look like. The stakeholders identified several key characteristics of an ideal regulatory system:

- It responds to society's multiple public and private interest goals
- It takes an integrated approach that moves away from a focus on media, such as air or water, and toward whole farm management
- It considers the net benefits of on-farm innovations over time
- It explicitly focuses on incentivizing beneficial behavior
- It is outcome- and risk-based, moving beyond practice-focused regulations
- It encourages shared understanding and learning, and has the capacity to adapt to new information and innovation
- It provides good customer service to the regulated community and good results for the public

PHOTOS FROM LEFT: David M Schrader, iStockPhoto; unknown; Hedgerow Farms; Stock Exchange; Ag Innovations Network

CONTENTS

I. Introduction 1

II. Stakeholder Perspectives 3

III. Call-to-Action
RECOMMENDATIONS FOR THE EXISTING REGULATORY FRAMEWORK 17

IV. Rethinking Achievement of Environmental Outcomes: ENVISIONING A MODERN REGULATORY SYSTEM 25

V. Conclusions 28

I. INTRODUCTION

We have created a regulatory scheme that frustrates farmers, does not always deliver environmental outcomes, and can leave those charged with implementing regulations without the flexibility or resources to do their jobs well.

The Preface

Over the course of dozens of meetings that Ag Innovations Network has held with food system stakeholders during the past several years, the complexity of California's regulatory setting has been consistently identified as one of the top three issues facing specialty crop agriculture, along with lack of reliable supply of both labor and water. In 2010, members of the multi-stakeholder group, the California Roundtable on Agriculture and the Environment,[1] addressed aspects of the issue in *Permitting Restoration: Helping Agricultural Land Stewards Succeed in Meeting California Regulatory Requirements for Environmental Restoration Projects*.[2] Food System Alliances,[3] now active in eight counties throughout California, have similarly prioritized regulatory challenges.

The Problem

California farmers face a complex regulatory environment. The already challenging proposition of growing food has been further complicated by increases in the number of activities subject to regulation as well as the number of agencies with authority over on-farm actions. While individual regulations represent important public interests, they can at times conflict with one another.

Rather than identifying a particular legislative statute, regulation, or agency as problematic, specialty crop farmers are much more concerned about the cumulative impact of navigating, comprehending, and complying with myriad regulatory requirements. They report frustration with the lack of transparency in the regulatory system, which is also thought to be unreasonably costly and time-consuming, as well as deterring implementation of innovative projects.

Meanwhile, members of the conservation community express concern that existing regulations are not achieving a sufficient level of environmental protection, and report feeling that the current system does not adequately distinguish projects of public benefit, inadvertently impeding or even preventing their completion.

Regulators acknowledge many of the problems conveyed by the agricultural and conservation communities. However, the static nature of current laws and regulations does not provide the flexibility or adaptability needed to address the dynamic problems society faces today. Regulators explain that the statutory or traditional agency structure and culture, limited funding and staff, and competing mandates compromise their ability to proactively address many of the challenges. They also report the need for greater cooperation

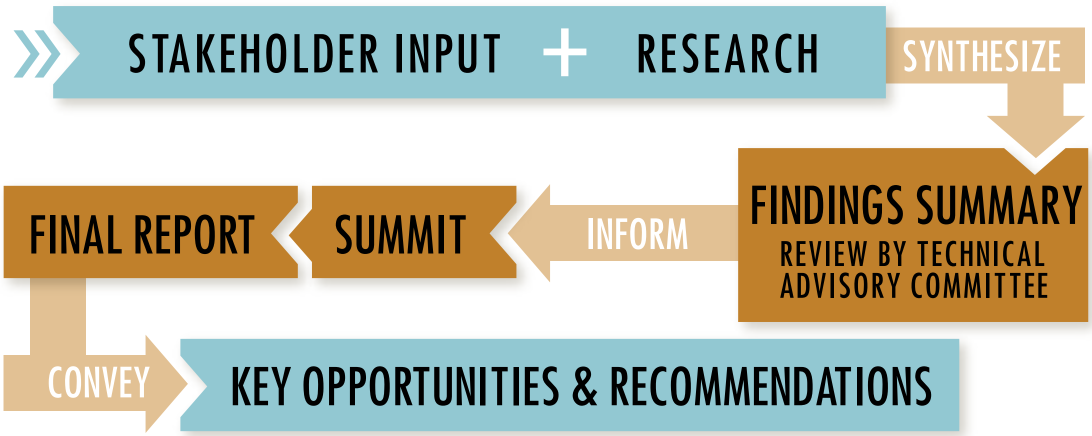


Figure 1: Process approach used in the project.

and collaboration with those they regulate. All stakeholder groups express this sentiment in various ways, suggesting a need for improved relationships between communities.

In short, we have created a regulatory scheme that frustrates farmers, does not always deliver environmental outcomes, and can leave those charged with implementing regulations without the flexibility or resources to do their jobs well.

The Project

In response to requests from agricultural, conservation, and regulatory partners, Ag Innovations Network launched a project in early 2012 to seek solutions that simultaneously reduce the business challenges associated with regulatory compliance for specialty crop farmers and meet the underlying public goals of regulation.

OBJECTIVES

- **Foster communication and collaboration toward minimizing regulatory challenges**
  - Build a common understanding of key regulatory issues across stakeholder groups
  - Establish connections between stakeholders concerned with and already working on key regulatory issues
- **Identify and advance both short- and long-term solutions that:**
  - Produce beneficial public outcomes
  - Minimize the challenges associated with regulatory compliance for California specialty crop farmers
  - Complement and expand upon existing local and statewide efforts to decrease regulatory burdens

APPROACH

Through research on the current regulatory structure and existing efforts to address challenges, interviews with key stakeholders, and focused listening sessions with agricultural, conservation, and regulatory representatives, Ag Innovations Network documented a range of perspectives on regulatory issues. The process allowed stakeholders to share their experiences, describe specific challenges, and propose solutions to those challenges.

A Technical Advisory Committee[4] reviewed and vetted early findings, helping to prioritize top recommendations for further consideration. The project culminated with the *Summit on Regulations Affecting Agriculture*, which was an opportunity for all stakeholders to come together to learn, share, and collaborate on further developing the key recommendations presented in this report.

The following pages incorporate the results of research, conversations, and collaborative problem solving into a set of priority recommendations for constructively addressing the desired regulatory outcomes identified in this project. More detail on the project and its findings is available at aginnovations.org/regulations.■

II. STAKEHOLDER PERSPECTIVES

STAKEHOLDER VOICES

During the summer and fall of 2012, Ag Innovations Network held listening sessions, focus groups, and one-on-one interviews with agricultural, conservation, and government agency stakeholders.[5] The following perspectives are synthesized from those conversations.[6]

One goal of these interactions was to identify some of the many efforts currently underway to address regulatory challenges.[7] In the pages that follow, you will find examples of relevant efforts listed alongside participants' recommendations. Not all listed projects address the specific concerns raised by stakeholders, but reflect efforts that are directionally consistent and could be built upon.

STAKEHOLDER GROUP: AGRICULTURE

During listening sessions, farmers explained that they understand regulation to be a necessary part of running a farming operation and often agree with the underlying intent of regulations. Rather than facilitate the business of producing food and encouraging best environmental and social practices, however, the regulatory system is experienced as unduly burdensome. Navigating the regulatory process is confusing to most farmers, leaving them feeling uncertain about cost and timelines and fearful of additional scrutiny. The regulatory process is perceived as expensive, time-consuming, uncoordinated, and at times arbitrary. Farmers expressed feeling that requirements often seem less targeted to accomplishing a set of societal goals and more about jumping through hoops and paying fees that perpetuate a flawed system. Some feel that small-scale farmers are disproportionately affected by these challenges.

Members of the agricultural community conveyed feeling misunderstood by regulators and the general public, who they perceive as not having a sufficiently complete understanding of the realities and complexities of agriculture or the innovative practices farmers are trying to employ. They reported feeling constrained by the rigidity of a system that does not have the capacity to allow innovation and, as a result, prevents projects that might actually achieve the underlying goals of the regulation if viewed in a broader way. Farmers expressed frustration and concern about the impact that the costs and restrictions associated with the regulatory process have on the economic feasibility of their business.

THE LONG ROAD TO PROJECT COMPLETION

START HERE

1. GOAL: PRESERVE PRIME AG LAND BY USING A PREVIOUSLY DEVELOPED SITE

RESULT: Prohibitive electricity upgrade costs

IMPACT: 1. Prime ag land taken out of production; 2. Mitigation fees

ENTITIES INVOLVED: PG&E, CA Department of Fish & Wildlife YC Planning Department

2. GOAL: DIVERT STORMWATER TO MULTIPLE AGRICULTURAL FIELDS

RESULT: Solution not recognized by building code

ENTITIES INVOLVED: Public Works Department, Sacramento-Yolo Mosquito & Vector Control District, CA Department of Fish and Wildlife

SHARE NEIGHBOR'S DETENTION BASIN

IMPACT: 1-year delay

INSTALL DETENTION BASIN ON-SITE

IMPACT: 1. Conflicting requirements; 2. Additional permit; 3. Time consuming; 4. Costly; 5. Loss of prime ag land

3. GOAL: CONSOLIDATE PROCESS WATER AS PART OF SPILL PREVENTION PROGRAM

RESULT: Approach unfamiliar to regulators. Advised that excess process water spill onto ground.

IMPACT: Excess process water will spill on ground

ENTITY INVOLVED: CV Regional Water Quality Control Board

4. GOAL: STORE SEED PROCESSING WATER FOR IRRIGATION & FERTILIZATION OF VARYING FIELDS

RESULT: Small producer waiver required a plan for each field involved

ENTITY INVOLVED: CV Regional Water Quality Control Board

TRUCK THE WATER OFF-SITE

IMPACT: 1. Need additional permit; 2. Ongoing cost; 3. Environmental consequences

APPLY FOR WAIVER; SUBMIT PLANS FOR EACH APPLICABLE FIELD

IMPACT: Time consuming

REDESIGN SEEDWASHING PROCESS

IMPACT: 1. High cost to reinvent machinery; 2. Ongoing operational cost; 3. Loss of potential income gained by processing seed for others

5. GOAL: SEED DRYING AT LOW TEMPERATURES

RESULT: Avoid permitting, licensing and annual reporting required of high temperature seed dryers

IMPACT: Time consuming

ENTITY INVOLVED: CA Air Resources Board

6. GOAL: INSTALL LED LIGHTING TO INCREASE ENERGY EFFICIENCY

RESULT: LED lighting had not yet gone through the Title 24 rating process, so this energy-efficient option was not permitted

ENTITY INVOLVED: YC Building Department

USE FLUORESCENT LIGHTING

IMPACT: Reduction in energy efficiency compared to LEDs

WAIT UNTIL LED LIGHTING RATED & APPROVED BY TITLE 24

IMPACT: Costly time delay

INSTALL LEDS ILLEGALLY

IMPACT: Potential violation and associated consequences

7. GOAL: INSTALL THERMAL HEATING SYSTEM

RESULT: Because this idea came late in the permitting process, adding it to the project would have required resubmitting plans.

ENTITY INVOLVED: YC Building Department, Engineer

RESUBMIT PLANS

IMPACT: 1. 3 week project delay; 2. Costly

INSTALL WITHOUT SEEKING APPROVAL AFTER GATHERING DATA FROM ENGINEER

IMPACT: Potential violation and associated consequences

8. GOAL: RENEW WINERY LICENSE

RESULT: Complications in the change of address process caused the winery to experience a lengthy delay in: 1. submitting quarterly tax returns; 2. shipping wine to other states; 3. acquiring wine pouring permits; 4. renewing winery license.

IMPACT: Time consuming; business operations compromised

ENTITIES INVOLVED: CV Regional Water Control Board, Federal Tax and Trade Bureau, CA Alcoholic Beverage Control, Board of Equalization

ADDITIONAL REGULATORY STEPS

- Planning process
- Approval of final plans
- Onsite procedures and plans
- Pre-occupancy inspection
- Conditional use permit
- Impact fees

FINISH

FINALIZE PROJECT The landowners were dedicated to building an environmentally sound facility, but found that cutting edge approaches were very hard to get permitted, and had to remove many green features from the project design. Ultimately, they felt that the regulatory requirements created many tough choices, inhibited innovation, and provided a disincentive for best practices from a business and ecological standpoint. While the initial project plans included a tasting room and creamery for future phases, it is unlikely that these will be built due to the challenges faced in the first phase.

TOTAL NUMBER OF MONTHS: 34 TOTAL NUMBER OF ENTITIES INVOLVED: 24

FARMERS REPORT THAT WHAT MAKES IT DIFFICULT TO COMPLETE PROJECTS IS THE COMPLEX INTERACTION OF PRIVATE CHOICES, REAL COSTS, AND REGULATORY CHALLENGES.

LEGEND

CA = CALIFORNIA
CV = CENTRAL VALLEY
YC = YOLO COUNTY

= BUSINESS CHALLENGES
= REGULATORY CHALLENGES
= OPTION
= ULTIMATE OUTCOME

= COST/LOSS OF REVENUE
= TIME CONSUMING
= LOSS OF AG LAND
= PAPERWORK
= VIOLATION
= NOT ECO-FRIENDLY

Figure 2: A Yolo County farmer wished to build a wine and seed processing facility on his land. This diagram depicts the farmer's experience in bringing the project to completion.

Regulatory costs were in excess of 30% of the total project cost, making it virtually impossible to complete. It was impossible to identify all the rules, regulations, and people involved in the process, making it very challenging to budget a project like this or develop a real timeline.

Navigating the Regulatory System

WHAT'S THE EXPERIENCE?

"We wanted to do everything correctly to develop the land for farming, so we attempted to get all the permits we needed. We've gotten over 40 permits since 2005. We didn't know all the requirements upfront, and new ones frequently arose, which set us back significantly. None of the permitting agencies could help us navigate the process because they didn't know what the other agencies required or which permits were needed. There have been many players involved, it's been quite expensive, and work has not been able to be completed in a timely manner." (Ventura farmer, 2012)

WHAT COULD MAKE IT BETTER?

Permit assistance tools

- Online regulatory road map
- Web portal
- Guidelines/manuals
- Ombudsperson positions

One-stop permit shop

- Lead agency/lead staff person

Differentiate regulated activities

- Pre-approve certain practices
- Replicate/expand programmatic permit programs

WHAT'S ALREADY BEING DONE?

- *CalGOLD, Governor's Office of Business and Economic Development*[8]
- *Joint Aquatic Resources Permit Application, Washington State*[9]
- Guide to Watershed Permitting in the State of CA, *CA Assoc. of Resource Conservation Districts*[10]
- *Ombudsperson positions at state and local agencies throughout the state*[11]
- *Consolidated Permitting Program, California EPA*[12]
- *Permit Coordination, Alameda Co. Resource Conservation District*[13]
- *Statewide Programmatic Permitting Program, Sustainable Conservation*[14]

A Costly and Time-Consuming Regulatory System

WHAT'S THE EXPERIENCE?

"As a farmer, there can be short windows in which you have the time and money available for a project. As soon as you enter the realm of seeking approval for that project, you lose momentum." (Yolo farmer, 2012) In Ventura, a farmer attempting to permit a cogeneration facility to produce energy from waste in his operation found that: "…regulatory costs were in excess of 30% of the total project cost, making it virtually impossible to complete. It was impossible to identify all the rules, regulations, and people involved in the process, making it very challenging to budget a project like this or develop a real timeline." (2012)

WHAT COULD MAKE IT BETTER?

Transparent fee structures

- Fixed or capped fees
- Tiered fees according to project size and complexity

Transparent timelines

- Automatic project approval for complete applications that are not processed on time
- Incentives for agency staff to process applications in a more timely manner

Expedite beneficial projects

Reduce the cost of regulatory compliance

- Conduct rigorous economic analysis of proposed regulations
- Resolve unnecessary fees and processes in existing regulations
- Reward farmers for contributions they make to society (e.g., ecosystem services)

WHAT'S ALREADY BEING DONE?

- *Conditional Waiver of Waste Discharge Requirements, Central Coast Regional Water Quality Control Board*[15]
- *California Government Code, Section 65952, Approval of Development Permits*[16]
- *AB 1961, Coho Salmon Habitat Enhancement Leading to Preservation Act*[17]
- *Regulatory Accountability Act of 2011*[18]
- *SB 617, Financial and Administrative Accountability*[19]
- *Incentive programs, various state agencies*[20]

Lack of Understanding Among Stakeholders

WHAT'S THE EXPERIENCE?

"Agriculture in California is diverse. One size does not fit all and there is a lack of understanding about the agricultural landscape." (Ventura farmer, 2012) Farmers express feeling misunderstood and taken for granted by agency staff and the general public due to insufficient understanding of what farmers do, how food is grown, and the myriad benefits that working landscapes contribute to communities and ecosystems.

WHAT COULD MAKE IT BETTER?

Increase understanding of core interests among stakeholder groups → *County-level Food System Alliances, Ag Innovations Network*[21]

Increase understanding of agriculture → *Agri-Culture Program, Santa Cruz County Farm Bureau*[22]

» Farm visits

» Meet farmers and learn about farming → *Ag Education/Training Program for Regulators, Ventura County Ag Futures Alliance*[23]

WHAT'S ALREADY BEING DONE?

County-level Food System Alliances, Ag Innovations Network[21]

Agri-Culture Program, Santa Cruz County Farm Bureau[22]

Ag Education/Training Program for Regulators, Ventura County Ag Futures Alliance[23]

Disincentives for Innovation

WHAT'S THE EXPERIENCE?

A Yolo farmer sought approval for a multi-use processing facility, and found that, "Rather than designing a facility to meet business and environmental goals, the design was driven by an uncoordinated set of regulations." (2012) Farmers report that the regulatory system typically does not accommodate cutting-edge solutions or technologies and that, in spite of the diversity of agricultural operations, rules are applied in a one-size-fits-all fashion, inhibiting innovation and providing a disincentive for best practices.

WHAT COULD MAKE IT BETTER?

Creative collaboration among all affected stakeholders to foster mutual goals

» Engage stakeholders in developing new regulations

» Pilot projects to test new ideas

» Innovation or education permits → *Experimental Research Permit Exemption, San Joaquin Valley Air Pollution Control DIstrict*[24]

» Safe harbor agreements → *Safe Harbor Agreements, U.S. Fish and Wildlife Service*[25]

Incentives for beneficial projects → *Agricultural Water Quality Grant Program, State Water Resources Control Board*[26]

Outcome-based regulatory approaches → *Best Available Control Technologies (BACT)*[27]

» Employ a holistic approach to achieving underlying goals of regulation

WHAT'S ALREADY BEING DONE?

Experimental Research Permit Exemption, San Joaquin Valley Air Pollution Control DIstrict[24]

Safe Harbor Agreements, U.S. Fish and Wildlife Service[25]

Agricultural Water Quality Grant Program, State Water Resources Control Board[26]

Best Available Control Technologies (BACT)[27]

SUCCESS STORY 1

Collaborative Problem Solving[28]

KAREN GIOVANNINI | AGRICULTURE OMBUDSMAN
UC Cooperative Extension, Sonoma County

The Agriculture Ombudsman helps farmers navigate the regulatory process and works to improve the permitting process.

PROBLEM

A dairy family began making artisan cheese to diversify its fluid milk production and stay in business. To do so, the family converted a former tank room into a cheese-making room. The family subsequently discovered not only that cheese-making operations of any size require a use permit, but also that their tank room conversion triggered a reclassification of the building which required them to bring the room up to code. Between the $5,000 use permit and the fees, permits and construction costs required for the code improvements, the whole process was very costly and time consuming for the small business.

SOLUTION

The Ombudsman met first with the cheese maker to gain a better understanding of the operation, and then with the appropriate county departments to understand their requirements. She then convened a meeting of all of the relevant stakeholders, including the cheese maker, staff from the Planning and Resource Management Department, and the District Supervisor to discuss the project and collaborate on potential solutions.

RESULT

The effort led to an update to the Sonoma County zoning code that designates small agricultural processing on agricultural zoned land as a permitted use, which means that a use permit is no longer required. In addition, an existing exemption from the reclassification requirement for small-volume winemaking was expanded to all family-operated agricultural processing in buildings under 3,000 square feet.

LESSONS LEARNED

- A best practice for arriving at creative solutions is to get all stakeholders in the same room.
- Not all county staff have the authority to move forward on innovative solutions, so it is important to include decision-makers with an executive role, such as the District Supervisor.
- A neutral third party, such as an ombudsperson, is a key to creative thinking and collaboration on innovative solutions.

STAKEHOLDER GROUP: CONSERVATION

During focus groups, members of the conservation community emphasized the importance of assuring the long-term, sustainable protection of healthy ecosystems along with consideration of economic viability for agricultural operations.

Conservation representatives explained that statutes are passed to achieve environmental goals such as air quality, water quality, and species protection. Regulations have been created to implement statutes, and the conservation community sees them as vital to reducing negative impacts to the public and the environment. However, they noted that the current regulatory system has not achieved the desired level of environmental performance, due both to the complex regulatory structure and lack of resources for agencies to effectively carry out their mandates. Conservation representatives reported that the system has also produced unintended consequences, including costly regulatory compliance for conservation projects, which limits funds for additional beneficial efforts. They recommended that a distinction be made between projects that contribute to ecosystem health and those with a negative impact on communities and the environment. They cautioned that any efforts to "streamline" the regulatory system must be carefully executed to improve environmental outcomes rather than undermining these goals. Members of the conservation community shared their impression that environmental regulations are unduly blamed for causing broader "regulatory burden" and pointed out that there are many other regulations and non-regulatory requirements that farmers must comply with. Furthermore, they expressed that compliance with laws such the Clean Water and Clean Air Acts represent a basic level of performance that should be considered part of the cost of doing business. While they acknowledged the importance of business growth, they underscored the importance of harmonizing that growth with environmental objectives. Some participants commented that money spent fighting environmental laws might better go to collaborative problem solving or compliance.

Achieving Environmental Outcomes

WHAT'S THE EXPERIENCE?

"While there is an essential need for regulation, accretion of the regulatory structure over time has led to the perverse situation in which the regulatory framework can actually impede the underlying environmental goal." In addition, "There are insufficient resources to carry out and enforce existing regulations. Regulations will become less effective over time if the public sector capacity continues to collapse." (California conservation representatives, 2012)

WHAT COULD MAKE IT BETTER?

Outcome-based regulatory approaches
- Feedback loop to ensure achievement of underlying environmental goals

Increase agency capacity and efficiency
- Additional funding to agencies
- Improved coordination among and between agencies and technical support organizations

WHAT'S ALREADY BEING DONE?

- *Performance-based incentive model, Santa Cruz Resource Conservation District & Sustainable Conservation*[29]
- *California/Federal Dairy Digester Working Group*[30]

Distinguishing Beneficial Practices

WHAT'S THE EXPERIENCE?

"A distinction is needed between people that are engaged in egregious practices and those who are contributing to ecosystem health." (California conservation representative, 2012) While regulations are intended to set a basic standard and prevent negative impacts to the environment, they can also have the unintended consequence of hindering beneficial projects.

WHAT COULD MAKE IT BETTER?

Clear definition of "beneficial"

Expedite beneficial projects
- Tiered regulatory structure

Incentives for beneficial practices

Permit assistance tools
- Increase technical support capacity through coordination of existing channels of support and reallocation of regulatory resources
- Increase technical support outreach to both regulators and farmers

WHAT'S ALREADY BEING DONE?

- *Partners in Restoration Program, Sustainable Conservation*[31]
- *AB 1961, Coho Salmon Habitat Enhancement Leading to Preservation Act*[32]
- *Conservation Stewardship Program, Natural Resources Conservation Service*[33]
- *Technical support capacity-building efforts, Sustainable Conservation and California Association of Resource Conservation Districts*[34]

Misplaced Blame Regarding Cost of Regulation

WHAT'S THE EXPERIENCE?

"It is not accurate to lump all regulations together and then single out environmental regulations as the source of the burden." (California conservation representative, 2012) Environmental regulations are put in place to stop the cost of agricultural impacts from being borne by others in society and the environment. However, environmental regulations are just one subset of the many regulatory and business requirements facing farmers.

WHAT COULD MAKE IT BETTER?

Focus resources on best practices and prevention of environmental degradation, rather than resisting regulation

Creative collaboration among all affected stakeholders to foster mutual goals
- Seek improved technologies that both save money and result in desired environmental outcomes

WHAT'S ALREADY BEING DONE?

- *Fish Friendly Farming (third party certification)*[35]
- *Technology Advancement Program, San Joaquin Valley Air Pollution Control District*[36]

Lack of Trust and Collaboration Among Stakeholders

WHAT'S THE EXPERIENCE?

"Relationships and trust building are important, *and* these efforts must be mutual." (California conservation representative, 2012) Collaboration, particularly among agricultural and environmental communities, can be challenging. While individuals may be able to work well together, conservation representatives report that the relationship between the broader communities is often characterized by lack of trust and frustration with one another.

WHAT COULD MAKE IT BETTER?

Build trust and understanding among all stakeholder groups
- Communicate clearly with one another
- Convey the value of data collection and information sharing to all stakeholders

WHAT'S ALREADY BEING DONE?

- *County Food Systems Alliances, Ag Innovations Network*[37]
- *Watershed planning efforts*[38]

SUCCESS STORY 2

Permit Streamlining[39]

DANIEL MOUNTJOY | DIRECTOR OF RESTORATION ON PRIVATE LAND
Sustainable Conservation

In collaboration with local Resource Conservation Districts, the Partners in Restoration program facilitates conservation work on private land by simplifying the regulatory process for landowners.

PROBLEM

Dozens of regulations and associated permits affect farmers' attempts to do projects on their land. The complexity, cost, and time-consuming nature of this system frequently result in landowners deciding to cancel projects before completion.

SOLUTION

The Partners in Restoration program identifies priority resource issues and commonly used conservation practices, and then works closely with agencies to help craft watershed- or county-based programmatic permits. Environmental stakeholders are engaged early on to ensure that environmental goals are not undermined in the effort toward more efficient navigation of the regulatory requirements. Under Partners in Restoration, permits are issued directly to local Resource Conservation Districts, which then act as a one-stop-shop for farmers and ranchers.

RESULT

The Partners in Restoration program has resulted in 227 projects implemented in eight watersheds, with more than 17 miles of riparian habitat enhanced and 200,000 tons of soil loss prevented. Under the Partners in Restoration program, an average of five projects are installed per year, compared to one project per year before the program. Although it takes time to coordinate among all relevant agencies for a common set of management conditions, the program has been successful in securing agreement about specific practices among diverse stakeholders within a watershed or county.

LESSONS LEARNED

- The average time to develop the Partners in Restoration program was 3½ years.
- The average cost to develop the Partners in Restoration program in each watershed was $373,000. This would translate to millions of dollars on a larger scale.
- The cost of project implementation was transferred from farmers to Sustainable Conservation and the Resource Conservation Districts.
- Projects were impeded by limited agency staff time.
- Overall, more and better-planned projects were executed. The coordinated operating system resulted in improved relationships between Sustainable Conservation, Natural Resources Conservation Service, and the Resource Conservation Districts.
- The role of a neutral party is key to putting projects together and negotiating between different agencies.

STAKEHOLDER GROUP: REGULATORY

Both state and local agencies contributed perspectives to this project. Views from federal agency representatives are not included here because many of them delegate implementation and enforcement of regulations to state agencies, while providing oversight and guidance.

> *State agency representatives underscored the lack of staff and funding, which hinders their ability to effectively carry out existing regulatory programs, coordinate with one another, and launch new efforts.*

State Agency Perspective

During interviews, representatives of key state agencies explained that regulatory agencies are charged with developing and implementing regulations and programs, consistent with federal and state laws, to protect public health and the environment. Achieving these regulatory goals, they reported, is a complex and difficult task, made more so by competing interests, demands, lawsuits, and, sometimes, the political process. Like any complex system or set of rules and requirements, the system includes flaws, shortcomings and inefficiencies, which can result in confusion and frustration for the regulated community, the public, and even regulators themselves. State agency representatives emphasized their dedication to minimizing these challenges through better interagency coordination and collaboration, and expressed frustration at the difficulty in achieving meaningful coordination with other agencies at all levels of government. However, there is generally a strong desire to communicate with all stakeholder groups to better understand their needs and concerns, and advance projects that achieve environmentally beneficial results. To do this and ensure a smooth regulatory process, regulators requested cooperation from the regulated community. They pointed out that when regulations are called into question, the resulting revisions are often more complex than the previous iteration as regulators attempt to incorporate new considerations. In addition, state agency representatives reported that a lack of data about agricultural practices and impacts has compromised their ability to make educated decisions in achieving their mandates, which can further complicate regulatory requirements. State agency representatives underscored the lack of staff and funding, which hinders their ability to effectively carry out existing regulatory programs, coordinate with one another, and launch new efforts.

Lack of Interagency Coordination

WHAT'S THE EXPERIENCE?

"Regulatory agencies often develop regulations in a stovepipe fashion without meaningful or effective consultation with other agencies." (California state agency representative, 2012) The resulting regulations target specific issues, but ignore the interconnectedness of the system in which they're applied.

WHAT COULD MAKE IT BETTER?

Team approach among agencies
- Memoranda of understanding
- Interagency working groups
- Strategic division of responsibilities
- Collaboration with diverse legislative and industry champions

One-stop permit shop

WHAT'S ALREADY BEING DONE?

- *California Biodiversity Council*[40]
- *California/Federal Dairy Digester Working Group*[41]
- *California Dairy Quality Assurance Program*[42]
- *Consolidated Permitting program, Cal/EPA*[43]

Agricultural Understanding and Outreach

WHAT'S THE EXPERIENCE?

Traditional agency culture has discouraged meaningful communication and collaboration amongst agency representatives and those they regulate. Regulatory staff express that they do not feel empowered to reach out directly to farmers and develop greater understanding of agricultural perspectives.

WHAT COULD MAKE IT BETTER?

Build trust and understanding among all stakeholder groups
- Foster an agency culture that encourages communication and collaboration
- Information sharing between agricultural community and regulators

Increase understanding of agriculture
- Create opportunities for agency staff to spend time in the field

Permit assistance tools
- Ombudsperson positions
- Increase capacity of technical support organizations
- User-friendly web tools
- Additional technical and financial assistance to smaller growers

WHAT'S ALREADY BEING DONE?

- *California Roundtable on Agriculture and the Environment, Ag Innovations Network*[44]
- *CalAgPermits, California Agricultural Commissioners and Sealers Association*[45]
- *Agri-Culture Program, Santa Cruz County Farm Bureau*[46]
- *Ombudsperson positions at state and local agencies throughout the state*[47]
- *Technical support capacity-building efforts, Sustainable Conservation and California Association of Resource Conservation Districts*[48]
- *CalGOLD, Governor's Office of Business and Economic Development*[49]

Beneficial Projects

WHAT'S THE EXPERIENCE?

"New forms of investment in working lands are needed to complement and reinforce traditional ways of paying for conservation." (California state agency representative, 2012) Regulators report being in favor of projects on working lands that conserve natural resources or are otherwise beneficial to the environment, as they align with the underlying goals of many regulations. However, they understand that the existing regulatory structure can pose a barrier to permitting these types of projects and feel constrained in their ability to support efforts due to budget shortfalls.

WHAT COULD MAKE IT BETTER?

Expedite beneficial projects
» Expand existing efforts to ease implementation of conservation practices such as AB 1961, Conservation Pivot, and Partners in Restoration

Raise awareness about the importance of regulation in achieving societal goals

WHAT'S ALREADY BEING DONE?

Statewide Programmatic Permitting Program, Sustainable Conservation[50]

CONTEXT FOR ENVIRONMENTAL LAWS AND REGULATIONS[51]

JOVITA PAJARILLO | RETIRED
U.S. Environmental Protection Agency, Region 9

THE PROBLEM

The post-World War II boom in the United States led to rising commerce, industrial growth, commercial and urban development, an exploding population, increased demand for housing and public services, the expansion of agriculture, increased construction of highways and roads, and an unprecedented number of cars on the road.

Although beneficial for the U.S. economy, this rapid growth had consequences for public health and the environment. Unregulated discharges of industrial and municipal waste, such as toxic chemicals and raw sewage, resulted in habitat degradation and loss, fish kills, and historic disasters, such as the Cuyahoga River fire. New and increasing pesticide use jeopardized bird populations, ranging from iconic bald eagles to hummingbirds. Smog from traffic and factories began to pollute the air, while environmental catastrophes, such as the massive 1969 oil spill off the coast of Santa Barbara, polluted California's shores.

THE RESPONSE

Growing public awareness and concern about these ecological problems resulted in both grassroots and legislative action. The first Earth Day was held in April 1970, sanctioning the environmental movement and spawning new organizations such as Friends of the Earth, Natural Resources Defense Council, and Greenpeace. In the early 1970s, President Nixon signed a flurry of landmark environmental laws including the National Environmental Policy Act[52] (which established the Environmental Protection Agency), the Clean Air Act,[53] the Clean Water Act,[54] and the Endangered Species Act.[55] These laws established a new wave of government ethic, and were followed closely by other statutes such as the Safe Drinking Water Act,[56] the Resource Conservation Recovery Act,[57] and the Comprehensive Environmental Response, Compensation, and Liability Act (i.e., Superfund).[58] These federal statutes gave states responsibility for implementation and allowed them to develop more stringent programs than required by federal legislation. Since they were first enacted, many of the statutes have been amended to reflect a new understanding of the conditions.

County Agency Perspective

During focus groups with local regulators, participants noted that the cascade of regulations over the last 10 years has been overwhelming to all industries, not just to agriculture. Farmers' reported sense of "regulatory burden" was thought by county representatives to stem from their historic exemption from many regulatory processes and permit requirements, resulting in their being unaccustomed to the quantity of regulations now affecting their businesses. County agency representatives described their unique position at the intersection of local stakeholder needs and legally mandated state and federal laws. They also conveyed awareness of emerging regulatory needs and reported that the bureaucracy of the public agency structure prevents timely response. This, they said, is compounded by the current budgetary climate, which has forced agencies to manage growing enforcement requirements with fewer staff and diminished funds.

Relationship with the Agricultural Community

WHAT'S THE EXPERIENCE?

"The goal of local regulators is not to make life difficult for farmers, but rather to implement responsible land use policies and then get out of their way so they can produce food and fiber." (Fresno County agency representative, 2012) As they develop and implement laws, regulators are responding to the needs of all constituents. Advocates for new laws anticipate that regulations will resolve their concerns, while those who are being regulated feel burdened by these new regulations. Although new laws are well intended, they are complex, making it impossible to predict all consequences. Regulators have expressed that a better understanding of farmers' needs could result in more effective policies, but they find it challenging to get constructive input from farmers.

WHAT COULD MAKE IT BETTER?

Build trust and understanding among all stakeholder groups

» Understand one another's experiences more fully

» Utilize farmers' existing relationships with ag support organizations to expand communication

Farmer engagement and feedback directly to regulators

» Feedback mechanisms that accommodate farmers' schedules and preferences

WHAT'S ALREADY BEING DONE?

Ag Education/Training Program for Regulators, Ventura County Ag Futures Alliance[59]

Partnership building, Resource Conservation Districts[60]

Ag Issues Workshop Program, San Joaquin Valley Air Pollution Control District[61]

A Rapidly Changing Landscape of Food and Agriculture

WHAT'S THE EXPERIENCE?

"Regulators are very good at following the rules that have been set up, but they are a little behind the curve on innovation." (Sonoma County agency representative, 2012) Agriculture is not the same as it was even 10 years ago. Many non-agricultural activities now take place on farmland, ranging from weddings and farm dinners to large-scale solar installations. Farmers are increasingly interested in small-scale, on-farm processing to create additional income from value-added products. These shifting conditions raise a host of issues that were never contemplated by regulators. As they struggle to address these emerging areas in a timely manner, regulators explain that they are seeking a balance between the public's interest and the changing business needs of agriculture.

WHAT COULD MAKE IT BETTER?

Creative collaboration among all affected stakeholders to foster mutual goals

» Work together to set the right policies at the beginning of the rule making process

Differentiate regulated activities

» Segregate activities by risk or scale and regulate accordingly

Share resources among counties

» Emerging policies and ordinances

» Guidelines to assist farmers with permitting and compliance

Permit assistance tools

» Online information, communication, and reporting resources

WHAT'S ALREADY BEING DONE?

Ag Liaison Advisory Board, San Luis Obispo County[62]

AB 1616, California Homemade Food Act[63]

Ag tourism ordinances, various counties[64]

Small-scale On-farm Food Processing in Marin County, *Marin County*[65]

CA Environmental Reporting System (CERS), California Environmental Protection Agency[66]

Forces Beyond Local Control

WHAT'S THE EXPERIENCE?

"It would be helpful for farmers to both advocate for their needs and also take into consideration what is demanded of county agencies, such as meeting mandates from state agencies." (Sonoma County agency representative, 2012) Local regulators report that they understand the needs of their agricultural communities, yet they are required to comply with and enforce state and federal laws, even when they recognize that those laws are not appropriate to local needs or have an undesirable local impact. There are also many non-regulatory pressures that compound the sense of burden farmers feel about regulation, but there is often little that regulators can do about this.

WHAT COULD MAKE IT BETTER?

Increase understanding of core interests among stakeholder groups

» Determine county-level solutions

Encourage farmers to advocate for their needs at the state level so policies trickle down to counties

WHAT'S ALREADY BEING DONE?

County Food Systems Alliances, Ag Innovations Network[67]

Local outreach and engagement, Resource Conservation Districts[68]

Local information networks such as Resource Conservation Districts, Farm Bureaus, and Cattlemen's Associations

...the cascade of regulations over the last 10 years has been overwhelming to all industries, not just to agriculture. Farmers' reported sense of "regulatory burden" was thought by county representatives to stem from their historic exemption from many regulatory processes and permit requirements, resulting in their being unaccustomed to the quantity of regulations now affecting their businesses.

COMMON GROUND AND KEY OPPORTUNITIES

Among stakeholder recommendations, several common themes emerged

Use the following key to see which stakeholder groups identified each solution set.

● AGRICULTURE ● CONSERVATION ● STATE REGULATORS ● LOCAL REGULATORS

ASSISTANCE FOR FARMERS

» Permit assistance tools ● ● ● ●

» One-stop permit shop ● ●

» Differentiate regulated activities ● ●

STAKEHOLDER COLLABORATION

» Increase understanding of core interests among stakeholder groups ● ●

» Increase understanding of agriculture ● ●

» Build trust and understanding among all stakeholder groups ● ● ●

» Creative collaboration among all affected stakeholders to foster mutual goals ● ● ●

ACHIEVEMENT OF BENEFICIAL OUTCOMES

» Outcome-based regulatory approaches ● ●

» Incentives for beneficial practices ● ●

» Expedite beneficial projects ● ● ●

These common solution sets were refined by the project's Technical Advisory Committee and formed the basis for discussion during the June 2013 *Summit on Regulations Affecting Agriculture*. The resulting recommendations are shared in the next two sections. ■

III. CALL TO ACTION

In collaboration with the project's Technical Advisory Committee, the recommendations common to multiple stakeholder groups were refined and presented to participants at the *Summit on Regulations Affecting Agriculture* in June 2013.

The short-term, more immediate recommendations fit into two categories — relationship building among stakeholders and easing navigation of the regulatory system — and serve to improve and simplify the existing regulatory system. The next section takes a longer view, describing the ideal characteristics of a modern regulatory framework.

Working in small groups, *Summit* participants prioritized and specified action and potential leads on the recommendations presented on the following pages.

Recommendations to Build Relationships

Objective One

Increase regulatory efficiency and effectiveness, increase innovation, and reduce conflict by developing a better shared understanding among stakeholders of the public outcomes sought, the unique nature of agriculture, and the limits of the laws and regulations in place. This objective focuses on the relationships between regulators, the regulated, and the public.

STRATEGIES FOR CHANGE

1. INCREASE PRODUCTIVE INTERACTION BETWEEN STAKEHOLDERS DEALING WITH REGULATORY ISSUES

Mutual misunderstanding is the cause of a great deal of tension among the agricultural, conservation, and regulatory communities. Farmers frequently feel that they are taken for granted and imposed upon, the conservation community is concerned that environmental goals are not being met and that stakeholders are not cooperating adequately with one another, and regulators feel torn between legal mandates and constituent needs as they try to maneuver bureaucratic obstacles with limited staff and funding. Lack of understanding among stakeholders has often resulted in lawsuits, a reality that limits regulators' flexibility in implementation of laws as well as their ability to focus on outcomes rather than procedure. Better understanding of one another's experiences and interests can lead to more efficient project timelines, reduced lawsuits, and better business and environmental outcomes.

» Implementation

a) Create opportunities for dialogue at both state and local levels. Successful examples of relationship- and trust-building include the state water plan process, the California Roundtable on Agriculture and the Environment (CRAE), initiatives of some Regional Water Quality Control Boards, and the work of local Resource Conservation Districts.

Potential Lead: Individual agencies at both state and local levels in collaboration with organizations specializing in multi-stakeholder engagement

b) Develop and implement farm tour programs and other opportunities for learning exchanges among stakeholders (e.g., seminars, workshops, and annual conferences) to encourage smarter regulations and beneficial outcomes.

Potential Lead: California Department of Food and Agriculture, California Agricultural Commissioners and Sealers Association, Resource Conservation Districts, and industry groups

c) Foster accountability for consistent implementation and enforcement of all regulation, and develop specific procedures to identify and expedite projects that contribute to habitat and species recovery.

i. Implement training programs for regulators that issue permits. Require certification with a continuing education component.[69] Include field tours or site visits in the training program.

ii. Streamline the voluntary conservation permitting process by setting agency goals that incentivize staff to prioritize review and evaluation of applications that have a benefit to habitat and species. Communicate these goals and resulting processes to the regulated community.

iii. Encourage regulatory staff to hold pre-meetings with project proponents early in the development of the project to clarify the project's goals and objectives, the permitting process, and establish a timeline. This exchange would prevent pitfalls and enable more effective regulatory coordination.

Potential Lead: California Department of Fish and Wildlife, NOAA Fisheries, and U.S. Fish & Wildlife Service

2. INCREASE FLOW OF INFORMATION CRITICAL TO DECISION MAKING

Insufficient information is a challenge commonly expressed by multiple stakeholders. Farmers desire clearer and more transparent information about regulatory processes, while regulators and the conservation community would like better data about farming practices and their impacts to make more accurate policy decisions. Although all stakeholders are calling for more information, there is some disagreement about the type of information shared and how it is collected, stored, and utilized. Beyond the philosophical differences, the slow uptake of modern information technology, such as online communication platforms, further hinders the exchange of information between farmers and regulators. Improved flow of information between producers and regulators that demonstrates environmental outcomes, is seen by some stakeholders as the easiest and most cost-effective


Photo: Ag Innovations Network

way to relieve regulatory stress. Several of the less contentious recommendations to improve information sharing are listed below, and may help to alleviate some regulatory stress in this area.

» Implementation

a) Develop a comprehensive resource on permit requirements to share with farmers, or enhance an existing resource.

Potential Lead: UC Davis Agricultural Sustainability Institute in collaboration with regulatory permitting agencies

b) Increase the specificity of the business types listed on the CalGOLD website so that more are identified upfront, making it easier for farmers to locate the requirements applicable to their operation.

Potential Lead: Governor's Office of Business and Economic Development

c) Create a searchable knowledge base, as well as a list of experts and landowners, to expand relevant scientific information and beneficial practices from small plots to the field.[70]

Potential Lead: California Rangeland Conservation Coalition, UC Davis, and California Environmental Protection Agency

d) Support efforts to create an anonymous database in which farmers and ranchers can report monitoring results from their practices as well as the results of implementing best management practices (BMPs) to inform regulators of compliance efforts and outcomes.

Potential Lead: Resource Conservation Districts

3. BETTER ACCOMMODATE INNOVATIVE ON-FARM PRACTICES

Farmers report finding that there is little flexibility within the current regulatory framework to accommodate new and emerging on-farm technologies. Meanwhile, regulators' obligation to maintain public health and safety prevents them from approving new technologies without rigorous testing. Developing frameworks that allow new practices and technologies to be tested in a cost- and time-effective way would assist both farmers and regulators.

» Implementation

a) Initiate and expand research collaboration between interested farmers and researchers to pilot new projects and technologies. Consider regulatory exemptions under controlled conditions to allow farmers to innovate, while also fostering needed research.

Potential Lead: California Department of Food and Agriculture's Fertilizer Research and Education Program,[71] UC Cooperative Extension, and private crop advisors, in conjunction with the associated regulatory agencies

b) Conduct outreach and encourage farmers to take advantage of the existing California Department of Fish and Wildlife

Better understanding of one another's experiences and interests can lead to more efficient project timelines, reduced lawsuits, and better business and environmental outcomes.

Voluntary Local Program and Safe Harbor Program to minimize risk when undertaking projects.

Potential Lead: California Rangeland Conservation Coalition, California Department of Fish and Wildlife, California Cattlemen's Association, California Farm Bureau Federation, California Association of Resource Conservation Districts, and the Alameda County Resource Conservation District

4. ENGAGE STAKEHOLDERS EARLY ON IN THE RULEMAKING PROCESS

Societal activities and priorities change over time, resulting in the need to evolve regulatory laws and policies. In many cases, important regulatory decisions are made with limited input from affected stakeholders, which can lead to frustration, dissatisfaction, and other unintended consequences. Early stakeholder involvement allows the regulated community to better understand the reasoning behind new regulations, and helps to create regulations that are more easily implemented.

» Implementation

a) Develop a comprehensive understanding of current and emerging issues before regulations are drafted. Facilitate a process of identifying issues and convening key stakeholders at the appropriate scale to build shared understanding and gather input for developing new regulations.

Potential Lead: California Department of Food and Agriculture and California Environmental Protection Agency

b) Co-create emerging regulations.

- **i.** Encourage agencies to engage stakeholders early on in the process of drafting new regulations, at both local and state levels, to ensure that policies consider local concerns and practical knowledge from the start.
- **ii.** Encourage stakeholders to stay involved and engage directly with regulators to adequately address concerns.

Potential Lead: State and local agencies in collaboration with forums such as the state-level California Roundtable on Agriculture & the Environment, and county-based Food System Alliances

Objective Two

Increase interagency coordination to more effectively achieve the underlying goals of regulation while reducing the number of duplicative, conflicting, or otherwise uncoordinated regulatory requirements. This objective focuses on the relationships between regulators at all levels.

STRATEGIES FOR CHANGE

1. INCREASE COORDINATION BETWEEN STATE AND LOCAL AGENCIES

Local government often goes unrecognized in discussions about interagency coordination due to the large number of counties, cities, and other local government agencies in California. However, building greater understanding and sharing information among state and local agencies could help avoid duplication or conflict, improve assistance to farmers, and make the regulatory system easier to navigate.

» Implementation

Increase collaboration between state and local agencies, sharing or coordinating responsibilities and better understanding one another's roles. Hold regular meetings that include both state and local agency representation, and include time for information sharing.[72]

Potential Lead: California State Association of Counties, California Agricultural Commissioners and Sealers Association, California Environmental Protection Agency, Regional Water Quality Control Boards, local Air Districts, and Resource Conservation Districts

2. ENCOURAGE A TEAM APPROACH AMONG AGENCIES

All stakeholders identified lack of effective interagency coordination as a primary source of inefficiency, conflict, and duplication within the existing regulatory framework. Incorporating interagency coordination into the infrastructure of the regulatory process could reduce these challenges.

» Implementation

Encourage a team approach though interagency working groups for coordinated goals, strategies, and actions among agencies at all levels. This approach is usually driven by a specific purpose or project.

- **i.** Identify and address barriers to coordination such as timing, resources, incentives, boundaries/territory, etc.
- **ii.** Include Native American tribes as sovereign nations, as well as technical support organizations.
- **iii.** Evaluate the potential for the formation of multi-agency regulatory teams as part of a streamlined process.[73] This could be funded through the Department of Conservation, development fees, or a farm gate assessment. Legislative changes may be needed to consolidate permits.

Potential Lead: California Biodiversity Council and California State Water Plan Agency Steering Committee in partnership with top levels of local, regional, state and federal government

Photo: Ag Innovations Network

Recommendations to Ease Navigation of the Regulatory System

Objective

Develop a coherent framework to allow easier navigation of the regulatory system.

STRATEGIES FOR CHANGE

1. INCREASE PERMIT EFFICIENCY

Customary practices or beneficial projects, such as stream bank restoration, can be needlessly delayed or terminated by the standard permitting process, which tends to be confusing, lengthy, and costly. Examples of regulatory processes that avoid this challenge should be expanded and replicated, such as ministerial permits for projects that fit a pre-determined set of criteria.

» Implementation

Develop a set of standard conditions at the state level, applied to a broad range of project types, that can be used to determine a project's permit requirements.[74] Consider funding this system through the state revolving loan fund used to finance Programmatic Environmental Impact Reports. A legislative component would also be required.

Potential Lead: Sustainable Conservation or other third-party consultant/organization, Resource Conservation Districts, California Environmental Protection Agency, and California Department of Fish and Wildlife

2. DEVELOP A REGULATORY ROADMAP

Navigating the regulatory process can be quite confusing and unpredictable, resulting in unexpected costs, time delays, and additional requirements. A regulatory roadmap would assist farmers in planning projects and complying with regulations.

» Implementation

Develop an online permit assistance tool[75] that allows a farmer to input data about their operation or project and subsequently displays the regulatory consequences of various options (e.g., cost, additional regulations triggered, etc.). Consider organizing the tool by commodity and including links to relevant codes and regulations, as well as contact information for decision makers at each point in the process. Incorporate a layered Geographic Information Systems (GIS) map into the tool, including the locations of Biological Opinions, impaired waters and Total Maximum Daily Loads (TMDLs), agency boundaries, etc. to inform the user of existing regulatory programs, issues, and key players.

Potential Lead: California Environmental Protection Agency and California Natural Resources Agency in partnership with the Governor's Office of Business and Economic Development,[76] municipalities, the private sector, and foundations

Navigating the regulatory process can be quite confusing and unpredictable, resulting in unexpected costs, time delays, and additional requirements. A regulatory roadmap would assist farmers in planning projects and complying with regulations.

3. CREATE ONE-STOP PERMIT SHOPS

Farmers must frequently engage with multiple agencies in complying with an assortment of regulations, often encountering confusing, conflicting, or duplicative requirements. The permit applicant is then required to reconcile these requirements into an acceptable project design, which can range from burdensome to impossible. The Consolidated Permit Process, currently managed by the California Environmental Protection Agency, works to alleviate this challenge by assigning one lead agency to direct and manage the regulatory process.

» Implementation

a) Engage agencies in expanding the Consolidated Permit Process to address a broader set of issues. Assign a dedicated agency staff person or ombudsperson with the authority and knowledge to efficiently shepherd the applicant through the process. The lead agency would mediate on behalf of the applicant with the regulatory agencies involved, ensure that all agencies adhere to timelines, and work with affected stakeholders.

Potential Lead: California Environmental Protection Agency and the Governor's Office of Business and Economic Development could assist appropriate lead agencies and staff people at both state and local levels to collaborate on pertinent issues

b) Employ agency staff with agricultural background or training to better reflect the specific challenges of regulating agricultural activities. The Governor's Office of Business and Economic Development is the single point of contact for permitting issues for all businesses, including agriculture. Ensure that agricultural literacy is consistently represented among the staff devoted to resolving interagency conflict to augment efforts already underway to train staff and improve regulatory processes.

Potential Lead: Governor's Office of Business and Economic Development

4. INCREASE TECHNICAL SUPPORT CAPACITY

Farmers understand that time delays cost money and can result in missed opportunities within the limited windows of the growing season or financial assistance programs. Expensive consultants are often needed to assist farmers in complying with complicated regulations. Meanwhile, technical support organizations are well equipped to provide assistance, but lack sufficient funding and staff to do so effectively. Increasing the capacity and coordination of existing channels of support could result in improved technical assistance to growers, particularly regarding regulatory requirements.

» Implementation

a) Implement a sliding scale fee structure for technical support organizations[77] and encourage farmers to use them as they would a consultant. Consider partnering with trade organizations and their members to provide services. Maximize technical support resources through group workshops or seminars on a particular technical subject and increase the capacity of participants by focusing on training that can be easily shared between farmers. In an era of limited funding and staff resources for agencies, this may be a funding opportunity for agricultural support organizations.[78]

Potential Lead: Technical support organizations, such as UC Cooperative Extension, Natural Resources Conservation Service, Resource Conservation Districts, and the California Department of Food and Agriculture

b) Ensure that ombudspeople at both state and local agencies communicate and collaborate with one another.

Potential Lead: Governor's Office of Business and Economic Development

5. ESTABLISH A WEB PORTAL

Many agencies ask for much of the same data or reporting information from farmers, resulting in redundancy of information submission. Meanwhile, farmers find it challenging to locate specific regulatory requirements or guidelines and contact information for agency representatives. A central online location for information upload and download could serve the information needs of both the regulated and regulators.

» Implementation

Establish a single web portal that allows the farmer to submit or update required information in one place for all agencies to access, and also allows the farmer to view or download the applicable information from each regulatory entity. The portal would be designed fulfill multiple regulatory requirements while reducing the cost to all parties. Allow electronic signatures on documents and incorporate electronic tracking of permits. Distinguish project permitting from compliance reporting, and establish a system for each.

i. Project permitting: Assign each project application a number and submit it to all appropriate agencies for review. If the project fulfills specific criteria (e.g., meeting CEQA and Environmental Impact Report requirements), it can be permitted without further review. Otherwise, it undergoes the complete review process. A pre-meeting between agencies and the project proponent may be useful in determining the project's path upfront.

ii. Compliance reporting: Applicants upload information to a single portal that goes to all agencies requiring similar compliance information. As long as the applicant's required data falls in the compliant range, they can choose not to share details or extraneous information with agencies.

Pilot the program first to ensure effectiveness and mutual satisfaction, and work out any technical and/or data collection issues. Contrary to popular perception, many farmers are technologically savvy; those who are not could be provided with technical support. While statewide implementation would be costly, it would ultimately save many resources.

Potential Lead: A collaborative effort between California Environmental Protection Agency, Governor's Office of Business and Economic Development, Regional Water Quality Control Boards, Sustainable Conservation, Resource Conservation Districts, and private organizations already engaged with producers on information systems.

Coordination of the Recommendations

There are significant opportunities to increase the efficiency and effectiveness of the current regulatory system as it affects agriculture. To move more quickly toward implementing these recommendations, executive leadership at the Governor's level and the appointment or utilization of senior staff familiar with the issues will be critical. ■

To move more quickly toward implementing these recommendations, executive leadership at the Governor's level will be critical.

IV. RETHINKING ACHIEVEMENT OF ENVIRONMENTAL OUTCOMES

While there is significant relief that can be accomplished through information exchange, reducing regulatory friction, and permit streamlining, stakeholders also identified the need to begin envisioning a modern regulatory system for agriculture.

Participants at the *Summit on Regulations Affecting Agriculture* spent their last session together considering the regulatory system that is needed for the 21st century. Several decades have passed since many regulations and regulatory structures were first put in place. During that time, much has been learned and much has changed in the world. Given the opportunity to build the system from scratch today, participants were asked to consider the characteristics of a modern regulatory system and how it might be structured for success.[79] The results of this conversation are synthesized below, comprising a preliminary set of considerations that could start a robust dialogue on a more effective way to accomplish societal goals than the current regulatory approach. Stakeholders reported that they believe the time is right to consider the following vision and embark on the long process of creating better environmental, social, and economic outcomes for California's farms.

Characteristics of a Modern Regulatory System

RESPONDS TO SOCIETY'S MULTIPLE PRIVATE AND PUBLIC INTEREST GOALS

- Answers the question, "What are the overriding public and private interests and how should regulations serve those interests?"
- Embodies these societal goals in a clear and concise way.
- Is dynamic, adapting to changing science and situations.
- Is centered on the values of economic sustainability, environmental stewardship, and public health, and encourages conducting business in alignment with these values.

IS AN INTEGRATED SYSTEM

- Integrates (rather than excludes) natural components, including soil, water, air, plants, animals, and people.
- Integrates (rather than silos) institutions, including but not limited to local, regional, state, and federal agencies.
- Integrates (rather than distinguishes) goals, including economic viability, public health, and environmental quality.

CONSIDERS NET BENEFITS OVER TIME

- Compares net benefits to costs and considers trade-offs when necessary to maximize net environmental and societal benefits.
- Looks to the future, encouraging longer-term thinking when considering impacts (i.e., utilizes time-based accounting to gauge regulatory impact).
- Considers a farm's track record (e.g., a history of using good practices).
- Assures that the public good is being met, including public health, environmental quality, resource protection and ecosystem services, and economic viability of farming and farm communities.

INCENTIVIZES BENEFICIAL BEHAVIOR

- Prioritizes incentives over penalties.
- Incentivizes beneficial behavior on the part of regulators, legislators, and the regulated alike.

IS OUTCOME-BASED

- Has clear goals that align with societal priorities.
- Is oriented to achieve desired outcomes/performance.
- Has a focus on problem solving, is open to solutions, and flexible in how desired outcomes are met.
- Is project-based rather than process-based.
- Has innovative leadership with the flexibility to enforce the spirit of the law creatively.
- Positions agencies in a leadership role, leveraged by the private sector.
- Allows local regulatory variability.

There is a strong emerging sense that without addressing these underlying challenges in our regulatory approach, California will end up with both fewer farms and further depletion of our natural resources and capital.

IS RISK-BASED

- Regulates according to risk in a tiered manner.
- Allows self-certification or third party certifications for low-risk activities.

ENCOURAGES SHARED UNDERSTANDING

- Fosters trust.
- Reframes “regulator” as “educator” and achieves compliance through education.
- Encourages two-way education between regulators and farmers.
- Is proactive rather than reactive, encouraging collaborative approaches.
- Fosters hope and optimism rather than pessimism and cynicism about government.

PROVIDES GOOD CUSTOMER SERVICE

- Encourages a customer service approach among regulators.
- Is user-friendly and easy to understand.

Next Steps

Tackling the fundamental way society regulates agriculture is a major undertaking that requires both significant expertise and political skill. Yet there was considerable appetite to approach this challenge, particularly from prominent leaders in all three stakeholder groups. There is a strong emerging sense that without addressing these underlying challenges in our regulatory approach, California will end up with both fewer farms and further depletion of our ecosystem and human capital.

To move forward will require a step-wise approach that includes:

1. Getting leadership endorsement for a multi-year program to create a more modern regulatory framework.
2. Identifying the key stakeholders with both the knowledge of the issues and the capacity to find common ground to lead the effort.
3. Research on global best practices for agricultural regulation and how they would apply in the California context.
4. Elaboration of the key characteristics of the new approach, including core principles and administrative vehicles.
5. Stakeholder review of the proposals and iterative attention to key points of concern.
6. Creation of the appropriate legislative and/or administrative vehicles for implementation.
7. Gaining broad political support for the proposals.

To accomplish these seven steps will take the cooperation and support of political, business, and public interests. With executive leadership from the Governor, industry leadership from agricultural leaders, and public support from both private foundations and nonprofit organizations skilled in the various tasks that are required, participants believe a robust, modern regulatory system for agriculture can be created.

V. CONCLUSIONS

Key Outcomes

During the course of this focused examination of the challenges and opportunities related to regulations affecting agriculture, it became clear that there are two classes of recommended solutions:

1. Immediate adjustments to the current system to relieve the sense of burden or frustration experienced by each stakeholder group.

2. Broader solutions that go beyond the current system to envision how societal goals might better be accomplished within a new, ideal regulatory framework.

The result is a tiered approach to resolving the identified challenges.

In the Call-to-Action section of this report, near-term remedies include building understanding among stakeholder groups, increasing the flow of critical information between regulators and the regulated, and stakeholder engagement in policy development. Recommendations to improve interagency coordination stretch to involve historically excluded local agencies, and encourage working groups to align goals and action. A suite of high-priority solutions to simplify and ease navigation of the regulatory system includes a more efficient and coordinated permitting process, a regulatory roadmap, the use of one-stop-shops, improved technical support capacity, and a web portal for consolidation of crucial information. A lead entity is identified wherever possible to shepherd recommendations into action.

The next section, Rethinking Achievement of Environmental Outcomes, departs from our current system to envision the characteristics of a modern regulatory system. This ideal system responds to society's goals, is an integrated system, considers net benefits over time, incentivizes beneficial behavior, is outcome-based and risk-based, encourages shared understanding, and provides good customer service to the regulated community. This vision is offered as a set of considerations to guide changes to the regulatory structure as they occur.

Next Steps

While this report marks the end of this particular project, it is anticipated that the many participants and other interested parties will continue to build on the shared understanding established throughout this process, and each do what is possible to move the short-term recommendations forward, while collaborating to bring the vision of a modern regulatory system to fruition.

TOUGH QUESTIONS, HOPEFUL DIRECTIONS

JOSEPH McINTYRE | EXECUTIVE DIRECTOR
Ag Innovations Network

The discussions captured in this report were rich and often laced with both anger and resignation. It became clear that deep underlying questions, that included but went beyond regulation, were affecting the responses of the stakeholder participants. Some of these critical questions included:

- ***How do we ensure the cumulative effect of business conditions, changing markets, and regulations do not result in a loss of agriculture in California?***
  Farmers consistently told us that their concerns were more about these cumulative effects as opposed to specific laws, regulations, or agencies. There is no doubt that the global market in food has profoundly reshaped the nature of farming in California. California's unique history of, and emphasis on, environmentally and socially responsible farming is easily seen as a stumbling block in this more competitive world. However, participants also told us that California's products were uniquely valued in the marketplace, precisely because they are produced with what is perceived to be the highest safety standards in the world. There is clear middle ground to be discovered, particularly around setting reasoned outcome targets for farms and providing producers and regulators the flexibility to achieve those targets.

- ***How do we avoid reducing environmental and social outcomes as we attempt to streamline regulatory processes?***
  Public interest and conservation groups are gravely concerned that hard fought protections are at risk with efforts to simplify permitting or fast track projects. There is a real public interest conflict between immediate economic returns and long-term environmental and social outcomes. Moving forward on regulatory reform will require a significant improvement in the relationships and trust between public interest and agricultural groups. Relying on regulators to be a buffer or arbitrator between these groups is unlikely to be sufficient. There are robust examples of these productive relationships, but more leadership is required from all parties.

- ***How can we move to a more data- and outcome-oriented approach to regulations?***
  Almost all participants in these dialogues agreed that moving toward a more outcome-based regulatory approach makes sense. They also understand that this requires the provision of appropriate data to demonstrate results. Yet there is deep and ongoing concern about data sharing between farmers and regulators, and even deeper concern about sharing between farmers and public interest groups. Fear of litigation and/or marketplace vilification is dramatically hindering the sharing of current data and the collection of new data. However, there are examples of potential trusted intermediaries who can create a data bridge between producers, regulators, and the public. Agricultural management information services providers, certifiers, and intermediaries such as Resource Conservation Districts can provide, and in some case have provided, these bridges.

There is a great opportunity for real progress to be made toward better outcomes for both farmers and society. Participants feel that now is the time to make real progress toward building more relationships and partnerships capable of answering these and many more regulatory challenges in California. ■

END NOTES

1. http://aginnovations.org/roundtables/crae
2. http://aginnovations.org/images/uploads/Permitting_Restoration.pdf
3. http://aginnovations.org/alliances
4. http://aginnovations.org/regulations/tac
5. Results of these conversations can be found at http://aginnovations.org/regulations/progress
6. This synthesis has been vetted and approved by members of each stakeholder group. However, these comments do not necessarily reflect consensus within each group.
7. A more complete listing of relevant efforts compiled as part of this project can be found at http://aginnovations.org/regulations/reg_resources
8. http://aginnovations.org/regulations/reg_resources/calgold
9. http://www.epermitting.wa.gov/site/alias__resourcecenter/jarpa_introduction/10042/introduction.aspx
10. http://ucanr.org/sites/csnce/files/57548.pdf
11. http://aginnovations.org/regulations/reg_resources/#Ombudsperson%20Positions
12. http://aginnovations.org/regulations/reg_resources/consolidated_permit_program
13. http://aginnovations.org/regulations/reg_resources/alameda_county_permit_coordination_program
14. http://aginnovations.org/regulations/reg_resources/the_partners_in_restoration_project
15. http://aginnovations.org/regulations/reg_resources/tiered_water_quality_permits
16. http://aginnovations.org/regulations/reg_resources/california_government_code_section_65952
17. http://aginnovations.org/regulations/reg_resources/california_state_legislature_assembly_bill_1961
18. http://aginnovations.org/regulations/reg_resources/regulatory_accountability_act_of_2011_house_resolution_3010
19. http://aginnovations.org/regulations/reg_resources/financial_and_administrative_accountability_senate_bill_617
20. http://aginnovations.org/regulations/reg_resources/#Incentives%20and%20Funding
21. http://aginnovations.org/regulations/reg_resources/california_food_system_alliance_network
22. http://aginnovations.org/regulations/reg_resources/agri-culture
23. http://aginnovations.org/regulations/reg_resources/agriculture_education_program
24. http://aginnovations.org/regulations/reg_resources/san_joaquin_valley_air_pollution_control_district_experimental_research_per
25. http://aginnovations.org/regulations/reg_resources/us_fish_and_wildlife_service_safe_harbor_agreements
26. http://aginnovations.org/regulations/reg_resources/state_water_resources_control_board_agricultural_water_quality_grant_p
27. http://aginnovations.org/regulations/reg_resources/best_available_control_technologies_bact
28. Narrative based on a presentation delivered by Karen Giovannini at the *Summit on Regulations Affecting Agriculture* on June 12, 2013.
29. http://aginnovations.org/regulations/reg_resources/performance-based_conservation_incentives
30. http://aginnovations.org/regulations/reg_resources/california_federal_dairy_digester_working_group
31. http://aginnovations.org/regulations/reg_resources/the_partners_in_restoration_project
32. http://aginnovations.org/regulations/reg_resources/california_state_legislature_assembly_bill_1961
33. http://aginnovations.org/regulations/reg_resources/conservation_stewardship_program_csp
34. http://aginnovations.org/regulations/reg_resources/capacity_building_for_resource_conservation_districts
35. http://aginnovations.org/regulations/reg_resources/fish_friendly_farming
36. http://aginnovations.org/regulations/reg_resources/technology_advancement_program_tap
37. http://aginnovations.org/regulations/reg_resources/california_food_system_alliance_network
38. http://aginnovations.org/regulations/reg_resources/watershed_planning
39. Narrative based on a presentation delivered by Daniel Mountjoy at the *Summit on Regulations Affecting Agriculture* on June 12, 2013.
40. http://biodiversity.ca.gov
41. http://aginnovations.org/regulations/reg_resources/california_federal_dairy_digester_working_group
42. http://aginnovations.org/regulations/reg_resources/california_dairy_quality_assurance_program
43. http://aginnovations.org/regulations/reg_resources/consolidated_permit_program
44. http://aginnovations.org/roundtables/crae
45. http://aginnovations.org/regulations/reg_resources/pesticide_use_reporting
46. http://aginnovations.org/regulations/reg_resources/agri-culture
47. http://aginnovations.org/regulations/reg_resources/#Ombudsperson%20Positions
48. http://aginnovations.org/regulations/reg_resources/capacity_building_for_resource_conservation_districts
49. http://aginnovations.org/regulations/reg_resources/calgold
50. http://aginnovations.org/regulations/reg_resources/statewide_programmatic_permitting_program
51. A more detailed version of this article can be accessed at http://aginnovations.org/regulations/progress
52. http://www.epa.gov/compliance/nepa
53. http://www.epa.gov/air/caa
54. http://cfpub.epa.gov/npdes/cwa.cfm?program_id=45
55. http://www.fws.gov/endangered/laws-policies
56. http://water.epa.gov/lawsregs/rulesregs/sdwa/index.cfm
57. http://www2.epa.gov/laws-regulations/summary-resource-conservation-and-recovery-act
58. http://www.epa.gov/superfund/policy/cercla.htm
59. http://aginnovations.org/regulations/reg_resources/agriculture_education_program
60. http://aginnovations.org/regulations/reg_resources/resource_conservation_districts
61. http://aginnovations.org/regulations/reg_resources/ag_issues_workshop_program
62. http://aginnovations.org/regulations/reg_resources/san_luis_obispo_county_agricultural_liaison_advisory_board_alab
63. http://aginnovations.org/regulations/reg_resources/cottage_food_industry_bill_assembly_bill_1616
64. http://aginnovations.org/regulations/reg_resources/agritourism_ordinances
65. http://aginnovations.org/regulations/reg_resources/small-scale_on-farm_food_processing_in_marin_county
66. http://aginnovations.org/regulations/reg_resources/california_environmental_reporting_system_cers
67. http://aginnovations.org/regulations/reg_resources/california_food_system_alliance_network
68. http://aginnovations.org/regulations/reg_resources/resource_conservation_districts
69. E.g., Natural Resource Conservation Service conservation planning certification and/or certified crop advisor programs
70. Build on current efforts described at http://rangelandwatersheds.ucdavis.edu
71. http://www.cdfa.ca.gov/is/ffldrs/frep/index.html
72. Regional Water Management groups are an example of this kind of coordination.
73. E.g., Consolidated Permit Process, California Environmental Protection Agency
74. Consider Programmatic Environmental Impact Reports and Sustainable Conservation's Statewide Programmatic Permitting program as models.
75. The Turbo Tax format was referenced as a model.
76. See CalGOLD as an example (http://www.calgold.ca.gov).
77. Examples include UC Cooperative Extension, Natural Resources Conservation Service, and Resource Conservation Districts.
78. Participants expressed concern that increased emphasis on paid technical support could adversely effective smaller producers and recommended steeply sliding scales to assure access.
79. Sets of potential future actions resulted from this session as well, and are detailed at http://aginnovations.org/regulations/progress.

Ag Innovations Network is a nonprofit, nonpartisan organization dedicated to helping stakeholders solve problems in the food system through effective collaboration.

aginnovations.org | 707.823.6111 | info@aginnovations.org

Cover Photo: iStockPhoto

Draft Summary

Stakeholder Perspectives on Moving Toward a New Regulatory Compact for Agricultural and Environmental Health

Prepared by Ag Innovations Network

December 2012

Table of Contents

Introduction……………………………………………………………………………………….2
Agricultural Stakeholder Group…………………………………………………………….3
Perspective
Experiences
Navigating the Regulatory System
Regulatory System as Costly and Time-Consuming
Lack of Understanding Among Stakeholders
Disincentives for Innovation
Environmental/Conservation Stakeholder Group…………………………………10
Perspective
Experiences
Achieving Environmental Outcomes
Distinguishing Beneficial Practices
Misplaced Blame Regarding Cost of Regulation
Lack of Trust and Collaboration Among Stakeholders
Regulatory Stakeholder Group……………………………………………………………..15
Perspective: State Agencies
Experiences
Lack of Interagency Coordination
Agricultural Understanding and Outreach
Beneficial Projects
Agency Resources
Perspective: County Agencies
Experiences
Relationship with the Agricultural Community
A Rapidly Changing Landscape of Food and Agriculture
Forces Beyond Local Control
Synthesis of Stakeholder Experiences and Perspectives…………………………23
Priorities
Assistance for Producers
Beneficial Outcomes
Stakeholder Collaboration

Introduction
California farmers frequently cite compliance with regulations as a major barrier to the viability and profitability of agriculture in the state. While this might be seen as a clash of views between agricultural and environmental stakeholders, in fact both believe that regulatory frameworks must be effective in protecting our environment and natural resources. Participants in both the California Roundtable on Agriculture and the Environment (http://aginnovations.org/roundtables/crae/) and the Food System Alliances (http://aginnovations.org/alliances/) now active in eight counties across California, have identified regulatory issues as a top priority, and in response, Ag Innovations Network launched the *Regulatory Compact* project to seek solutions that simultaneously reduce the challenges associated with regulatory compliance and improve environmental performance.

Through research on the regulatory structure and existing efforts, interviews with key stakeholders, and focused listening sessions with agricultural, environmental, and regulatory representatives, Ag Innovations Network has documented perspectives on regulatory challenges from a range of stakeholders. The process allowed stakeholders to share their experiences, describe specific challenges, and propose solutions to those challenges. More information on findings is available at http://aginnovations.org/regulations/.

This report represents the initial synthesis of findings. Below, you will find sections dedicated to the perspectives, top challenges, and recommendations of each stakeholder group with links to recent efforts or models that can be the basis for progress. ***Note that each section represents the views of one stakeholder group and does not reflect consensus.*** The report concludes with a synthesis of stakeholder experiences and perspectives, and identifies the issue areas that all stakeholders agree upon as potential starting points for collective efforts to reduce regulatory barriers for specialty crop agriculture while preserving high environmental standards. The purpose of this report is to build a shared understanding of one another's experiences and assist stakeholders in selecting the recommendations with the most potential to address the issue at hand: What changes can be made to the regulatory system that will both improve ecosystem health and ensure economic viability for California farmers?

Reading Recommendation
It may be helpful to start by reading the top-level perspectives of each stakeholder group and then the synthesis at the end to get a broad sense of the findings before delving into the individual experiences, challenges, and proposed recommendations.

Acknowledgements
This effort would not have been possible without the generous contributions of time and perspective from farmers and agricultural advocates, environmental and conservation representatives, agency staff at all levels, and others who have taken an interest in this project. We are particularly grateful to the members of the California Roundtable on Agriculture and the Environment and the California Food System Alliance Network for their vision and participation. The entire Ag Innovations Network staff has participated in this project, with special thanks to Katy Mamen, Joseph McIntyre, Serena Coltrane-Briscoe, Miriam Volat, Eric Cárdenas, and Helen McGrath, and interns Katherine Schugren-Meyer and Erica Gross. Consultant Jovita Pajarillo also provided critical project support. We are grateful for project funding from a United States Department of Agriculture Specialty Crop Block Grant, administered by the California Department of Food and Agriculture.

Stakeholder Group: Agriculture

Perspective[1]:
Agricultural producers understand regulation to be a necessary part of running a farming operation. While they often agree with the underlying intent of regulations, the application of regulations is felt to be unduly burdensome. Rather than facilitate the business of growing, processing, and selling food, and encouraging best environmental and social practices, the regulatory system is experienced as a cumbersome realm to contend with. Navigating the regulatory process is very confusing to most producers, costing large amounts of money and time. The process is perceived as unclear, uncoordinated, and at times arbitrary. For the individual producer engaged in this process, the requirements can appear to be less about accomplishing a set of societal goals and more about jumping through hoops and paying fees that perpetuate a flawed system. Small-scale producers are disproportionately affected by these challenges. Members of the agricultural community express feeling misunderstood by regulators and the general public, who they perceive as not having a holistic understanding of agriculture or the innovative practices they are trying to employ. They feel constrained by the rigidity of a system that does not have the capacity to innovate and, as a result, prevents projects that might actually achieve the underlying goals of the regulation if viewed in a broader way. This leaves growers feeling frustrated and concerned that the costs and restrictions associated with the regulatory process could impact the economic feasibility of their business.

The following four tables represent the most frequently heard experiences of the regulatory framework during our conversations with members of the agricultural community. The full range of challenges heard can be downloaded at http://aginnovations.org/regulations/progress/. Each table includes challenges and recommended solutions, which are paired with current efforts or models where relevant. Current efforts and models (detailed at http://aginnovations.org/regulations/reg_resources/) have varying applicability to the specific recommendations and will require further investigation upon pursuit of that recommendation.

Producer Experience: *Navigating the Regulatory System*

"We wanted to do everything correctly to develop the land for farming, so we attempted to get all the permits we needed. We've gotten over 40 permits since 2005. We didn't know all the requirements upfront, and new ones frequently arose, which set us back significantly. None of the permitting agencies could help us navigate the process because they didn't know what the other agencies required or which permits were needed. There have been many players involved, it's been quite expensive, and work has not been able to be completed in a timely manner."

Navigating the regulatory process can be confusing and cumbersome for producers. The lack of transparency about requirements, costs, and timelines, combined with a large number of regulations, leaves growers feeling uncertain about their ability to comply with or afford the process and vulnerable to additional cost, compliance, or scrutiny once they have begun the process.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
The regulatory process and	***Objective:*** Provide transparency about regulatory	• *Oregon Environmental Restoration Permit Guide,*

[1] This perspective is a synthesis of conversations with agricultural stakeholders and may not represent all views in the agricultural community.

requirements are not transparent and are unpredictable.	requirements, agency hierarchy, timeline, and cost.	Oregon Watershed Enhancement Board • *Permit Guidance Manual for Anaerobic Digestion Projects*, Cal/EPA • Resource Conservation District guides • California Public Resources Code Section 71001: Environmental Protection Permit Reform Act of 1993
	Strategy 1: Provide a regulatory roadmap, such as an online permit assistance tool (similar to Turbo Tax) that includes: ○ Checkboxes to describe the project/operation (e.g., number of acres, number of employees, etc.). ○ Reveal the regulatory consequences of each answer (e.g., cost, additional regulations triggered, etc.). ○ Include links to relevant codes/regulations and contact information for decision-makers at each point in the process. ○ Provide credit for environmentally or socially beneficial aspects of the operation/project. ○ Allow the regulator to be flexible based on the answers in this system (i.e., consider net environmental or social benefit). The system should ultimately encourage producers to improve their operations to a higher standard.	• CalGOLD, Governor's Office of Business and Economic Development
	Strategy 2: Pre-approve certain practices that can be done with a ministerial permit or no permit at all.	• CEQA exemption 15333 • Sonoma County Zoning Ordinance (allows processing for facilities up to a certain size without a use permit)
Permits are typically required from multiple agencies that may have different interpretations of the regulations and are often unaware of one another's requirements, thus being unable to provide navigation assistance. Accurately describing a proposed project to regulators	***Objective:*** Assist project proponents in navigating the regulatory process.	• CA Dairy Quality Assurance Program • Water Quality Coalitions • California Rangeland Water Quality Management Plan
	Strategy 1: Establish a single web portal that allows the project proponent to input information once for all agencies to access, and also allows the producer to view/download the applicable information from each regulatory entity.	• California Environmental Reporting System (CERS), Cal/EPA • Washington State Joint Aquatic Resources Permit Application (JARPA) • CA Biodigester Regulatory Working Group unified web portal for application process (planned)
	Strategy 2: Establish a lead agency to direct the process and serve as a one-stop shop.	• Resource Conservation Districts and other organizations sometimes act in this role for specific project types.

is tricky. The wrong word choice (e.g., commercial vs. processing kitchen) can lead an applicant down the wrong regulatory path, and not being familiar with regulatory thresholds (e.g., square footage) can trigger additional requirements or cost.	*Strategy 3:* Assign an ombudsperson or agency staff person with the authority and knowledge to efficiently shepherd the applicant through the process.	• Ombusperson/Farmbudsperson positions in some counties throughout the state. • AB 691 would have established a state-level ombudsperson through CDFA (bill died Feb. 2012)
	Strategy 4: Establish, replicate, or expand programmatic permit programs.	• Partners in Restoration Program, Sustainable Conservation (watershed or regional basis) • Salinas Watershed Program • Consolidated Permit Program, CalEPA (Hazardous Waste only) • Permit Streamlining Effort (underway), CARB
Guidelines to inform project design are lacking and there is little information on regulatory goals that might help project applicants meet or exceed these targets.	***Objective:*** Assist project proponents in achieving regulatory goals.	
	Strategy 1: Share guidelines with producers to help them meet or exceed targets (e.g. water or air quality).	• *Residential Construction Manual*, Sonoma County
	Strategy 2: Offer incentives to exceed targets.	• Carl Moyer Memorial Air Quality Standards Attainment Program • SWRCB Agricultural Water Quality Grant Program • Clean Water State Revolving Fund • USDA-NRCS conservation programs • Department of Conservation Watershed Coordination Grants • NOAA Restoration Center funding • DFG Fisheries Restoration Grant Program

Producer Experience: *Regulatory System as Costly and Time-Consuming*
"As a farmer, there can be short windows in which you have the time and money available for a project. As soon as you enter the realm of seeking approval for that project, you lose momentum."

The regulatory process can be both time-consuming and expensive for project proponents. Direct costs are associated with both permitting (fees) and compliance (operational changes, new equipment, monitoring and reporting, hiring new employees, etc.). Once the costs associated with the amount of time required to navigate the system, cope with frequent delays, and comply with the requirements are factored in, regulatory requirements can amount to a hefty proportion of project cost.

One producer cited the following of his experience trying permit a cogeneration facility as part of his operation: *"…regulatory costs were in excess of 30% of the total project cost, making it virtually impossible to complete. It was impossible to identify all the rules, regulations, and people involved in the process, making it very challenging to budget a project like this or develop a real timeline."*

Stated Challenges	Proposed Recommendations	Relevant Current Efforts/Models
The costs associated with regulatory compliance are unpredictable, making it challenging to budget. Larger operations are better able to handle this, which encourages larger-scale businesses.	***Objective:*** Allow project proponents to accurately budget the cost of regulatory compliance.	
	Strategy: Establish fixed or capped fees, both for regulatory agencies and third party consultants. *(Caveat: Cutting fees to regulatory agencies could reduce their capacity to respond efficiently to applicants.)*	
Navigating the regulatory process can be very time-consuming and unpredictable, making it challenging to plan a project on a timeline.	***Objective:*** Allow project proponents to establish accurate timelines for regulatory compliance.	
	Strategy 1: Mandate timelines for agencies. Applications not processed within this period are automatically approved.	
Delays can stem from difficulty navigating the process, stalled applications, difficulty reaching agency contacts, and complying with duplicative or unanticipated requirements.	***Objective:*** Encourage movement of projects through the regulatory system in a timely manner.	
	Strategy 1: Create performance standards for agencies that reflect numbers of projects approved and length of processing time.	
	Strategy 2: Establish cross-departmental liability for agencies that don't take action. Free regulators from liability so they can make the right decision without fear of reprisal by allowing landowners to assume the liability for their projects.	• H.R. 3010: the Regulatory Accountability Act
	Strategy 3: Establish parameters that allow the producer to easily identify projects that can be done without a permit.	
The time and money required to comply with regulations can act as a disincentive or make a project infeasible. It also decreases the ability of California producers to compete in domestic and global markets.	***Objective:*** Reduce the cost of regulatory compliance.	
	Strategy 1: Acknowledge the contributions many growers make to their communities in the form of property taxes and ecosystem services.	• *Environmental Farming Act Science Advisory Panel -* The panel reviews and documents ag's positive impacts to the environment.
	Strategy 2: Conduct rigorous economic analysis of every newly proposed rule.	• California's SB 617, Financial and Administrative Accountability (signed into law Oct. 2011; effective Nov. 2013 – Nov. 2014) revises current law to require regulatory impact analysis. • Administrative Procedure Act

	Strategy 3: Identify unnecessary fees and processes and implement simple solutions to resolve them. For example: • Encourage counties to notify landowners when their Conditional Use Permit (CUP) is about to expire to avoid the expense of reinstating an expired CUP; or • Create a mechanism to reinstate expired CUPs.	
Many costs are due to fees and paperwork that don't appear to result in the underlying social or environmental goals of regulations. Furthermore, the frequent delays in the regulatory process can have social and environmental consequences, such as slowing job-creation, restoration, etc.	***Objective:*** Ensure that the time and cost of the regulatory process contribute to achieving the underlying regulatory goals.	
	Strategy 1: Establish performance-based regulatory systems that evaluate projects based on outcomes rather than requiring specific practices.	
	Strategy 2: Projects that achieve important public policy objectives should be fast-tracked for approval (e.g. reduce the time and cost to comply with CEQA as long as project complies with all other environmental protection laws that have been adopted since 1970).	• Existing options for streamlining the permit application process for certain project-types include general permits (SWRCB and Army Corps); Biological Opinions from NOAA, NMFS, US FWS; Fisheries Restoration Grant Program (DFG); CEQA exemption 15333; Long Term 1600 (DFG). • AB 1961 the Coho Salmon Habitat Enhancement Leading to Preservation Act (Coho HELP Act) • Tiered Permitting System (regulates according to risk), Department of Toxic Substances Control (DTSC) and the Integrated Waste Management Board (IWMB)

Producer Experience: *Lack of Understanding Among Stakeholders*

"Agriculture in California is diverse. One size does not fit all and there is a lack of understanding about the agricultural landscape."

Producers often feel misunderstood and taken for granted by agency staff and the general public. The non-agricultural community does not have an holistic understanding of what producers do, how their food is grown, or the myriad benefits working landscapes contribute to our communities and ecosystems.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
Each stakeholder group thinks and acts in isolation, resulting in a lack of understanding of or appreciation for one another's core interests and goals. The agricultural community itself	***Objective:*** Increase understanding of core interests among stakeholder groups.	• California Biodiversity Council • County Food System Alliances, Ag Innovations Network
	Strategy 1: Increase coordination and collaboration among all stakeholders to develop tangible solutions.	
	Strategy 2: Support ombudsperson programs.	• Ombusperson/Farmbudsperson positions in some

tends to recirculate information to the same groups within their industry.		counties throughout the state.
	Strategy 3: Demonstrate that producers understand a certain level of regulation is in their best interest as well.	
There is a lack of holistic understanding about agriculture and the benefits beyond crop production among agency staff (including inspectors) and the general public.	***Objective:*** Increase holistic understanding of agriculture among regulators and the general public.	• Ag Training for Regulators "Inreach" Program, Ventura County Ag Futures Alliance • Tech Notes, NRCS
	Strategy 1: Host farm visits that demonstrate how farmers are accomplishing shared goals (e.g. addressing climate change).	• Ag Tourism Ordinances (e.g. Sacramento County, San Luis Obispo, Santa Clara)
	Strategy 2: Reach out to the growing number of people interested in buying locally grown foods (a.k.a. locavores) and urban populations to "put a face on the farmer." Invite them to meet farmers, and learn who they are, what they do, and how their contribution is beneficial.	• Colorado rancher's billboard: "If you like what you see, thank a rancher."
Agricultural stakeholders are not sufficiently involved in the development of local ordinances.	***Objective:*** Ensure that agricultural stakeholders are involved with the development of local ordinances.	
	Strategy 1: Engage stakeholders early on in the process of creating new ordinances.	

Producer Experience: *Disincentives for Innovation*
"Requirements inhibit innovation and provide a disincentive for best practices from a business and ecological standpoint."

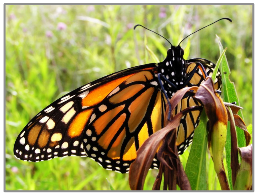
The regulatory system typically does not accommodate cutting edge solutions or technologies and producers feel that, in spite of the diversity of agricultural operations, rules are applied in a one-size-fits-all fashion. This can dampen innovative ideas and cause a project proponent to eliminate otherwise beneficial features of their project.

One producer sought approval for a multi-use processing facility, and found that, *"Rather than designing a facility to meet business and environmental goals, the design was driven by an uncoordinated set of regulations."*

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
Engaging in best practices from a business, social, or ecological standpoint can often result in a very complex and costly regulatory experience, which acts as a disincentive. Instead,	***Objective:*** Encourage producers to be innovative and engage in best practices.	• AB 1616: the California Homemade Food Act
	Strategy 1: Encourage creative collaboration between producer and regulator to foster mutual goals.	
	Strategy 2: Establish a government position that can assist producers with best practices.	

projects are driven by the need to comply with an uncoordinated set of requirements that do not accommodate innovative solutions.	*Strategy 3:* Consider innovation or education permits. Safe harbor agreements may help to protect innovative projects from agencies that are not on board.	• Safe Harbor Agreements, US FWS
	Strategy 4: Use pilot projects to test innovative technologies.	
	Strategy 5: Provide incentives to make improvements and complete projects that are beneficial to society and the environment (e.g., give credits for good performance).	• Conservation Stewardship Program, NRCS
Implementation of regulations is not always aligned with the underlying purpose of regulation, such as community and environmental benefit. There is no distinction between conventional development and projects with broad public and environmental benefits.	***Objective:*** Ensure that the regulatory process is achieving the underlying goals of regulation.	
	Strategy 1: Recognize and reward farmers' contributions to the greater good (providing habitat, carbon sequestration, producing fewer contaminants, energy conservation, job creation, etc.).	• *Environmental Farming Act Science Advisory Panel* review and documentation of ag's positive impacts to the environment. • Fish Friendly Farming (third party certification)
	Strategy 2: Shift from practice-based to outcome-based regulations.	• Performance-based incentive model, Santa Cruz RCD & Sustainable Conservation
	Strategy 3: Conduct life cycle analyses comparing innovative approaches to traditional approaches.	
	Strategy 4: Ensure that funding to assist growers with regulatory compliance supports environmental outcomes (not just monitoring).	

Stakeholder Group: Environment/Conservation



Perspective[2]:
Historically, environmental interests have not been brought into the conversation about regulatory reform except as adversaries, yet the conservation community understands that economic concerns must be considered as part of the effort to assure the protection of healthy ecosystems that all need. Statutes are passed to achieve environmental goals such as air quality, water quality, and species protection. Regulations have been created to implement statutes, and the conservation community sees them as vitally important to reducing negative impacts to society and the environment. However, the current regulatory system has not achieved the desired level of environmental performance, due both to the complex regulatory structure and lack of resources for agencies to effectively carry out their mandates. The system has also produced unintended consequences, including costly regulatory compliance for conservation projects, which limits funds for additional beneficial efforts. A distinction is needed between projects that contribute to ecosystem health and those with a negative impact on communities and the environment. However, any efforts to "streamline" the regulatory system must be carefully executed to improve environmental outcomes rather than undermining these goals. Finally, there is a sense that environmental regulations are unduly blamed for causing broader "regulatory burden." There are many other regulations and non-regulatory requirements that producers must comply with, and members of the conservation community believe that money spent fighting environmental laws might better go to collaborative problem-solving or compliance.

The following four tables represent the most frequently heard experiences of the regulatory framework for agriculture during our conversations with members of the environmental and conservation community. The full range of challenges heard can be downloaded at http://aginnovations.org/regulations/progress/. Each table includes challenges and recommended solutions, which are paired with current efforts or models where relevant. Current efforts and models (detailed at http://aginnovations.org/regulations/reg_resources/) have varying applicability to the specific recommendations and will require further investigation upon pursuit of that recommendation.

Environmental/Conservation Experience: *Achieving Environmental Outcomes*
"Accretion of the regulatory structure over time has led to the perverse situation in which the regulatory framework can actually impede the underlying environmental goal. While there is an essential need for regulation, a constant feedback loop should ensure achievement of the underlying environmental goals."

The environmental and conservation communities see regulations as vitally important mechanisms for environmental protection. However, many environmental problems still exist and while regulations are just one part of the solution, the regulatory framework could be improved to more effectively address these. Both structural and resource considerations must be taken into account when assessing how the regulatory system might better achieve its underlying environmental goals.

---

[2] This perspective is a synthesis of conversations with environmental stakeholders and may not represent all views in the environmental and conservation community.

"There are insufficient resources to carry out and enforce existing regulations. Regulations will become less effective over time if the public sector capacity continues to collapse."

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
Regulations do not always achieve their desired outcomes. The regulatory framework itself can actually impede the underlying environmental goal.	***Objective:*** Ensure achievement of environmental goals.	
	Strategy 1: Implement a constant feedback loop.	
	Strategy 2: Promote outcome-based standards. Define the goal and then allow the resourcefulness of both farmers and agencies to meet these goals.	
Implementation of regulations can be delayed, and once implemented, they are not always sufficiently or consistently enforced. This is due both to lack of resources for regulatory agencies and lack of effective interagency coordination.	***Objective:*** Ensure that regulatory agencies have the capacity to effectively carry out their regulatory mandates.	
	Strategy 1: Increase resources for regulatory agencies to allow them more capacity and efficiency.	
	Strategy 2: Encourage the agricultural community to support funding for agencies by demonstrating that this would help create a more flexible and supportive regulatory system.	
	Strategy 3: Support funding for conservation programs and technical support through the Farm Bill and NRCS.	
	Strategy 4: Improve coordination among agencies, among technical support organizations, and between the two to increase their collective capacity.	

Environmental/Conservation Experience: *Distinguishing Beneficial Practices*
"A distinction is needed between people that are engaged in egregious practices and those who are contributing to ecosystem health."

Compliance with the Clean Water and Clean Air Acts represent a basic level of performance that farmers are required to achieve – this is simply the cost of doing business and is non-negotiable in the eyes of the environmental/conservation community. While regulations are intended to set a basic standard and prevent negative impacts to the environment, they can also have the unintended consequence of hindering beneficial projects. Expediting projects that improve the environment is something multiple stakeholders can find common ground on, once a clear definition has been widely agreed upon.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
The challenges of navigating the regulatory process and the cost of completing even simple projects can prevent beneficial projects and lead to further	***Objective:*** Define and encourage beneficial projects.	
	Strategy 1: Develop a clear definition of a beneficial project between conservation professionals and the environmental community.	• Partners in Restoration Program, Sustainable Conservation
	Strategy 2: Establish a 2-tiered regulatory track (e.g. the	• AB 1961 Coho HELP Act

environmental degradation.	stewardship track vs. the standard track) and expedite the beneficial projects. Consider sorting by landowner or land use. Build on existing efforts, including programmatic permitting programs.	• SWRCB wetland and riparian area protection policy (in progress) • Partners in Restoration Program, Sustainable Conservation
	Strategy 3: Establish incentive programs to reward beneficial practices and encourage high performance. Consider reducing regulatory requirements for those with appropriate third party certifications or providing tax breaks to those undertaking beneficial projects.	• Conservation Stewardship Program • San Mateo County Green Building Ordinance (established a reasonably achievable required baseline and included incentives for higher levels of performance). • Fish Friendly Farming (third party certification)
	Strategy 4: Follow-up with landowners who have received money for on-the-ground restoration to ensure the restoration is actually happening.	
Existing mechanisms to assist landowners with beneficial projects are underutilized. For example, California's provisions for safe harbor agreements and voluntary local programs have each only been used once.	***Objective:*** Assist landowners to implement beneficial projects effectively.	
	Strategy 1: Ensure that landowners are aware of existing tools.	
	Strategy 2: Determine which tools will best assist private landowners in successfully undertaking beneficial projects on their lands.	
	Strategy 3: Coordinate and better utilize existing channels of support (i.e., UCCE, NRCS, RCDs, Farm Bureau, and private companies) to provide technical assistance for beneficial practices to growers. Reallocate regulatory resources to include support mechanisms.	
A small percentage of landowners may take advantage of efforts to reduce regulatory barriers for beneficial practices to engage in destructive practices.	***Objective:*** Ensure that efforts to streamline permitting for beneficial practices do not inadvertently provide opportunities for environmental degradation.	
	Strategy 1: Target incentives at those who are managing their land well on a regular basis and do not reward those who have mismanaged their land.	

Environmental/Conservation Experience: *Misplaced Blame Regarding Cost of Regulation*
"It is not accurate to lump all regulations together and then single out environmental regulations as the source of the burden."

Environmental and conservation representatives point out that environmental regulations are actually a very small percent of the total cost of regulation, and that a significant amount of money is spent fighting regulation rather than facilitating compliance. Environmental regulations are justifiable because they are trying to stop the cost of agricultural impacts from being borne by others in society and the environment.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
The regulatory landscape for agriculture includes requirements for labor, building, food safety, and a variety of self-imposed regulations, in addition to environmental laws. There is a tendency to blame the cost of regulation on environmental issues, although they are a very small percent of the total cost of regulation.	***Objective:*** Assess the cost of environmental regulation and seek strategies to reduce costs while achieving environmental goals.	
	Strategy 1: Assess the real cost of regulation for agriculture. Develop metrics against which to measure cost of regulation.	
	Strategy 2: Focus on preventing environmental degradation, which is far less expensive than cleaning up after the fact. Encourage collaboration on positive solutions between the environmental/conservation community and the agricultural industry.	
	Strategy 3: Encourage development and use of improved technologies that could both save money and result in the desired environmental outcomes.	
The agricultural industry spends a significant amount to time fighting regulation and rebutting accepted science, which is much more costly than simply complying with environmental regulations.	***Objective:*** Ensure that resources are being put toward solutions that increase environmental performance and reduce costs for producers.	
	Strategy 1: Collaborate on solutions with all relevant stakeholders.	
	Strategy 2: Assess how the agricultural industry delivers its services and identify opportunities for cost savings to growers.	
	Strategy 3: Encourage the agricultural industry to reallocate resources from fighting regulations to assisting farmers with best practices.	

Environmental/Conservation Experience: ***Lack of Trust and Collaboration Among Stakeholders***
"Relationships and trust building are important, but must be mutual."

Collaboration, particularly among agricultural and environmental communities, can be challenging. While individuals may be able to work well together, the broader relationship is characterized by frustration and a lack of trust for one another.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models

A lack of willingness to collaborate and understand one another exists between stakeholder groups.	***Objective:*** Encourage collaborative problem-solving to both reduce regulatory burden and ensure environmental outcomes.	
	Strategy 1: Build trust among stakeholder groups and endeavor to understand one's impacts on the other. Communicate clearly and work together to dispel misconceptions immediately.	• California Roundtable on Agriculture and the Environment, Ag Innovations Network • County Food System Alliances, Ag Innovations Network • California Biodiversity Council
	Strategy 2: Encourage the agricultural community to educate their constituents on the need for regulation.	
The agricultural community does not provide robust information to regulators due to fear of additional regulation and concern that environmental organizations will not treat this data fairly. Instead, producers turn to gatekeeper organizations to collect and present as little data as possible, which leads regulatory agencies to impose a more costly regime so they can get the information they need. This scenario makes it hard to collaborate on improvements.	***Objective:*** Encourage the agricultural community to share relevant information with regulators.	
	Strategy 1: Dispel the fear of sharing data by demonstrating to producers that this would result in a less onerous process that could be better tailored to their real needs.	

Stakeholder Group: Regulatory

Both state and local agencies participated in this study. Federal agency perspectives are not included in this report as they typically delegate implementation and enforcement of regulations to state agencies, while providing oversight and guidance.

State Agency Perspective[3]:
Regulatory agencies are charged with developing and implementing regulations and programs, consistent with federal and state laws, to protect public health and the environment. They recognize that the flaws, shortcomings, and inefficiencies of the current regulatory system can result in confusion and frustration for the regulated community. They are dedicated to minimizing these challenges through better interagency coordination and collaboration, communicating with stakeholder groups to better understand their needs and concerns, and advancing projects that achieve environmental results. However, these efforts are hindered by the lack of additional staff and funding to effectively carry out existing regulatory programs and launch new efforts.

The following four tables represent the most frequently heard experiences of regulatory agencies themselves during conversations with state level staff. The full range of challenges heard can be downloaded at http://aginnovations.org/regulations/progress/. Each table includes challenges and recommended solutions, which are paired with current efforts or models where relevant. Current efforts and models (detailed at http://aginnovations.org/regulations/reg_resources/) have varying applicability to the specific recommendations and will require further investigation upon pursuit of that recommendation.

State Agency Experience: ***Lack of Interagency Coordination***
"Regulatory agencies often develop permitting regulations in a stovepipe fashion without meaningful or effective consultation with other agencies."

Regulators are frustrated by the lack of meaningful coordination other agencies at all levels of government as they develop new requirements. This results in regulations targeted at specific issues that ignore the interconnectedness of the system in which they're applied. Agency staff understand that this is equally frustrating for the regulated community.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
Regulation happens in piecemeal fashion. As a result, laws can be duplicative or inconsistent with one another. E.g., compliance with a water requirement could result in	***Objective:*** Improve regulatory coordination.	
	Strategy 1: Forge a memorandum of understanding (or a framework agreement) among agencies at the highest level to catalyze and improve interagency coordination, communication, consultation, joint funding, collaborative action, and provide needed leadership on key priorities.	• California Biodigester Regulatory Work Group

[3] This perspective is a synthesis of conversations with state-level regulatory stakeholders and may not represent all state agency views.

noncompliance with an air requirement		
New and emerging priorities (such as renewable energy projects) can be challenging to address in the current regulatory framework due to lack of interagency coordination. The magnitude of work to be done far outstrips the human and financial resources of one agency.	***Objective:*** Collaboratively develop mechanisms to address emerging regulatory areas.	
	Strategy 1: Encourage a team approach though interagency working groups for coordinated goals, strategies, and actions among state agencies.	• California Biodiversity Council • 2012 Bioenergy Action Plan Bioenergy Interagency Working Group
	Strategy 2: Collaborate with diverse legislative champions.	• AB 1961 Coho HELP Act • CEQA streamlining, State Assembly on Natural Resources • 1600 permits, Senate Environmental Quality Committee
No one agency is in charge of permitting or assistance for agriculture.	***Objective:*** Ensure that agricultural stakeholders get the assistance they need to comply with regulations.	• Consolidated Permitting Program • CalGOLD, Governor's Office of Business and Economic Development
	Strategy 1: Divide agency responsibilities among levels of government, and establish one point of contact at the local level to engage directly with producers.	• Ombusperson/Farmbudsperson positions in some counties throughout the state.

State Agency Experience: *Agricultural Understanding and Outreach*
"Promote greater mutual understanding among farmers and regulators to build support for environmental regulatory programs."

Traditional agency culture has discouraged meaningful communication and collaboration amongst agency representatives and those they regulate. Regulatory staffs do not feel empowered to reach out directly to producers and develop greater understanding of agricultural perspectives. Meanwhile, the environmental community is concerned that regulatory reform could result in decreased environmental protection, which can further discourage regulators' efforts to reach out to agricultural stakeholders. However, there is growing recognition that building trust and understanding among all stakeholders is important to the creation of an effective regulatory system, and that assisting producers with best practices can result in better environmental outcomes.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
There is a general lack of knowledge and understanding about California agriculture and agricultural practices among agency staff.	***Objective:*** Increase understanding of agriculture among agency staff.	• California Biodiversity Council
	Strategy 1: Foster an agency culture that encourages being open to agricultural perspectives, establishing relationships, learning from one another, and collaborating.	
	Strategy 2: Support opportunities for agency staff to better understand farmers by spending time in the field and	• Field days and other ag education efforts of the County Food System Alliances, Ag Innovations Network

	exchanging ideas about solutions.	
	Strategy 3: Build on creative solutions for information sharing between the agricultural community and regulators.	• Ag Training for Regulators "Inreach" Program, Ventura County Ag Futures Alliance
	Strategy 4: Collaborate with NRCS to populate a database for "customary, reasonable and usual" agricultural practices that should be exempt from permitting.	
More outreach and education to the regulated agricultural community is needed.	***Objective***: Provide regulatory assistance to producers.	
	Strategy 1: Strengthen and build capacity at the local resource conservation district level to provide technical assistance on land use and sustainability planning.	• Sustainable Conservation/RCD collaboration
	Strategy 2: Create ombudsperson positions to mediate disputes related to agricultural permits and projects (at county and/or state levels)	• Ombusperson/Farmbudsperson positions in some counties throughout the state. • AB 691 (would have established a state-level ombudsperson through CDFA; bill died Feb. 2012)
	Strategy 3: Develop user-friendly web tools for producers.	• CalGOLD, Governor's Office of Business and Economic Development • California Environmental Reporting System (CERS), Cal/EPA • Washington State Joint Aquatic Resources Permit Application (JARPA) • CA Biodigester Regulatory Working Group unified web portal for application process (planned)
	Strategy 4: Advocate for incentives for smaller growers (e.g. technical assistance, bond funds, etc.).	

State Agency Experience: *Beneficial Projects*

"New forms of investment in working lands are needed to complement and reinforce traditional ways of paying for conservation."

Regulators are in favor of projects on working lands that conserve natural resources or are otherwise beneficial to the environment, as they align with the underlying goals of many regulations. However they understand that the existing regulatory structure can pose a barrier to permitting these types of projects. The shortage of funding further hinders agencies' ability to encourage and support conservation projects on working lands.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
Regulatory hurdles often prevent producers from implementing conservation practices and watershed	***Objective:*** Allow producers to more easily implement conservation practices.	
	Strategy 1: Promote and advance promising initiatives such as the Conservation Pivot, which encourages conservation	• Conservation Pivot, Department of Conservation

restoration projects.	through market incentives and regulatory efficiencies.	
	Strategy 2: Replicate AB 1961 statewide as an example for achieving collaboration and coordination for conservation on private agricultural lands and regulatory coordination for environmental benefit.	• AB 1961 Coho HELP Act
	Strategy 3: Support existing efforts to expand regional programmatic permitting programs for watershed restoration statewide.	• Partners in Restoration Program, Sustainable Conservation

State Agency Experience: *Agency Resources*
"Constructive actions are often paralyzed by budget cuts."

Agencies have experienced regular budget cuts over the past several years, which prevent them from carrying out their existing mandates and also slow their ability to act on solutions to regulatory challenges. .

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
Without adequate funding and staffing, solutions are difficult to pursue. Resources are needed not only to create new regulations and enforce existing regulations, but also to engage in collaborative efforts for a more effective regulatory system and assist the regulated community with compliance.	***Objective:*** Increase support for agency funding.	
	Strategy 1: Increase understanding about the role of agencies and raise awareness about the importance of regulation to achieving societal goals among the regulated community and general public.	

County Agency Perspective[4]:
Local regulators note that the cascade of regulations over the last 10 years has been overwhelming to all industries, not just to agriculture. Because producers have historically been exempt from a number of regulatory processes and permit requirements, they are unaccustomed to the quantity of regulations now affecting their business, which contributes to their sense of "regulatory burden." County agencies are in the unique position of being beholden to both local stakeholder and state and federal laws. They are also aware of emerging regulatory needs, yet

[4] This perspective is a synthesis of conversations with county-level regulatory stakeholders and may not represent all local agency views.

find that their bureaucratic structure prevents timely response. This is compounded by the current budgetary climate, which has forced agencies to manage a growing enforcement load with fewer staff and less funding.

The following three tables represent the most frequently heard experiences of regulatory agencies themselves during conversations with county level staff. The full range of challenges heard can be downloaded at http://aginnovations.org/regulations/progress/. Each table includes challenges and recommended solutions, which are paired with current efforts or models where relevant. Current efforts and models (detailed at http://aginnovations.org/regulations/reg_resources/) have varying applicability to the specific recommendations and will require further investigation upon pursuit of that recommendation.

County Agency Experience: *Relationship with the Agricultural Community*
"The goal of local regulators is not to make life difficult for producers, but rather to implement responsible land use policies and then get out of their way so they can produce food and fiber."

Regulators are responding to the needs of all constituents in developing laws. On the one hand, they have advocates for regulation, who expect that new law will resolve their concerns. On the other side are those who are being regulated and who feel burdened by these new regulations. While new laws are well intended, they are complex, making it impossible to predict all consequences. A better understanding of producers' needs could result in more effective policies; however, regulators find that getting input from farmers can be challenging.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
County agency staff hear frequent complaints from producers about over-regulation. However, in order to address the underlying issues, regulators need specific feedback.	***Objective:*** Allow agency staff to more effectively address regulatory problems.	
	Strategy 1: Foster relationships between producers and local agency staff that build trust and understanding of one another's experiences.	
	Strategy 2: Encourage the agricultural community to stay engaged, read new legislation, and give specific feedback about regulatory issues. Engage directly with local regulators before taking positions, writing letters, or commenting publicly.	
Producers are hard to reach and are often not responsive to regulator attempts to get input. While some members of the agricultural community do respond to requests to review regulatory proposals, they are typically passed to lawyers,	***Objective:*** Increase effective communication among regulators and the agricultural community.	
	Strategy 1: Build trust through transparency, collaboration and empathy.	• County Food System Alliances, Ag Innovations Network
	Strategy 2: Utilize producers' existing relationships with ombudspeople, ag advisory committees, or ag support organizations to expand communication between agencies and producers.	• Ag Training for Regulators (Inreach) Program, Ventura County Ag Futures Alliance

which results in wordsmithing rather than assisting regulators in developing better policy based on producer concerns.	*Strategy 3:* Encourage the agricultural community to respond to invitations from regulators to discuss new proposals. These meetings are intended to ensure that new laws will not prevent someone from doing business if written in a certain way.	

County Agency Experience: *A Rapidly Changing Landscape of Food and Agriculture*

"Regulators are very good at following the rules that have been set up, but they are a little behind the curve on innovation."

Agriculture is not the same as it was even 10 years ago. Many non-agricultural things are now happening on farmland, ranging from weddings and farm dinners to large-scale solar installations. Meanwhile, there is a demand for small-scale processing and value-added products. These situations raise a host of issues that were never contemplated by regulators. As they struggle to address these emerging areas in a timely manner, regulators are seeking a balance between the public's interest and the changing business needs of agriculture.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
Food production has changed rapidly over the last several decades and regulations have not kept pace. Emerging regulatory areas include ag tourism, renewable energy on ag land, small-scale food processing, and direct marketing, all of which have impacts that require regulatory attention. Regulators don't have a regulation that fits every situation.	***Objective:*** Address emerging regulatory areas in an effective and efficient way.	
	Strategy 1: Encourage communication and collaboration between agricultural stakeholders and regulators. Discuss project proposals and work cooperatively towards a solution that works for all parties.	
	Strategy 2: Share emerging policies and ordinances among counties.	• Solar Energy ordinances in San Luis Obispo and Sacrame • Ag Tourism ordinances in San Luis Obispo, Santa Barbara, and Sacramento.
	Strategy 3: Segregate activities by risk or scale and regulate accordingly.	• Tiered Permitting System (regulates according to risk), Department of Toxic Substances Control (DTSC) and the Integrated Waste Management Board (IWMB) • AB 1616: Cottage Food Law
	Strategy 4: Establish a system in which a project that fits a pre-determined set of criteria is easily permitted, while a project that falls outside that requires more discretion.	• Sonoma County Zoning Ordinance (allows processing for facilities up to a certain size without a use permit)
	Strategy 5: Develop sets of standards or handbooks to assist farmers with permitting and compliance (e.g. food processing, animal waste handling)	• *Small-scale On-farm Food Processing in Marin County*, Marin County • *Residential Construction Manual*, Sonoma County
Outdated codes and ordinances can stand in the way of activities that may be	***Objective:*** Enable local agencies to respond to the needs of producers in a timely and effective way.	
	Strategy 1: Collaborate on setting the right policies at the	

acceptable today. However it can be challenging to change existing laws and can take years to enact new ordinances. There is a need to be proactive and respond quickly to the changing needs of agriculture, but this is challenging due to the nature of bureaucracy and the lack of agency resources.	beginning of the rule making process to allow local agencies to be more creative.	
	Strategy 2: Encourage producers to advocate for policy change at the state level, which will trickle down to the local level.	
The government is slow to adapt to modern technology, which can contribute to the sense of regulatory burden for producers and regulators alike. E.g., Government offices are open from 8am-5pm, but farmers are out from daylight to dark, making it challenging to collect paperwork and get original signatures.	***Objective:*** Encourage the use of modern technology in the regulatory process.	
	Strategy 1: Allow producers to submit or update information online.	• California Environmental Reporting System (CERS), Cal/EPA
	Strategy 2: Allow producers to electronically sign documents (originals are currently required on many documents).	

County Agency Experience: *Forces Beyond Local Control*

"Farmers need to advocate for their needs and also take into consideration what is demanded of county agencies, such as meeting mandates from state agencies."

Many local regulators understand the needs of their agricultural communities, yet they are required to comply with and enforce state and federal laws, even when they recognize that those laws that are not appropriate to local needs or have an undesirable local impact. There are also many non-regulatory pressures that compound the sense of burden producers feel about regulation; however, there is often little that regulators can do about this.

Stated Challenges	Proposed Recommendations	Relevant Efforts/Models
There can be discrepancy between state or federal laws and local needs. However, local agencies often do not have control over the laws they are charged to enforce.	***Objective:*** Build understanding and support for local regulators.	
	Strategy 1: Support the Ag Commissioner and other local agencies in their role of sharing information with the agricultural community, especially when abrupt regulatory changes occur.	

There are many pressures on producers that contribute to the sense of “burden,” but they are not all regulatory. E.g., economic development issues, market-driven requirements, and immigration issues.	***Objective:*** Identify the correct source of “burden” and develop appropriate solutions.	
	Strategy 1: Problem-solve cooperatively between county staff and the producer. Identify core interests and determine what can be done at the county-level to develop solutions (e.g. put together a package that facilitates both permitting and economic development).	

Synthesis of Stakeholder Experiences and Perspectives:

Agricultural, environmental, and agency stakeholders agree that regulation is important. They also acknowledge that the regulatory system can be improved, although their recommendations for improvement are not always compatible.

Agricultural producers, environmental and conservation representatives, and staff at local and state agencies are all striving to meet their obligations to the best of their abilities given their existing resources:

- The agricultural community is responsible for working the land to grow, process, and sell food consistent with best practices and societal expectations. Producers operate businesses, and also fulfill the critical need of providing food to members of society. They are proud of their stewardship ethic and are simultaneously concerned that the regulations affecting their business may compromise the economic viability of their operations.
- Environmental and conservation organizations represent the public's interest in a healthy environment and work to protect the natural resources that sustain us all. They are concerned that the current regulatory system does not sufficiently meet the environmental goals of society.
- Regulatory agencies are charged with responding to the concerns of all their constituents, while protecting the public interest by interpreting, implementing, and enforcing laws. They struggle to address the shortcomings of regulatory system while carrying out their mandates in an era of declining resources.

As members of society working on various aspects of our shared world, the efforts of these three stakeholder groups intersect and can impact one another, for better or for worse. For example, working landscapes can have both positive side effects (e.g., ecosystem services) and negative side effects (e.g., pesticide drift); environmental efforts to protect water quality may hinder producers' ability to maximize yield; and application of well-intended regulatory requirements can lead to paperwork or fees that do not appear to result in improvements to environmental health.

Ultimately, all of these efforts are trying to make our world a better place to live by providing plentiful and safe food, a thriving environment, and economic viability for all. The question is how can our regulatory system respond to these (at times competing) societal goals without unduly burdening any one interest or social need? What changes can be made to the regulatory structure and process that will accommodate our shared goals while resolving the current challenges?

As a first step to answering these questions, the top three issue areas shared by all stakeholder groups were identified and comprise the recommended strategies and relevant efforts/models below. Note that many of these strategies repeat those listed in earlier parts of the report.

1. Assistance for Producers

Objectives include increasing transparency and assisting project proponents to more easily navigate the regulatory process, as well as providing support in achieving environmental outcomes.

Proposed Recommendations	Relevant Efforts/Models
Objective: Provide regulatory guidance to producers.	
Strategy 1: Develop and share standards, guidelines, or manuals to help farmers meet or exceed targets and better navigate the permitting and compliance processes.	• Oregon Environmental Restoration Permit Guide • Resource Conservation District guides • *Permit Guidance Manual for Anaerobic Digestion Projects*, Cal/EPA • *Small-scale On-farm Food Processing in Marin County*, Marin County • Residential Construction Manual, Sonoma County • California Public Resources Code Section 71001: Environmental Protection Permit Reform Act of 1993
Strategy 2: Establish a lead agency to direct the process and serve as a one-stop shop. Assign an ombudsperson or agency staff person with the authority and knowledge to efficiently shepherd the applicant through the process, and a broad perspective on relevant issues.	• Resource Conservation Districts and other organizations sometimes act in this role for specific project types. • Ombusperson/Farmbudsperson positions in some counties throughout the state. • AB 691 (would have established a state-level ombudsperson through CDFA; bill died Feb. 2012) • CA Dairy Quality Assurance Program • Water Quality Coalitions • California Rangeland Water Quality Management Plan
Strategy 3: Establish a system in which a project that fits a pre-determined set of criteria is easily permitted, while a project that falls outside that criteria requires more discretion.	• Sonoma County Zoning Ordinance (allows processing for facilities up to a certain size without a use permit) • CEQA exemption 15333
Strategy 4: Pre-approve “customary, reasonable and usual” agricultural practices that can be done with a ministerial permit or no permit at all, and ensure that agency staff and producers are aware of these (e.g., via a database).	• NRCS (work on approved practices)
Objective: Ensure that producers have the technical support they need to comply with regulatory requirements.	
Strategy 1: Ensure that landowners are aware of existing assistance tools.	
Strategy 2: Determine which tools will best assist private landowners in successfully complying with regulatory requirements.	
Strategy 3: Coordinate and better utilize existing channels of support (i.e., UCCE, NRCS, RCDs, Farm Bureau, and private companies) to provide technical	

assistance to growers regarding regulatory requirements. Support funding and capacity-building for conservation programs and technical support organizations.	
Objective: Develop user-friendly web tools for producers.	• CalGOLD, Governor's Office of Business and Economic Development • California Environmental Reporting System (CERS), Cal/EPA • Washington State Joint Aquatic Resources Permit Application (JARPA) • CA Biodigester Regulatory Working Group unified web portal for application process (planned)
Strategy 1: Provide a regulatory roadmap, such as an online permit assistance tool (similar to Turbo Tax) that includes: ○ Checkboxes to describe the project/operation (e.g. number of acres, number of employees, etc.). ○ Reveal the regulatory consequences of each answer (e.g. cost, additional regulations triggered, etc.). ○ Include links to relevant codes/regulations and contact information for decision-makers at each point in the process. ○ Provide credit for environmentally or socially beneficial aspects of the operation/project. ○ Allow the regulator to be flexible based on the answers in this system (i.e., consider net environmental or social benefit). The system should ultimately encourage producers to improve their operations to a higher standard.	• CalGOLD, Governor's Office of Business and Economic Development
Strategy 2: Establish a single web portal that allows the project proponent to submit or update information in one place for all agencies to access, and also allows the producer to view/download the applicable information from each regulatory entity. Allow producers to electronically sign documents (originals are currently required on many documents).	• California Environmental Reporting System (CERS), Cal/EPA • Washington State Joint Aquatic Resources Permit Application (JARPA) • California Biodigester Regulatory Working Group unified web portal for application process (planned)

2. Beneficial Outcomes

Objectives include ensuring achievement of environmental goals, encouraging innovation and best practices, and supporting beneficial projects.

Proposed Recommendations	Relevant Efforts/Models
Objective: Collaborate with producers on innovative project proposals and best practices.	
Strategy 1: Encourage creative collaboration between producer and regulator	

to foster mutual goals. Discuss project proposals and work cooperatively towards solutions that work for all parties.	
Strategy 2: Establish a government position that can assist producers with best practices.	• Ombusperson/Farmbudsperson positions in some counties throughout the state.
Strategy 3: Share emerging policies and ordinances among counties.	• Solar Energy ordinances in San Luis Obispo and Sacramento. • Ag Tourism ordinances in San Luis Obispo, Santa Barbara, and Sacramento.
Strategy 4: Consider innovation or education permits. Safe harbor agreements may help to protect innovative projects from agencies that are not on board.	• Safe Harbor Agreements, US FWS
Strategy 5: Use pilot projects to test innovative technologies.	
Objective: Differentiate beneficial projects.	
Strategy 1: Develop a clear definition of a beneficial project between conservation professionals and the environmental community.	• Partners in Restoration Program, Sustainable Conservation
Strategy 2: Establish a 2-tiered regulatory track, such as the stewardship track and the standard track, effectively sorting projects by landowner, land use, or project type.	• AB 1961 Coho HELP Act • SWRCB wetland and riparian area protection policy (in progress)
Strategy 3: Segregate activities by risk or scale and regulate accordingly.	• Tiered Permitting System (regulates according to risk), Department of Toxic Substances Control (DTSC) and the Integrated Waste Management Board (IWMB) • AB 1616: Cottage Food Law
Strategy 4: Conduct life cycle analyses comparing innovative approaches to traditional approaches.	
Strategy 5: Support existing efforts to expand programmatic permit programs.	• Partners in Restoration Program, Sustainable Conservation • Salinas Watershed Program • Consolidated Permit Program, CalEPA (just for Hazardous Waste currently) • Permit Streamlining Effort (underway), CARB
Objective: Incentivize beneficial practices and high performance.	
Strategy 1: Recognize and reward farmers' contributions to the greater good (e.g., providing habitat, carbon sequestration, producing fewer contaminants, energy conservation, job creation, etc.). Consider net environmental benefit.	• *Environmental Farming Act Science Advisory Panel* - The panel reviews and documents ag's positive impacts to the environment. • Fish Friendly Farming (third party certification)
Strategy 2: Offer incentives such as technical assistance, expedited application processing, funding, or tax breaks to those who exceed regulatory targets and engage in projects that are beneficial to society and the environment.	• Carl Moyer Memorial Air Quality Standards Attainment Program • SWRCB Agricultural Water Quality Grant Program • Clean Water State Revolving Fund

	• USDA-NRCS conservation programs • Dept. of Conservation Watershed Coordination Grants • NOAA Restoration Center funding • DFG Fisheries Restoration Grant Program • Conservation Stewardship Program, NRCS • San Mateo County Green Building Ordinance (established a reasonably achievable required baseline and included incentives for higher levels of performance).
Strategy 3: Advance initiatives that encourage conservation through market incentives and regulatory efficiencies.	• Conservation Pivot, Department of Conservation
Strategy 4: Target incentives at those who are managing their land well on a regular basis and do not reward those who have mismanaged their land.	
Objective: Ensure that efforts result in environmental outcomes.	
Strategy 1: Shift from practice-based to outcome-based regulatory approaches. Define the goal and then allow the resourcefulness of both farmers and agencies to meet these goals.	• Performance-based incentive model, Santa Cruz RCD & Sustainable Conservation
Strategy 2: Implement a constant feedback loop that tests for achievement of environmental goals.	
Strategy 3: Ensure that efforts to streamline permitting for beneficial practices do not inadvertently provide opportunities for environmental degradation.	
Strategy 4: Ensure that funding to assist growers with regulatory compliance supports environmental outcomes (not just monitoring).	
Strategy 5: Follow up with landowners who have received money for on-the-ground restoration to ensure the restoration is actually happening.	

3. Stakeholder Collaboration

Objectives include building trust, increasing understanding of one another, solving problems collaboratively, and coordinating efforts to both reduce regulatory burden and ensure environmental outcomes.

Proposed Recommendations	Relevant Efforts/Models
Objective: Increase understanding and collaboration among stakeholder groups.	
Strategy 1: Build trust through transparency, collaboration and empathy. Foster relationships among stakeholder groups by better understanding one	• CA Biodiversity Council • California Roundtable on Agriculture and the Environment, Ag

another's interests and experiences. Communicate clearly and work together to dispel misconceptions immediately.	Innovations Network • County Food System Alliance Network, Ag Innovations Network • Partners in Restoration Program, Sustainable Conservation
Strategy 2: Encourage collaborative problem-solving among all stakeholders to both reduce regulatory burden and ensure environmental outcomes.	
Objective: Increase holistic understanding of agriculture among regulators and the general public.	
Strategy 1: Foster an agency culture that encourages regulators to be open to agricultural perspectives, establish relationships, learn from one another, and collaborate. Utilize producers' existing relationships with ombudspeople, ag advisory committees, or ag support organizations to expand communication between agencies and producers.	• Ag Training for Regulators "Inreach" Program, Ventura County • Tech Notes, NRCS
Strategy 2: Host farm visits that demonstrate how farmers are accomplishing shared goals (e.g. addressing climate change).	• Ag Tourism Ordinances (e.g. Sacramento County, San Luis Obispo, Santa Clara) • Field days and other ag education efforts of the County Food System Alliances, Ag Innovations Network
Strategy 3: Reach out to the growing number of people interested in buying locally grown foods (a.k.a. locavores) and urban populations to "put a face on the farmer." Invite them to meet farmers, and learn who they are, what they do, and how their contribution is beneficial.	• Colorado rancher's billboard: "If you like what you see, thank a rancher."
Strategy 4: Encourage the agricultural community to share relevant information with regulators by dispelling fears that the information will be abused and demonstrating that better understanding of their operations could result in a less onerous process that could be better tailored to their real needs.	
Objective: Involve all relevant stakeholders in the rule-making process.	
Strategy 1: Engage stakeholders early on in the process of creating new laws to ensure the policies are set correctly from the start.	
Strategy 2: Encourage the agricultural community to stay engaged, read new legislation, and give specific feedback about regulatory issues. Engage directly with local regulators before taking positions, writing letters, or commenting publicly.	
Strategy 3: Encourage producers to advocate for policy change at the state level, which will trickle down to the local level.	
Objective: Improve interagency coordination and collaboration.	
Strategy 1: Forge a memorandum of understanding (or a framework agreement) among agencies at the highest level to catalyze and improve	• California Biodigester Regulatory Work Group

interagency coordination, communication, consultation, joint funding, collaborative action, and provide needed leadership on key priorities.	
Strategy 2: Encourage a team approach though interagency working groups for coordinated goals, strategies, and actions among state agencies.	• California Biodiversity Council • 2012 Bioenergy Action Plan Bioenergy Interagency Working Group
Strategy 3: Collaborate with diverse legislative champions.	• AB 1961 Coho HELP Act • CEQA streamlining, State Assembly on Natural Resources • 1600 permits, Senate Environmental Quality Committee
Strategy 4: Divide agency responsibilities among levels of government, and establish one point of contact at the local level to engage directly with producers. Consider establishing ombudsperson positions to fill this role.	• Ombusperson/Farmbudsperson positions in some counties throughout the state.
Strategy 5: Improve coordination among agencies, among technical support organizations, and between the two to increase their collective capacity.	

SUMMIT ON REGULATIONS AFFECTING AGRICULTURE

Date: Wednesday, 12 June 2013
Location: Freeborn Hall, UC Davis, Davis, CA 95616

Desired Meeting Results

- Build a common understanding of the key regulatory issues
- Establish connections between stakeholders concerned with and already working on key regulatory issues
- Identify potential short- and long-term improvements to the regulatory system that address needs identified by stakeholders
- Explore new frameworks for accomplishing regulatory objectives

AGENDA

9:00 AM **Registration**

10:00 AM **Plenary**

- Welcome
- Keynote
  Secretary Karen Ross, California Department of Food and Agriculture
- Participant Introductions
- Project Summary
- Success Stories
  Karen Giovannini, University of California Cooperative Extension, Sonoma County
  Daniel Mountjoy, Sustainable Conservation

10:50 AM **Setting the Context**
Stakeholder Perspectives
Brian Leahy, Department of Pesticide Regulation
Sandy Morey, California Department of Fish & Wildlife
Antoinette Mantz, San Mateo County Environmental Health Division
Chris Turkovich, Turkovich Family Wines
Moira Burke, Agricola: flora et fauna
Russ Lester or Jenny Lester Moffitt, Dixon Ridge Farms (tentative)
Juliet Christian-Smith, Pacific Institute
Pablo Garza, The Nature Conservancy
Kim Delfino, Defenders of Wildlife (tentative)
Mark Nechodom, California Department of Conservation

12:35 PM **Lunch**

1:20 PM	**Break-Out Session: Moving Toward Action**

a) Relationship Building
Karen Buhr, California Association of Resource Conservation Districts
Sandra Schubert, California Department of Food and Agriculture
Leslie Koenig, Alameda County Resource Conservation District

b) Navigating the Regulatory Environment
Paul Martin, Governor's Office of Business and Economic Development
Daniel Mountjoy, Sustainable Conservation

2:50 PM **Break**

3:05 PM **Dialogue: A Regulatory Framework for the 21st Century**
Jovita Pajarillo, Consultant, formerly with US Environmental Protection Agency, Region 9
Sandra Schubert, California Department of Food and Agriculture

4:45 PM **Closing**
- Break-out Session Report Backs
- Next Steps

5:00 PM **Adjourn**

SPEAKER BIOGRAPHIES
Listed in order of first appearance.

Karen Ross
Secretary, California Department of Food and Agriculture

Karen Ross was appointed Secretary of the California Department of Food and Agriculture on January 12, 2011 by Governor Edmund G. Brown Jr. Secretary Ross has deep leadership experience in agricultural issues nationally, internationally, and here in California. Prior to joining CDFA, Secretary Ross was chief of staff for U.S. Agriculture Secretary Tom Vilsack, a position she accepted in 2009. Before her time at the United States Department of Agriculture, Secretary Ross served more than thirteen years as President of the California Association of Winegrape Growers (CAWG), based in Sacramento. During that same time period she served as the Executive Director of Winegrape Growers of America, a coalition of state winegrower organizations, and as Executive Director of the California Wine Grape Growers Foundation, which sponsors scholarships for the children of vineyard employees. Among Secretary Ross' many achievements at CAWG was the creation of the nationally-recognized Sustainable Winegrowing Program, which assists wine grape growers in maintaining the long-term viability of agricultural lands and encourages them to provide leadership in protecting the environment, conserving natural resources, and enhancing their local communities.

Karen Giovannini
Agriculture Ombudsman, University of California Cooperative Extension, Sonoma County

Karen Giovannini began as the Agriculture Ombudsman, which started as a pilot position, in February 2012. Karen has assisted and advised over 60 projects ranging from road side produce stands to meat sales to cheese creameries. She has also given presentations about regulations to various agricultural groups and created a website with fact sheets for those interested in learning about regulations requirements for specific subjects: http://ucanr.edu/sites/CESonomaAgOmbuds/. In 2010, Karen was hired by University of California Cooperative Extension (UCCE) Sonoma to define ecosystem services that occur on rangelands, documenting best management practices that increase services, and create tools to educate rangeland managers, policy makers, agencies, and NGOs on increasing economic opportunities to create markets for ecosystem services. She created a website housing this information, which can be visited at http://ucanr.org/sites/RangelandES/. Before coming to UCCE, Karen had a career as a product manager for two national mortgage companies. She received a BS in Agriculture Management, Cal Poly, San Luis Obispo.

Daniel Mountjoy
Director of Restoration on Private Lands, Sustainable Conservation

Dr. Daniel Mountjoy is responsible for leadership of three program areas at Sustainable Conservation: statewide expansion of the Partners in Restoration Program, Ecosystem Services, and Water Management. In support of these program areas, he is also working on strategies to strengthen the capacity of Resource Conservation Districts to assume a greater role in implementing small scale restoration projects. Prior to joining Sustainable Conservation, Daniel was Assistant State Conservationist for the Natural Resources Conservation Service serving the California Central Coast and San Francisco Bay-Delta regions. During his 17-year career with NRCS he fostered partnerships with Resource Conservation Districts, technical advisors, researchers and the agricultural community to promote water quality and habitat protection practices, and led efforts to integrate food safety with conservation practices. He collaborated with Sustainable Conservation for more than a decade to pioneer and expand permit coordination programs for restoration projects. Daniel earned a PhD in human ecology from UC Davis for his research on strategies to improve cross-cultural communication for resource management with Hispanic farmers. He also holds a BA in agroecology from UC Santa Cruz and an MA in Latin American studies from Stanford University. Daniel has practical on-the-ground experience as a farm and land manager on rural properties in northern California in the 1970s and as a landscape contractor in Santa Cruz in the 1980s.

Brian Leahy

Director, Department of Pesticide Regulation

Brian R. Leahy was appointed director of the California Department of Pesticide Regulation (DPR) on Feb. 2, 2012, by Governor Brown. Prior to joining DPR, Mr. Leahy served as assistant director for the Division of Land Resource Protection in the California Department of Conservation for five years. His focus was the potential for maximizing the benefits from open space management, including farmland management, to improve public health, transportation, biodiversity, climate change adaptation and natural resources. He has held many leadership roles in agriculture and has a strong history of working collaboratively with environmental organizations, agricultural groups, trade associations, local government officials and other stakeholders. Mr. Leahy served as executive director for the California Association of Resource Conservation Districts from 2004 to 2006 and executive director for the California Certified Organic Farmers from 2000 to 2004.

In 1980, he became one of California's pioneering organic and biodiversity farmers when he took over operations of Cherokee Ranch Inc., a 900-acre rice farm in Butte County that converted to organic farming practices. He leased out the farm in 1992, but owned the property until 2003. From 1992 to 1994, he operated the 800-acre organic corn, soybean, alfalfa and cattle Ackerlund farm in Fremont, Neb. Mr. Leahy also assisted a small international fair trade company for sustainable agriculture, worked as a Legal Aid attorney and was the co-founder of an inner-city market garden educational nonprofit in Nebraska. A native Californian, Mr. Leahy grew up in Ontario. He earned a Juris Doctorate degree from Creighton University School of Law in Omaha, Neb. A resident of Sacramento, Mr. Leahy is a member of the California Roundtable on Agriculture and the Environment.

Sandy Morey

Deputy Director, California Department of Fish & Wildlife

Sandy is Deputy Director of the California Department of Fish and Wildlife's Ecosystem Conservation Division. In that capacity she oversees statewide policy branches dealing with water issues, environmental review and permitting, conservation planning, and invasive species. She also oversees the Department's engineering programs. Sandy has been with the Department of Fish and Wildlife since 1988 in various capacities including managing its North Central Region, which encompasses the northern Sierra Nevada and the Sacramento Valley.

Antoinette Mantz

Food Program Supervisor, San Mateo County Environmental Health Division

Antoinette Mantz currently works as the Food Program Supervisor with San Mateo County's Environmental Health Division. She began her work with food systems issues over 11 years ago while assisting with a Farm to School feasibility study in Monterey County during her time at CSU Monterey Bay. She later completed a Masters in Public Health at San Diego State University with an emphasis in Environmental Health while also taking on a regulatory role within the food system. As a public health regulator at the local level, Antoinette works to promote not only food safety, but also security and sustainability.

Chris Turkovich

Farmer/Winemaker/Proprietor, Turkovich Family Wines

Chris Turkovich is the second of three sons and the winemaker in the family. He graduated from Cal Poly as a Wine & Viticulture major and is putting his degree to use. He has worked extensively in wineries throughout the world including Edna Valley Vineyards in San Luis Obispo, CA; RH Phillips in the Dunnigan Hills, CA; Veramonte in Casablanca, Chile; Chapel Hill Winery in McLaren Vale, Australia; and Kim Crawford in New Zealand. He brings a unique and varied exposure to his winemaking from the many regions and dealings with many varieties. Chris' responsibilities include working on the Button & Turkovich Ranch as a field supervisor and vineyard manager as well as the winemaker for Turkovich Family Wines.

Moira Burke

Owner, Agricola: flora et fauna

Moira Burke has been a family farm owner/operator since 1969. She owns Agricola: flora et fauna, which produces grassfed beef, organic hay, and grassfed lamb in Solano County. She also owns forestland in Sierra County. Moira is co-chair of the Solano County Ag Advisory Committee. Her primary interest is protecting farmland and natural resources. A fourth-generation Californian, Moira is a UC Davis graduate with a B.S. in Animal Science/Design. She has a California Teaching Credential and has been a public school teacher; is a former research scientist with beef cattle at UC Davis; and a scientific artist, also at UC Davis.

Russ Lester

Co-owner, Dixon Ridge Farms

Russ Lester is co-owner of Dixon Ridge Farms and a fourth generation California farmer. Russ began farming organically in 1989 and has helped shape many organic farming concepts and practices for orchards. An advocate for farmland protection, Russ serves on the Board of Directors for Solano Land Trust and the Solano County Agricultural Advisory Board. He has been a featured speaker at national conferences on farmland protection and organic agriculture. In addition, Russ is past president of the Winters Joint Unified School District. He is a graduate of the University of California at Davis and the California Agricultural Leadership Program.

Juliet Christian-Smith

Senior Research Associate, Pacific Institute

Dr. Juliet Christian-Smith is a Senior Research Associate with the Pacific Institute's Water Program. Her interests include agricultural water uses, comparative analyses of water governance structures, water reuse, and climate change. Dr. Christian-Smith is a recipient of the Environmental Protection Agency's Award for Outstanding Achievement and served on the Executive Board of the Agricultural Water Management Council. She is also a Frontiers of Science Fellow for the National Academy of Sciences. Prior to coming to the Pacific Institute, Dr. Christian-Smith was in Portugal on a Fulbright Fellowship studying the implementation of the European Union Water Framework Directive and examining agricultural water usage in the Alentejo region. During graduate school, she worked on several water policy projects in California through the University of California Cooperative Extension, managing the field work and data collection for an empirical study of agricultural water demand in California. Dr.

Christian-Smith holds a Ph.D. in Environmental Science, Policy and Management from UC Berkeley and a B.A. in Biology from Smith College.

Pablo Garza
Associate Director of External Affairs & State Policy, The Nature Conservancy

Pablo started with the Nature Conservancy in March of 2008. His work involves outreach to elected officials, government agencies, and community groups to build coalitions, influence public policy decisions, and further the conservation goals of the Nature Conservancy. He worked on policy issues affecting the Central Valley and Sierra for three years and was then promoted to manage state government relations, advancing the Conservancy's priorities at the State Legislature and with state agencies. Pablo is a California native and grew up in Orange County. He attended UC Davis where he earned a B.A. in English. After college, Pablo taught English for a semester in Campeche, Mexico and then returned to California and moved to Los Angeles to attend UCLA and earn an M.A. in Latin American Studies. After completing his degree, he accepted a job working for a Southern California lawmaker in the State Assembly to pursue his passion for public policy and politics. Pablo spent five years as staff in the state legislature where he worked on a variety of issues, including consumer protection, natural resources, education, health, and public contracting.

Kim Delfino
California Program Director, Defenders of Wildlife

Kim Delfino oversees the work of Defenders' six-person California program team in protecting and restoring California's imperiled wildlife and the places in which they live. Since joining Defenders in 2000, Kim co-authored the revision of the California Natural Community Conservation Planning Act and helped create the Salton Sea Coalition and Defenders' California desert program. She was also one of the key leaders in establishing the California Rangeland Conservation Coalition. Core California program issues include restoration of the Salton Sea; promoting wildlife conservation on agricultural and ranch lands, particularly in the Central Valley; protecting California's desert; promoting regional conservation planning; and protecting California's coastal waters. Kim was a co-author of the 2008 report, 'Economic Oasis: Revealing the True Value of the Mojave Desert'. Before joining Defenders of Wildlife, Kim worked for the U.S. Public Interest Research Group as a staff attorney and for CALPIRG as Legislative Director. She began her career as an associate attorney in Washington, D.C. with the public interest law firm of Meyer & Glitzenstein, where she specialized in cases involving the Endangered Species Act, Clean Water Act and other environmental laws including NEPA. Kim Delfino holds a B.A. in Political Science, Public Service (Environmental Policy Emphasis) from the University of California-Davis and a J.D., cum laude, from McGeorge School of Law at the University of the Pacific.

Mark Nechodom,
Director, California Department of Conservation

Mark Nechodom has dedicated his professional life to integrating conservation, regulation and development right where it matters the most: on the land, on the farm, and in the forest. His mission has been to inspire sustainable production and practices while maintaining a sensible balance between economic opportunities, environmental health and human well-being. Mark's background serves the Department well as he leads DOC's four divisions, unified by the mission of *Managing California's Working Lands*. Prior to his recent appointment as DOC Director, Mark was a Senior Policy Advisor to the Secretary of the US Department of Agriculture (USDA). He also served as Director of the Office of Environmental Markets at USDA, and as the Senior Climate Science Policy Advisor to the Chief of the US

Forest Service. Mark was the USDA representative on the team that negotiated the greenhouse gas reporting protocol for forestry for California's Climate Action Reserve, and provided scientific and technical support to the California Air Resources Board and the Board of Forestry in the development of the state climate strategy under AB 32 (the Global Warming Solutions Act of 2006). In the mid-1990's, Mark helped to establish the California Biodiversity Council, which has continued to provide a forum for California's local, state and federal conservation leadership for over two decades. He was the founder and co-director of the Land Use and Natural Resources program at UC Davis, a program that has provided training and certification for over 4,000 professional state and federal land and resource planners working across the US. Mark earned his doctorate in political science and environmental policy from the University of California, Santa Cruz, where he taught for several years.

Karen Buhr
Executive Director, California Association of Resource Conservation Districts

Karen Buhr supports the 99 Resource Conservation Districts (RCDs) in CA in addressing California's most pressing conservation issues from a local perspective including supporting a thriving agricultural community and making conservation work on the ground. She is passionate about local conservation. Ms. Buhr holds a BA in Environmental Studies from Macalester College and a MS in Natural Resource Science and Management from the University of Minnesota where she graduated with high distinction.

Sandra Schubert
Undersecretary, California Department of Food and Agriculture

Undersecretary Sandra Schubert was appointed by Governor Jerry Brown in May of 2011. She has spent two decades as a legal and political strategist for government and non-profits on a variety of agricultural, public health, environmental and resource issues, and has nearly 15 years experience working in Washington, DC. On behalf of the Majority Leader of the U.S. Senate and a Ranking Committee member, she developed and successfully carried out campaigns on major energy, environmental quality and agricultural issues. Undersecretary Schubert has advised Presidential, Congressional and local campaigns on a range of issues. Undersecretary Schubert has lectured nationally on numerous issues and taught at the Georgetown University School of Law.

Leslie Koenig
Biologist, Alameda County Resource Conservation District

Leslie is a biologist with the Alameda County Resource Conservation District. She has been working on permitting and addressing regulatory program issues in Alameda County for the last five years. One of the primary programs that Leslie works on in Alameda County is the Wildlife Friendly Ponds Program, which provides regulatory and financial incentives to landowners to implement pond restoration projects that benefit the landowners and listed species. Leslie received her B.S. in Biology in 2004 from Fort Lewis College in Durango, Colorado. She grew up in the mountains of Colorado and moved to California in 2004. She worked for an environmental toxicology firm as a laboratory technician in Davis before joining the District and moving to Livermore.

Paul Martin
Deputy Director of Permit Assistance, Governor's Office of Business and Economic Development

Paul Martin, of Petaluma, is deputy director of permit assistance in the Governor's Office of Business and Economic Development. Martin was director of environmental services at Western United Dairymen from 2000 to 2012 after starting as a field representative in 1999. He was owner and operator of Paul and Jill Martin Dairy from 1976 to 1999 and a partner in the Claude Martin and Son Dairy from 1969 until 1976. Martin is a former member of the United States Department of Agriculture Agricultural Air Quality Task Force and currently serves on the Farm, Ranch, and Rural Communities Federal Advisory Committee of the United States Environmental Protection Agency. He received his Bachelor of Science degree in Agricultural Production from the University of California, Davis and his Master of Arts degree in Environmental Policy from California State University, Sonoma.

Jovita Pajarillo
Consultant, formerly with US Environmental Protection Agency, Region 9

Jovita Pajarillo is a newly minted retiree of the U.S. Environmental Protection Agency, Pacific Southwest Region, in San Francisco. This regional office includes the states of California, Nevada, Arizona, Hawaii, the Pacific Basin, and 144 federally recognized tribes. As a manager in the Water Division, Jovita was responsible for the implementation of Clean Water Act programs specific to agriculture and water quality. She has been recognized for her ability to build bridges to, and foster partnerships with the agriculture community to advance EPA's mission. She was the coordinator of a newly authorized Clean Water Act (1987) program which was to develop the nonpoint source program in the states (most notably agricultural runoff) and pioneered the watershed approach at EPA. Jovita participated in EPA's rulemaking of the Concentrated Animal Feeding Operations NPDES permit program, particularly for dairies and provided policy assistance and guidance to local regional water boards in the development of conditional ag waiver programs. She also participated in the Ag Vision 2030 process. Jovita initiated at EPA a forum among other federal/state agencies and academia to create a dialogue on ag and environmental protection. This forum focused on mutually-agreed upon solutions, or sought opportunities to create synergy to problem solving (including funding), and identify common ground (e.g., members included NRCS, state environmental quality department, universities, etc.) Jovita's efforts advocated for collaboration among partnering agencies, the ag community and NGOs to improve environmental performance such as the California Dairy Quality Assurance Program which won the 2007 Governor's LEED award. Jovita has been a member of the Ag Innovations Network Roundtables, Roots of Change, and is an active member of the California Water Policy Conference Committee and CA Envirothon. She is an alumnus of the California Ag Leadership Program, Class 28 and UC Berkeley.

Throughout 2012 and into 2013, Ag Innovations Network has heard from agricultural, conservation, and regulatory stakeholders about the challenges associated with regulations affecting agriculture. These conversations have been part of an effort to identify and help implement a broadly supported set of recommendations to simultaneously assure high environmental performance and the viability of farming operations at all scales. A subset of those recommendations is included below, along with the challenges as experienced by the listed stakeholder group and efforts or models that might be relevant to implementing the recommendation. More information on the efforts or models listed can be found at http://aginnovations.org/regulations/reg_resources/.

I. RELATIONSHIP BUILDING

Objective A: Build shared understanding among stakeholders (regulator – regulated – public/environment)

Stated Challenges	Strategies	Relevant Efforts/Models
Farmer: There is a lack of holistic understanding about agriculture and the benefits beyond crop production among agency staff (including inspectors) and the general public. ***State Regulator:*** There is a general lack of knowledge and understanding about California agriculture and agricultural practices among agency staff.	1. Increase holistic understanding of agriculture among regulators and the general public. Examples include farm tours, introducing farmers to the urban populations they serve (i.e., putting a face on the farmer), and training programs for regulators.	• Ag Tourism Ordinances (e.g. Sacramento County, San Luis Obispo, Santa Clara) • Field days and other ag education efforts of the County Food System Alliances, Ag Innovations Network • Farm-to-Fork Office, California Department of Food and Agriculture • Ag Education/Training Program for Regulators, Ventura County Ag Futures Alliance • Agri-Culture Program, Farm Bureau Santa Cruz County • Tech Notes, NRCS • Elkhorn Slough Coastal Training Program for Decisionmakers

Stated Challenges	Strategies	Relevant Efforts/Models
Conservation Representative: The agricultural community does not provide robust information to regulators due to fear of additional regulation and concern that environmental organizations will not treat this data fairly. Instead, producers turn to gatekeeper organizations to collect and present as little data as possible, which leads regulatory agencies to impose a more costly regime so they can get the information they need. This scenario makes it hard to collaborate on improvements. ***State Regulator:*** Outreach and education to the regulated agricultural community is insufficient.	2. Increase the flow of information between regulators and the regulated. Foster a culture that encourages farmers to share relevant data with regulators to allow more accurate regulation and encourages regulators to share regulatory processes with farmers to allow better compliance.	• Natural Resources Conservation Service • Resource Conservation Districts • UC Cooperative Extension • Ombudsperson/ Farmbudsperson positions in some counties throughout the state • CalGOLD, Governor's Office of Business and Economic Development
Conservation Representative: A lack of willingness to collaborate and understand one another exists between stakeholder groups. ***Local Regulator:*** County agency staff hear frequent complaints from producers about over-regulation. However, in order to address the underlying issues, regulators need specific feedback.	3. Foster relationships and build trust among stakeholder groups by better understanding one another's interests and experiences.	• California Roundtable on Agriculture and the Environment, Ag Innovations Network • County Food System Alliance Network, Ag Innovations Network • Agri-Culture Program, Farm Bureau Santa Cruz County • California Agricultural Commissioners and Sealers Association (CACASA)

Stated Challenges	Strategies	Relevant Efforts/Models
Farmer: Each stakeholder group thinks and acts in isolation, resulting in a lack of understanding of or appreciation for one another's core interests and goals. The agricultural community itself tends to recirculate information to the same groups within their industry. ***Local Regulator:*** Producers are hard to reach and are often not responsive to regulator attempts to get input. While some members of the agricultural community do respond to requests to review regulatory proposals, they are typically passed to lawyers, which results in wordsmithing rather than assisting regulators in developing better policy based on producer concerns.	4. Encourage collaborative problem solving among all stakeholders to foster mutual goals.	• California Biodiversity Council • Partners in Restoration Program, Sustainable Conservation • Coastal Training Program, Elkhorn Slough Foundation
Farmer: Agricultural stakeholders are not sufficiently involved in the development of local ordinances. ***Local Regulator:*** Outdated codes and ordinances can stand in the way of activities that may be acceptable today. However it can be challenging to change existing laws and can take years to enact new ordinances. There is a need to be proactive and respond quickly to the changing needs of agriculture, but this is challenging due to the nature of bureaucracy and the lack of agency resources.	5. Engage stakeholders early on in the process of creating new laws, at both local and state levels, to ensure that policies are set correctly from the start. Encourage stakeholders to stay involved and engage directly with regulators when there is a concern.	

Objective B: Increase interagency coordination (regulator – regulator)

Stated Challenges	Strategies	Relevant Efforts/Models
State Regulator: Regulation happens in piecemeal fashion. As a result, laws can be duplicative or inconsistent with one another. E.g., compliance with a water requirement could result in noncompliance with an air requirement	1. Forge a memorandum of understanding among agencies at the highest level to improve interagency coordination and provide needed leadership on key priorities. Ensure participation of the leadership (decision-makers).	• California Biodigester Regulatory Working Group • Governor's Drinking Water Stakeholder Group
State Regulator: New and emerging priorities (such as renewable energy projects) can be challenging to address in the current regulatory framework due to lack of interagency coordination. The magnitude of work to be done far outstrips the human and financial resources of one agency.	2. Encourage a team approach though interagency working groups for coordinated goals, strategies, and actions among state agencies. Incorporate interagency coordination within the infrastructure of the regulatory process. Identify and address barriers to inter-agency coordination such as timing, resources, etc.	• California Biodiversity Council • 2012 Bioenergy Action Plan Bioenergy Interagency Working Group
State Regulator: No one agency is in charge of permitting or assistance for agriculture. ***Local Regulator:*** There can be discrepancy between state or federal laws and local needs. However, local agencies often do not have control over the laws they are charged to enforce.	3. Increase coordination among state and local agencies, dividing responsibilities and establishing clear roles. For example, appoint one person at the local level to engage directly with farmers.	• Coordinated Permit Process, Cal/EPA • Ombudsperson/ Farmbudsperson positions in some counties throughout the state
Conservation Representative: Implementation of regulations can be delayed, and once implemented, they are not always sufficiently or consistently enforced. This is due both to lack of resources for regulatory agencies and lack of effective interagency coordination. ***State Regulator:*** Outreach and education to the regulated agricultural community is insufficient.	4. Improve coordination between regulatory agencies and technical support organizations to increase their collective capacity.	• California Biodigester Regulatory Working Group • Sustainable Conservation/Resource Conservation District collaboration

II. NAVIGATING THE REGULATORY SYSTEM

Objective: Develop a coherent framework for navigating the regulatory system.

Stated Challenges	**Strategies**	**Relevant Efforts/Models**
State Regulator: No one agency is in charge of permitting or assistance for agriculture.	1. Establish a lead agency to direct the regulatory process and serve as a one-stop shop. Assign an ombudsperson or agency staff person with the authority and knowledge to efficiently shepherd the applicant through the process, and provide a broad perspective on relevant issues.	• Resource Conservation Districts and other organizations sometimes act in this role for specific project types. • Ombusperson/Farmbudsperson positions at both state and local levels throughout the state. • AB 691 (would have established a state-level ombudsperson through CDFA; bill died Feb. 2012) • CA Dairy Quality Assurance Program • Water Quality Coalitions • California Rangeland Water Quality Management Plan • Cal/EPA Consolidated Permitting program • CA Biodigester Regulatory Working Group consolidated permitting process (Public Resources Code Sec. 71021)
Conservation Representative: Existing mechanisms to assist landowners with beneficial projects are underutilized. For example, California's provisions for safe harbor agreements and voluntary local programs have each only been used once. ***State Regulator:*** Outreach and education to the regulated agricultural community is insufficient.	2. Increase the capacity and coordination of existing channels of support (i.e., UC Cooperative Extension, Natural Resources Conservation Service, and Resource Conservation Districts) to provide effective technical assistance to growers regarding regulatory requirements.	• Sustainable Conservation/Resource Conservation District collaboration

Stated Challenges	Strategies	Relevant Efforts/Models
Farmer: Guidelines to inform project design are lacking and there is little information on regulatory goals that might help project applicants meet or exceed these targets.	3. Develop and increase the visibility of standards, guidelines, or manuals to help farmers meet or exceed targets and better navigate the permitting and compliance processes.	• Oregon Environmental Restoration Permit Guide • Resource Conservation District guides • *Permit Guidance Manual for Anaerobic Digestion Projects*, Cal/EPA • *Small-scale On-farm Food Processing in Marin County*, Marin County • *Residential Construction Manual*, Sonoma County • California Public Resources Code Section 71001: Environmental Protection Permit Reform Act of 1993 • *Agriculture Improving Resources (AIR's)* Conservation Management Handbook, SJVAPCD • *Best Available Control Technology Guidelines*, SJVAPCD
Farmer: The regulatory process and requirements are not transparent and are unpredictable. Accurately describing a proposed project to regulators is tricky. The wrong word choice (e.g., commercial vs. processing kitchen) can lead an applicant down the wrong regulatory path, and not being familiar with regulatory thresholds (e.g., square footage) can trigger additional requirements or cost. ***Conservation Representative:*** The challenges of navigating the regulatory process and the cost of completing even simple projects can prevent beneficial projects and lead to further environmental degradation.	4. Provide a regulatory roadmap, such as an online permit assistance tool (similar to Turbo Tax) that allows a farmer to input data about their operation and project and subsequently reveals the regulatory consequences of each answer (e.g., cost, additional regulations triggered, etc.). The tool should include links to relevant codes/regulations and contact information for decision-makers at each point in the process.	• CalGOLD, Governor's Office of Business and Economic Development • City of Vallejo Central Permit Center

Stated Challenges	Strategies	Relevant Efforts/Models
Farmer: Permits are typically required from multiple agencies that may have different interpretations of the regulations and are often unaware of one another's requirements, thus being unable to provide navigation assistance. ***Local Regulator:*** The government is slow to adapt to modern technology, which can contribute to the sense of regulatory burden for producers and regulators alike. E.g., Government offices are open from 8am-5pm, but farmers are out from daylight to dark, making it challenging to collect paperwork and get original signatures.	5. Establish a single web portal that allows the farmer to submit or update information in one place for all agencies to access, and also allows the farmer to view/download the applicable information from each regulatory entity. Allow producers to electronically sign documents (originals are currently required on many documents). Consider incorporating electronic tracking of permits.	• California Environmental Reporting System (CERS), Cal/EPA • Washington State Joint Aquatic Resources Permit Application (JARPA) • California Biodigester Regulatory Working Group unified web portal for application process (planned) • Central Coast Water Board website allows electronic document submittal, has guidelines, etc. The "tech mobile" a van contains computers on which the Board spends time helping growers with forms.
Farmer: The regulatory process and requirements are not transparent and are unpredictable. ***State Regulator:*** Regulatory hurdles often prevent producers from implementing conservation practices and watershed restoration projects. ***Local Regulator:*** Food production has changed rapidly over the last several decades and regulations have not kept pace. Emerging regulatory areas include ag tourism, renewable energy on ag land, small-scale food processing, and direct marketing, all of which have impacts that require regulatory attention. Regulators don't have a regulation that fits every situation.	6. Establish a system in which a project that fits a pre-determined set of criteria is easily permitted, while a project that falls outside those criteria requires more discretion.	• Sonoma County Zoning Ordinance (allows processing for facilities up to a certain size without a use permit) • CEQA exemption 15333 • AB 1961 • Partners In Restoration Programs, Sustainable Conservation • *Creating a Statewide Program for Voluntary Restoration on Private Lands* (Recommendation #2), Sustainable Conservation • Tiered Permitting System (regulates according to risk), Department of Toxic Substances Control (DTSC) and the Integrated Waste Management Board (IWMB)

Toward a New Regulatory Compact for Agricultural and Environmental Health

In early 2012, Ag Innovations Network began work on a project to examine the regulatory challenges related to California agriculture, and identify recommended solutions to solving those challenges.

The regulatory environment has been a longstanding concern for agricultural producers. From a farmer's perspective, the montage of regulations affecting their business often is cumbersome and confusing, can stifle environmental performance, and can delay innovative projects. The cost of compliance with regulations is frequently cited as a major barrier to the viability and profitability of California farmers. However, both agricultural and environmental stakeholders believe that regulatory frameworks must be effective in protecting our environment and natural resources.

In response to demand from, and in partnership with our agricultural, environmental, and agency partners, Ag Innovations Network has launched a new effort to identify and help implement a broadly supported set of recommendations to simultaneously improve environmental performance and reduce the cost of regulatory compliance in California. Multiple efforts within our network have demonstrated that there is a growing willingness among diverse stakeholders to explore and engage in a path forward, including the California Roundtable on Agriculture and the Environment's landmark *Permitting Restoration* report.[1]

Toward a New Regulatory Compact for Agricultural and Environmental Health is expanding upon existing efforts and work to foster communication and collaboration among agricultural producers and regulatory agencies. Through research, regional forums in Ventura and Yolo counties, and other targeted information collection efforts, the project has gathered data on key challenges and proposed solutions. This information has been synthesized and vetted by the project's Technical Advisory Committee, resulting in the *Summit on Regulations Affecting Agriculture*, followed by final recommendations for wide dissemination and implementation. This project is funded through the California Department of Food and Agriculture's Specialty Crop Block Program and, as such, focuses on the issues faced by specialty crop producers.

Project Goals

> *DEVELOP:* Contribute meaningfully to the process of developing a broad and transformative framework for 21st century environmental and agricultural performance that reflects all affected stakeholders.

> *COORDINATE:* Improve communication and coordination among stakeholders in the regulatory process.

> *IMPROVE:* Identify small changes in the regulatory system that will have the greatest positive impact for growers and maximize environmental health.

> *INFORM:* Publish an online resource center and final recommendations.

Contact Information

Project information and findings can be found at http://aginnovations.org/regulations/. Project Coordinator, Serena Coltrane-Briscoe, can be reached at 707.823.6111 x220 or serena@aginnovations.org.

---

[1] Published November 2010. Available at http://aginnovations.org/images/uploads/Permitting_Restoration.pdf.

University of California
Agriculture and Natural Resources

UCCE

Sonoma County
133 Aviation Blvd., Suite 109
Santa Rosa CA 95403
(707) 565-2321 office
(707) 565-2623 fax
http://CESonoma.ucanr.edu

Agriculture Ombudsman

Karen Giovannini

Kgiovannini@ucdavis.edu 707.565.2328

The Agriculture Ombudsman helps agricultural producers navigate the permitting process and facilitates meetings between different county, state and federal agencies. By helping these agriculture businesses develop value added products; their economic viability improves and increases local food access in Sonoma County.

Agriculture Ombudsman can assist with:

What can I do with my property?
What type of permits will I need to do what I want to do?
Where do I start?
Why so many conditions, are they all required?

Examples:

Creating a milk processing making plant
Meat sales and meat processing
Value add food products
Agritourism
Special Events
Permit violations

http://ucanr.edu/sites/CESonomaAgOmbuds/

Permit Assistance

The Governor's Office of Business and Economic Development ("GO-Biz") was created by Governor Edmund G. Brown Jr. to serve as California's single point of contact for economic development and job creation efforts. The Permit Assistance unit provides comprehensive permit and regulatory compliance assistance for businesses in California and serves as the central source for permit guidance. The Permit Assistance unit also manages CalGOLD, the on-line permit assistance website.

Permit Identification and Compliance Assistance

Permit Assistance staff, combined with local, regional, and state permitting agencies, provide permit identification and regulatory compliance assistance. The Permit Assistance staff provides these services confidentially and free of charge. Knowledgeable staff help business owners identify the permits needed to start a new or to expand an existing business. The unit schedules pre-application meetings between businesses and the appropriate regulatory agencies to help streamline the permitting process. The Permit Assistance staff acts as a neutral facilitator between state regulating agencies and businesses to resolve permitting issues.

CalGOLD On-line Permit Assistance

CalGOLD is the on-line permit assistance tool (www.calgold.ca.gov) that provides a listing of federal, state and local permits, webpage links, addresses, application forms and phone numbers for over 150 business types. Over 15,000 new visitors use CalGOLD each month to obtain information about the permitting requirements for their business.

Consolidated Permitting

GO-Biz has partnered with Cal-EPA to reinvigorate the Consolidated Permit Process. Consolidated Permitting is a process whereby a permit applicant can request to have all of their state environmental permits issued by one agency. This saves the applicant from having to submit numerous documents to numerous agencies, each of whom may be using a different timeline, application form, etc. Please contact us if you'd like to learn more about this process.

Contact Us

Paul Martin
Deputy Director
Paul.Martin@gov.ca.gov
(916) 322-0572

Andrew Sturmfels
Senior Permit Specialist
Andrew.Sturmfels@gov.ca.gov
(916) 322-0669

Lillian Conroe
Senior Permit Specialist
Lillian.Conroe@gov.ca.gov
(213) 897-9517

Frank Ramirez
Senior Permit Specialist
Frank.Ramirez@gov.ca.gov
(916) 322-0563

Shannan West
Senior Permit Specialist
Shannan.West@gov.ca.gov
(916) 322-0562

Translate: Deutsch I 官话 I Español

Governor's Office of Business and Economic Development GO-Biz

ABOUT US WHY CA START A BUSINESS RELOCATE / EXPAND PROGRAMS CHINA

Home > Programs > Permits > Streamlining Super Stars

Permit Assistance

STREAMLINING SUPERSTAR

GO-Biz Recognizes the California Department of Corporations
6/6/2013 3:55:00 PM

California Department of Corporations is recognized as a Streamlining Superstar for going the extra mile in providing outstanding customer service to their licensees. The Department's Broker Dealer and Investment Adviser Division licenses and regulates securities broker dealers and state-licensed investment advisers. Even though State and Federal requirements result in a comprehensive licensing process, the Department hasn't let that stop them from providing attentive customer service.

New applicants are provided a single staff contact who handle the application from start to finish. Staff provide their direct contact information and communicate with applicants regularly to ensure applications are complete, reducing processing times on the back end. The Department also provides licensees with electronic communication letting them know they can start doing business as soon as their application is approved, removing the need to have to wait for the certificate in the mail.

Zachary Gronich, a current licensee, confirms the positive user experience. "California has always been one of the easiest states to work with because we were always assigned a single examiner for each registration, who helped my firm through the entirety of the registration process. Timely emails, near-immediate response times and helpful reminders on what needed to be done both during and after registration were a tremendous help."

STREAMLINING SUPERSTAR

GO-Biz Recognizes Cal Recycle and the Central Valley Regional Water Quality Control Board
4/25/2013 2:20:00 PM

Kudos goes to both the **Central Valley Regional Water Quality Control Board** and **CalRecycle** for their ongoing efforts to find and fix areas of regulatory overlap when permitting dairy digesters. The Central Valley Regional Water Board and CalRecycle are combining forces to develop a single permit application to serve as a first step for both agencies. This example of interagency collaboration should help streamline application processing.

Programs

- Small Business
- Permits
  - **Streamlining Super Stars**
- More Resources
- International Trade & Investment
- Innovation
- EB-5 Program
- Business Investment Services

Get Business Help

Use our online form to get help with your business needs

Find a Local Resource

Our Mapping tool is a great way to find business resources in your area.

Check out the maps

"Streamlining processes not only takes hard work but requires collaboration --and these agencies have shown it," said Paul Martin, Deputy Director of Permit Assistance at Go-Biz. "We would like to recognize them as two of California's Streamlining Superstars."

GO-Biz Recognizes the Department of Toxic Substances Control
4/24/2013 1:37:00 PM

Kudos goes out to the **Department of Toxic Substances Control** for their recent cooperative work with DuPont. On a recent project in Oakley, DTSC partnered with DuPont to help remediate DuPont's Antioch Works property, a former chemical manufacturing plant. The site is now ready for redevelopment. DTSC continues their commitment to the protection of public health and the environment while at the same time working with their private sector partner to successfully complete this re-use project.

"DTSC's assistance in timely cleanups for development projects and assurance of future support in redevelopment is why they were chosen to be our Streamlining Superstar," said Paul Martin, Deputy Director of Permit Assistance at Go Biz. Martin also pointed out that DuPont, DTSC's private sector partner on the Oakley project praised their collaboration.

"On the business side, all of us on the Oakley project are committed to long-term protection of people and the environment, and ensuring a sustainable redevelopment and re-use of the site," said Roberto Nelson, Program Manager of Public and External Affairs at DuPont. "DTSC has been committed to helping DuPont identify a business use for the site that successfully re-positions it as an asset to the community. DTSC been clear, consistent and engaged with us throughout our process and that's been welcome."

For more information, check out this link

Go-Biz Recognizes State Water Resources Control Board and the CA Department of Fish and Wildlife
4/18/2013 9:22:00 AM

A big hand goes out to the **State Water Resources Control Board's Permitting and Licensing Section** as well as the **California Department of Fish and Wildlife** for their work with agricultural and fisheries advocates. Their efforts to speed up and simplify the application process for stockponds and small irrigation ponds demonstrates how constructive collaboration can make good things happen.

"Agricultural and fishery advocates will deal with less regulation because of these agencies efforts and cooperation," said Paul Martin, Deputy Director of Permit Assistance at Go-Biz. "We would like to praise these groups on their efforts and recognize them as two of California's Streamlining Superstars."

For more info on the stockponds program, check out this link

View Past Streamlining News

USCID Water Management Conference

Groundwater Issues and Water Management — Strategies Addressing the Challenges of Sustainability

USCID

The U.S. society for irrigation and drainage professionals

Cooperating Organization —

Groundwater Resources Association of California

March 4-7, 2014
Sacramento, California

Program

Monday, March 3

The Workshop scheduled for Monday afternoon has been cancelled.

Tuesday, March 4

7:00 a.m. - 5:30 p.m **Registration**

8:00 a.m. - 11:30 a.m. **Field Tour**

This half-day field trip will visit the **Sacramento Regional Water Authority**, for presentations on ground water issues. The return will feature a drive past Folsom Dam, providing a view of the new spillway and facilities.

12:00 noon - 1:15 p.m. **Lunch with Speaker**

Moderator — **Bryan P. Thoreson**, President, USCID, Conference Co-Chair, and Davids Engineering, Inc., Davis, CA

David Guy, Northern California Water Association, Sacramento, CA

1:30 p.m. - 3:00 p.m. **Plenary Session — Panel Discussion: *California's Water Future: Picking up the Pace***

Moderator — **Thaddeus L. Bettner**, Glenn-Colusa Irrigation District, Willows, CA

Irrigation stakeholders will discuss California's current debate over facilities and ecosystem investments that are critical to long-term surface and groundwater reliability and sustainability. Panel Members include:

Lewis Bair, Reclamation District No. 108, Grimes, CA
John Sweigard, Merced Irrigation District, Merced, CA
Roger K. Patterson, Metropolitan Water District of Southern California, Los Angeles, CA
Dee Dee D'Adamo, State Water Resources Control Board, Stanislaus, CA
Richard Roos-Collins, Water and Power Law Group PC, Berkeley, CA

3:00 p.m. - 3:30 p.m. **Break**

3:30 p.m. - 5:00 p.m. **Plenary Session, continued**

Moderator — **Chris Peterson**, West Yost Associates, Davis, CA

Overdraft, Safe Yield, and Sustainable Yield: Lessons from Central Valley Groundwater Basins
Daniel Wendell and **Maurice Hall**, The Nature Conservancy; and **Ali Taghavi**, RMC Water and Environment, Sacramento, CA

Water, Salt, and Nitrate Movement on a Large Scale for California's Central Valley
Barbara Dalgish, **Dylan Boyle** and **Vicki Kretsinger**, Luhdorff & Scalmanini Consulting Engineers, Woodland, CA

Groundwater Management in the Upper Klammath Basin, Oregon and California: Balancing the Benefits of Groundwater for Agriculture and Wildlife.
Brian Wagner and **Marshall Gannett**, U.S. Geological Survey, Sacramento, CA

5:00 p.m. - 5:30 p.m. **Meet the Exhibitors**

5:30 p.m. - 7:30 p.m. **Networking Reception and Exhibition**

Wednesday, March 5

7:00 a.m. - 5:00 p.m **Registration**

7:00 a.m. - 8:00 a.m. **Continental Breakfast in Exhibit Hall**

8:00 a.m. - 9:30 a.m. **Technical Session 1A — Evapotranspiration**

Moderators — **Jason Smesrud**, CH2M Hill, Portland, OR; and **John Sweigard**, Merced Irrigation District, Merced, CA

California Irrigation Management Information System (CIMIS) Updates
Bekele Temesgen, California Department of Water Resources, Sacramento, CA

New Techniques for CUNL
Delbert M. Smith, Bureau of Reclamation, Denver, CO

ET — Crop Measurements
Khalid Bali, University of California, Cooperative Extension, Holtville, CA

9:30 a.m. - 10:30 p.m. **Break in Exhibit Hall**

10:30 a.m. - 12:00 noon **Technical Session 1B — Evapotranspiration**

Moderators — **Jason Smesrud** and **John Sweigard**

Validation of Remotely Sensed Surface Energy Balance Data at Field Scale: A Case Study from Southern California
Saleh Taghvaeian, Oklahoma State University, Stillwater, OK

Indicators of Changes in Sacramento Valley Consumptive Use
Byron Clark, **Grant Davids**, **Deepak Lal** and **Bryan Thoreson**, Davids Engineering, Inc., Davis, CA; and **Steve Macaulay**, Macaulay Water Resources, Davis, CA

Satellite Mapping of Agricultural Water Requirements in California
Forrest S. Melton, **Lee Johnson**, **Christopher Lund**, **Kirk Post**, **Alberto Guzman** and **Sam Hiatt**, NASA ARC-CREST, Moffett Field, CA; **Diganta Adhikari**, California State University, Fresno, Fresno, CA; and **Cayle Little**, **Bekele Temesgen** and **Kent Frame**, California Department of Water Resources, Sacramento, CA

12:00 noon - 1:15 p.m. **Lunch with Speaker**

Moderator — **Bryan P. Thoreson**

Groundwater Regulation: Is There a Place for State Regulation in Local Groundwater Basins?
Valerie C. Kincaid, Partner, O'Laughlin & Paris LLP, Sacramento, CA

1:30 p.m. - 3:00 p.m. **Technical Session 2A — Irrigation Technology**

Moderators — **James E. Ayars**, Agricultural Research Service, USDA, Parlier, CA; and **Neil W. Schild**, MWH Americas, Sacramento, CA

Methods Used by Bureau of Reclamation Economists to Estimate Irrigation Benefits when Water Supply Changes Occur
Rob Davis, Bureau of Reclamation, Denver, CO

Results from 2012-2013 Irrigation Trials in Cool Season Vegetables
Lee Johnson, NASA ARC-CREST, Moffett Field, CA; **Michael Cahn**, University of California, Cooperative Extension, Salinas, CA; **Frank Martin**, **Forrest Melton** and **Sharon Benzen**, Agricultural Research Service, USDA, Salinas, CA; **Barry Farrara**, University of California, Cooperative Extension, Salinas, CA; and **Christopher Lund** and **Kirk Post**, NASA ARC-CREST, Moffett Field, CA

Irrigation Monitoring for Floodplain Riparian Restoration on the Lower Colorado River
Matthew R. Grabau, GeoSystems Analysis, Inc., Tucson, AZ; **Dianne Bangle**, Bureau of Reclamation, Boulder City, NV; **Michael A. Milczarek** and **Lindsey A. Hovland**, GeoSystems Analysis, Inc., Tucson, AZ; and **Barbara Raulston**, Bureau of Reclamation, Boulder City, NV

3:00 p.m. - 3:30 p.m. **Break in Exhibit Hall**

3:30 p.m. - 5:00 p.m. **Technical Session 2B — Drainage and Irrigation Technology**

Moderators — **James E. Ayars** and **Neil W. Schild**

Irrigation and Nitrogen Management Decision Support Tool for Vegetables and Berries
Michael D. Cahn, **Richard F. Smith** and **Barry F. Farrara**, University of California Cooperative Extension, Salinas, CA; **Timothy K. Hartz**, University of California, Davis, Davis, CA; and **Lee F. Johnson**, **Forrest S. Melton** and **Kirk M. Post**, NASA ARC-CREST, Moffett Field, CA

Drainage Reuse by Grassland Area Farmers: The Road to Zero Discharge
C. Linneman, Summers Engineering, Inc., Hanford, CA; **A. Falaschi**, Panoche Drainage District, Firebaugh, CA; **J. D. Oster**, University of California, Graeagle, CA; **S. Kaffka**, University of California, Davis, Davis, CA; and **S. Benes**, California State University, Fresno, Fresno, CA

Remote-Sensing-Based Comparison of Water Consumption: Drip- Versus Flood-Irrigated Fields
David Jordan, INTERA Incorporated, Albuquerque, NM; **Richard G. Allen**, University of Idaho, Twin Falls, ID; **Guillermo Martinez**, INTERA Incorporated, Austin, TX; and **Amber Whittaker**, INTERA Incorporated, Albuquerque, NM

6:30 p.m. - 7:00 p.m. **Reception**

7:00 p.m. - 9:30 p.m. **Dinner with Speaker**

Moderator — **Bryan P. Thoreson**

Groundwater and Water Management in California
Jay R. Lund, Director, Center for Watershed Sciences, University of California, Davis, CA

Thursday, March 6

7:00 a.m. - 5:00 p.m **Registration**

7:00 a.m. - 8:00 a.m. **Continental Breakfast**

8:00 a.m. - 10:00 a.m. **Concurrent Session 3A — Groundwater Banking**

Moderators — **W. Martin Roche**, Consultant, Grass Valley, CA; and **Delbert M. Smith**, Bureau of Reclamation, Denver, CO

Managed Recharge Study and Implementation in the Eastern Snake Plain, ID, and Yakima, WA
Jennifer Johnson, Bureau of Reclamation, Boise, ID

Groundwater in Colorado — From the Headwaters to the Plains
Suzanne S. Paschke, U.S. Geological Survey, Denver, CO

Groundwater Banking — Fresno Irrigation District
Randy Hopkins, Provost & Pritchard Consulting Group, Fresno, CA

Westwide Climate Change Risk Assessment — Estimation of Changes in Crop Evapotranspiration and Irrigation Requirements for 8 Western U.S. River Basins
Alan Harrison, Bureau of Reclamation, Denver, CO

8:00 a.m. - 10:00 a.m. Concurrent Session 4A — Salts and Nutrients

Moderators — **David E. Bradshaw**, Imperial Irrigation District, Imperial, CA; and **J. D. Oster**, University of California, Graeagle, CA

Crop Specific Drainage and NO_3 Leaching in California's Central and Salinas Valleys: Monitoring and Management
K. Post, **C. Lund**, **A. Purdy** and **I. Harlan**, NASA ARC-CREST, Moffett Field, CA; **L. Pierce**, California State University, Monterey Bay, Seaside, CA; and **L. Johnson** and **F. Melton**, NASA ARC-CREST, Moffett Field, CA

Nitrogen Management Practices for Groundwater Assessment in Santa Maria Valley, California
Samuel W. Schaefer, GEI Consultants, Inc., Santa Barbara, CA; and **Rob Almy**, Weston & Sampson, Peabody, MA

Protecting Groundwater Quality with Subsurface Drip Irrigation
James E. Ayars, Agricultural Research Service, USDA, Parlier, CA; and **Claude J. Phene**, SDI+, Clovis, CA

New Jerusalem Drainage District (NJDD) Subsurface Drainage System Management Alternatives
Sargeant J. Green, California Water Institute, Fresno, CA

10:00 a.m. - 10:30 a.m. Break

10:30 a.m. - 12:00 noon Concurrent Session 3B — Conjunctive Use

Moderators — **W. Martin Roche** and **Delbert M. Smith**

Conjunctive Management of Groundwater and Surface Water in Chowchilla Water District
Doug Welch, Chowchilla Water District, Chowchilla, CA; **Peter Leffler**, Fugro Consultants, Inc., Oakland, CA; **Bryan P. Thoreson**, Davids Engineering, Inc., Davis, CA; and **Nels Ruud**, Consultant, Sacramento, CA

Conveyance Enhancement for Conjunctive Use and Regional Water Management in Kern County, California
Marc Rozman, GEI Consultants, Inc., Glendale, CA; **Dana Munn**, North Kern Water Storage District, Bakersfield, CA; **Dave Ansolabehere**, Cawelo Water District, Bakersfield, CA; **Isela Medina** and **Samuel Schaefer**, GEI Consultants, Inc., Bakersfield, CA; **William Zeiders**, Zeiders Consulting, Bakersfield, CA; and **Brad Arnold**, GEI Consultants, Inc., Rancho Cordova, CA

Conjunctive Management of Surface Water and Groundwater in the Turlock Irrigation District
Debra C. Liebersbach, Turlock Irrigation District, Turlock, CA; and **Bryan P. Thoreson** and **Byron Clark**, Davids Engineering, Inc., Davis, CA

10:30 a.m. - 12:00 noon Concurrent Session 4B — Irrigation and Water Quality Management

Moderators — **David E. Bradshaw** and **J. D. Oster**

New Cropping Systems for Water Conservation in Arid Regions
Khalid M. Bali and **Oli G. Bachie**, University of California, Cooperative Extension, Holtville, CA; and **Daniel H. Putnam**, University of California, Davis, Davis, CA

A Farm Management Based Approach to Assess Nitrate Leaching Risk in the Kern Subwatershed
John Schaap, Provost & Pritchard Consulting Group, Visalia, CA; and **Stephanie Tillman**, Land IQ, Sacramento, CA

Critical Success Factors in SCADA Real-time Wireless Communication and Initiatives
Alan Gatlin, Firetide Inc., Los Gatos, CA

12:00 noon - 1:15 p.m. Lunch with Speaker

Moderator — **Bryan P. Thoreson**

Speaker — **David Murillo**, Regional Director, Bureau of Reclamation, Sacramento, CA

1:30 p.m. - 3:00 p.m. Concurrent Session 5A — Groundwater

Moderators — **Todd L. Hillaire**, California Department of Water Resources, Red Bluff, CA; and **Thaddeus L. Bettner**, Glenn-Colusa Irrigation District, Willows, CA

Sustainable Capture Fractions, Sustainable Capture Thresholds, Capture Efficiency, and Sustainable Groundwater Storage: Concepts for Managing Stream-Aquifer Systems
Jeffrey C. Davids, Davids Engineering, Inc./California State University, Chico/H2oTech, Chico, CA; **Steffen W. Mehl**, California State University, Chico, Chico, CA; and **Grant G. Davids**, Davids Engineering, Inc., Davis, CA

Conjunctive Management: Changing Water Regulation and Evolving Strategies
Laura A. Schroeder and **Brian R. Sheets**, Schroeder Law Offices, PC, Portland, OR

Promoting Sustainable Groundwater & Water Transfers in the Sacramento Valley
David R. E. Aladjem, Downey Brand Attorneys LLP, Sacramento, CA: and **Steve Macaulay**, Macaulay Water Resources Inc., Davis, CA

1:30 p.m. - 3:00 p.m. **Concurrent Session 6A — Water Management**

Moderators — **Franklin E. Dimick**, Dimick Water Resources Engineering, Monroe, UT; and **Khalid Bali**, University of California, Cooperative Extension, Holtville, CA

The Historical Re-Operation of the Exchequer Project
Hicham ElTal, Merced Irrigation District, Merced, CA

Reoperation of Lake Yosemite and Crocker Dam
Hicham ElTal, Merced Irrigation District, Merced, CA

Electrical Resistivity Investigation of Fluvial Architecture to Evaluate Potential Seepage Conduits to Agricultural Lands Along the San Joaquin River, Merced County, California, 2012-2013
Krishangi D. Groover, **Matthew K. Burgess** and **James F. Howle**, U.S. Geological Survey, San Diego, CA

3:00 p.m. - 3:30 p.m. **Break**

3:30 p.m. - 5:00 p.m. **Concurrent Session 5B — Groundwater**

Moderators — **Todd L. Hillaire** and **Thaddeus L. Bettner**

Canal Water and Groundwater: Foes or Friends?
Ian C. Tod, Ian Tod Associates, Aliso Viejo, CA; **Muhammad Nawaz Bhutta**, National Development Consultants, Lahore, Pakistan; **Mehmood ul Hassan**, Government of Pakistan, Lahore, Pakistan; and **Axel Braxein**, Independent Water Resources Consultant, Lahore, Pakistan

Climate Change, Groundwater and Water Conservation: A Basin Study in the Santa Ana River Watershed
Subhrendu Gangopadhyay, **Kristine Blickenstaff**, **Ian Ferguson**, **Laura Condon** and **Tom Pruitt**; Bureau of Reclamation, Denver, CO

Klammath Groundwater
Darren B. Cordova, MBK Engineers, Sacramento, CA

3:30 p.m. - 5:00 p.m. **Concurrent Session 6B — Water Management**

Moderators — **Franklin E. Dimick** and **Khalid Bali**

CABY — Maintaining Sustainable Water Supplies in a Rural Area of California
W. Martin Roche, Consulting Engineer, Grass Valley, CA

Mobile Monitoring Technologies: The Mobiletracker and Remotetracker
Peter-Jules van Overloop, Delft University of Technology, Delft, The Netherlands; **Jeffrey C. Davids**, H2oTech, Chico, CA; and **Meinte Vierstra**, Mobile Canal Control, Delft, The Netherlands

Implementation of a Decision Support System for Improving Irrigation Water Delivery
Kristoph-Dietrich Kinzli, Florida Gulf Coast University, Fort Myers, FL; **David Gensler**, Middle Rio Grande Conservancy District, Albuquerque, NM; **Ramchand Oad**, Colorado State University, Fort Collins, CO; and **Nabil Shafike**, New Mexico Interstate Stream Commission, Albuquerque, NM

Friday, March 7

8:00 a.m. - 5:30 p.m. **Field Tour**

The Tour will focus on **irrigation distribution system modernization** with a visit to the **South San Joaquin Irrigation District** Division 9 Irrigation Enhancement Project, near Ripon. The project consists of the design, construction and operation of a **pressurized irrigation water system**, including a 19-mile network of pressurized pipeline, a water storage basin, a pumping station, a turnout at each participating parcel containing a flow control valve and meter, and a radio-based SCADA system. The project will enable the District to more efficiently deliver water to the farmers and monitor its usage, while eliminating operational spills.

Following lunch, the tour will visit **Oakdale Irrigation District**'s new Northside Reservoir and automated lateral demonstration project. The project involved the replacement of 28 check structures and the design and installation of 31 gates on the 6.5 mile Claribel Lateral and the 8.5 mile Cometa Lateral to demonstrate Rubicon's Total Channel Control (TCC). The goal of the demonstration project was to improve distribution efficiency and enhance service levels to farmers by providing a near on-demand supply.

(Updated February 23, 2014)

Table 1

Profitability Analysis of Varying Levels of Irrigation on Blackberries, Blueberries and Strawberries

	CROP AND IRRIGATION TREATMENT												
	Blackberries				Blueberries					Strawberries			
PER ACRE YIELD, COSTS & RETURNS	**50%ET**	**75%ET**	**100%ET**	**125%ET**	**50%ET**	**75%ET**	**100%ET**	**125%ET**	**150%ET**	**50%ET**	**75%ET**	**100%ET**	**125%ET**
Yield (pounds)	5100	5500	5600	7400	13000	13500	14000	17700	17000	53000	54000	56000	57000
Irrigation costs	473	709	945	1181	804	1206	1608	2010	2412	277	416	555	694
irrigation/total costs	1.9%	2.8%	3.6%	4.1%	1.6%	2.4%	3.0%	3.1%	3.8%	0.5%	0.8%	1.0%	0.8%
Net returns	9922	11821	12118	21342	1618	1607	1595	3862	3115	7338	7812	8897	9371
Net returns if irrigation costs increase:													
doubled	9450	11112	11173	20161	814	401	-13	1852	703	7061	7396	8343	8677
tripled	8977	10403	10228	18979	10	-805	-1621	-158	-1709	6783	6980	7788	7983
quadrupled	8032	8986	8338	16617	-1598	-3217	-4837	-4178	-6533	6229	6148	6679	6595

SEPARATION METHODS AND CHEMICAL AND NUTRITIONAL CHARACTERISTICS OF TOMATO POMACE

D. Shao, G. G. Atungulu, Z. Pan, T. Yue, A. Zhang, X. Chen

ABSTRACT. *Tomato processing generates a large amount of pomace as a low-value by-product that is primarily used as livestock feed or disposed of. The objectives of this research were to investigate the chemical and nutritional characteristics and determine effective separation methods of the peel and seed of commercial tomato pomace from hot and cold break processes. The chemical composition of pomace, including fatty acid content of the seed oil, and the nutritional quality, including amino acid profile of defatted seed, were determined. The impacts of dry and wet separation on physicochemical properties of the peel and seed were evaluated. Based on the results, the studied pomace samples were rich in nutrients, including fat (8.37% to 16.24%), protein (15.08% to 22.70%), insoluble dietary fiber (IDF) (48.49% to 64.75%), soluble dietary fiber (SDF) (8.91% to 10.04%), and lycopene (98.16 to 172.07 mg kg^{-1}). The seed oil had total unsaturated fatty acid content up to 80.10%, and the defatted tomato seed contained six kinds of essential amino acids, with histidine, an essential amino acid for infants, as the most dominant (23.34%). Both the dry and wet separation methods were effective for separation of the studied pomace. However, wet separation caused significant loss of micronutrients. The study indicated that commercial tomato pomace can be separated without water and used to produce value-added products with high nutrients.*

Keywords. *Chemical and nutritional characteristics, Separation, Tomato pomace.*

Tomato is one of the most widely cultivated vegetable crops in the world, with a total production over 130 million tons in 2008 (USDA, 2010). Approximately one-third of tomatoes are consumed in the form of processed products such as juice, ketchup, and salsa (Cantarelli et al., 1993; Del Valle et al., 2002). Tomato pomace, the by-product generated in the related processing, represents 3% to 5% (in weight) of the fresh product and consists mainly of peel and seed, which account for approximately 40% and 60% of the total waste, respectively (Ruiz Celma et al., 2009). Typically, this low-value pomace is used as livestock feed, as a soil amendment by land application, or is otherwise dumped in landfills, which can cause environmental problems (King and Zeidler, 2004; Sogi et al., 2005). Tomato pomace could potentially be a significant source of value-added products with high nutritional quality. In order to identify the potential uses of pomace, it is vital to study its chemical and nutritional characteristics and develop effective methods for separating the peel and seed.

The two major tomato processing methods used by the industry are hot and cold break methods. In these processes, tomatoes are normally chopped and passed through tubular heaters at 90°C to 95°C (hot break) or at 60°C to 65°C or room temperature (cold break) (Germini et al., 2007; Lavelli et al., 2008). Hot break causes inactivation of enzymes important to viscosity and is used to produce the majority of tomato products that have high viscosity, such as paste. Conversely, the cold break method allows enzyme activity and results in less viscous products, such as juices (Goodman et al., 2002). The resulting pulp is then passed through finishers (with different sizes of screens) to remove the peel and seed, resulting in a mixture called pomace.

Based on our literature survey, there are some reports about the chemical composition of tomato pomace. Del Valle et al. (2006) reported the chemical composition of tomato pomace as 59.03% neutral detergent fiber (insoluble dietary fiber, IDF), 25.73% total sugars, 19.27% protein, 7.55% pectins, 5.85% total fat, and 3.92% minerals (dry weight). King and Zeidler (2004) stated that tomato pomace contained 5.05% moisture, 11.93% fat, 26.88% protein, and 26.30% crude fiber. Both of these studies had no information about lycopene, and the contents of insoluble dietary fiber (IDF) and/or soluble dietary fiber (SDF) were not clear. Similarly, Alvarado et al. (2001) stated that pomace contained 101.4 g water, 175.6 g protein, 95.9 g lipids, 36.4 g ash, and 590.7 g total carbohydrates per kg of residue, and the carbohydrates

Submitted for review in August 2012 as manuscript number FPE 9881; approved for publication by the Food & Process Engineering Institute Division of ASABE in November 2012.

The authors are **Dongyan Shao,** Graduate Student, College of Food Science and Engineering, Northwest Agriculture and Forestry University, Yangling, China, and Department of Biological and Agricultural Engineering, University of California, Davis, California; **Griffiths G. Atungulu, ASABE Member,** Associate Project Engineering, Department of Biological and Agricultural Engineering, University of California, Davis, California; **Zhongli Pan, ASABE Member,** Research Engineer, USDA-ARS-WRRC Processed Foods Research Unit, Albany, California, and Adjunct Professor, Department of Biological and Agricultural Engineering, University of California, Davis, California; **Tianli Yue,** Professor, College of Food Science and Engineering, Northwest Agriculture and Forestry University, Yangling, China; **Ang Zhang,** Graduate Student, College of Enology, Northwest Agriculture and Forestry University, Yangling, China, and Department of Biological and Agricultural Engineering, University of California, Davis, California; **Xi Chen,** Professor, Department of Chemistry, University of California, Davis, California. **Corresponding author:** Zhongli Pan, USDA-ARS-WRRC Processed Foods Research Unit, 800 Buchanan St., Albany, CA 94710; phone: 510-559-5861; e-mail: zhongli. pan@ars.usda.gov.

were mainly dietary fiber (495.3 g) of which 405.4 g were insoluble fiber. Again, there was no information about lycopene. Although some reports noted the lycopene content in tomato peel or seed (Kassama et al., 2008; Kaur et al., 2006; Knoblich et al., 2005), the information about other components in these reports was not sufficient. Therefore, it is necessary to provide more complete information about the chemical composition of tomato pomace. It is also important to study the effect of different processing methods (hot and cold break) on the characteristics of pomace. For example, because of lycopene's susceptibility to isomerization and oxidation caused by heat, its heated degradation followed the first-order reaction model (Kaur et al., 2006). To date, there is no report about the effect of processing methods on the chemical composition of tomato pomace. Additionally, tomato variety and region of cultivation may also affect the characteristics of pomace. In California, processing tomato production represented 94% of the national production and reached 12.4 million tons in 2007 (Pan et al., 2009), indicating about 0.5 million tons of pomace produced. To effectively utilize this large amount of by-product in California, it is necessary to investigate the chemical and nutritional characteristics of the pomace.

It is generally known that dietary fiber and lycopene are mainly in tomato peel, while the seed is rich in fat and protein. To effectively recover these individual nutrients, separation of the peel and seed is the first step. At present, no valid method is available in the tomato industry to achieve reasonably clean separation of peel and seed. In 2005, a pilot-scale flotation-cum-sedimentation system was studied for separating the peel and seed (Kaur et al., 2005). The authors used water to separate the peel and seed and achieved separation efficiency ranging from 58% to 71% for peel and from 42% to 65% for seed. However, the water use and generation of wastewater during separation were concerns. In addition, there was no information on nutrient loss caused by the processing, since nutrients may dissolve and leach into the water. Suitable separation methods are needed to achieve effective separation of tomato pomace.

The objectives of this research were as follows: (1) determine the chemical composition of tomato pomace produced from hot and cold break processes of different commercial tomato processors in California; (2) determine and compare the effects of dry (sieve) and wet (water) separation methods on purity, yield, chemical composition, and color characteristics of separated peel and seed; and (3) determine the nutritional characteristics of tomato pomace, including fatty acid content of the seed oil and amino acid profile of the defatted seed.

Materials and Methods

Pomace Samples

Three commercial tomato pomace samples were used in this research. Two fresh pomace samples (H109 and H209) produced from hot break processes were collected from tomato processing plants of the Campbell Soup Company (Dixon, Cal.) and Pacific Coast Producers (Woodland, Cal.), respectively. Another pomace sample produced from a cold break process (C09) was also obtained from the Campbell Soup Company. All samples were by-products generated by processing tomatoes of mixed varieties. The samples were stored at -18°C until used for the tests.

Determination of Peel and Seed Amounts

The three tomato pomace samples (H109, H209, and C09) had different physical characteristics, such as particle size and ratio of peel and seed. For measurement of the amounts of peel and seed, the pomace samples were thawed at 4°C and then dried at 40°C in an oven (637G, Colorado Springs Utilities Investment Recovery, Colorado Springs, Colo.) for 24 h to a moisture content of 5.0% ±0.2%. A 10 g sample from each large dried sample was obtained with a sample divider and then manually separated into two fractions (peel and seed). The amounts (%) of peel and seed were determined as the dry weight percentages of peel and seed in the pomace samples.

Measurement of Chemical Composition

The dried pomace was ground to powder using a mill (M2, Steinlite Corp., Atchison, Kans.) and sieved through a Tyler sieve shaker (Ro-Tap, W.S. Tyler Co., Cleveland, Ohio) with a 0.42 mm sieve opening to achieve the particle size requirement for measuring the chemical composition according to the following methods: moisture (m 934.06), fat (m 903.09), protein (m 978.04), total dietary fiber (TDF) (m 991.43), including soluble dietary fiber (SDF) and insoluble dietary fiber (IDF), and ash (m 930.05) contents of tomato pomace were determined by AOAC methods (AOAC, 1990). Lycopene content was evaluated by using the spectrophotometric method (Anthon and Barrett, 2007).

Dry and Wet Separation Methods

For the dry (sieve) separation method, a 50 g dried pomace sample was first scattered for 6 s in a 1 L blender (31BL92, Waring Commercial, Torrington, Conn.) to collapse the lumps of peel and seed that adhered together in the process of drying. To prevent grinding of the pomace due to the sharp blades of the blender, the blades were covered with adhesive tape. Because of the different characteristics of the three pomace samples (table 1), the separation processes were different. In the case of H109 and H209, the pomace was passed through a 2 mm opening sieve, which eliminated most of the smaller-size peel. The sample remaining on the sieve was mainly seed. In the case of C09, The size of most peel was larger than the seed. Therefore, the pomace was passed through a 3 mm opening sieve to obtain peel and seed portions at the top and bottom of the sieve, respectively.

For the wet separation method, a 70 g thawed pomace sample (50 g dry weight) was mixed with water of five times the sample weight (w/v) in a 1 L beaker, stirred with a glass rod, and left to stand for 0.5 min. Two portions were obtained; the upper portion was mainly peel, and the lower portion had more seed. The two portions were separated using a fine (0.13 mm opening) screen to drain off the water to minimize peel or seed loss due to particle sizes smaller than the screen. The separation process was repeated several times for the two portions until no more separation of seed from peel, or peel from seed, was possible. The peel and seed portions were then dried at 40°C to obtain dehydrated samples.

EVALUATION OF SEPARATED PEEL AND SEED

Purity and Yield of Peel and Seed

The yields and purities of the seed and peel samples obtained from the dry and wet separation of the three pomace samples were determined. The yields of peel and seed were calculated as follows:

$$\text{Yield of peel (\%)} = \frac{W_{peel}}{50} \times 100 \quad (1)$$

$$\text{Yield of seed (\%)} = \frac{W_{seed}}{50} \times 100 \quad (2)$$

where W_{peel} and W_{seed} are the dry weights (g) of the peel and seed samples separated from pomace, respectively, and 50 is the dry weight (g) of the original pomace sample.

In order to evaluate the purity of the peel and seed, 10 g samples of peel and seed were further separated manually. The purity of the peel and seed samples was calculated as follows:

$$\text{Purity of peel (\%)} = \frac{W_{peel}}{10} \times 100 \quad (3)$$

$$\text{Purity of seed (\%)} = \frac{W_{seed}}{10} \times 100 \quad (4)$$

where W_{peel} is the dry weight (g) of peel in the peel sample, W_{seed} is the dry weight (g) of seed in the seed sample, and 10 is the dry weight (g) of the separated peel or seed sample.

Chemical Compositions of Peel and Seed

The chemical composition, including fat, protein, IDF, SDF, ash, and lycopene content, of the obtained peel and seed samples was determined using the same methods used for the tomato pomace samples.

Color Measurement of Peel and Seed

The color of the peel and seed samples was measured using a colorimeter (CR-200, Minolta Camera Co., Ltd., Osaka, Japan) and expressed in terms of $L*$ (lightness and darkness), $a*$ (redness and greenness), and $b*$ (yellowness and blueness) according to the method reported by Arias et al. (1999).

FATTY ACID COMPOSITION OF SEED OIL AND AMINO ACID PROFILE OF SEED PROTEIN

To investigate the nutritional quality of tomato pomace, the fatty acid composition of the oil and amino acid profile of the protein from tomato seed were studied. Based on preliminary results on the chemical composition of the three tomato pomace samples (H109, H209, and C09), H209 had the highest fat and protein contents. Therefore, H209 was chosen for evaluating the nutritional quality of tomato pomace.

Seeds were separated from pomace H209 using the dry separation method. The residual peel in the seed portion was removed manually to obtain a pure seed sample, which was ground to powder using the method described previously. Oil extraction was performed using hexane in a 200 mL brown flask with 400 rpm stirring speed according to our previously reported method (Shao et al., 2012).

The defatted tomato seed was considered as crude protein because of its high protein content and was used as raw material for amino acid analysis. The defatted seed was a by-product of oil processing and was obtained by completely removing the oil from tomato seed using the Soxhlet method (m 903.09) (AOAC, 1990). Fatty acid composition of the oil and amino acid profile of the protein were determined by Anresco Laboratories (San Francisco, Cal.) using AOAC standard methods.

All reported data are on dry basis, and all trials were carried out in triplicate. Each reported result represents the average of replicated experiments, and all chemicals used were of analytical grade.

STATISTICAL ANALYSIS

Duncan's test ($\alpha = 0.05$) in one-way ANOVA using SPSS software (ver. 17.0, SPSS, Inc., Chicago, Ill.) was performed to determine significant differences in chemical composition between the three tomato pomace samples and significant differences in the separation effect, chemical composition, and color characteristics of the peel and seed samples obtained from the dry and wet separation methods.

RESULTS AND DISCUSSION

PHYSICAL AND CHEMICAL CHARACTERISTICS OF TOMATO POMACE

Due to variations in the raw materials and processing methods, the hot break (H209 and H109) and cold break (C09) tomato pomaces had different physical and chemical characteristics (fig. 1 and tables 1 and 2). The sizes of peel obtained from the cold break process were larger than those of the hot break samples. The high temperature in the hot break process resulted in thin, curly pieces of peel. In addition, more seeds were broken in the hot break pomace samples than in the cold break pomace. The amounts of peel and seed in the three pomace samples were also different. The pomace from the cold break process had more peel than those from hot break process (table 1).

Except SDF, which was 8.91% to 10.04% for all three studied pomaces, the contents of fat, protein, IDF, ash, and lycopene of all three pomace samples were significantly different ($p < 0.05$) (table 2). Literature mentioned the SDF content of tomato pomace to be about 9% (Alvarado et al., 2001), which was in agreement with our findings. In our study, the IDF content ranged between 48.49% and 64.75%. However, other studies reported that the IDF content ranged from 25% to 59% (Alvarado et al., 2001; Del Valle et al., 2006). The higher IDF content in our results was possibly due to the difference in tomato varieties, cultivation region, or processing methods. The fat and protein contents of the three pomace samples were

H209 H109 C09

Figure 1. Samples of commercial tomato pomace from hot (H209 and H109) and cold (C09) break processes.

Table 1. Characteristics of tomato pomace samples from hot and cold break processes.[a]

Pomace	Characteristics	Amount of Peel in Pomace (%)	Amount of Seed in Pomace (%)
H209	Peel is curly and thin. Peel size is medium compared to H109 and C09. Most seeds are intact (2 to 3.5 mm avg. dia.).	44.80 ±2.91 a	55.20 ±2.91 c
H109	Peel is curly and thin. Sizes of peel and seed < H209 and C09. More broken seeds than H209.	63.56 ±1.59 b	36.44 ±1.59 b
C09	Peel is in large pieces. Peel size > H209 and C09; size of some peel >3 mm; some are similar to seed. Almost all seeds are intact (2 to 3.5 mm avg. dia.).	74.65 ±4.33 c	25.35 ±4.33 a

[a] H209 and H109 were from hot break process at two different processors; C09 was from cold break process. Different letters between rows indicate significant difference at $p < 0.05$.

Table 2. Chemical composition of tomato pomace samples from hot and cold break processes.[a]

Pomace	Fat (%)	Protein (%)	IDF (%)	SDF (%)	Ash (%)	Lycopene (mg kg^{-1})
H209	16.24 ±0.28 c	22.70 ±0.22 c	48.49 ±2.57 a	10.04 ±1.08 a	4.40 ±0.01 b	98.16 ±6.45 a
H109	10.41 ±0.41 b	17.87 ±0.06 b	58.95 ±2.09 b	9.09 ±0.83 a	2.88 ±0.01 a	136.39 ±0.55 b
C09	8.37 ±0.06 a	15.08 ±0.32 a	64.75 ±1.78 c	8.91 ±0.95 a	2.89 ±0.01 a	172.07 ±6.86 c

[a] H209 and H109 were from hot break process at two different processors; C09 was from cold break process. Different letters between rows indicate significant difference at $p < 0.05$.

variable. Sample H209 had the highest values of 16.24% and 22.70% for fat and protein contents, respectively. The lowest quantities of fat and protein were found in sample C09 at 8.37% and 15.08%, respectively.

Lycopene content ranged from 98.16 to 172.07 mg kg^{-1}, with sample C09 having the highest amount. It is believed that this is the first time that the lycopene content of tomato pomace from commercial operations with different processing methods has been reported, although Kaur et al. (2006) determined the lycopene content of tomato peel as 1.75 mg per 100 g peel (dry basis), while Knoblich et al. (2005) reported the values of 734 and 130 mg kg^{-1} (dry basis) for peel and seed, respectively. George et al. (2004) reported that tomato peel had 2.5 times higher lycopene than the pulp.

Compared to the cold break pomace, the pomaces obtained from the hot break process had higher fat and protein contents and lower IDF and lycopene contents ($p < 0.05$). Higher SDF contents were also found in the hot break samples, although the difference was not statistically significant ($p > 0.05$). The higher temperature of the hot break process may have contributed to the difference in chemical composition of the pomaces. Higher temperature inactivated the enzymes that contribute to pectin degradation, resulting in higher SDF content and reduced lycopene content by destroying the structure of lycopene.

Conclusively, the studied commercial tomato pomaces displayed differences in chemical composition, but all of them were rich in various nutrients, indicating that tomato pomace could be utilized as a potential source of dietary fiber, lycopene, oil, or protein.

Effect of Pomace Separation Method on Purity and Yield of Peel and Seed

Overall, dry separation was the more suitable method for obtaining higher purity of peel compared to wet separation (table 3). On the contrary, higher purity of seed was achieved by wet separation. In most cases, the higher purity also corresponded to lower yield.

Additionally, because of the differences in peel and seed sizes of the studied tomato pomaces, the influences of separation method on the purity and yield of peel and seed of the different samples were different ($p < 0.05$). For H209, the purities of peel and seed obtained by dry separation were 93.09%, and 84.26%, and the corresponding yields were 37.49% and 62.51%, respectively. For wet separation, the corresponding purities were 89.65% and 96.6%, and the yields were 48.01% and 51.99%. The results indicated that both methods worked well for separation of H209 because of the high purities of peel and seed and the reasonable yields (table 1). Separation results for H109 showed similar trends as H209, although the purity was lower ($p < 0.05$). The low purity for H109 could be attributed to the fact that both the peel and seed of H109

Table 3. Purity and yield of peel and seed of tomato pomace samples from hot and cold break processes separated by dry and wet methods.[a]

	Separation Method	Sample	H209	H109	C09
Purity (%)	Dry	Peel	93.09 ±0.08 b	89.20 ±2.41 b	90.63 ±2.19 a
		Seed	84.26 ±3.64 a	72.78 ±2.85 a	52.01 ±2.29 a
	Wet	Peel	89.65 ± 0.39 a	82.43 ± 3.16 a	95.05 ±0.67 b
		Seed	96.60 ± 0.97 b	95.54 ± 0.81 b	95.71 ±0.37 b
Yield (%)	Dry	Peel	37.49 ±2.98 a	58.77 ±2.28 a	62.52 ±3.31 a
		Seed	62.51 ±2.98 b	41.23 ±2.28 b	37.48 ±3.31 b
	Wet	Peel	48.01 ±0.60 b	75.80 ±3.58 b	77.52 ±0.57 b
		Seed	51.99 ±0.60 a	24.20 ±3.58 a	22.48 ±0.57 a

[a] H209 and H109 samples were from hot break process at two different processors; C09 was from cold break process. For the peel or seed portion of one pomace sample, different letters between different separation methods indicate significant difference at $p < 0.05$.

were smaller than those of H209, and the difference between the sizes of peel and seed was not as large as H209, resulting in harder separation compared to H209.

Sample C09 had different results compared to H209 and H109. Due to the larger size of some peel than seed, dry separation was suitable for separating peel from C09, with a high peel purity of 90.63%. However, dry separation may not be the best choice for seed separation (a low seed purity of 52.01%) because of the separation difficulty caused by the similar sizes of some peel and seed. In contrast, wet separation achieved desirable results, with relatively high peel and seed purities of 95.05% and 95.71%, respectively. The results demonstrated that the selection of separation method should consider the physical characteristics, especially the particle size, of the tomato pomace.

Effect of Pomace Separation Method on Chemical Composition of Peel and Seed

Figure 2 shows the effect of the two separation methods on protein, SDF, ash, fat, IDF, and lycopene contents of the peel and seed from the three studied tomato pomaces. Overall, the peel and seed obtained from the wet separation method had lower protein, SDF, ash, and lycopene contents than those from the dry separation method ($p < 0.05$).

For dry separation, the protein, SDF, and ash contents of the three pomace samples were 11.05% to 14.57%, 9.61% to 11.95%, and 2.30% to 3.97% for the peel and 27.84% to 32.93%, 7.01% to 7.95%, and 3.51% to 4.50% for the seed, respectively. Compared to dry separation, wet separation caused decreases of 6.24% to 6.52% and 1.70% to 3.20% in protein, 8.74% to 13.90% and 8.56% to 12.55% in SDF, and 7.38% to 18.26% and 2.82% to 9.97% in ash for peel and seed, respectively. The reason for the lower micronutrient values with wet separation was that some of the nutrients dissolved during processing and leached out with the water. Furthermore, because of the smaller particle sizes of peel and seed of the hot break pomaces, H209 and H109 had more micronutrient loss than the cold break pomace C09 ($p < 0.05$). In addition, the protective covering on the seed surface resulted in less micronutrient loss from the seed than from the peel. Because of the micronutrient loss with the wet method, the corresponding fat and IDF contents were higher than with dry separation and were 4.24% to 7.09% and 64.79% to 72.08% for the peel and 20.64% to 25.08% and 31.44% to 39.89% for the seed of the three samples, respectively.

Compared to dry separation, the lycopene contents of peel samples obtained by wet separation dropped from 190.59 to 178.11 mg kg^{-1}, from 180.25 to 165.23 mg kg^{-1}, and from 217.03 to 205.24 mg kg^{-1} for H209, H109, and C09, respectively. The 5.43% to 8.35% decrease ($p < 0.05$) of lycopene could be attributed to its high susceptibility to isomerization and oxidation when exposed to light (Nguyen and Schwartz, 1999). For the wet separation method, a much longer time was needed, which caused excessive sample exposure to light, resulting in more lycopene loss in the process. The lycopene content changes of the seed samples had a similar trend as the peel, but wet separation did not cause significant loss (0.86% to 1.65%, $p > 0.05$) due to the protection of the seed cover.

Color Measurement of Peel and Seed

The color parameters of the peel and seed obtained from the two different separation methods are shown in table 4. Overall, the peel and seed samples from the dry separation method had lower L^* values ($p > 0.05$) and remarkably higher a^* and a^*/b^* values ($p < 0.05$) than those from the wet separation method. Arias et al. (1999) mentioned that L^* and a^* values had very good correlations with lycopene content, the b^* value could not be used to predict lycopene content, and the a^*/b^* ratio also correlated with lycopene content. While the lycopene content increased, the L^* value decreased and the a^* and a^*/b^* values increased. Our color results indicated that the lycopene contents of samples from the wet separation method were lower than those from dry separation. This finding was also in agreement with the chemical analysis results.

Fatty Acid Composition of Seed Oil and Amino Acid Profile of Seed Protein

Table 5 shows the fatty acid composition of the tomato seed oil from H209. It can be seen that the total unsaturated fatty acid content of the oil was up to 80.10% and the major fatty acid was linoleic (C18:2), with a concentration of 53.70%, followed by oleic (C18:1) at 23.80% and linolenic (C18:3) at 2.1%. Palmitic acid (C16:0), at 13.70%, was found to be the dominant saturated fatty acid, which was in agreement with other reported values (Al-Wandawi et al., 1985; Takásová et al., 1995; Lazos and Kalathenos, 1988). Some 5.4% of stearic (C18:0) and small amounts of C20:1, C14:0, etc., were also found in the tomato seed oil. Based on the obtained results, tomato seed oil belongs to the linoleic-oleic acid oils category and could be used as an edible oil with high nutritional quality.

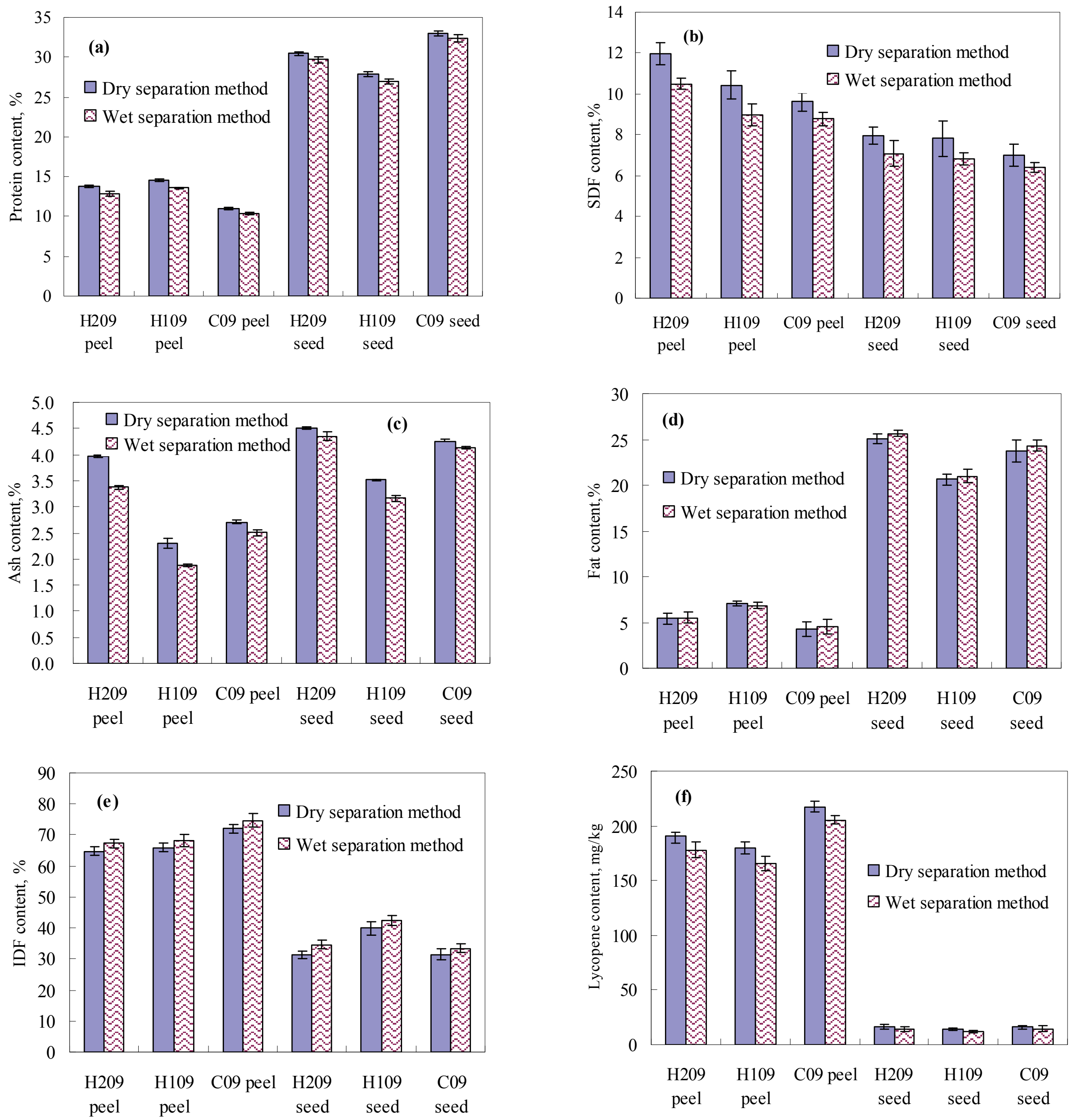


Figure 2. Effect of dry and wet separation on the (a) protein, (b) soluble dietary fiber (SDF), (c) ash, (d) fat, (e) insoluble dietary fiber (IDF), and (f) lycopene content in peel and seed of tomato pomace samples from hot break (H209 and H109) and cold break (C09) processes.

The amino acid profile of the protein in tomato seed is presented in table 6. The data showed that defatted tomato seed contained six kinds of essential amino acids. Histidine, glutamic acid, and glycine were the major amino acids, with concentrations of 23.42%, 14.33%, and 14.24%, respectively. The protein also contained threonine (10.76%), valine (7.35%), tryptophan (6.77%), and isoleucine (6.48%). Notably, histidine, an essential amino acid for infants, was the dominant amino acid in the defatted tomato seed, which indicated that defatted tomato seed could be a special protein source for infant food. Our results differed from other reports, which found the highest values for glutamic acid, aspartic acid, and arginine (Brodowski and Geisman, 1980; Latlief and Knorr, 1983; Persia et al., 2003). Morad et al. (1980) claimed that aspartic acid was the main amino acid, followed by threonine, methionine, and serine. The variation between different studies may be attributed to different tomato varieties or environmental factors. Because of the abundance of various amino acids, defatted tomato seed could be used for producing various food products.

Table 4. Color of peel and seed of tomato pomace samples from hot and cold break processes separated by dry and wet separation methods.[a]

Pomace	Sample and Separation Method	L^*	a^*	b^*	a^*/b^*
H209	Peel, dry	54.56 ±2.45 a	23.83 ±0.28 b	50.51 ±1.11 b	0.47 ±0.01 b
	Peel, wet	56.76 ±2.06 a	17.18 ±1.41 a	46.83 ±1.79 a	0.37 ±0.03 a
	Seed, dry	53.25 ±1.51 a	12.47 ±1.77 a	33.18 ±2.89 a	0.38 ±0.05 a
	Seed, wet	54.19 ±2.02 a	10.56 ±0.81 a	29.34 ±2.13 a	0.36 ±0.03 a
H109	Peel, dry	54.43 ±2.11 a	20.19 ±2.44 b	48.19 ±2.46 a	0.42 ±0.05 b
	Peel, wet	58.11 ±3.26 a	17.41 ±0.80 a	45.54 ±1.78 a	0.38 ±0.02 a
	Seed, dry	51.48 ±1.73 a	10.09 ±0.85 b	27.61 ±2.43 b	0.36 ±0.03 b
	Seed, wet	52.09 ±1.37 a	7.38 ±0.40 a	25.00 ±0.98 a	0.30 ±0.02 a
C09	Peel, dry	55.17 ±1.78 a	23.14 ±1.91 b	46.55 ±1.83 b	0.50 ±0.04 b
	Peel, wet	57.44 ±0.83 b	19.39 ±1.33 a	44.32 ±0.92 a	0.44 ±0.03 a
	Seed, dry	53.71 ±1.46 a	5.75 ±0.49 b	21.26 ±1.09 a	0.27 ±0.02 b
	Seed, wet	54.90 ±1.47 a	5.10 ±0.22 a	20.99 ±1.15 a	0.24 ±0.01 a

[a] H209 and H109 samples were from hot break process at two different processors; C09 was from cold break process. For the peel or seed portion of one pomace sample, the different letters between different separation methods indicate significant difference at $p < 0.05$.

Table 5. Fatty acid composition of tomato seed oil of hot break tomato pomace (H209).

Fatty Acid	Concentration (%)
Myristic C14:0	0.11
Palmitic C16:0	13.70
Margaric C17:0	0.10
Stearic C18:0	5.40
Arachidic C20:0	0.40
Behenic C22:0	0.10
Lignoceric C24:0	0.20
Total saturated	20.01
Palmitoleic C16:1	0.40
Oleic C18:1	23.80
Linoleic C18:2	53.70
Gadoleic C20:1	0.10
Linolenic C18:3	2.10
Total unsaturated	80.10

Table 6. Amino acid profile of protein in defatted tomato seed of hot break tomato pomace (H209).

Amino Acid	Concentration (%)
Aspartic acid	0.50
Serine	4.49
Glutamic acid	14.33
Glycine	14.24
Histidine	23.42
Alanine	4.78
Proline	3.61
Cystine	1.29
Tyrosine	6.77
Valine	7.35
Lysine	1.45
Isoleucine	6.48
Phenylalanine	0.54
Threonine	10.76

CONCLUSIONS

Chemical analysis of three commercial pomace samples showed that all three samples, regardless of differences in tomato variety and processing methods, were rich in various nutrients, including fat (8.37% to 16.24%), protein (15.08% to 22.70%), IDF (48.49% to 64.75%), SDF (8.91% to 10.04%), and lycopene (98.16 to 172.07 mg kg^{-1}). The nutritional value of tomato seed from pomace H209 was high; the total unsaturated fatty acid content of the tomato seed oil was up to 80.10%, and the defatted tomato seed contained various essential amino acids, with histidine, an essential amino acid for infants, being dominant with a concentration of 23.34%. The separation method could affect residual nutrients, yield, and purity of the peel and seed from pomace. Overall, the dry and wet separation methods were both effective for achieving separation of the studied pomaces. However, wet separation led to loss of important micronutrients due to nutrient leaching. In addition to the observed micronutrient loss, the wet separation method is also expected to be water intensive and could pose wastewater disposal problems. Therefore, dry separation is recommended as a more promising method for achieving effective separation of tomato pomace. This research indicated that tomato pomace has a great potential as a resource for high-value components utilizable for human nutrition.

ACKNOWLEDGEMENTS

The authors greatly appreciate Dr. Roberto Avena and Mr. Donald Olson of the USDA-ARS and Dr. Yanhong Li of UC Davis for their technical support in this research, and Pacific Coast Producers and the Campbell Soup Company for providing the tomato pomace samples.

REFERENCES

Alvarado, A., E. Pacheco-Delahaye, and P. Hevia. 2001. Value of a tomato byproduct as a source of dietary fiber in rats. *Plant Food Human Nutr.* 56(4): 335-348.

Al-Wandawi, H., M. Abdul-Rahman, and K. Al-Shaikhly. 1985. Tomato processing wastes as essential raw materials source. *J. Agric. Food Chem.* 33(2): 804-807.

Anthon, G., and D. M. Barrett. 2007. Standardization of a rapid spectrophotometric method for lycopene analysis. *Acta Horticulturae* 758: 111-127.

AOAC. 1990. *Official Method of Analysis*. 14th ed. Gaithersburg, Md.: Association of Official Analytical Chemists.

Arias, R., T.-C. Lee, L. Logendra, and H. Janes. 1999. Correlation of lycopene measured by HPLC with the *L*, *a*, *b* color readings of a hydroponic tomato and the relationship of maturity with color and lycopene content. *J. Agric. Food Chem.* 48(5): 1697-1702.

Brodowski, D., and J. R. Geisman. 1980. Protein content and amino acid composition of protein of seeds from tomatoes at various stages of ripeness. *J. Food Sci.* 45(2): 228-229.

Cantarelli, P. R., M. A. B. Regitano-d'Arce, and E. R. Palma. 1993. Physicochemical characteristics and fatty acid composition of tomato seed oils from processing wastes. *Sci. Agric.* (Piracicaba, Brazil) 50(1): 117-120.

Del Valle, M., M. Cámara, and M. A. E. Torija. 2002. Effect of pomace addition on tomato paste quality. *Acta Horticulturae* 613: 399-406.

Del Valle, M., M. Cámara, and M.-E. Torija. 2006. Chemical characterization of tomato pomace. *J. Sci. Food Agric.* 86(2): 1232-1236.

George, B., C. Kaur, D. S. Khurdiya, and H. C. Kapoor. 2004. Antioxidants in tomato (*Lycopersium esculentum*) as a function of genotype. *Food Chem.* 84(1): 45-51.

Germini, A., A. Paschke, and R. Marchelli. 2007. Preliminary studies on the effect of processing on the IgE reactivity of tomato products. *J. Sci. Food Agric.* 87(4): 660-667.

Goodman, C. L., S. Fawcett, and S. A. Barringer. 2002. Flavor, viscosity, and color analyses of hot and cold break tomato juices. *J. Food Sci.* 67(1): 404-408.

Kassama, L. S., J. Shi, and G. S. Mittal. 2008. Optimization of supercritical fluid extraction of lycopene from tomato skin with central composite rotatable design model. *Sep. Purif. Tech.* 60(3): 278-284.

Kaur, D., D. S. Sogi, S. K. Garg, and A. S. Bawa. 2005. Flotation-cum-sedimentation system for skin and seed separation from tomato pomace. *J. Food Eng.* 71(4): 341-344.

Kaur, D., D. S. Sogi, and A. A. Wani. 2006. Degradation kinetics of lycopene and visual color in tomato peel isolated from pomace. *Intl. J. Food Prop.* 9(4): 781-789.

King, A. J., and G. Zeidler. 2004. Tomato pomace may be a good source of vitamin E in broiler diets. *California Agric.* 58(1): 59-62.

Knoblich, M., B. Anderson, and D. Latshaw. 2005. Analyses of tomato peel and seed byproducts and their use as a source of carotenoids. *J. Sci. Food Agric.* 85(7): 1166-1170.

Latlief, S. J., and D. Knorr. 1983. Tomato seed protein concentrates: Effects of methods of recovery upon yield and compositional characteristics. *J. Food Sci.* 48(6): 1583-1586.

Lavelli, V., C. Pompe, and M. A. Casade. 2008. Optimization of color and antioxidant activity of peach and nectarine puree: Scale-up study from pilot to industrial plant. *J. Agric. Food Chem.* 56(16): 7091-7099.

Lazos, E. S., and P. Kalathenos. 1988. Technical Note: Composition of tomato processing wastes. *Intl. J. Food Sci. Tech.* 23(6): 649-652.

Morad, M. M., A. H. El-Tamimi, A. H. Rady, and S. S. Ibrahim. 1980. Tomato seed oil: II. Evaluation of the Egyptian tomato seed oil and the residual meal. *Fette, Seifen, Anstrichemittel* 82(2): 122-124.

Nguyen, M. L., and S. J. Schwartz. 1999. Lycopene: Chemical and biological properties. *Food Tech.* 53(2): 38-45.

Pan, Z., X. Li, G. Bingol, T. H. McHugh, and G. G. Atungulu. 2009. Technical Note: Development of infrared radiation heating method for sustainable tomato peeling. *Applied Eng. in Agric.* 25(6): 935-941.

Persia, M. E., C. M. Parsons, M. Schang, and J. Azcona. 2003. Nutritional evaluation of dried tomato seeds. *Poultry. Sci.* 82(1): 1232-1236.

Ruiz Celma, A. R., F. Cuadros, and F. López-Rodríguez. 2009. Characterisation of industrial tomato by-products from infrared drying process. *Food and Bioproducts Proc.* 87(4): 282-291.

Shao, D., G. G. Atungulu, Z. Pan, T. Yue, A. Zhang, and X. Li. 2012. Study of optimal extraction conditions for achieving high yield and antioxidant activity of tomato seed oil. *J. Food Sci.* 77(8): E202-E208.

Sogi, D. S., R. Bhatia, S. K. Garg, and A. S. Bawa. 2005. Biological evaluation of tomato waste seed meals and protein concentrate. *Food Chem.* 89(1): 53-56.

Takásová, J., M. Drdák, and I. I. Minarovičová. 1995. Characteristics of lipids in tomato seeds. *Food / Nahrung* 39(3): 244-245.

USDA. 2010. U.S. tomato statistics. Ithaca, N.Y.: Cornell University, USDA Economics, Statistics, and Market Information System. Available at: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1210. Accessed 7 July 2012.

OPTIMIZATION OF MECHANICAL EXTRACTION CONDITIONS FOR PRODUCING GRAPE SEED OIL

Journal:	*American Society of Agricultural and Biological Engineers*
Manuscript ID:	Draft
Journal Name:	Transactions of the ASABE
Manuscript Type:	Full-length article
Date Submitted by the Author:	n/a
Complete List of Authors:	Venkitasamy, Chandrasekar; UC Davis, Biol. & Ag Engineering Teh, Hui; UC Davis, Biol. & Ag Engineering Atungulu, Griffiths; UC Davis, Biol. & Ag Engineering; University of Arkansas, Food Science McHugh, Tara; USDA ARS WRRC, Processed Food Research Unit; UC Davis, Biol. & Ag Engineering Pan, Zhongli
Keywords:	Grape pomace, Grape seed oil, Expeller, extraction
Abstract:	Abstract.docx

THIS PAGE IS FOR INDEXING PURPOSES AND WILL NOT BE PRINTED.

Author

First Name or initial	Middle Name or initial	Surname	Role (ASABE member, professor, etc.)	E-mail (and phone for contact author)	Contact author? yes or no
Chandrasekar		Venkitasamy	Postdoctoral scholar	cvenkitasamy@ucdavis.edu	no

Affiliation

Organization	Address	Country	URL or other info.
Department of Biological and Agricultural Engineering, University of California, Davis	One Shields Avenue, Davis, CA 95616	USA	

Author

First Name or initial	Middle Name or initial	Surname	Role (ASABE member, professor, etc.)	E-mail (and phone for contact author)	Contact author? yes or no
Hui	Ean	Teh	Graduate student	hteh@ucdavis.edu	no

Affiliation

Organization	Address	Country	URL or other info.
Department of Food Science and Technology, University of California, Davis	One Shields Avenue, Davis, CA 95616	USA	

Author

First Name or initial	Middle Name or initial	Surname	Role (ASABE member, professor, etc.)	E-mail (and phone for contact author)	Contact author? yes or no
Griffiths	G	Atungulu	ASABE member and Assistant Professor	ggatungulu@ucdavis.edu	no

Affiliation

Organization	Address	Country	URL or other info.
Department of Biological and Agricultural Engineering, University of California, Davis	One Shields Avenue, Davis, CA 95616	USA	
Department of Food	2650 N Young Avenue,	USA	

Science, University of Arkansas	Fayetteville, AR 72704		

Author

First Name or initial	Middle Name or initial	Surname	Role (ASABE member, professor, etc.)	E-mail (and phone for contact author)	Contact author? yes or no
Tara	H	McHugh	ASABE member	Tara.McHugh@ars.usda.gov	no

Affiliation

Organization	Address	Country	URL or other info.
Department of Biological and Agricultural Engineering, University of California, Davis	One Shields Avenue, Davis, CA 95616	USA	
Processed Foods Research Unit, Western Regional Research Center, USDA-ARS	800 Buchanan St., Albany, CA 94710	USA	

Author

First Name or initial	Middle Name or initial	Surname	Role (ASABE member, professor, etc.)	E-mail (and phone for contact author)	Contact author? yes or no
Zhongli		Pan	ASABE member and Professor	zlpan@ucdavis.edu Phone: 530-752-4367	yes

Affiliation

Organization	Address	Country	URL or other info.
Department of Biological and Agricultural Engineering, University of California, Davis	One Shields Avenue, Davis, CA 95616	USA	
Processed Foods Research Unit, Western Regional Research Center, USDA-ARS	800 Buchanan St., Albany, CA 94710	USA	

Optimization of Mechanical Extraction Conditions for Producing Grape Seed Oil

C. Venkitasamy, H. E. Teh, G. G. Atungulu, T. H. McHugh, Z. Pan

The authors are **Chandrasekar Venkitasamy,** Postdoctoral Scholar, Department of Biological and Agricultural Engineering, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA; **Hui Ean Teh,** Doctoral Student, Department of Food Science and Technology, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA; **Griffiths G. Atungulu1, ASABE Member,** Associate Project Engineer, Department of Biological and Agricultural Engineering, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA and Assistant Professor, Department of Food Science, University of Arkansas, 2650 N Young Avenue, Fayetteville, AR 72704, USA; **Tara H. McHugh**, Research Leader, Processed Foods Research Unit, Western Regional Research Center, USDA-ARS, 800 Buchanan St., Albany, CA 94710, USA and Adjunct Professor, Department of Biological and Agricultural Engineering, University of California, Davis, One Shields Avenue, Davis, CA, and **Zhongli Pan, ASABE Member,** Adjunct Professor, Department of Biological and Agricultural Engineering, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA and Research Engineer, Processed Foods Research Unit, Western Regional Research Center, USDA-ARS, 800 Buchanan St., Albany, CA 94710, USA. **Corresponding author: Zhongli Pan,** Adjunct Professor, Department of Biological and Agricultural Engineering, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA; phone: 530-752-4367; e-mail: zlpan@ucdavis.edu.

Abstract.

In the United States, over 150 thousand metric tons of dried grape seeds containing 13-19% of oil are produced every year, as a byproduct from processing of about 5.8 million metric tons of grapes. The health promoting properties of grape seed oil is due to the presence of many bioactive components such as unsaturated fatty acids, antioxidants, and high-density lipoprotein. The chemical (hexane) extraction method is detrimental to these vital bioactive components and accelerates the oil oxidation process. The objectives of this study were to determine the effects moisture content (MC) and particle size of grape seeds, screw speed and die diameter of mechanical expeller on grape seed oil yield, and optimize the operating conditions of the expeller for maximum grape seed oil yield. Results showed that preheating of screw press with a ring heater to 60 °C almost eliminated the initial time lag to extract oil. Reducing the particle size by grinding of seeds did not significantly influence the oil yield, and hindered the extraction by clogging the feeding chute. Increasing screw speed from 140 to 500 rpm increased the filtered oil production rate from 0.20-0.57 kg h-1 at 10 mm die diameter and 5.3% seed moisture content, without significantly affecting the oil extraction percentage. Increasing the die diameter from 6 to 10 mm increased the oil production rate from 0.15 to 0.43 kg h-1 at 380 rpm for 5.3 % moisture seeds and decreased the filtered oil extraction percentage from 9.2 % to 7.3%. The seed moisture content in the range of 3.1% to 8.7% did not affect the oil yield; however, beyond 8.7% MC, oil yield was reduced significantly. Extracting whole grape seeds of 5.3% MC at 500 rpm using 10 mm die diameter was found to be the optimum condition which produced grape seed oil yield of 7.6 % at an oil extraction rate of 0.57 kg h-1 and seed residence time of 8.6 s.

Keywords. *Grape pomace, Grape seed oil, Expeller, Extraction*

INTRODUCTION

The fruit and vegetable industries produce huge quantity of seeds and peels as pomace in the waste stream. The pomace is normally used as low value cattle feed and compost or dumped to landfill and burnt in open thereby polluting the environment. In particular, more than 20% of grape production typically becomes waste during wine production (Fernandez et al., 2010). The grape pomace contains 51% skins, 47% seeds and 2% stalks on dry basis (Jordan, 2002). About 5.8 million metric tons of grapes were processed for juice and wine making in the U.S. in 2012 (USDA, 2013) which resulted in over 1 million tons of pomace or a potential of producing over 150 thousand tons of dried grape seeds in the waste stream. The grape pomace could be used for production of seed oils, pectin, protein, fiber rich products, bio-ethanol, and bio diesel with vast applications in food, fuel, pharmaceutical and cosmetic industries. Increasing production trends of grapes and stringent environmental pollution abatement programs have forced the industry to consider potential byproduct recovery from these solid residues (Kinsella, 1974).

Grape seeds contain about 10-22% oil which has potential application as specialty salad or cooking oil (Kinsella, 1974; Oomah et al., 1998; Baydar and Akkurt, 2001; Beveridge et al., 2005). The grape seed oil has many advantages for human consumption owing to its high level of unsaturated fatty acids (Gomez et al., 1996). Grape seed oil has high linoleic acid content (important for prostaglandin synthesis, which has an influence on platelet aggregation and inflammatory processes), high vitamin E content (helps to reduce the risk of suffering from arteriosclerosis) and low values of cholesterol, therefore, its intake may be beneficial to prevent heart and circulatory problems (Oomah et al., 1998; Pardo et al., 2009). Lipid contents of the seeds from red grapes were reported to be higher than those from seeds of white grapes (Izzo and Muratore, 1993). The grape seed oil is characterized by light flavor with fruity touches, high smoke point (216 °C), high digestibility, and a slight increase in viscosity when used for batch frying (Kinsella, 1974).

Oil extraction using hexane as solvent is the widely used industrial process. The disadvantages of solvent extraction include severe environmental footprints, health hazard to workers and low product value which discourages oil consumption due to safety concerns on solvent residue. Recently, extraction with supercritical CO2 has been reported (Gomez et al., 1996; Beveridge et al., 2005; Fiori, 2007; Pardo et al., 2009). Supercritical CO2 extraction of oil requires high pressure equipment that is both expensive and energy intensive. Screw pressing is experiencing renewed interest as an alternative process to solvent extraction, especially for specialty oils (Haumann, 1997). The “organic” or “virgin” segment of the edible-oils industry forbids the use of certain process technologies, especially oil extraction by using solvents; this effectively leaves screw pressing as the one alternative that is both commercially viable and acceptable to that segment. In the case of new specialty industrial oils, such as oil from the grape, pomegranate and tomato seeds, screw pressing provides a simple means of processing small batches of seed.

The moisture content and particle size of oil seeds are important seed parameters influencing the rate of extraction of oil from oil-bearing materials (Coats et al., 1950; Snyder et al., 1984). The optimum moisture content to obtain maximum oil yield varies among oil seeds. Khan and Hanna (1983) reported that the maximum soybean oil was obtained at MC of 9% – 10%. It was found that MC of 9.5 to 10% maximized the mustard oil yield (Shukla et al., 1992) and MC of 6-15% is best for rapeseed oil (Varma et al., 1993). The effect of particle size on oil yield and extraction rate during solvent and supercritical CO_2 extraction were studied for soybeans, peanuts and cotton seeds (Snyder et al., 1984), grape seeds (Gomez et al., 1996), soybean, sunflower seed, and rapeseed oils (Coats et al., 1950; Stahl et al. 1980). The effect of particle size on oil yield by solvent and supercritical CO_2 extraction had been established that smaller particles increase the oil extraction by increasing the surface area for solvent to react and extract oil. However, the minimum particle size considered in design or operation is limited by the production of fines, which have an adverse effect on the other steps of the process (Coats et al., 1950). The effect of minimum particle size is more appropriate in case of expeller pressing as there is a potential for clogging of oil passage holes by these fines.

The screw speed and the die diameter are both important operating parameters as they directly influence the residence time of seeds and pressure exerted on the seeds. A slower screw speed increases the residence time and reduces the seed feed rate or oil production rate, while a faster screw speed reduces the residence time and does not allow the seeds to receive needed heat and squeeze in press resulting in low percentage of oil yield (Deli et al., 2011). A small die diameter exerts more pressure on the seed and produces high percentage of oil yield. Also, smaller die diameter could result in clogging of press, lowering of oil production capacity or increasing the extraction temperature which may affect the quality of oil. Therefore, it is very important to optimize the screw speed and die diameter of screw press to achieve reasonably high oil yield and oil production capacity. Few researchers have reported the parameters that affect oil pressing processes such as particle size, moisture content, and applied pressure or die diameter (Ajibola et al., 2000; Baryeh, 2001; Olayanju et al., 2006; Mwithiga and Moriasi, 2007; Deli et al., 2011). Though they have reported extraction of grape seed oil by physical means using a hydraulic or a screw press (Pardo et al., 2009; Fernandez et al., 2010), there was no research data reported on the influence of seed particle size, seed moisture content and screw expeller die (nozzle) diameter and speed on the extraction of grape seed oils. Therefore, the objective of this study is to examine the effect of these four variables on grape seed oil yield using a single screw oil expeller (KOMET CA-59G, IBG Monforts, Germany).

MATERIALS AND METHODS

GRAPE SEEDS

Grape seeds of Cabernet Sauvignon (Vitis vinifera L.) variety harvested during 2011 were obtained from Sonomaceutical Inc., Santa Rosa, CA, and used for all the experiments in this study. The seeds were cleaned manually to remove all foreign matters such as dust, dirt, stones and chaff. The initial moisture content of the seeds was determined by oven drying the seeds at 105 ± 1°C for 24 h (Kilickan et al., 2010) and was found to be 9.6% (d.b.). The grape seed samples of the desired moisture contents were prepared by drying to remove the water or adding the amount of distilled water calculated from the following relation (Kiliçkan et al., 2010).

$$Q = \frac{W_i\ (M_f - M_i)}{(100 - M_f)} \quad (1)$$

Where,

M_f = final moisture content of sample, % (d.b.),

M_i = initial moisture content of sample, % (d.b.),

Q = mass of water to add, g and

W_i = initial mass of sample, g.

The grape seeds were dried to required MCs of 3.1, 5.3 and 8.7% (d.b.) and seeds were rehydrated to 17.5% (d.b.) MC by adding distilled water. The drying was carried out in hot air oven (Grieve Corporation, USA) maintained at 50°C to minimize the loss of oil, nutrients and aroma from the grape seeds. The conditioned seeds with required moisture contents were stored in cold room at 5 °C until extraction. The grape seeds received from the Sonomaceutical Inc., Santa Rosa, CA with a moisture content of 4.40% was analyzed for its composition at the Analytical Laboratory, University of California, Davis, CA. The grape seeds contained 95.60% of total solids, 4.40% of moisture, 1.39% of nitrogen, 8.69% of protein, 14.30 % of fat, 46.70% of fiber and 2.50 % of ash. The composition of Cabernet sauvignon variety was found to have a similar composition compared with Pinot Noir, Red Blend and Sagrantino grape varieties reported by Fantazzi (1981).

SCREW PRESS

The oil extraction was carried out using a single screw oil press (KOMET CA-59G, IBG Monforts Oekotec GmbH & Co. Germany) with a feed-rate capacity of 5–8 kg h^{-1}. The vegetable oil produced by screw press need no refining, bleaching, or deodorizing, as long as the natural taste, smell, and color are acceptable. The sectional view of a Komet (single cylinder) oil expeller is shown in figure 1. The oil yield of the process was expressed as the mass of oil extracted from 100 g of dried grape seed (Fernandez et al., 2010). Three replicate samples of 200 g were extracted for each set of conditions.

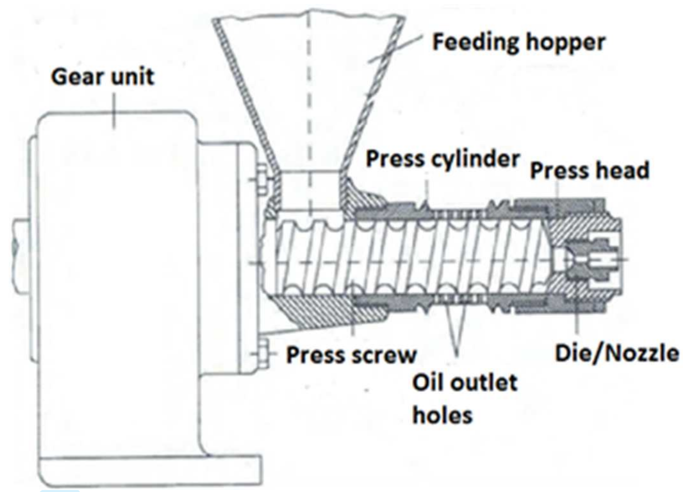


Figure 1. Sectional view of the single cylinder Komet screw press.
Source: IBG Monforts Oekotec GmbH & Co. Germany.

Selection of Seed and Screw Press Parameters

Different processing parameters studied are given in table 2. These parameters were selected from the preliminary trials conducted using the screw press. The Komet screw press can be operated in the speed range of 80 to 500 rpm. Four rpm values and three die sizes were chosen for the grape seed oil extraction studies from the preliminary experiments. The smaller die diameters of 4 and 5 mm resulted in the formation of very hard layers of oil cake in the screw which jammed the passage of grape seed and the machine was stuck. In order to determine the effect of particle size, the grape seeds were ground in a Stein mill (Steinlite Corporation, Atchison KS, USA) into fine particles and passed through 0.5 mm sieves. Whole grape seeds and ground seeds (<0.5 mm) were extracted in the screw press. Each experiment at the preset parameters was replicated three times and the mean value is reported.

Table 1. Seed and machine parameters used for the oil extraction experiments

Source	Parameter	Values
Machine	Screw speed (rpm)	140, 260, 380 and 500
	Die diameter (mm)	6, 8 and 10
	Preheating temperature	25°C (No preheating) and 60°C
Seed	Moisture content (% d.b.)	3.1, 5.3, 8.7 and 17.5
	Seed size	Whole seeds and grinding to < 0.5 mm

Oil Extraction Procedure

The flow chart of the grape seed oil extraction process from the grape pomace is shown in figure 2. The expeller press was assembled with the required die size and set at desired screw speed. The screw press was preheated using ring heaters. The screw press was allowed to run for 2 minutes to allow the temperature of the screw to stabilize. A sample of 200 g of grape seed was fed into the feeding hopper and stopwatch was used to time the processing time. The oil was collected in a glass beaker using a funnel. The temperature of the screw press was measured at the die by using a type K thermocouple connected to a digital temperature sensor (Omega Engineering Inc., USA) and the maximum temperature of the die for each extraction process was noted. As soon as the extraction was completed the stopwatch was stopped and the temperature of oil in the glass beaker was noted by using the type K thermocouple. The extracted raw oil was weighed using an electronic balance (Fulcrum Inc., USA). The raw oil was centrifuged (Effendorf, Germany) at 4000 rpm for 5 minutes and the supernatant overlying the sediment was transferred into a glass tube and weighed. The raw and filtered oil yields were calculated as mass of oil obtained (g) per 100 g of dry mass of grape seed. The capacity of screw press was calculated with respect to seed feeding (kg of seed fed per h) and oil production (kg of oil produced per h). Once the extraction was completed the screw press was allowed to cool and the die, barrel and screw were cleaned. The oil outlet holes of the barrel were cleaned with a wire brush and the screw press was reassembled for the next run. To determine the effect of screw speed, 5.3% moisture content seeds were extracted using 10 mm die diameter at four different screw speeds and the effect of die diameter was studied by extracting 5.3% moisture content seeds at a screw speed of 380 rpm by using 3 die diameters. The filtered oil yield data for four different screw speeds and three die diameters were statistically analyzed for the variance to determine the significance of screw speed and die diameter on oil extraction. To determine the effect of grape seed moisture content on oil extraction with screw press, grape seeds of 3.1, 5.3, 8.7 and 17.5 % (d.b.) MC were extracted with a 6 mm die diameter at 380 rpm screw speed. The residence (retention) time of the grape seed at the extraction zone or barrel was calculated from the relation

$$Residence\ time, s = \frac{Capacity\ or\ volume\ of\ the\ barrel\ (cm^3)}{Flow\ rate\ of\ grape\ seed\ through\ barrel\ (cm^3\ s^{-1})} \quad (2)$$

Flow rate of grape seeds ($cm^3\ s^{-1}$) was calculated by dividing the seed feeding rate of the machine ($g\ s^{-1}$) with the bulk density of grape seeds ($g\ cm^{-3}$). The average bulk density of the black grape seed was determined using the standard test weight procedure (Singh and Goswami, 1996; Kilickan et al., 2010) as 0.62±0.14 ($g\ cm^{-3}$).

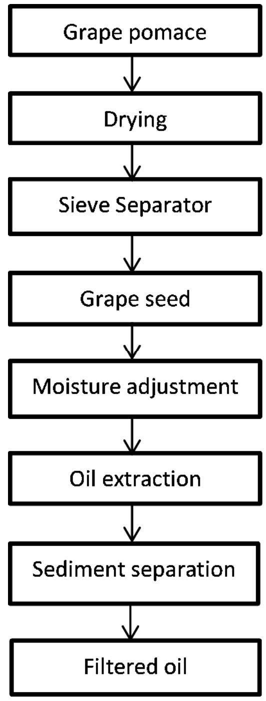


Figure 2. Flow diagram of grape seed oil extraction process from grape pomace.

RESULTS AND DISCUSSION

EFFECT OF PARTICLE SIZE

In order to determine the effect of particle size on the oil yield from screw press, whole seeds and the ground seeds (particle size < 0.5 mm) at 5.3% MC (d.b.) were extracted at 140 rpm screw speed using 10 mm die diameter without preheating. The filtered oil yield from the whole seeds was determined as 8.08±0.4 %. The extraction of oil from the ground seeds could not be replicated three times as the machine was stuck due to the blockage of the feeding chute and formation of hard oil cake at the cake outlet. After opening the barrel, the blockage of the feed hopper was found to be due to sticking fine particles on the screw surface which made conveying impossible. The oil outlet holes on the surface of the barrel were also clogged by fine particles. The sticking seed particles with addition of heat from friction formed hard layer on the machine. Therefore, further experiments were conducted with whole seeds.

EFFECT OF PREHEATING OF SCREW PRESS

It was recommended by the manufacturer to preheat the machine to 100 °C before starting the extraction. However, in order to perform the extraction at a low temperature to prevent the nutrient and flavor loss, initial experiments were done without preheating. When the machine was operated without preheating, the emerging cake was soft and flaky in the beginning and oil appeared through the barrel holes only after the screw and die were heated up by friction by running the machine for a few minutes. This initial time lag was found to vary from 3 to 5 minutes based on the screw speed and die diameter used for extraction. Therefore, the machine was preheated before extraction to 50 °C, 60 °C and 70 °C. The experiments showed that preheating the machine to 50 °C required a small time lag of 15 -20 s for oil flow and preheating to 60 °C and 70 °C eliminated the time lag in extracting the oil. However, to minimize external heat application and reduce the extraction temperature, preheating to 60 °C before starting the machine was considered as the best and followed in subsequent experiments.

EFFECT OF SCREW SPEED

The effects of screw speed (rpm) on the percentage of raw and filtered oil yields are shown in figure 3. Filtered oil yield obtained for the screw speed range of 140-500 rpm was 7.4 to 8.1% for grape seeds with 5.3% initial MC with a 10 mm die diameter used. The Analysis of Variance (ANOVA) of filtered oil yield resulted in P value of 0.093 ($P > 0.05$) which confirmed that the variation in screw speed did not significantly affect the oil yield. Using the crude fat content (14.30 %) from seed composition data, the oil recovery was calculated, which varied from 52 to 57%. It could be concluded that the speed of the screw did not significantly affect the oil yield and oil recovery rate. The extracted raw oil contained about 2.6% to 3.1% of sediments which were removed by centrifugation and sedimentation. Without centrifugation, sedimentation was allowed for 24 hours before filtering of the supernatant (Kurki et al., 2008).

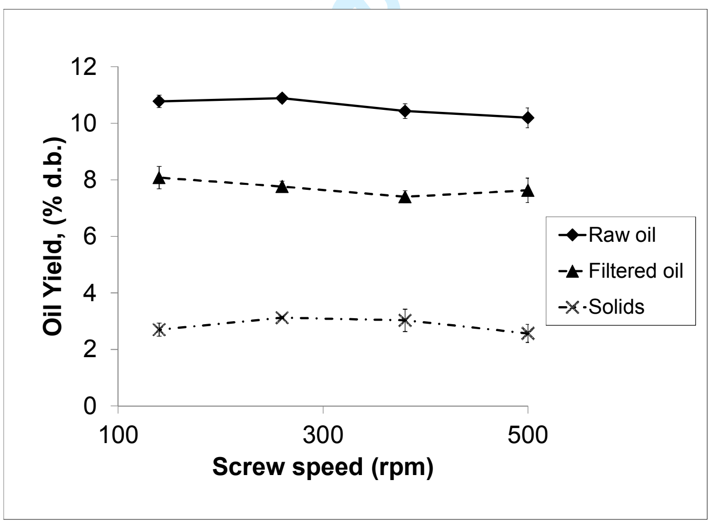


Figure 3. Effect of screw speed on oil yield for grape seeds of 5.3 % moisture content using 10 mm die diameter

The effects of screw speed on the grape seed feeding rate and the filtered oil production capacity are shown in figure 4. Seed feed rate increased from 2.6 kg h^{-1} to 7.9 kg h^{-1} and filtered oil production capacity increased from 0.20 to 0.57 kg h^{-1} as the screw speed increased from 140 rpm to 500 rpm. The increase in the seed feed rate and oil production capacity was obvious because faster rotating screw could allow feeding more seeds per unit time. The machine achieved a maximum seed feeding capacity of 7.9 kg h^{-1} which was almost the maximum recommended capacity of 5 to 8 kg h^{-1} of seed.

The effects of screw speed on the die (extraction) temperature and the residence time of grape seeds at the extraction zone are presented in figure 5. The die temperature ranged from 88 to 96°C. The die temperature gradually increased from the preheat temperature of 60°C due to the friction between the seeds and the screw surface and stabilized at 88 to 96°C during the extraction of 200 g of seed depending on the screw speed. This increased temperature helped better extraction and separation of oil from the seed cake by lowering the viscosity of oil. The residence time of seeds ranged from 9 seconds to 26 seconds at 500 and 140 rpm speed. This increase in residence time was the reason for increased filtered oil yield at lower speeds for the same die diameter or extraction pressure. A similar decrease in oil yield with increased screw speed was reported in Jatrpoha (Harmanto et al. 2009). The residence time is important as it has direct influence on the quantity and also quality of oil extracted. Higher residence time indicates that the seed and seed oil stay at elevated temperatures for longer periods of time which might affect the quality of oil due to loss of antioxidants and flavor from the grape seed oil. Thus, it can be concluded that the screw speed did not influence the oil yield and temperature of die significantly. Operating the expeller at high speed (500 rpm) increased the seed feed rate and oil production capacity by 4 times compared to low speed of 140 rpm.

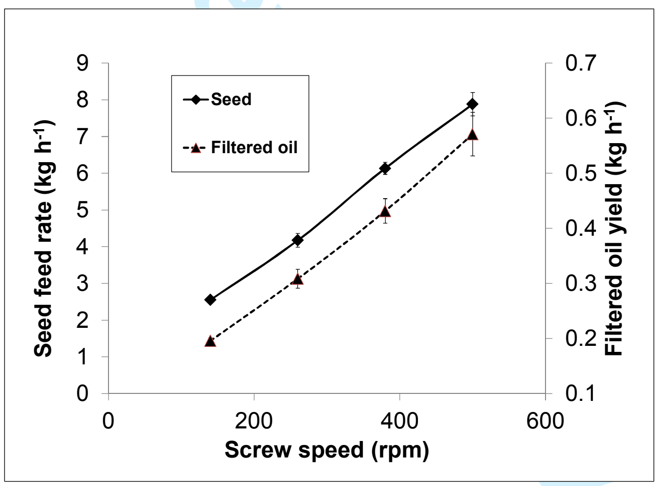


Figure 4. Effect of screw speed on the grape seed feeding rate and filtered grape seed oil production rate for 5.3% moisture content seeds using 10 mm die diameter

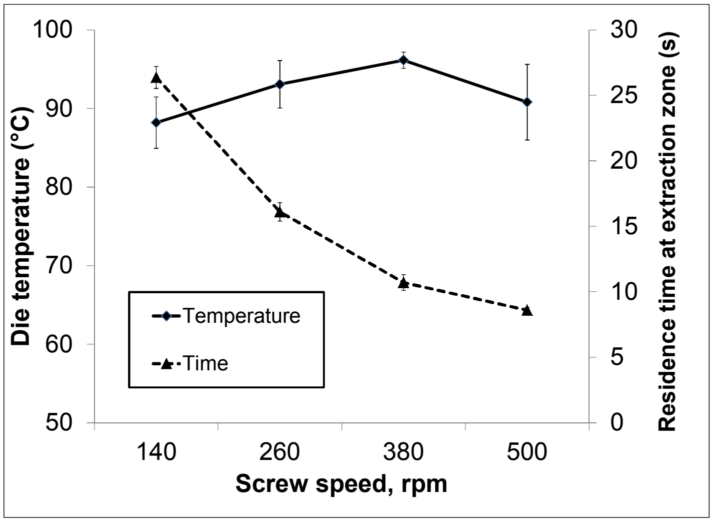


Figure 5. Effect of screw speed on the die temperature and grape seed residence time at the extraction zone

Effect of Die Diameter

The effect of die diameter on the oil yield is shown in figure 6. The filtered oil yield increased from 7.4 % to 9.2% as the die diameter decreased from 10 mm to 6 mm. The oil recovery increased from 52% to 65%. The ANOVA resulted in the P value of 0.001 ($P < 0.005$) showing that the die diameter significantly influenced the grape seed oil at 99% confidence level. Least significant difference (LSD) of the filtered oil yields at 99% confidence interval was calculated (0.6187) and all three mean values were found to be significantly different. The result confirmed that the die diameter plays a major role in oil extraction in a screw press. Harmanto et al. (2009) also reported the decrease in oil yield with increased die diameter for oil extraction from Jatropha. Deli et al. (2011) reported similar result for oil extraction using Komet screw expeller from N. Sativa seeds. A large die diameter resulted in low pressure inside the extraction barrel and the grape seeds were subject to insufficient pressure for complete squeezing or expulsion of oil from the seed. The smaller die diameter caused higher pressure inside the extraction barrel by restricting the flow of oil cake, therefore, more oil extraction was possible. The die diameter also determined the diameter of the oil cake extruded from the screw press.

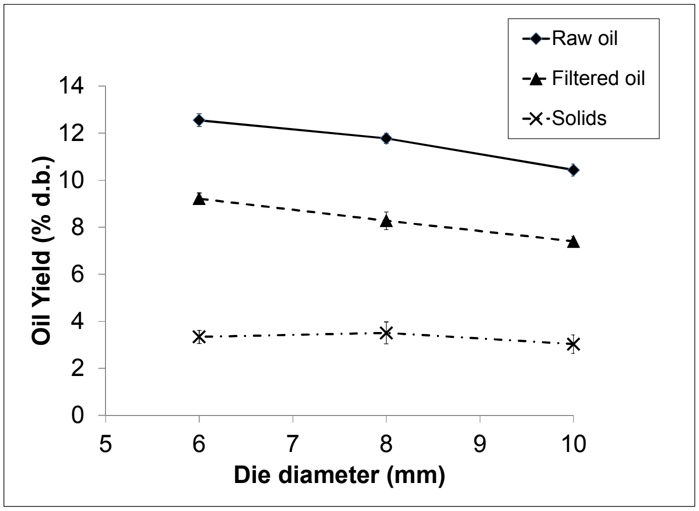


Figure 6. Effect of die diameter on oil yield for grape seeds of 5.3% moisture content at 380 rpm screw speed.

The grape seed feeding rate increased from 1.7 to 6.1 kg h^{-1} and the filtered oil yield from 0.15 to 0.43 kg/h as die diameter increased from 6 to 10 mm diameter (fig. 7). The increase of seed feed rate and oil production with larger diameter was very much expected as the larger diameter die made the flow of seed easy as it exerted less pressure inside the extraction chamber compared to a smaller diameter die. The die temperature and residence time of grape seeds in the extraction zone decreased from 131°C to 96°C and 39 to 11 s respectively as the die diameter increased from 6 to 10 mm. The smaller die diameter restricted the flow and conveying of the seed inside the barrel and thus increased the residence time inside the barrel. The smaller die diameter also increased the friction between the seeds and screw which caused the increase in die temperature during pressing. It was concluded that the die diameter significantly influenced the oil yield, temperature of die, seed feed rate, oil production capacity and grape seed residence time in the extraction zone. The increase in filtered oil yield (from 7.4% to 9.2%) by using a 6 mm die instead of 10 mm diameter is a significant increase and a welcome outcome. However, this increased oil yield was associated with increase in the extraction temperature (96°C to 131°C) and residence time (11 to 39 s) which was a serious concern with respect to quality of oil. It has been found that the proportion of biologically active compounds, especially polyphenol compounds, in grape seed oils is extremely dependent on the nature of the pressing process such as pressing temperature. The polyphenol content in grape seed oil obtained by high temperature extraction is significantly lower than that in the grape seed oil obtained from low temperature pressing process (Eckert et al., 2007). The high temperature and long residence time might also cause loss of nutrients in the oil. Therefore, it is suggested to use a larger die diameter (10 mm) considering the short residence time and die temperature which has a three times higher oil production capacity per unit time (0.43 kg h^{-1} against 0.15 kg $^{-1}$) when compared to 6 mm die diameter.

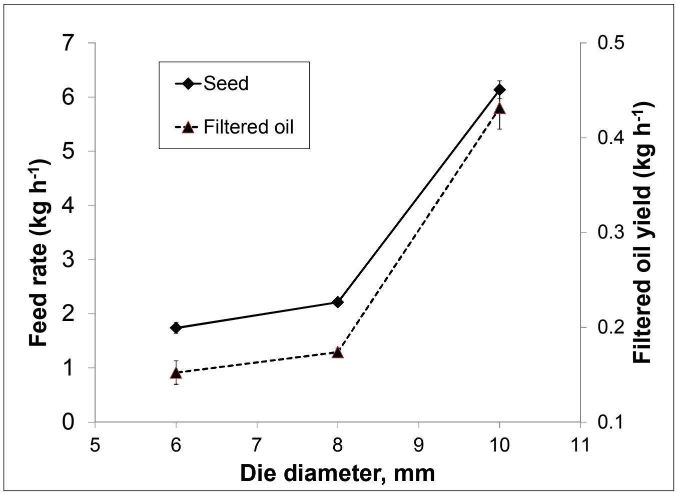


Figure 7. Effect of die diameter on seed feeding rate and filtered oil production for grape seeds of 5.3% moisture content at 380 rpm screw speed

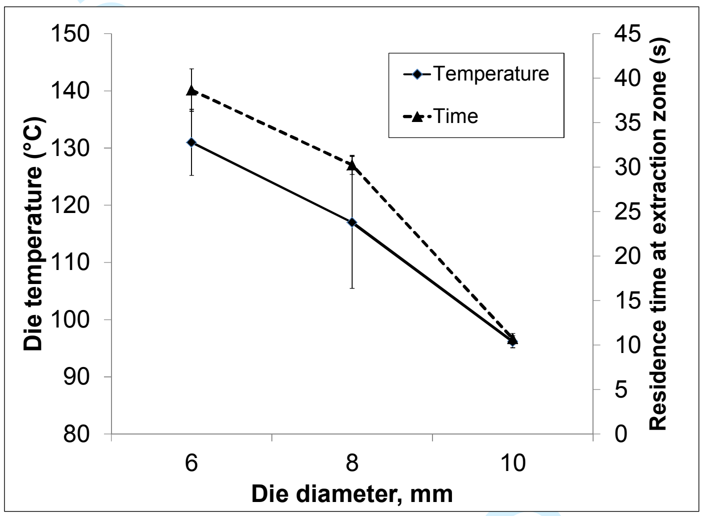


Figure 8. Effect of die diameter on die temperature and grape seed residence time for 5.3% moisture content seeds at 380 rpm screw speed

EFFECT OF SEED MOISTURE CONTENT

The seed moisture content at the time of pressing was another key processing variable, as reported by various researchers who used either hydraulic or screw presses with various oilseeds (Williams et al., 2008; Khan and Hanna, 1983; Pradhan et al., 2011). To determine the effect of grape seed moisture content on oil extraction with screw press grape seeds of 3.1%, 5.3%, 8.7% and 17.5 % (d.b.) MC were extracted with a 6 mm die diameter at 380 rpm screw speed. The effects of moisture content on oil yield and the die temperature are shown in figure 9.

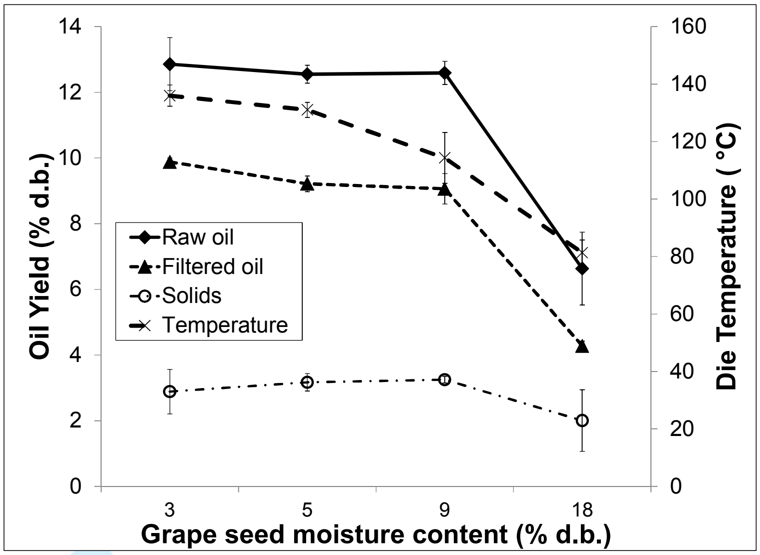


Figure 9. Effect of seed moisture content on grape seed oil yield and die temperature of screw press

The oil yield did not vary significantly in the moisture range of 3.1% to 8.7% (d.b.). However, the oil yield at high MC of 17.5% was only half of the oil yield at low moisture range (3.1% to 8.7%). Other researchers have also reported higher oil yields for low moisture seeds. Farsaie and Singh (1985) reported that maximum oil recovery was obtained when sunflower seeds were expressed at 6% moisture content and increasing the moisture content to 14% decreased oil recovery by 16%. Kabutey et al. (2010) worked on screw press performance for oil extraction from Jatropha seeds of different moisture contents and concluded that seeds with low moisture content produced more oil than seeds with high moisture content. One explanation for this trend was that higher moisture content increased plasticity and thereby reduced the level of compression and contributed to poor oil recovery (Singh and Bargale, 1990). Also it was reported that the higher pressures required for extraction in screw presses are primarily achieved by low moisture seeds than wet seeds (Boeck et al., 2011), and the moisture acted as a lubricant in the barrel; therefore, higher moisture content resulted in insufficient friction during pressing (Singh et al., 2002). The screw press or die temperature decreased with increase in the seed moisture (figure 10) as moisture acted as lubricant in the barrel, which absorbed the heat from friction and reduced the die temperature (Singh et al. 2002).

In the present study, highest filtered oil yield of 9.8% was obtained for 6 mm die diameter and speed of 380 rpm which was equal to 68% of oil recovery. This oil yield was much higher than the oil yield obtained by Pardo et al. (2009) who obtained an average of 7% oil yield for red grape varieties Monastrell, Garnacha Tintorera, Syrah and Petit Verdot in pilot screw press rotated at 60 rpm. Gomez et al. (1996) obtained 6.9% and 9% using supercritical CO_2 and hexane extraction respectively. The supercritical extraction of grape seed oil with CO_2 resulted in 12% of grape seed oil (Fiori, 2007; 2010). Beveridge et al. (2005) extracted seed oils from eight varieties of grapes by supercritical CO_2 and petroleum ether. Oil yields by supercritical CO2 ranged from 5.85 to 13.60 % (w/w), whereas petroleum ether yields ranged from 6.64 to 11.17 %. The highest yields of 13.60 % and 11.17 % were reported for Cabernet Sauvignon variety by supercritical CO2 and petroleum ether extractions respectively by Beveridge et al. (2005).

CONCLUSIONS

In this study, oil was extracted from grape seeds using screw press and the effect of press conditions, seed moisture and particle sizes were studied. The grape seeds with moisture contents of 3.1 to 8.7 % (d.b.) could yield about 9.2% of filtered oil using a 6 mm die diameter. The oil production capacity of 6 mm die diameter was 0.15 kg h^{-1}, hence to have a reasonably higher oil production capacity, 10 mm die diameter was suggested for grape seed oil extraction which produced filtered oil of 0.57kg h^{-1} at 7.6% yield. Pressing grape seeds with 10 mm die diameter resulted in die temperature of 90.8 °C and seed residence time of 8.6 s. Increasing the screw speed between 140 to 500 rpm did not affect the percentage of oil yield significantly. At high screw speed, the effective oil production rate increased from 0.20-0.57 kg h^{-1} at 10 mm die diameter at 5.3% seed moisture content. Grape seeds dried to 3.2 to 8.7% MC resulted in higher percentage of oil yield compared to high moisture seeds (17.5% MC).

ACKNOWLEDGEMENT

The authors wish to acknowledge the California Department of Food and Agriculture (CDFA) for funding this study and Sonomaceuticals, Inc., Santa Rosa, CA for supplying seeds for this research.

REFERENCES

Ajibola, O. O., S. O. Adetunji, and O. K. Owolarafe. 2000. Oil point pressure of sesame seeds. *IFE J. Tech*. 9: 57-62.

Baryeh, E. A. 2001. Effect of palm oil processing parameters on yield. *J. of Food Eng*. 48: 1-6.

Baydar, N. G., and N. Akkurt. 2001. Oil content and oil quality properties of some grape seeds. *Turk J Agric, Forestry.* 25:163-168.

Beveridge, T. H., B. Girard, T. Kopp, and J. C. Drover. 2005. Yield and composition of grape seed oils extracted by supercritical carbon dioxide and petroleum ether: varietal effects. *J. Agric. and Food Chem*. 53 *(5):* 1799-1804.

Boeck, H. 2011. Edible oil processing – Production, Expanding and Expelling. AOCS lipid library. Available at: www.lipidlibrary.aocs.org/processing/expanding/index.htm. Accessed July 23, 2013.

Coats, H. B., and M. R. Wingard. 1950. Solvent Extraction. III. The effect of particle size on extraction rate*. J. Am. Oil Chem. Soc*. 27, 93–96

Deli, S., M. F. Masturah, Y. T. Aris, and W. A. W. Nadiah. 2011. The effects of physical parameters of the screw press oil expeller on oil yield from Nigella sativa L seeds. *Intl. Food Res. J.* 18(4): 1367-1373.

Eckert, P., W. Heinen, and C. Knaudt. 2007. Grape seed, cold-pressed grape oil, crushed grape and grape flour. U S patent, US 7226627 B1.

Fantazzi, P. 1981. Grape seed: A potential source of protein. *J. Am. Oil Chem. Soc*., 1027-1031.

Farsaie, A., and M. S. Singh. 1985. Energy models for Sunflower oil expression. *Trans. ASABE*, 28: 275-279.

Fernandez, C. M., M. J. Ramos, A. Pérez, and J. F. Rodríguez. 2010. Production of biodiesel from winery waste:

extraction, refining and transesterification of grape seed oil. Bioresource Tech. 101:7019–7024.

Fiori, L. 2007. Grape seed oil supercritical extraction kinetic and solubility data: critical approach and modeling. J. Supercritical Fluid, 43: 43–54.

Fiori, L. 2010. Supercritical extraction of grape seed oil at industrial-scale: Plant and process design, modeling, economic feasibility. *Chem. Eng. Processing,* 49: 866–872.

Gomez, A.M., P. C. Lopez, and E. Martinez de la Ossa. 1996. Recovery of grape seed oil by liquid and supercritical carbon dioxide extraction: a comparison with conventional solvent extraction. *Chem. Eng. J.* 61:227-231.

Harmanto, A., E. Hendriadi, Rahmarestia, Mardison and J. Wiyono. 2009. Performance test of a screw-press machine for extracting Jatropha curcas seed into crude oil as an alternative energy source. *Indonesian J. of Agric.* 2 (1): 35-40.

Haumann, B.F. 1997. Mechanical Extraction: Capitalizing on Solvent-Free Processing, *inform*. 8: 165, 167–168, 171, 173–174

Izzo, R., and G. Muratore. 1993. Seed lipids from some varieties of grapes grown in Sicily. I. Fatty acid composition. *Riv. Ital. Sostanze Gras*. 70: 601-604.

Jordan, R. 2002. Eco-recycle Australian report on grape marc utilization—Cold pressed grape seed oil and meal, The cooperative research centre for International food manufacture and packaging science, available at:www.ecorecycle.sustainability.vic.gov.au. Accessed online 27 Dec. 2013.

Kabutey, A., Ceska, Z., and M. Katedra. 2010. Screw press performance for oil extraction from Jatropha curcas L. seeds of different moisture content. Scientia Agriculturae Bohemica. 41(4): 225-230.

Khan, L. M., and M. A. Hanna. 1983. Expression of oil from oilseeds – A Review. *J. Agric. Eng. Res.* 28:495-503.

Kiliçkan, A., N. Ucer, and I. Yalcin. 2010. Moisture-Dependent physical properties of black grape (VitisVinifera L.) seed. *Academic J. Sci. Res.* 5(16):2226-2233.

Kinsella, J.E. 1974. Grapeseed oil: A rich source of linoleic acid. *Food Tech.* 28: 58–60.

Kurki, A., J. Bachmann, H. Hill, L. Ruffin, and B. Lyons. 2008. Oilseed Processing for Small-Scale Producers. National Center for Appropriate Technology, Davis, Cal. Pages. 12.

Mwithiga, G., and L. Moriasi. 2007. A study of yield characteristics during mechanical oil extraction of preheated and ground soybeans. *J. Applied Sci. Res.* 3(10): 1146-1151.

Olayanju, T. M. A., R. Akinoso, and M. O. Oresanya. 2006. Effect of worm shaft speed, moisture content and variety on oil recovery from expelled beni seed. *Agric. Eng. Intl.* 8: 1-7.

Oomah, B. D., J. Liang, D. Godfrey, and G. Mazza, G. 1998. Microwave heating of grape seed: Effect on oil quality. *J Agric Food Chem.* 46: 4017–4021.

Pardo, J. E., E. Fernández, M. Rubio, A. Alvarruiz, and G. L. Alonso. 2009. Characterization of grape seed oil from different grape varieties (Vitis vinifera). *Eur. J. Lipid Sci. Tech.* 111: 188–193.

Pradhan, R. C., S. Mishra, S. N. Naik, N. Bhatnagar, and V. K. Vijay. 2011. Oil expression from Jatropha seeds using a screw press expeller. *Biosystems Eng.* 109:158-166.

Shukla, B.D., P. K. Srivastava, and R. K. Gupta. 1992. Oilseed Processing Technology. In *Technology Mission on Oilseed*, Central Institute of Agri. Eng. Bhopal, India: 155-156.

Singh, J., and P. C. Bargale. 1990. Mechanical Expression of Oil from Linseed (Linum usitatissimum L.). *J. Oilseeds Res.* 7:106–110.

Singh, K. K., and T. K. Goswami.1996. Physical properties of cumin seed. *J. Agric. Eng. Res.* 64(2): 93-98.

Singh, K. K., D. P. Wiesenborn, K. Tostenson, and N. Kangas. 2002. Influence of moisture content and cooking on screw pressing of Crambe seed. J. Am. Oil Chem. Soc. 79(2):165-170.

Snyder, J. M., J. P. Friedrich, and D. D. Christianson. 1984. Effect of moisture and particle size on the extractability of oils from seeds with supercritical CO_2. J. Am. Oil Chem. Soc. 61(12): 1851-1856.

Stahl, E., E. Schutz, and H. K. Mangold. 1980. Extraction of Seed Oils with Liquid and Supercritical Carbon Dioxide. *J. Agric. Food Chem.* 28, 1153-1157.

USDA. 2013. 2012 U.S. Grape report: Preliminary Summary reported in January 2013, USDA, NASS.

Varma, R.K., F. S. Champawant, and N. G. Bhole. 1993. Performance of a small screw expeller with rapeseed. In: *Proceedings of Indian Soc. Agric. Eng.* held at CIAE, Bhopal, India.

Williams, P., N. J. M. Kuipers, and A. B. De Haan, 2008. Hydraulic pressing of oilseeds: Experimental determination and modeling of yield and pressing rates. J. Food Eng. 89: 8-16.


Early Cover Crop Management in Almonds
Orchard Demonstration & Notes by Steve Pryor
March 7, 2014 in Winton, CA
Photos and Presentation by Derek Artz

Mixed flower strip at orchard edge; flowers planted at the same time using a seed drill

Mixed flower strip at orchard edge and one row in; *Phacelia tanacetifolia, P. cicutaria, P. ciliata, Nemophila menziesii, Eschscholzia californica, Collinsia heterophylla*

Mixed flower strip (6 species) at orchard edge; *Eschscholzia californica, Collinsia heterophylla*, and *Phacelia cicutaria* did not do well when planted as a mixed species seed mix

Mixed flower strip (6 species) at orchard edge; *Nemophila menziesii* did very well

Single species flower strip (*Phacelia tanacetifolia*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

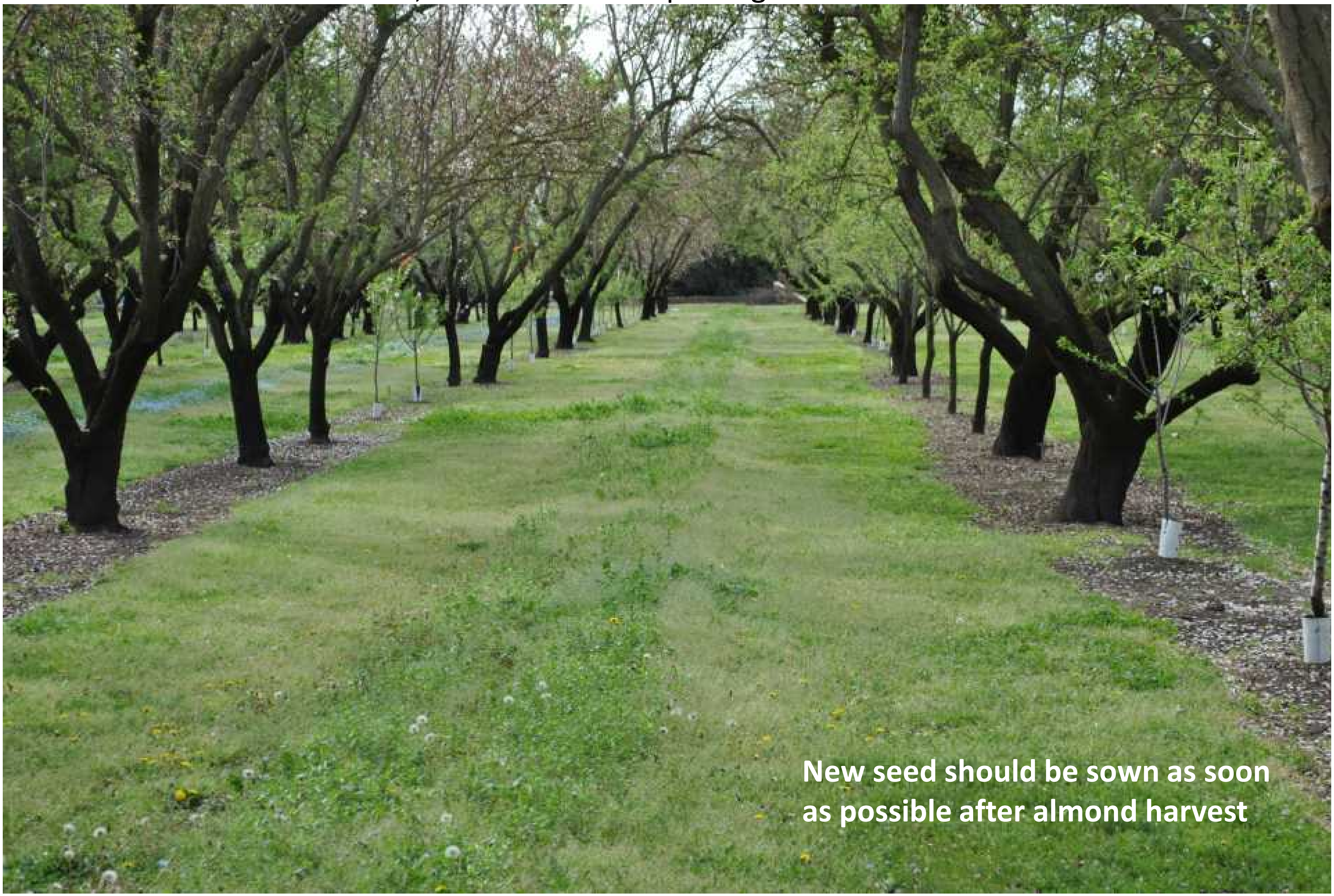
Single species flower strip (*Phacelia tanacetifolia*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Single species flower strip (*Phacelia tanacetifolia*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Single species flower strip (*Collinsia heterophylla*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Single species flower strip (*Collinsia heterophylla*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Single species flower strip (*Collinsia heterophylla*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment



Single species flower strip (*Nemophila menziesii*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Single species flower strip (*Nemophila menziesii*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Single species flower strip (*Nemophila menziesii*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Once cover crops have become naturalized to the orchard, use a ring roller after harvest to force the seed produced in the orchard down into the soil

Single species flower strip (*Nemophila menziesii*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Single species flower strip (*Phacelia cicutaria*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Single species flower strip (*Phacelia ciliata*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Excellent germination and establishment as a single species planting

Single species flower strip (*Phacelia ciliata*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Phacelia ciliata is a good choice for orchard between-row plantings

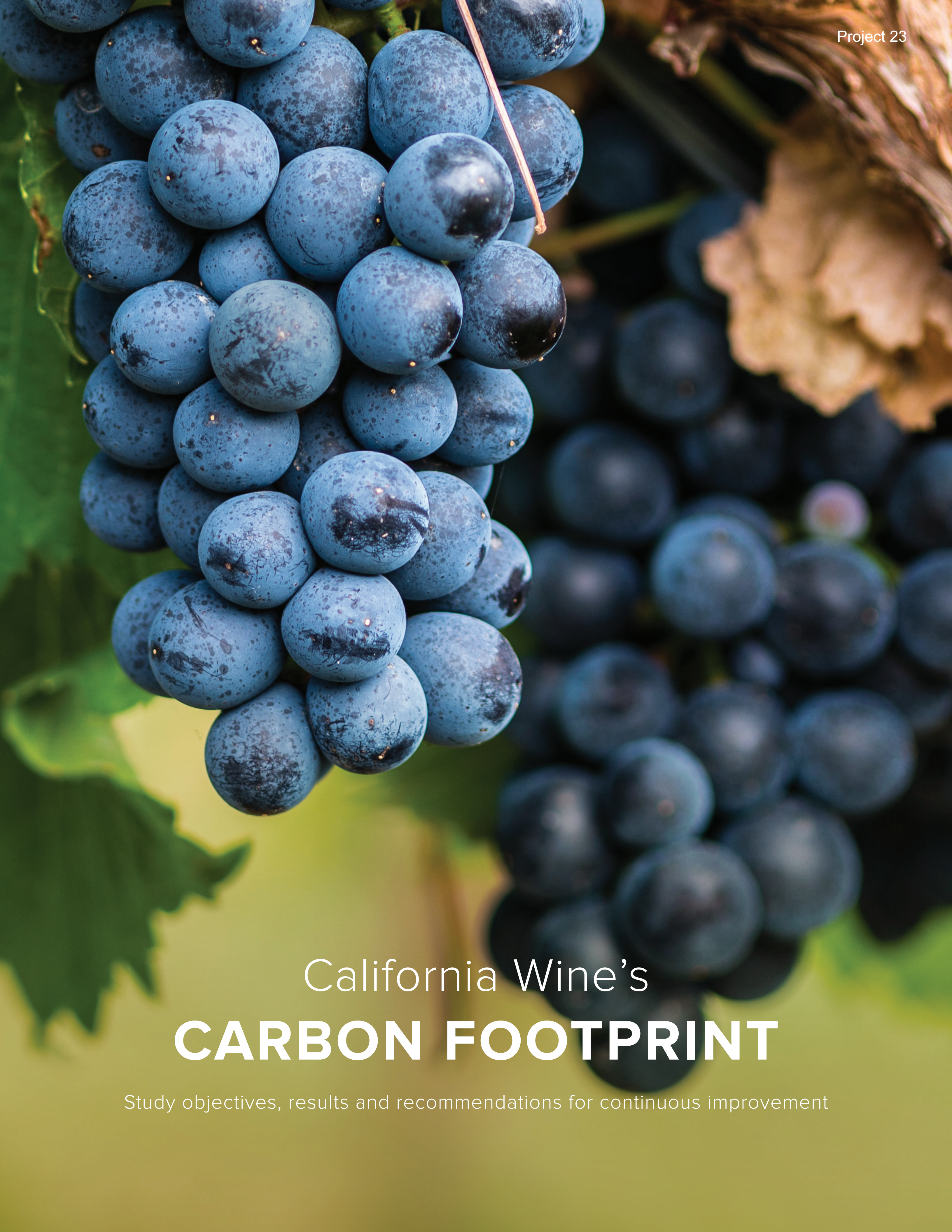
Single species flower strip (*Phacelia ciliata*) in orchard rows; 5 foot wide strips down the middle of the rows; seed drilled to improve germination and establishment

Single species flower strips
(*Collinsia* - foreground, *Nemophila* - middle, *Phacelia ciliata* - background)

Single species flower strips
(*Nemophila* - foreground, *Phacelia ciliata* - background)

1. Start with as bare a plot of ground as possible.
2. If not a bare plot, then at least get rid of grasses. Grasses will outcompete most wildflowers in dry years. Pollinators and most other beneficial insects find little value in grasses. Some grasses may serve as alternative hosts for some beneficials.
3. Try to control unwanted broadleafs, esp. *Malva parviflora* (cheeseweed), *Erodium cicutarium* (stork’s-bill) and *Chenopodium album* (lamb’s-quarters)
4. Do not mix desired species within rows. Plant single species per row. All species grow, bloom and set seed at different rates and times. Keeping species separated allows the mowing down of individual rows after the desired species has set seed. Additionally, the multiple desired cover crops species will not compete with each other if kept separate. Frost protection may necessitate the mowing down of poorly performing cover crops to improve air movement.
5. Only plant 5 foot wide strips down the middle of the “middles”. This will allow most orchard tractors to straddle the desired cover crop species and keeps them from competing with most of the crop root zone.
6. Use a seed drill to apply new seed. Drilled seed has a much higher germination rate and competes much better than surface broadcast seed. Use the small seed adaptor kit made for the seed drill or dilute the seed with some type of fine grind bran to establish an appropriate seeding rate. Birds can account for significant loss of surface broadcast seed.
7. New seed should be sown as soon as possible after harvest.
8. Once cover crops have become naturalized to the orchard, use a ring roller after harvest to force the seed produced in the orchard, down into the soil.
9. Irrigate as soon as possible after harvest to moisten and compact the seedbed.

Make sure incoming equipment tires are clean so that weed species don’t enter your acreage during spray or harvest operations.



California Wine's

CARBON FOOTPRINT

Study objectives, results and recommendations for continuous improvement

The California wine industry has long been committed to sustainable winegrowing and continuous improvement. In 2002, Wine Institute and the California Association of Winegrape Growers published a comprehensive California Code of Sustainable Winegrowing Self-Assessment Workbook, now in its third edition, and in 2003 created the California Sustainable Winegrowing Alliance (CSWA), a nonprofit organization devoted to providing vintners and growers with tools, resources, and workshops to promote the adoption of sustainable vineyard and winery practices[1]. In 2010, CSWA launched a third party certification option, Certified California Sustainable Winegrowing.

While the sustainability efforts of the industry have focused for many years on the areas of energy efficiency, water management, integrated pest management, ecosystem management, etc. the industry began a concerted effort to examine greenhouse gas emissions and climate change mitigation and adaptation in 2007. A literature review and the development of a comprehensive report that consolidates information about greenhouse gas emissions (GHG) and vineyards was undertaken in 2007. Also in 2007, Wine Institute joined together with wine associations from Australia, New Zealand and South Africa to develop the International GHG Protocol and calculator. In 2012, CSWA added Performance Metrics to its online self-assessment and reporting system for energy, water, and nitrogen use, as well as for energy-related GHGs to assist growers and vintners in measuring and tracking their resource use and related emissions. CSWA also worked with scientists to better understand the carbon and nitrogen fluxes occurring in the vineyard soil by calibrating and field testing the internationally used DeNitrification and DeComposition (DNDC) tool, which was then integrated into the Performance Metrics in 2013.[2]

In 2011, Wine Institute commissioned PE INTERNATIONAL to conduct a carbon footprint assessment of the California wine industry to better understand the specific areas within the winegrape growing and winemaking processes that have the greatest impact on GHG emissions. Since a carbon footprint assessment takes into account the life cycle of the product, it is a useful way to identify where opportunities exist to reduce the product's carbon footprint. The results of the carbon footprint assessment, completed for a 9L case of wine, are shown in Figure 1. The areas with the most opportunity for improvement to reduce a vineyard or winery's carbon footprint (also known as "hot spots" using the carbon footprint assessment terminology), are:

- Packaging, particularly the use of glass bottles;
- Vineyard field emissions, particularly nitrous oxide (N_2O) associated with bio-geochemical processes and nitrogen application;
- Vineyard and winery electricity usage for operations; and
- Distribution of packaged wine throughout the U.S. using truck and rail transport.

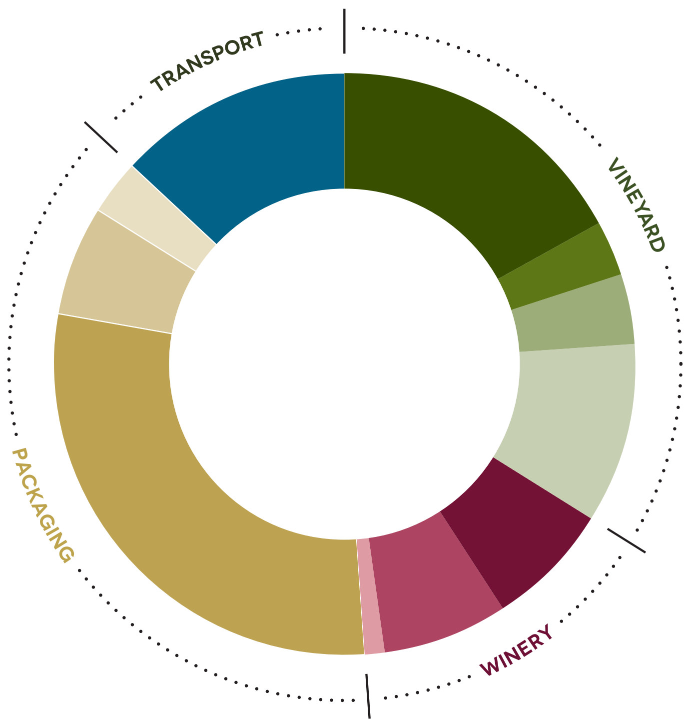
It is important to view these findings with an understanding that the results show an industry wide perspective on GHG emissions, but are expected to be representative of individual vineyards and wineries. Companies that want to understand their specific footprint should use the existing wine industry tools such as the International GHG Protocol and CSWA's Performance Metrics facility carbon footprint calculator. Suggested improvement opportunities for the industry associated with these four areas are provided in Table 1.

Many of the best practices already in use by the industry, and identified in the California Code of Sustainable Winegrowing, can help reduce the carbon footprint of wine. With the goal of continuous improvement, California growers and vintners can use the results of this study as a guide when considering opportunities to reduce their carbon footprint. Many opportunities for carbon footprint reduction will also lead to efficiencies in operations and reduced costs associated with raw material and energy purchases. Further, reduction of GHG emissions can help address regulatory and market pressures and mitigate business risk.

[1] Since 2002, CSWA has promoted continuous improvement in the wine industry through the Sustainable Winegrowing Program (SWP). More than 1,800 vineyards and wineries have participated, and over 10,000 growers and vintners have attended educational workshops. www.sustainablewinegrowing.org

[2] For more information: www.sustainablewinegrowing.org/docs/Vineyards_GHGs_Handout.pdf

FIGURE 1 Relative impacts for the carbon footprint of packaged wine, cradle-to-retail gate



1 Footprint associated with greenhouse gas emissions that are a result of natural bio-geochemical processes and impacted by local climate, soil conditions, and management practices like the application of nitrogen fertilizers.

2 Footprint associated with the manufacture and shipment of materials used at a vineyard such as fertilizers and pesticides.

3 Footprint associated with the transport of grapes from vineyard to winery, raw material production, refrigerant losses, and manufacturing waste treatment.

4 Footprint associated with the manufacture and shipment of materials used for packaging wine.

5 Footprint associated with the natural cork closure with aluminum foil and treatment of waste at packaging manufacture.

6 Footprint associated with fuel production and combustion in trucks and trains based on typical distances for the industry when shipping in the United States to retail facilities.

TABLE 1 Improvement opportunities for the California wine supply chain[3]

Packaging	Lightweight glass bottles Switch to alternative packaging designs (e.g.: bag-in-the box, wine kegs, plastic bottles)
Vineyard Field Emissions	Optimize nitrogen management plan
Vineyard and Winery Energy Use	Conduct an energy audit of the vineyard and/or winery Implement energy efficiency measures Install on-site renewable energy options
Distribution	Optimize distribution network Increase percentage of rail transport Switch to a low-emissions fleet Discuss carbon footprint reduction options with your distribution partner(s)

3 Examples of best practices can be found in the California Code of Sustainable Winegrowing and on the California Sustainable Winegrowing Alliance website (www.sustainablewinegrowing.org)

A SNAPSHOT OF THE CARBON FOOTPRINT

Objectives

CSWA is increasingly focused on understanding full product impacts and quantitative performance outcomes, and on providing tools and information to help wineries and winegrape growers respond to regulatory and market requests. For instance, the industry invested in the modeling of statewide vineyard emissions using the DeNitrification and DeComposition (DNDC) model, and developed online Performance Metrics, including a facility carbon footprint calculator. These tools are intended to help vineyards and wineries understand their carbon footprint so they can adjust management practices to improve resource conservation, reduce cost, and help mitigate climate change.

In response to industry commitment and stakeholder interest in GHG emissions in media, public policy and market arenas, Wine Institute commissioned an industry carbon footprint to identify hotspots and improvement opportunities, and ultimately provide an important baseline for the industry by which to measure its future success.

Approach

This study summarizes the cradle-to-gate carbon footprint of wine produced in California and shipped within the United States. The study includes the extraction and production of raw materials (e.g.: fertilizer, diesel), grape cultivation, transportation of the grapes to wineries, winery operations, packaging, and, finally, distribution to warehouses and retail stores in the United States (truck and rail transport only).

[4] The International Organization for Standardization (ISO) series of voluntary international LCA standards, ISO 14040, outlines the generally accepted principles and requirements for conducting an LCA. www.iso.org

[5] IPCC. Climate Change 2007: Working Group 1: *The Physical Science Basis*. www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

Terms and Definitions

Life Cycle Assessment

(LCA) is the internationally accepted and standardized methodology that defines a systematic set of procedures for "compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle".[4] A *cradle-to-grave system* boundary considers the life cycle stages of a product from raw material extraction through to the disposal at the end of life of the product. A cradle-to-gate system boundary considers the life cycle from raw material extraction through an intermediate life cycle stage (e.g.: product production).

Product Carbon Footprints

are a subset of LCA that focus only on the climate change or the global warming potential impact category. A product carbon footprint, reported in CO_2-equivalents, is a measure of *greenhouse gas (GHG) emissions* (carbon dioxide, methane, nitrous oxide, fluorinated gases) over a product's life cycle. Some GHGs have a stronger warming effect than carbon dioxide such as methane with a Global Warming Potential of 25 kg CO_2-equivalents and nitrous oxide 298 kg CO_2-equivalents.[5]

A **Hot Spot** is an area of the product life cycle that has significant potential impact on a given environmental aspect and is identified and generally agreed upon by experts. The intent of identifying hot spots is to understand where to focus improvement initiatives. It only provides relative context within the product life cycle and does not imply a comparison to other products.

The study began with an initial hot spot and gap analysis including a review of existing published LCAs on the cradle-to-gate impacts of packaged wine. The result of the analysis indicated that there is a significant range in the carbon emissions attributed to packaged wine—although energy, packaging and distribution were common hot spots. Additionally, most existing studies were Eurocentric, further necessitating the development of a baseline LCA model specific to the California industry.

In order to determine an industry average baseline for the carbon emissions associated with wine production in California, it was important to get a high level of representativeness. Data was collected through a variety of sources; vineyard and winery electricity, fuel and raw material consumption data (2011) were provided by companies who represent 4–5% of total vineyard acreage in California and 84% of cases produced in California. Additional vineyard information was derived from the DeNitrification and DeComposition (DNDC) tool, which models the carbon and nitrogen bio-geochemistry in a vineyard during the life cycle of a grapevine based on conditions such as weather, soil type, and management practice. The DNDC model was used to simulate field emissions in all of the winegrowing regions throughout California and, through calibration and testing, was shown to be an accurate representation of statewide vineyard field emissions.

Data was collected through the Sustainable Winegrowing Program Performance Metrics Calculator, customized questionnaires, and conversations with California growers and vintners. Additionally, the study drew on published guidance documents, consultation with industry experts, and PE INTERNATIONAL's in-house agricultural expertise to create a comprehensive picture of wine production in California.

Data Analysis

For the inputs and outputs of the wine life cycle, a weighted average was calculated using the known production totals for each vineyard and winery that provided data. Outliers were identified and individually assessed as to their inclusion or exclusion within the study. The work was further vetted through literature and conversations with industry experts. The collected information was then translated into quantitative environmental impacts using the GaBi Software for Product Life Cycle Assessments[6]. The results have been interpreted to highlight hot spots and inform industry recommendations for future carbon footprint reductions.

Results and Recommendations

The relative results of the carbon footprint for the California wine industry are summarized in Figure 1. Based on this analysis and depending on the stakeholder (e.g.: vineyard, winery, packaging or distribution company), different strategies can be implemented towards the goal of improving the overall environmental performance of the California wine industry.

Vineyard

Greenhouse gas emissions at the vineyard come primarily from nitrous oxide (N_2O) emissions released from the soil and related to natural bio-geochemical processes, local climate, soil conditions, and management practices like the application of nitrogen fertilizers. Typical N_2O and other field emissions for California were calculated using the DNDC model; the model simulates the interaction of local climate, soils and on-site management practices to predict crop yield and field emissions. The study considered all of the winegrowing regions of California looking at the field level variations. Production weighted average field emission factors were used and are considered highly representative. Understanding how the natural conditions and management practice affect field emissions may allow growers to further optimize their applied nitrogen use, thereby reducing on-farm N_2O emissions. Additionally, minimizing fossil fuel use for equipment will have positive environmental impacts, while also reducing operating costs.

Winery

Impacts at the winery can be attributed primarily to purchased energy, which includes electricity, diesel, and other fossil fuels. While the study considered the use of solar and other renewable energy sources, the overall percentage of renewable energy used in the California winemaking process remains relatively small. Future improvements may be seen through a concerted effort on first increasing energy efficiency (e.g.: refrigeration, lighting, insulating tanks), which would reduce impacts across all categories, and then considering feasibility of alternative energy sources.

Packaging

Impacts from packaging are due to the energy requirements of producing the requisite materials, such as the glass bottle and corrugated box. However, the closure had a relatively small impact on the overall wine life cycle with impacts ranging from 1–3%. Packaging has a significant contribution to the overall California wine footprint and packaging design decisions have the ability to significantly reduce a winery's footprint (refer to Figure 2). For example, light weighting (also called dematerialization) of glass bottles will lead to significant reductions in environmental burden.

---

[6] www.gabi-software.com

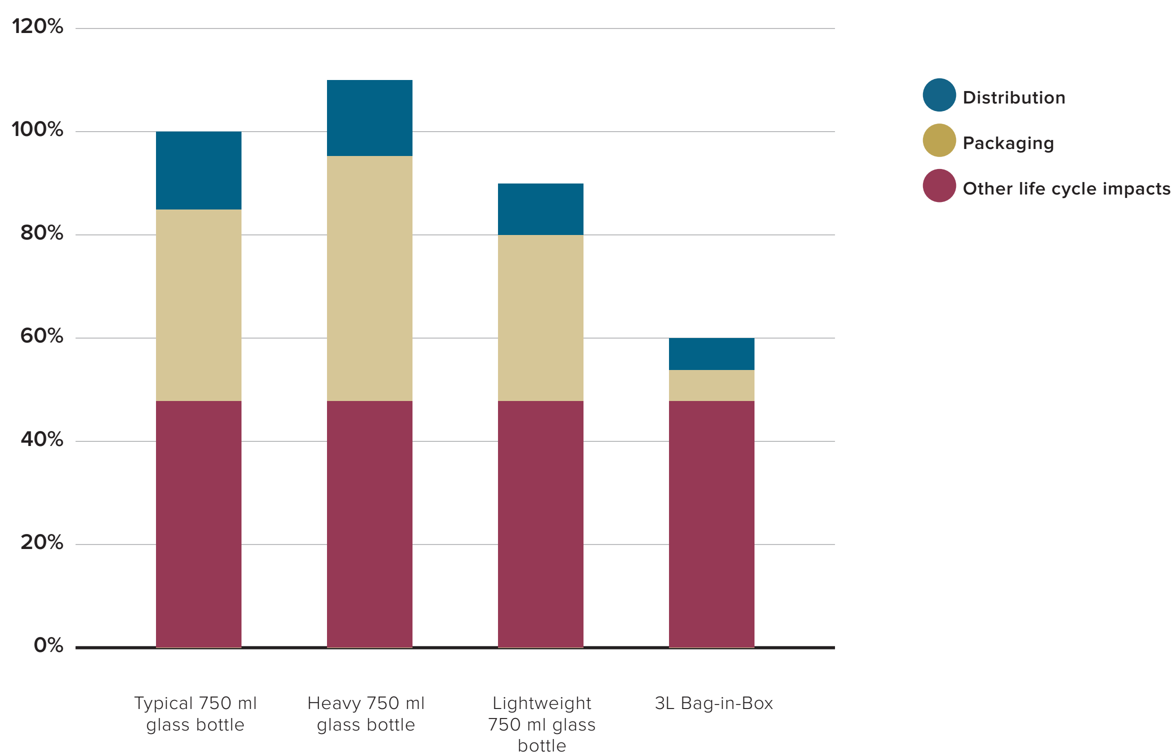
Using less glass also has the benefit of shipping less mass, thereby reducing the burden of distribution. Increasing both the recovery rate as well as the recycled content of new glass bottles can further improve overall packaging impacts.[7] The study showed that bag-in-the-box packaging has the potential to reduce the carbon wine footprint by 40% (Figure 2). While not included in the scope of this study, shipping in bulk reusable stainless steel wine kegs may have environmental benefits by reducing the packaging material and shipping weight burden per case (9L) of wine. Other packaging considerations not included in the scope of this study include quality and consumer preference.

Distribution

While packaging mass and configuration can dictate the distribution burden of California wineries, the mode of transportation (truck vs. rail) can also have a significant impact on the footprint of wine. Within the distribution from the winery to warehouse and retail locations, rail transport was found to be the least carbon-intensive mode of transportation. Therefore, the redesign of distribution networks to incorporate more railways for long haul transport, while still meeting logistic demands, is a key opportunity for improvement, next to optimizing volume utilization, and/or considering low-carbon fuels for distribution vehicles.

FIGURE 2 Packaging alternative assessment for the carbon footprint of packaged wine

Using an average 750 ml bottle as the baseline (100%) and a fixed impact for all upstream life cycle stages (grape and wine production), this graph illustrates packaging impact of various types of glass bottles (traditional, heavy and light weight) and bag-in-box scenarios.



[7] Glass Packaging Institute (GPI). 2010. Environmental Overview. *Complete Life Cycle Assessment of North American Container Glass*. www.gpi.org/sites/default/files/N-American_Glass_Container_LCA.pdf

Conclusions and Potential Next Steps

Based on the outcome of this study, the industry is updating its Performance Metrics to include packaging materials and distribution impacts. This update will enable companies to get a sense of the hot spots in their individual operations. By understanding the carbon footprint of the California wine industry, individual growers, vintners, and distributors can consider how to best use their resources and target specific greenhouse gas reduction activities. Small changes at the facility level can have a large impact on the overall industry footprint if adopted across the industry.

The results of the present study not only help to identify future improvement opportunities for the wine industry, but also point to areas to focus on for future updates of the study. Further refinement of the data collection process will enable a deeper understanding of variation by product, operation, and scale of facilities. Understanding and inclusion of the use phase (e.g.: storage and refrigeration) through a consumer use habit survey will add another level of detail to LCA results. To increase understanding of water consumption within the industry, a water footprint analysis for California vineyards and wineries should also be considered, as this resource is becoming increasingly important, particularly in agriculture supply chains.

Acknowledgements

PE INTERNATIONAL would like to thank the vineyards and wineries who shared their time and data, along with the Wine Institute Environmental Working Group, CSWA, SureHarvest, Kennedy/Jenks Consultants, and the California Department of Food and Agriculture (CDFA) Specialty Crop Block Grant Program for their support of the project.

Wine Institute

Established in 1934, Wine Institute is the association of 1,000 California wineries and affiliated businesses that initiates and advocates public policy to enhance the ability to responsibly produce, promote, and enjoy wine. Wine Institute works to bolster the economic and environmental health of the state and its communities by encouraging sustainable winegrowing and winemaking practices. The membership represents 85% of U.S. wine production and 90% of U.S. wine exports.

PE INTERNATIONAL

PE INTERNATIONAL is one of the world's most experienced sustainability software, content and strategic consulting firms. With 20 years of experience and 20 offices around the globe, PE INTERNATIONAL allows clients to understand sustainability, improve their performance and succeed in the marketplace. Through market-leading software solutions, strategic consulting services and implementation methodologies, PE INTERNATIONAL has worked with some of the world's most respected firms to develop the strategies, management systems, tools, and processes needed to achieve leadership in sustainability.

October 30, 2013

Allison Jordan
Executive Director, California Sustainable Winegrowing Alliance
Director of Environmental Affairs, Wine Institute
425 Market St. San Francisco, CA 94105

RE: Response to Colman and Päster's Red, White and "Green"

Dear Allison,

In October 2007, an article by Colman and Päster was published by the American Association of Wine Economists, examining the environmental performance of wine produced in two regions and delivered to consumers on the East coast of The United States.[1] The study concluded that there is a "green line", where the environmental impacts of transporting wine from Napa and Bordeaux are equal. As seen in Figure 1, the "green line" encroaches westward, well beyond the East coast and into the Midwest and southern regions. The figure implies that all areas eastward of the "green line" would benefit from purchasing wine produced in Bordeaux instead of wine produced in Napa to reduce their environmental footprint.

Figure 1: The "green line" shown in Colman and Päster (2007)

[1] Colamn, T., Päster, P. 2007. Red, White, and "Green": The Cost of Carbon in the Global Wine Trade. *American Association of Wine Economists, Working Paper No. 9.* http://www.wine-economics.org/workingpapers/AAWE_WP09.pdf

To understand the validity of this claim, the article was examined for its scope, data sources, methodologies, assumptions, and limitations. The largest limitations to this claim are that it is based solely on the distribution activities of wine to New York City from Napa, CA or Bordeaux, FR, and that the distribution assumptions are not based on actual industry practice. Additionally, upstream and downstream life cycle stages (vineyard practices, winery operation, packaging, warehousing, retail, consumer transport, and end-of-life) should be included in the analysis in order to draw meaningful conclusions on the 'break-even' point.

The following document examines the system boundary, choice of environmental indicators, data sources, assumptions about distribution logistics, and impact of packaging and how these influence the overall conclusions.

System Boundary

In 2012, the Wine Institute[2] commissioned PE INTERNATIONAL to conduct a Life Cycle Assessment[3] of a case (9L) of wine produced and shipped within the United States to understand the environmental impacts of the California wine supply chain. Amongst other impacts, the LCA identified the relative carbon footprint of each life cycle phase as shown in Figure 2. While it is clear that distribution is a carbon footprint hotspot, other life cycle stages such as packaging and vineyard emissions are also important drivers for the overall wine carbon footprint. The conclusion by Colman and Päster (2007) was made while "holding bottle mass constant"; from the article it can also be inferred that all upstream and downstream impacts from the transportation stage were also assumed to be equal across all scenarios. By simplistically considering distribution, Colman and Päster (2007) misses other potential differentiators and improvement opportunities in both supply chains such as packaging design, vineyard management practices, and energy efficiency. Moreover, changes to upstream activities can lead to a cascading effect, e.g., light-weighting of glass bottles reduces the carbon footprint of the packaging raw materials as well as reducing the carbon footprint of distribution across the US.

Therefore, considering a break-even point based on the wine supply chains is incomplete without considering the full product life cycle and other differences such as vineyard management or packaging material.

[2] The Wine Institute is an industry association representing more than 1,000 wineries in California. http://www.wineinstitute.org/

[3] The California wine LCA considered cradle-to-grave environmental impacts including vineyard operations, winery operations, packaging raw materials, distribution including warehousing, retail, consumer car transport for consumers to purchase wine, and packaging disposal at end-of-life. Use (refrigeration) of the wine in the home is excluded from the study. Primary data was collected by California vineyards and wineries to represent the industry using 2011 data.

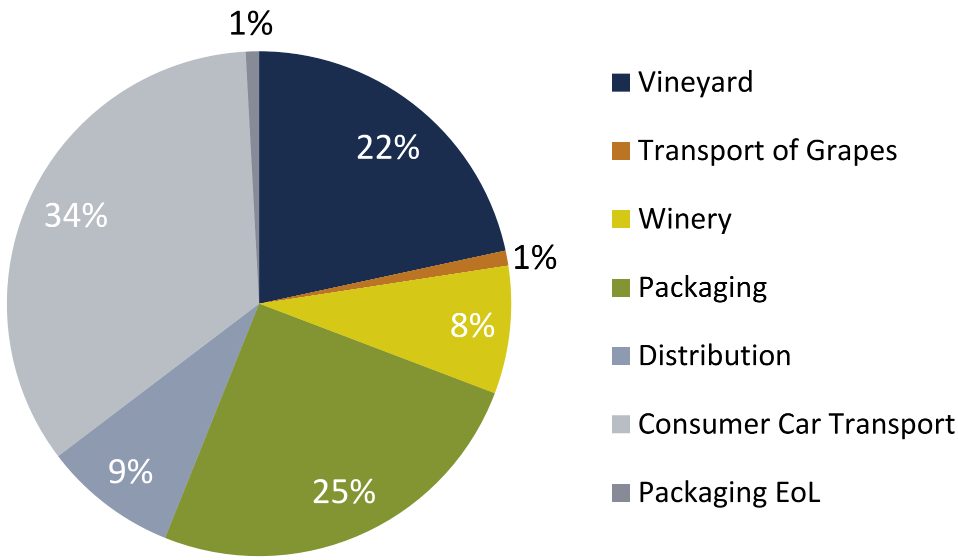


Figure 2: Relative carbon footprint contribution of life cycle stages for California wine with representative US distribution - 34% shipped by rail (2509 miles), 66% shipped by truck (549 miles).

Environmental Indicators

In addition to considering the entire supply chain, it is also important to assess a wider range of environmental impacts such as water and air pollution. A minimum set of environmental life cycle impact assessment categories (LCIAs) should include the following:

- Global warming potential (GWP) - Increased warming of the atmosphere due to anthropogenic greenhouse gases, such as carbon dioxide, trapping solar energy;
- Acidification potential (AP) - Acid rain due to the wash-out of acidifying gases in the air;
- Eutrophication potential (EP) - Excessive nutrient input into water, air, and land;
- Ozone depletion potential (ODP) - Destruction of UV-filtering layer of ozone in the Earth's stratosphere; and
- Smog formation potential (SFP) - Formation of harmful, low level ozone (smog) through a chemical reaction of pollutants combined with energy from sunlight.

While Colman and Päster focused on carbon footprinting, there is a gap in this single metric approach; by considering multiple environmental indicators, you are able to understand hidden tradeoffs or unforeseen environmental impacts such as a decrease in GHG emissions, but an increase in water pollution.

In order to understand how the two supply chains might compare considering other environmental indicators, PE modeled the distribution distance and transport mode assumptions outlined in Colman and Päster (2007). The supply chains summarized in Table 1 were modeled using PE's GaBi Software and

Databases[4] and the upstream and downstream models representing the California wine supply chain were used for a high level comparison of non-GHG life cycle impacts using the TRACI 2.1 methodology[5]. The results of this comparison are shown in Figure 3; each bar is subdivided into distribution and non-distribution impacts; the distribution bar shows the differences in impacts between the transportation from Napa and from Bordeaux.

Table 1: Summary of transport mode and distance to New York City from Napa and Bordeaux

Winery origin	Transport mode	Distance to NYC (miles)
Napa, California	Truck	2878
Bordeaux, France	Ocean cargo freight	3615

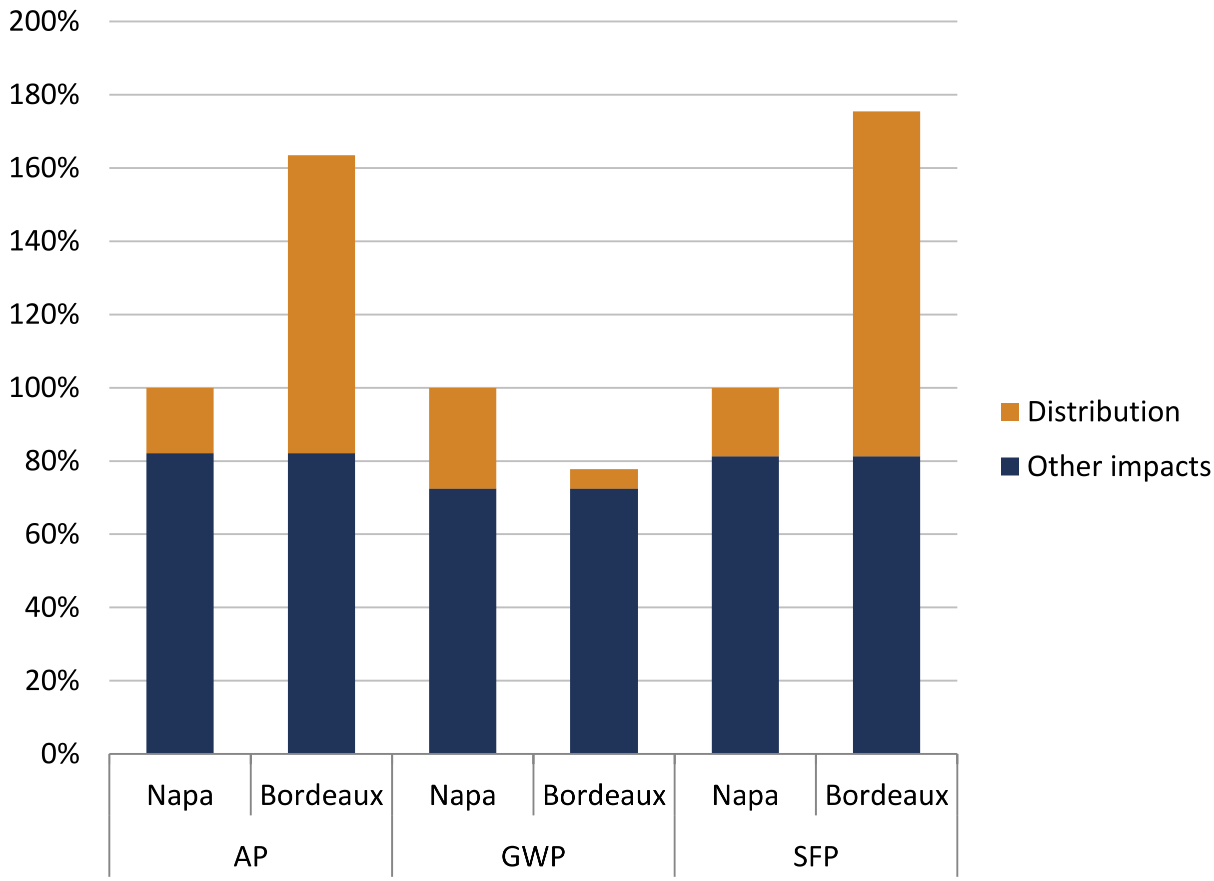


Figure 3: Comparison of distribution impacts across multiple environmental indicators (Napa wine scenario used as benchmark - 100%)

Figure 3 shows that while global warming potential is greater for California wine (with the assumption of 100% truck transport), the other categories show that Bordeaux wine has greater impacts or is

4 http://www.gabi-software.com/america/index/
5 http://www.epa.gov/nrmrl/std/traci/traci.html

comparable with California wine. The increase in acidification and smog formation indicates that there is a higher rate of polluting emissions from ocean freight transportation. Emissions of acidifying nitrogen oxides (NO_x) from fuel combustion are particularly high for ocean freight when compared with truck transportation due to the use of low-quality fuels in international waters.[6] The comparison also indicates that distribution is not the primary hot spot for eutrophication or ozone depletion, which are driven by agricultural practices and packaging materials, respectively.

Data Quality

A comparison of the emission factors cited in Colman and Päster (from CE Delft[7] and the GHG Protocol[8]) and the GaBi Life Cycle Inventory Database[9] is shown in Table 2; there are large differences between these data points. The CO_2 emissions per ton-kilometer of truck, ocean and rail transport are 3.5 to 7.5 times higher in Colman and Päster (2007). Moreover, the cited data source is at least seven years old.[10] In contrast, the GaBi Database is updated once a year to remove any outdated information and the emission factors are based on 2011 data (vs. 2006 or older) and thus deemed to be more recent and representative of current technologies.

Table 2: Comparison of transportation emission factors

Expressed in grams CO_2 per ton-kilometer, which are the emission rates of carbon dioxide for transporting one ton of cargo over a distance of one kilometer. a: GHG Protocol, b: CE Delft (2006)

	Colman & Päster (2007)	GaBi database (2011)	Factor
Truck [g/t·km]	252[a]	72.6	3.5x
Ocean freight [g/t·km]	52.1[b]	15.2	3.4x
Rail [g/t·km]	200[a]	26.7	7.5x
Air freight [g/t·km]	570[b]	769	0.74x

The use of outdated emission factors leads to a potential overestimation of the carbon footprint in Colman and Päster (2007). Applying the emission factors in Colman and Päster (2007), trucking 9 liters of wine over a distance of 3,000 miles would result in 13.7 kg CO_2-equivalents, whereas using GaBi emission factors would only result in 3.94 kg CO_2-equivalents for the same transportation assumption.

6 http://en.wikipedia.org/wiki/Fuel_oil#Bunker_fuel

7 CD Delft, Germanischer Lloyd, MARINTEK, Det Norske Veritas. 2006. Greenhouse Gas Emissions for Shipping and Implementation Guidance for the Marine Fuel Sulphur Directive.

8 WBCSD/WRI GHG Protocol

9 More information on the GaBi databases can be found at http://www.gabi-software.com/databases/gabi-databases.

10 The emission factor for container ships (52.1 g/t-km) was attributed to CE Delft (2006). However, the container ship emission factor shown in Table 11 of the source could not be used to replicate the value cited in Colman and Päster (2007). The emission factors for trucking and rail were attributed to the Greenhouse Gas Protocol, but a full bibliography was not given. Thus, the values could not be replicated.

Transportation Mode

The assumptions about distribution mode made in Colman and Päster (2007) are simplistic, assuming 100% truck transport from Napa and 100% ship transport from Bordeaux to New York City. The reality is that multiple modes of transportation are used to distribute wine including a combination of truck, rail, consumer car, ship, and plane. In order to make a comparison, a production weighted average shipping mode that is representative of both Napa and Bordeaux is required. Since no such detailed information was available, the following describes how transportation mode can have a significant impact on the conclusions of the comparison.

Figure 4Figure 2 shows the impact of California wine shipped to New York using 100% truck as assumed in Colman and Päster (2007) versus the impact when wine is shipped by rail (90% rail, 10% truck). Because rail is a more efficient mode of transport (Table 2), there is a significant reduction in environmental burden. The 90% rail scenario reduces the carbon footprint of the distribution stage by 66% for an overall life cycle footprint reduction of 22%.

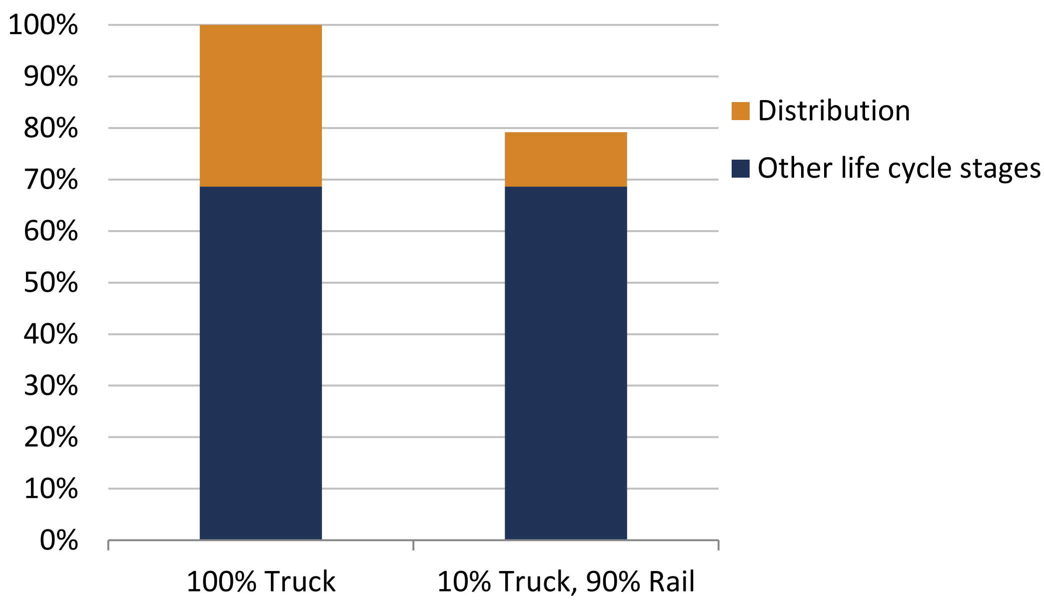


Figure 4: Comparison of global warming potential impacts of CA wine delivered to New York

Additionally, single mode transportation to represent the wine trade of Napa and Bordeaux is not realistic. The combination of modes will have a significant impact on the outcome of the study. In particular, the consideration of air freight through wine clubs or direct to consumer markets, which is by far the most impactful mode of transportation per ton-kilometer, could have a significant effect on the overall impacts.

Figure 5 shows the relative impact of using different modes of transportation. As can be seen, shipping only 5% of wine from Bordeaux to New York by plane would triple the distribution impacts for the supply chain. It is clear that mode of transport is a critical component of this comparison; as such, a closer study of the logistics of Napa and Bordeaux wine may lead to very different conclusions.

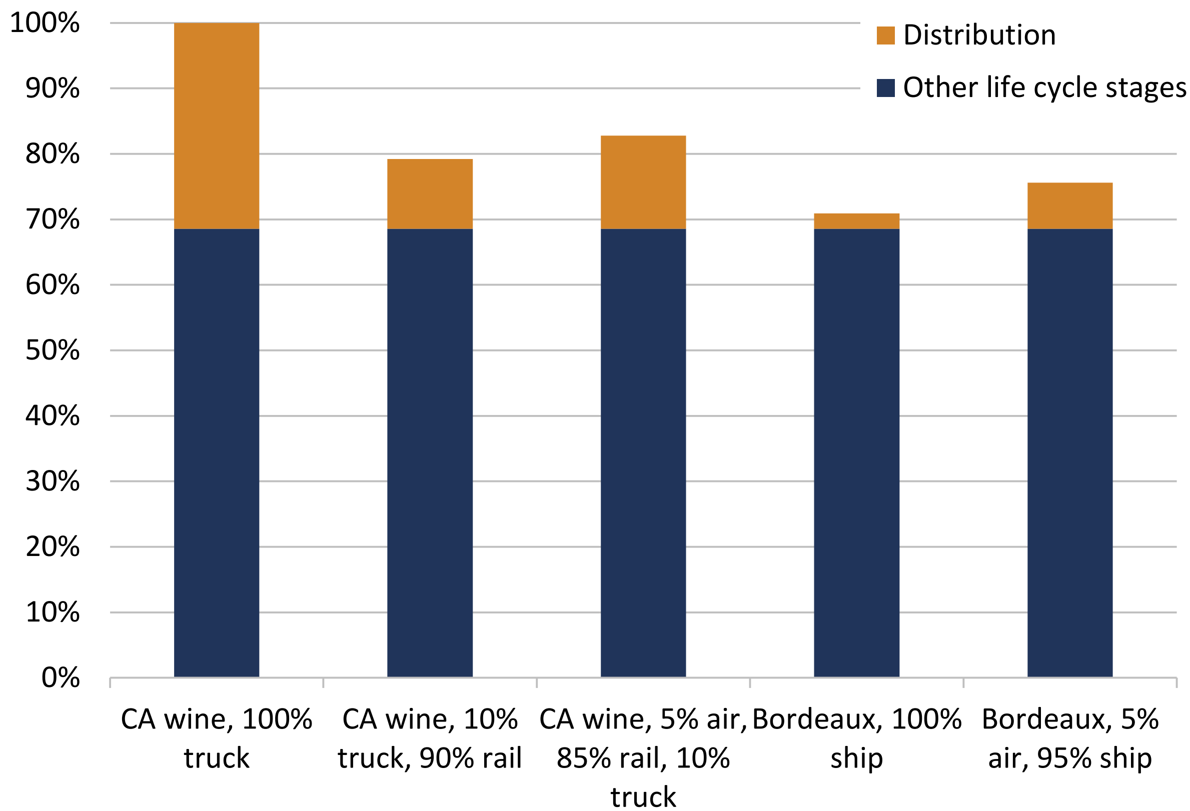


Figure 5: Comparison of alternative modes of transport for distribution of wine

Packaging

Packaging is a known environmental hot spot for wine; there is significant leverage in packaging design because of both the potential to reduce environmental burden of packaging materials as well as that of the distribution of the packaged wine. Packaging configuration and efficiency (volume of wine to packaging mass ratio) is an important factor in the overall distribution burden of wine. As shown in Figure 2, production of the packaging material was shown to contribute 25% of the total carbon footprint for the California wine industry. Therefore, the packaging of wine must be studied in much greater detail.

Light-weighting

The most direct way of reducing packaging production impacts is *dematerialization*—i.e., to use less glass per bottle. According to *Wine Business* Monthly, most commonly used glass bottle weights are 482 grams and 576 grams.[11] However, innovative lightweight designs are becoming a viable alternative solution. In fact, Ontario, Canada has limited the weight of non-hock (non-tapered neck) wine bottles to

---

[11] Wine Business Monthly. 2011. 2011 Packaging Survey Report: Glass and Wine Shippers. August 2011.

no more than 420 grams for wines costing CAN$15 or less[12]. This lighter bottle has approximately 13% less glass than a conventional 482 gram bottle. Additionally, the reduction in glass reduces the mass per bottle of 750 ml wine by 5%, thus reducing the distribution burden of the packaged wine.[13]

Packaging Material and Design

A much larger reduction in packaging production and distribution burdens can be achieved through material choice. Increasing recycled cullet content can reduce the environmental burden of a finished glass bottle significantly by requiring less raw materials (silica, etc.) and less energy in the furnace. A study by the Glass Packaging Institute[14] showed that increasing the recycled content of the glass from 10% to 50% results in a 27% reduction of GWP associated with the glass bottle.[15]

A more dramatic material choice would be switching from glass to polymer. A PET bottle can be as light as 10% of a glass bottle with equivalent volume capacity.[16] Therefore, a 750 ml PET bottle of wine can have a 46% reduction in overall mass, which translates to environmental benefit in distribution.

Additionally, alternative (non-bottle) packaging designs such as bag-in-box (bib) are becoming more popular in 1 liter, 3 liters, and 5 liters sizes. Bag-in-box is an extremely efficient packaging configuration for wine, as there is much better *volume utilization* with boxed wines to enable efficient packing in trucks and trains. This will enable trucks to ship more wine mass (vs. packaging mass). Additionally, the amount of packaging material per volume of wine is reduced significantly, having a 77% reduction in mass and an 85% reduction in the carbon footprint of wine packaging. Overall, there is a 42% reduction in global warming potential impacts across the life cycle associated with the packaging phase as well as cascading reductions in distribution, consumer car transport and end-of-life (Figure 6). As seen in Figure 6, there is a considerable reduction in packaging production impacts; additionally, there are notable impact reductions at distribution and consumer car transport stages.

---

12 Copeland, B.E., Devendra, A. 2012. Beverage Alcohol Brief: Recent developments in alcohol law. Accessed June 2013. http://www.nixonpeabody.com/Lightweighting_wine_bottles_eco-friendly_trend_becomes_mandatory_in_Ontario

13 Assuming the wine in a 750 ml bottle is approximately 750 grams, then a typical bottle of wine weights about 1,230 grams. Using a lightweight bottle will result in a 1,170 gram packaged bottle of wine weighing; this is an overall reduction in the distribution phase of 5% as a result of light weighting.

14 The Glass Packaging Institute (GPI). 2010. Environmental Overview: Complete Life Cycle Assessment of North American Container Glass. http://www.gpi.org/sites/default/files/N-American_Glass_Container_LCA.pdf

15 The CA wine study assumes a recycled content of glass bottles of 41%.

16 Wine Business.com. 2011. Canadian Supplier Launches Wines in First 1L PET Bottle for North American Airline Industry. Accessed June 28, 2013.

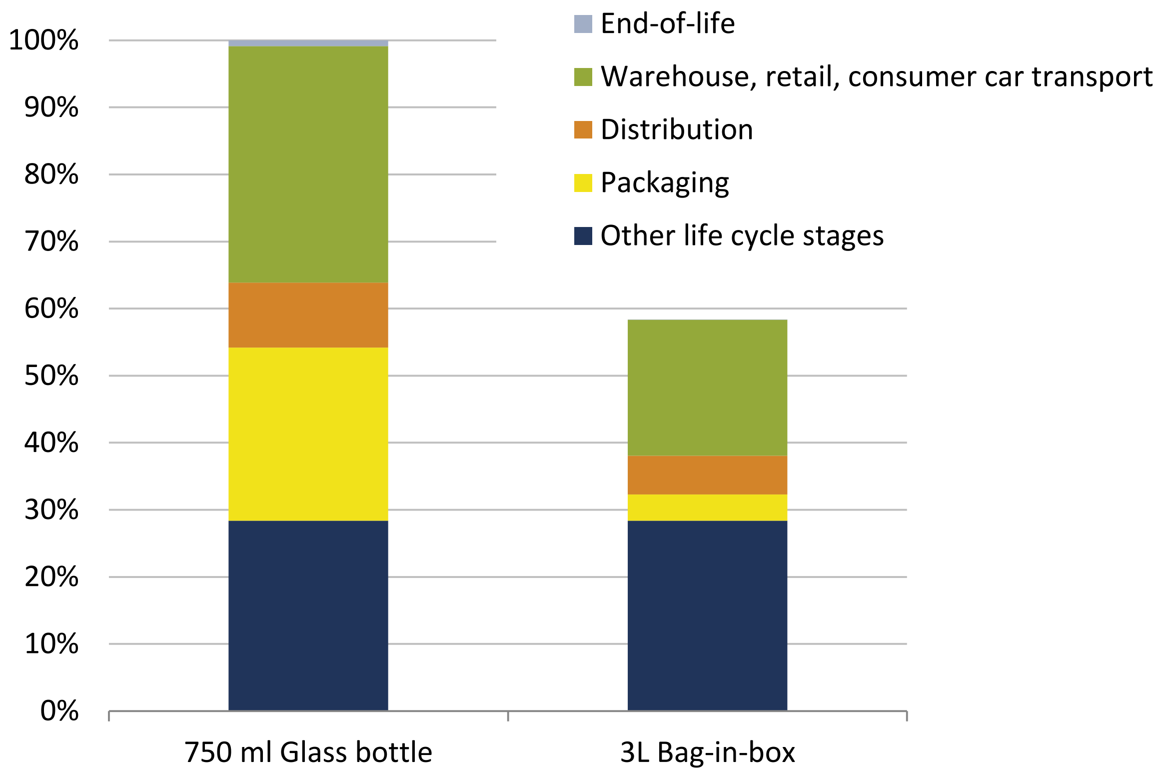


Figure 6: Comparison of global warming potential impacts for different packaging configurations.

Conclusions

The "green line" originates from the claim that there is a break-even point where the impact of shipping Napa wine eastward and shipping Bordeaux westward are equal. However, there are a multitude of factors outlined in this memo that contribute to the environmental performance of a product. The assumptions and analysis outlined in the study by Colman and Päster are insufficient and should not be used to conclude that one wine supply chain is preferable than another for an East coast wine consumer, especially since the analysis is limited to greenhouse gases only, which does not allow for any conclusions on the environmental superiority of one product system over another.[17]

In order to build a defensible breakeven point of these two wine supply chains, an ISO-compliant cradle-to-grave LCA study with critical review is highly recommended. This study would need to consider the following aspects as part of the analysis:

- Real, production-weighted data for Napa and Bordeaux considering the different modes of distribution and packaging designs;

---

[17] ISO/TS 14067:2013. Greenhouse gases -- Carbon footprint of products -- Requirements and guidelines for quantification and communication.

- Consideration of non-packaging, non-distribution phases such as differences in vineyard and winery operations;
- Evaluation of a wider range of environmental impacts, in addition to carbon footprint; and
- Validation of data sources for emission factors.

It is clear that transportation burdens associated with distribution is a hot spot for the wine; however, **carbon emissions from distribution logistics alone are not an indication of environmental preference between wine products.** Therefore, a more rigorous comparison is required before conclusions about environmental preference of wines can be drawn.

Please don't hesitate to contact me with any questions at 617-247-4477 x113 or l.morrison@pe-international.com.

Sincerely,

Laura Morrison

Laura Morrison
Senior Consultant
PE INTERNATIONAL, Inc.

Carbon Footprinting Workshop

Sonoma

Thursday, June 5, 2014

Benziger Family Winery

1883 London Ranch Road
Glen Ellen, CA 95442

Co-sponsored by: **California Sustainable Winegrowing Alliance** and **Wine Institute**

Partnering organizations: Sonoma County Winegrape Commission and Sonoma Valley Vintners & Growers Association

Funded in part by a CDFA Specialty Crop Block Grant

8:30 AM **Welcome, Introduction, and Overview of the Sustainable Winegrowing Program and Life Cycle Assessment Background**
Allison Jordan, California Sustainable Winegrowing Alliance

Overview of California Wine's Life Cycle Assessment and Opportunities for Improving your Carbon Footprint
Laura Morrison, PE INTERNATIONAL

Overview of the Sustainable Winegrowing Program's Performance Metrics and Demonstration of the Online Tool
Andrew Arnold, SureHarvest

9:50 – 10:00 **Break**
Coffee, pastries and water will be provided

Benefits and Trends for Lightweight and Alternative Packaging
Brian Hemphill, Director of Operations, Clos du Bois

Best Practices for Energy Efficiency and Rebates and Incentives
Lloyd Coker, Senior Account Manager, PG&E

Distribution and Transportation: FedEx Sustainable Solutions
Jerry Van Sickle, FexEx District Sales Manager

Sustainability and Greenhouse Gas Reduction Measures at Benziger Family Winery
Andrea Card, Production Manager, Benziger Family Winery
Jeffrey Landolt, Vineyard Manager, Benziger Family Winery

Noon - 1:00 **Lunch, followed by optional winery tour**

California Sustainable Winegrowing Program and Carbon Footprinting

June 2014

Workshop Agenda

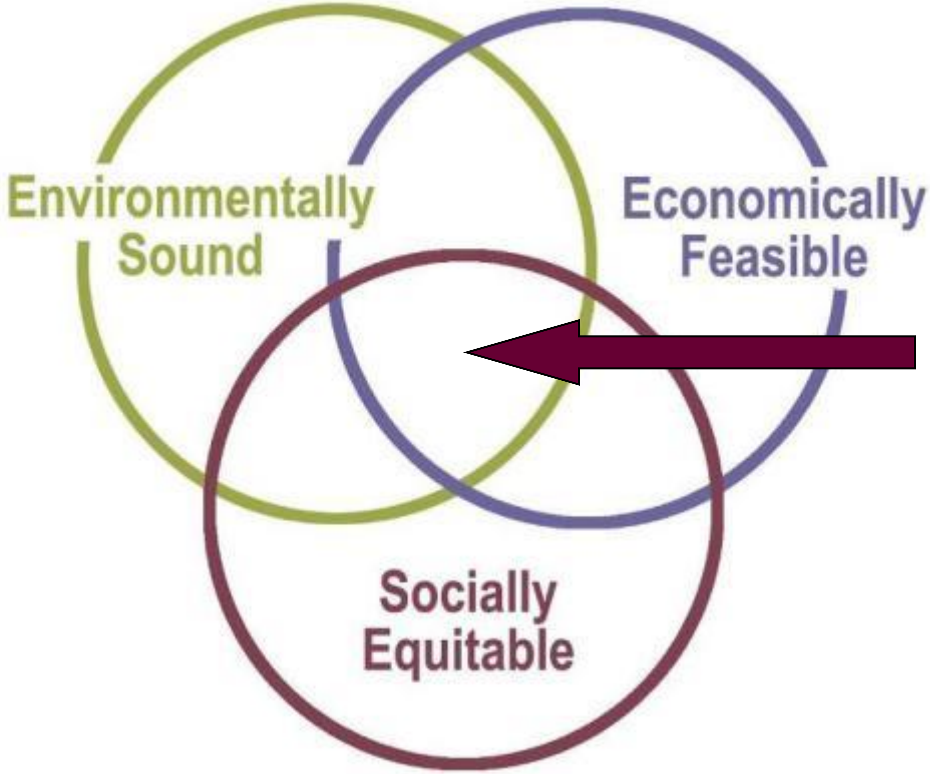
- Overview of the Sustainable Winegrowing Program and Climate Change Initiatives
- California Wine's Carbon Footprint and Opportunities for Improvement
- Performance Metrics and Demonstration of the Online Tool
- Break
- Sustainability and Greenhouse Gas Reduction Measures at Hope Family Wines
- Benefits and Trends for Lightweight and Alternative Packaging
- Best Practices for Energy Efficiency and Rebates and Incentives
- Nitrogen Management Best Practices
- Distribution and Transportation: FedEx Sustainable Solutions
- Lunch, followed by optional winery tour

CALIFORNIA
SUSTAINABLE WINEGROWING
ALLIANCE

Reality.


Community
Ecosystem Management
Pest Management
Env. Preferred Purchasing
Recycling & Reuse
Energy Efficiency
Water Quality
Wine Quality
Water Management
Employees
Viticulture
Soil Management

Where We Start…



Sustainable Winegrowing

A Grower & Vintner Alliance

The Code (2002).

WINE INSTITUTE

CALIFORNIA SUSTAINABLE WINEGROWING ALLIANCE

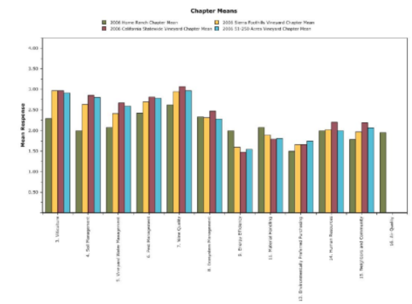
CALIFORNIA ASSOCIATION of WINEGRAPE GROWERS

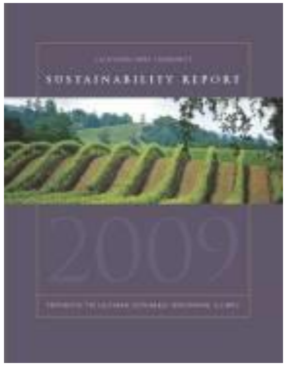
Defining Sustainability

- Viticulture
- **Soil Management**
- Vineyard Water Management
- Pest Management
- Wine Quality
- Ecosystem Management
- **Energy Efficiency**
- Winery Water Conservation & Quality
- Material Handling
- Solid Waste Reduction & Management
- **Environmentally Preferred Purchasing**
- Human Resources
- Neighbors & Communities
- Air Quality

3rd Edition Now Available!

CALIFORNIA CODE OF SUSTAINABLE WINEGROWING
THIRD EDITION





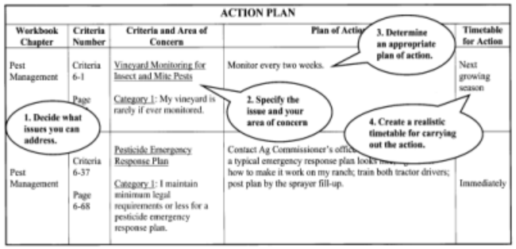
Self-Assess

Interpret Performance

Continuous Improvement

Develop Action Plans

Implement Change



ACTION PLAN				
Workbook Chapter	Criteria Number	Criteria and Area of Concern	Plan of Actio[n]	Timetable for Action
Pest Management	Criteria 6-1 Page	Vineyard Monitoring for Insect and Mite Pests Category 1: My vineyard is rarely if ever monitored.	Monitor every two weeks.	Next growing season
Pest Management	Criteria 6-37 Page 6-68	Pesticide Emergency Response Plan Category 1: I maintain minimum legal requirements or less for a pesticide emergency response plan.	Contact Ag Commissioner's offic[e] … a typical emergency response plan looks … how to make it work on my ranch; train both tractor drivers; post plan by the sprayer fill-up.	Immediately

Sustainability Progress Reports

www.sustainablewinegrowing.org

Climate Change & the Wine Industry

- Increasing media attention
- Scientific research & reports
- Climate Change Issues Impacting the California Wine Industry and Other Perennial Crops– event at UCD Mondavi Institute (2007)
- Workshops & materials focused on topics related to climate change mitigation/adaptation
  - energy and water efficiency
  - canopy and soil management
  - pest management and other

GHG & Vineyards Report

- A comprehensive report that consolidates GHG information
- A user-friendly handout – directional vineyard impacts on GHGs
- Identified research gaps

Funded by a CDFA Specialty Crop Block Grant

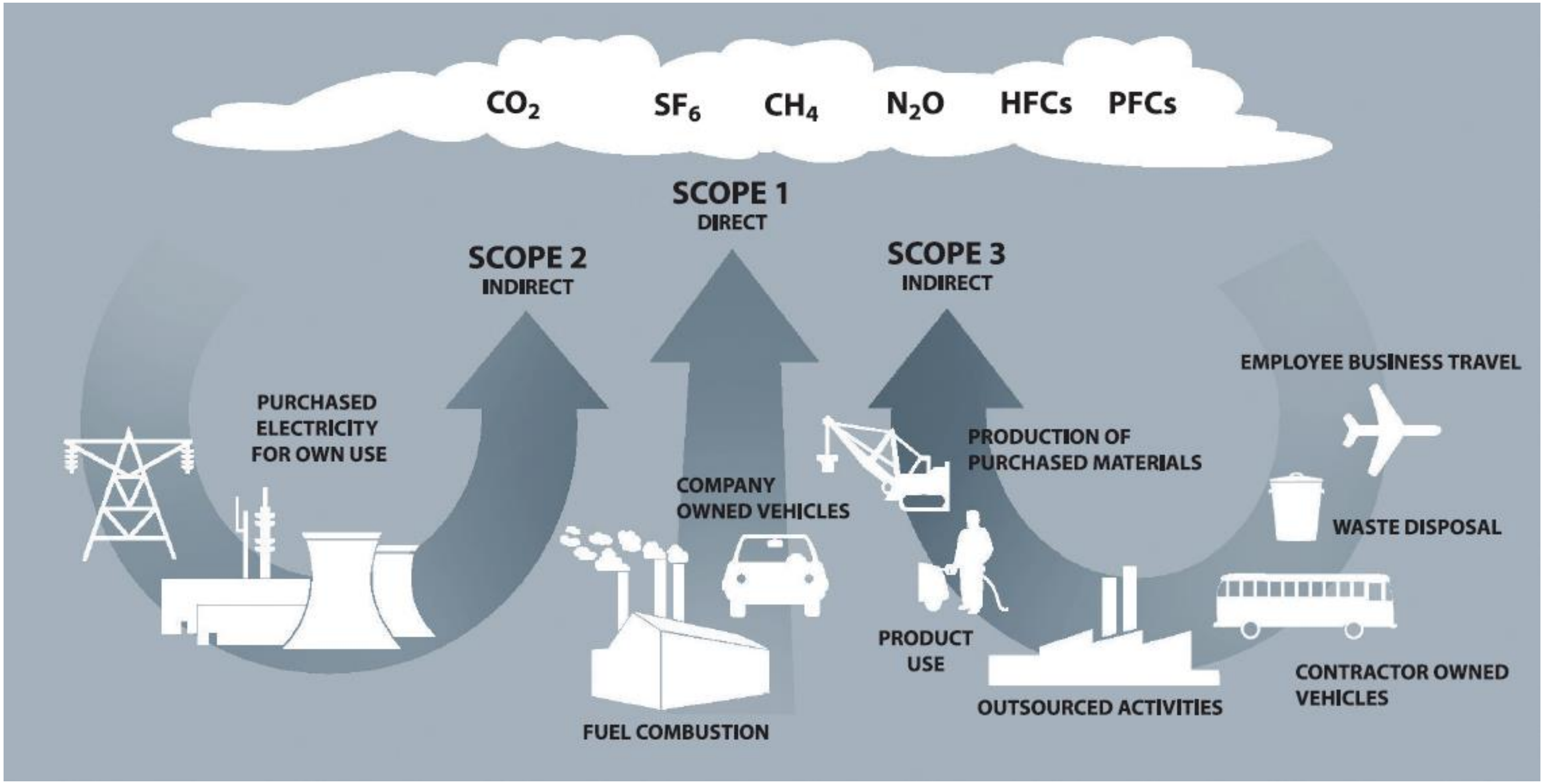
Vineyard Impacts on Atmospheric GHGs

Uncertainty

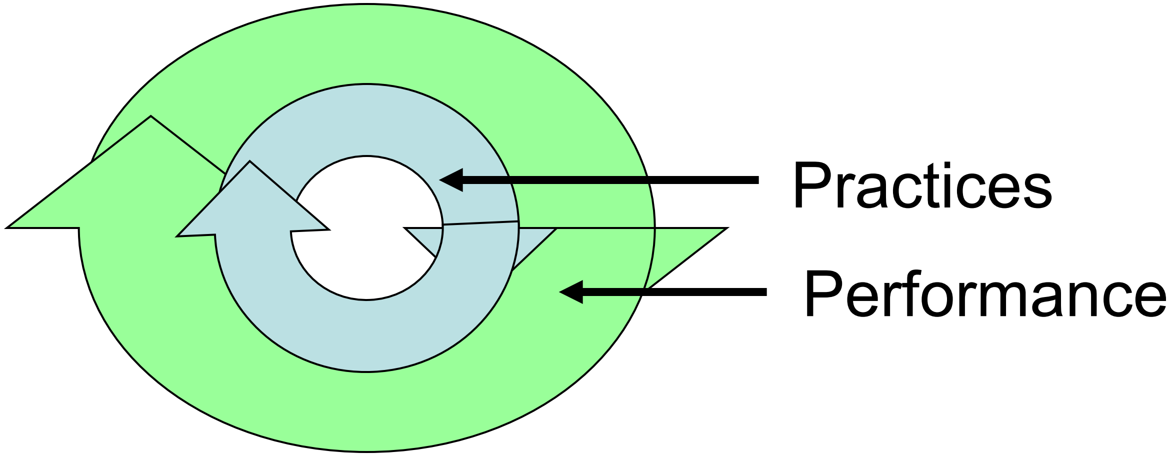
Model Components	CO_2 (X)	N_2O (300X)	CH_4 (25X)
Carbon Sequestration	– – –	+/–	+
Tillage	+ + +	+/–	+/–
Nitrogen Fertilizer	+/–	+++	–
Biomass			
Vine C Storage	– –	?	?
Vine Decomposition	+ + +	+ +	+
Soil Amendments			
Compost	– –	+ +	+
Manure	– –	+ +	+
Lime	+/–	+/–	?
Cover Cropping	+/–	+/–	+
Irrigation Water	+/–	+ + +	+
Fuel Use			
Vehicles	+ + +	+ +	+
Pumps	+ + +	+ +	+
Electrical Grid	+ + +	+ +	+

Legend: + = Increases – = Decreases ? = Unknown +/– = Site Specific
Number of symbols indicates relative magnitude of impact.

International GHG Protocol



Performance Metrics – The Missing Link?



Performance Metrics = feedback on your operation

- Relationship between practices and outcomes?
- Which practices have most impact?

Performance Metrics

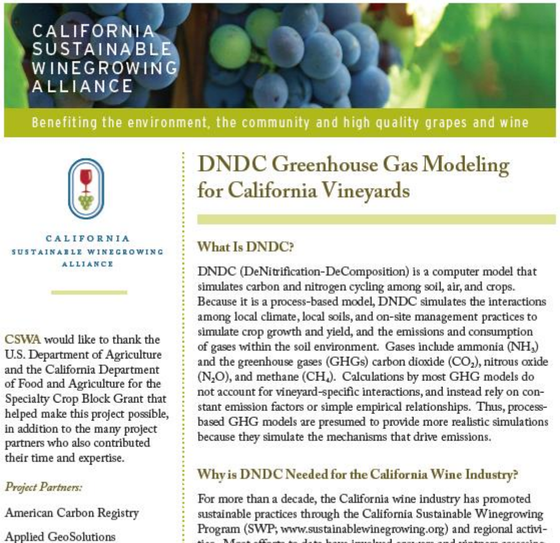
- Measurable Outcomes
  - Energy use
  - GHG emissions
  - Water use
  - Applied Nitrogen

"If you can't measure it, you can't manage it…"

DNDC Project – Vineyard GHG

- Quantified soil-related GHG emissions and carbon sequestration for California vineyards
- Calibrated & validated DeNitrofication DeComposition (DNDC) model using vineyard field data
  - Simulates the interactions among local climate, local soils, and on-site management practices to determine carbon and nitrogen fluxes
- Simplified DNDC tool integrated into online metrics to calculate vineyard GHG emissions
  - *DNDC Tool Inputs:* Vineyard location,
    Row spacing, Tillage practices,
    Use and type of cover crop,
    Amount of compost, Amount of N applied

Funded by a CDFA Specialty Crop Block Grant



CALIFORNIA SUSTAINABLE WINEGROWING ALLIANCE

Benefiting the environment, the community and high quality grapes and wine

CALIFORNIA SUSTAINABLE WINEGROWING ALLIANCE

CSWA would like to thank the U.S. Department of Agriculture and the California Department of Food and Agriculture for the Specialty Crop Block Grant that helped make this project possible, in addition to the many project partners who also contributed their time and expertise.

Project Partners:

American Carbon Registry

Applied GeoSolutions

DNDC Greenhouse Gas Modeling for California Vineyards

What Is DNDC?

DNDC (DeNitrification-DeComposition) is a computer model that simulates carbon and nitrogen cycling among soil, air, and crops. Because it is a process-based model, DNDC simulates the interactions among local climate, local soils, and on-site management practices to simulate crop growth and yield, and the emissions and consumption of gases within the soil environment. Gases include ammonia (NH_3) and the greenhouse gases (GHGs) carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). Calculations by most GHG models do not account for vineyard-specific interactions, and instead rely on constant emission factors or simple empirical relationships. Thus, process-based GHG models are presumed to provide more realistic simulations because they simulate the mechanisms that drive emissions.

Why is DNDC Needed for the California Wine Industry?

For more than a decade, the California wine industry has promoted sustainable practices through the California Sustainable Winegrowing Program (SWP; www.sustainablewinegrowing.org) and regional activi-

Drivers for a CA Carbon Footprint

West of the green line you should buy wine from Napa

East of the green line you should buy wine from Bordeaux

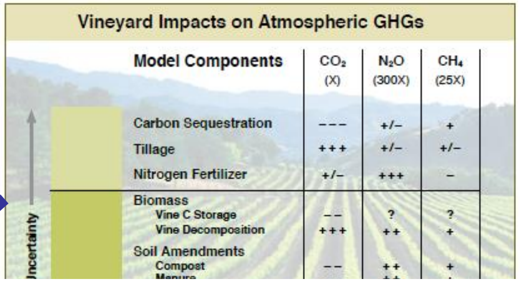
Coleman, Tyler & Pablo Päster. 2007. Red, White and "Green": the cost of carbon in the global wine trade. American Association of Wine Economists (AAWE). Working Paper No. 9. Oct. http://www.wine-economics.org/workingpapers/AAWE_WP09.pdf

Project Integration

Denitrification
Decomposition
(DNDC) Model
Vineyard Emissions

Cradle-to-Grave
Carbon Footprint of
9L of Wine

Industry Tools
to **Drive**
Sustainability
Improvement



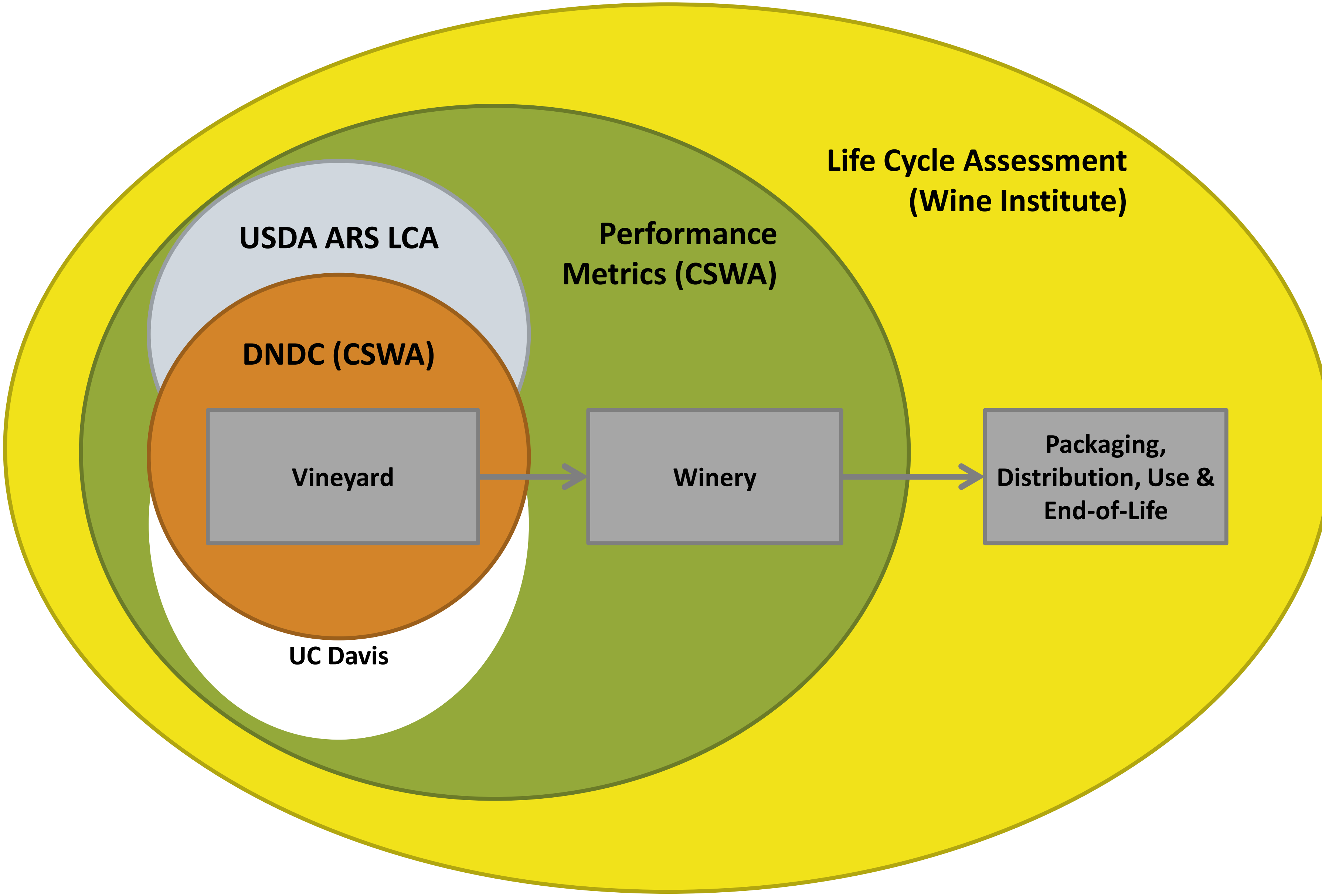
Vineyard Impacts on Atmospheric GHGs

Model Components	CO_2 (X)	N_2O (300X)	CH_4 (25X)
Carbon Sequestration	– – –	+/–	+
Tillage	+ + +	+/–	+/–
Nitrogen Fertilizer	+/–	+ + +	–
Biomass			
Vine C Storage	– –	?	?
Vine Decomposition	+ + +	+ +	+
Soil Amendments			
Compost	– –	+ +	+
Manure			

Uncertainty

Vineyard Management
Guidance

Performance Metrics
Scope 1 & 2 for
Vineyards and Wineries


Life Cycle Assessment
(Wine Institute)
USDA ARS LCA
Performance
Metrics (CSWA)
DNDC (CSWA)
Vineyard
Winery
Packaging,
Distribution, Use &
End-of-Life
UC Davis

Questions?

California Wine's Carbon Footprint

Opportunities for Continuous Improvement

June 2014 Workshops

PE INTERNATIONAL
SUSTAINABILITY PERFORMANCE

WINE INSTITUTE

Agenda

- Background Information
- Overview of the Carbon Footprint
- Results & Improvement Opportunities
- Conclusions & Next Steps

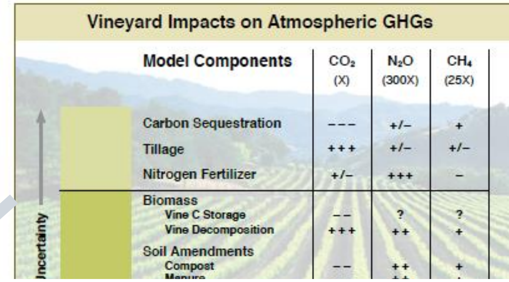
Background Information

History of Initiatives

Denitrification Decomposition (DNDC) Model Vineyard Emissions

Cradle-to-Grave LCA of 9L of Wine

Industry Tools to Drive Sustainability Improvement



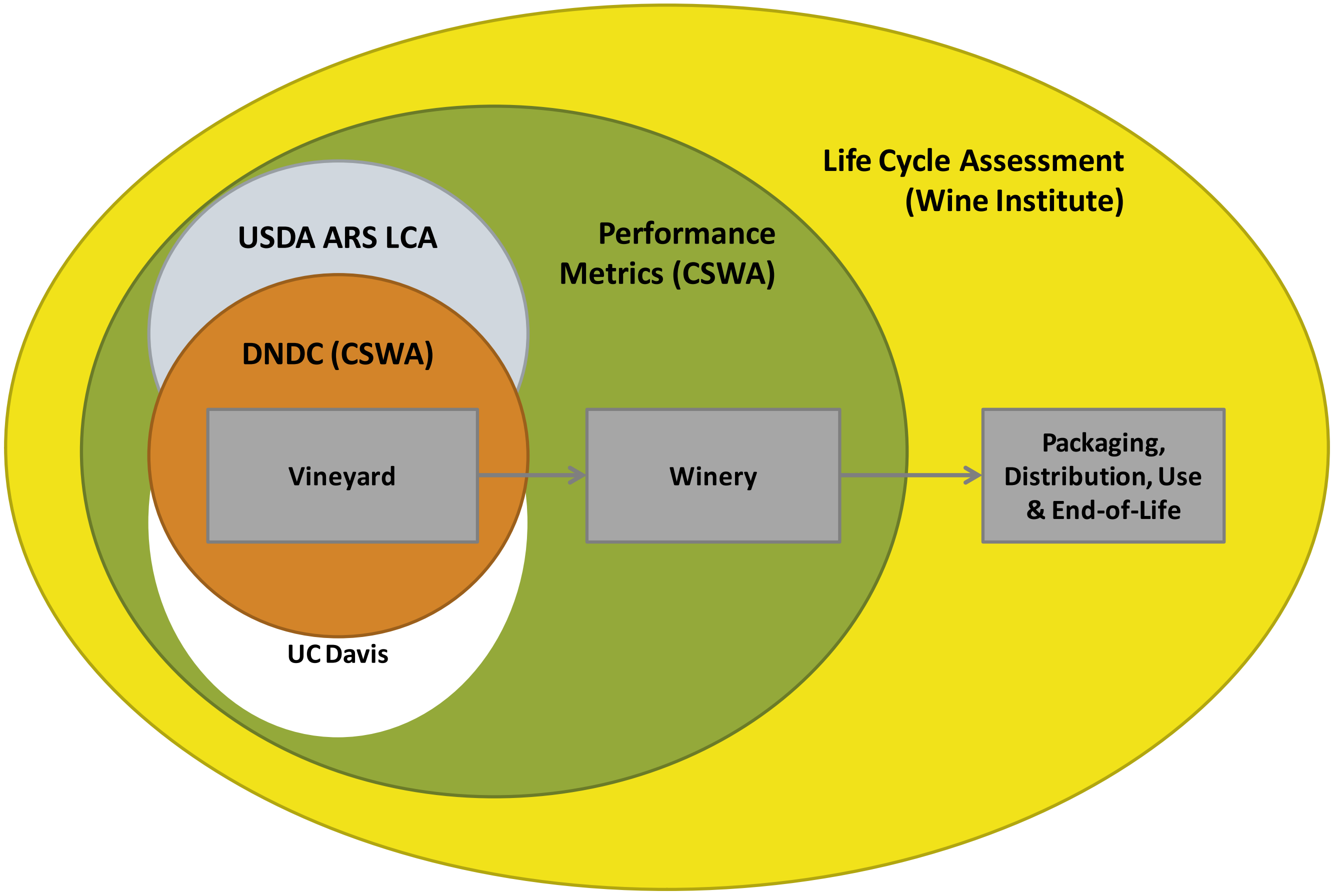
Vineyard Impacts on Atmospheric GHGs

Model Components	CO_2 (X)	N_2O (300X)	CH_4 (25X)
Carbon Sequestration	– – –	+/–	+
Tillage	+ + +	+/–	+/–
Nitrogen Fertilizer	+/–	+ + +	–
Biomass			
Vine C Storage	– –	?	?
Vine Decomposition	+ + +	+ +	+
Soil Amendments			
Compost	– –	+ +	+

Vineyard Management Guidance

Performance Metrics Scope 1 & 2 for Vineyards and Wineries

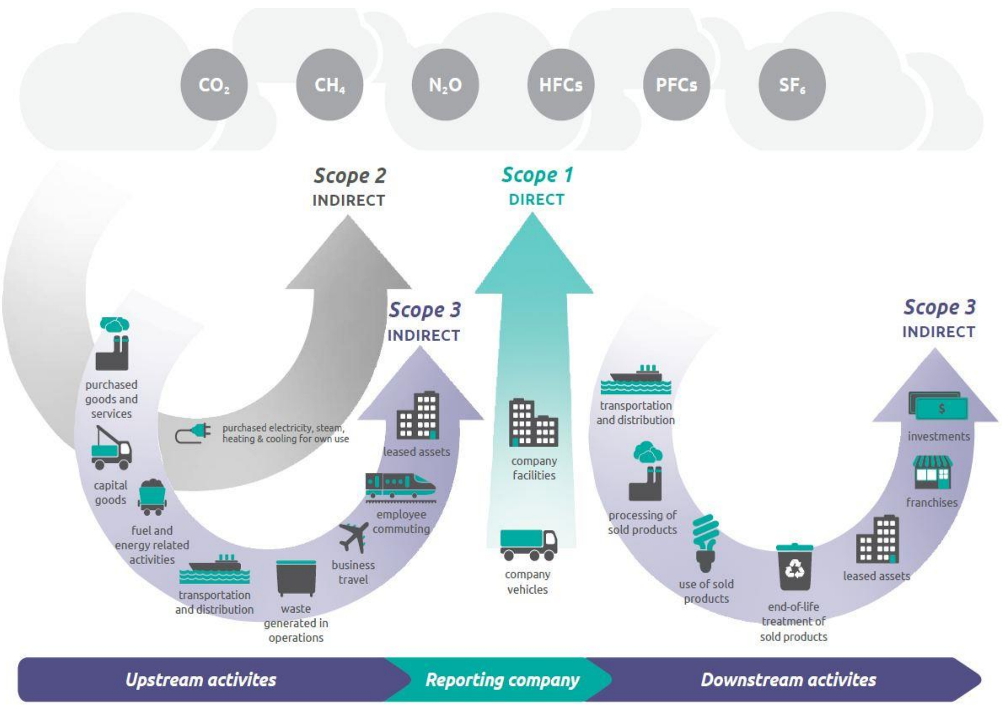
Overview of CA wine life cycle projects



Corporate Carbon Footprints

Terminology & Boundaries

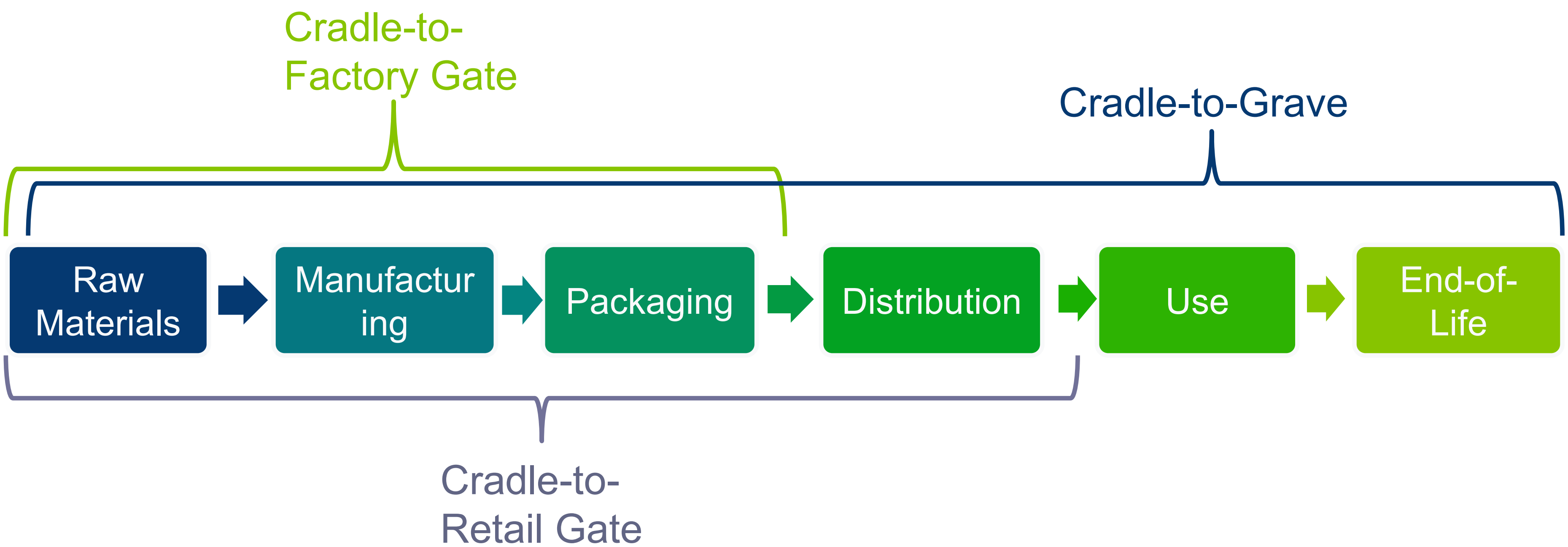
- Corporate accounting terminology Scope 1, 2, and 3 are related to direct financial control of the reporting party.
- One CSWA member's Scope 1 is another member's Scope 3.



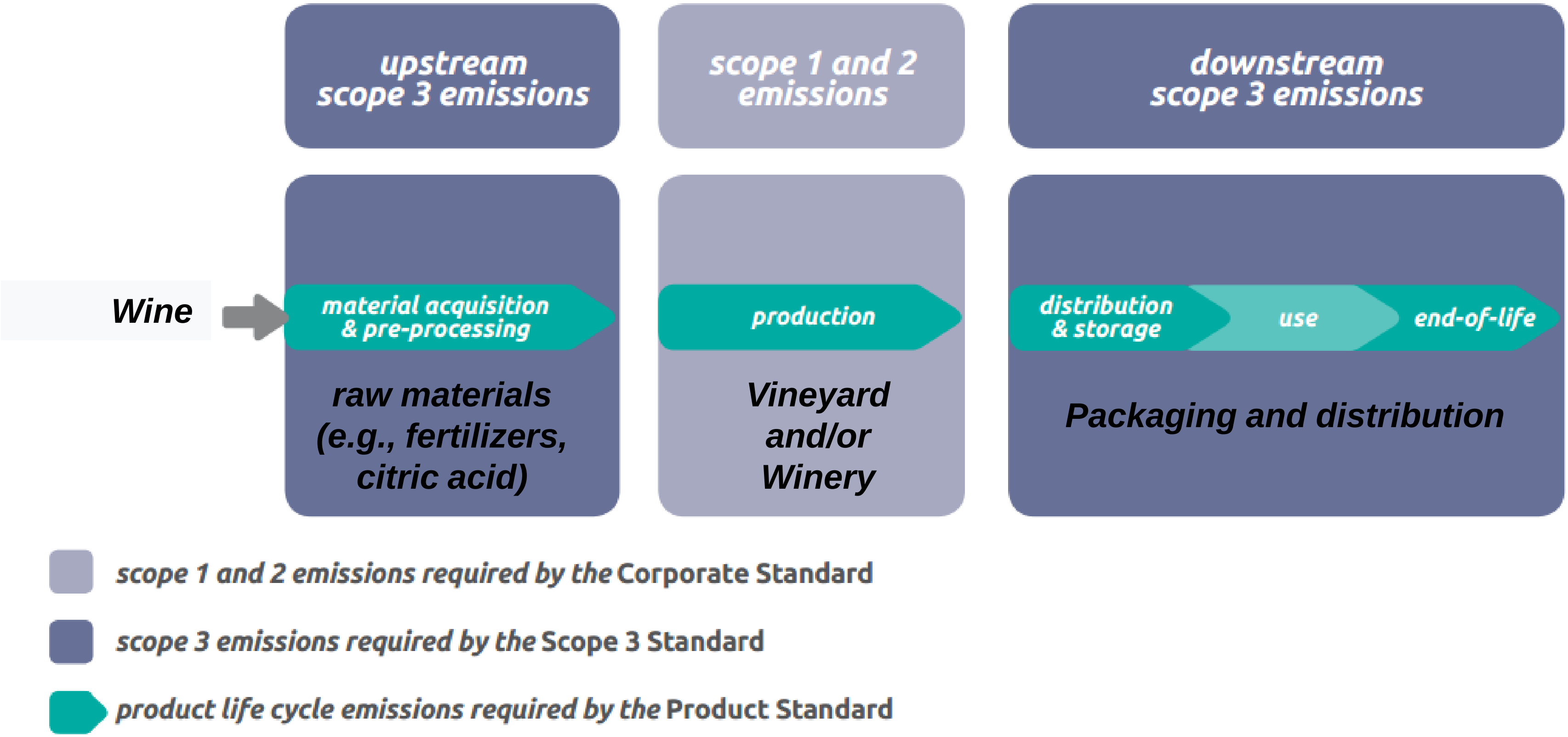
The Greenhouse Gas Protocol. Corporate Standard. 2012.

Product Carbon Footprints

Terminology & Boundaries



Product vs. Corporate Environmental Footprinting



Source: GHG Protocol Product Life Cycle Accounting and Reporting Standard

Terminology

Life Cycle Assessment (LCA)

- internationally accepted and standardized methodology (ISO 14040/44)
- defines a systematic set of procedures for "compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle".

Product Carbon Footprints

- a subset of LCA that focus only on the climate change or global warming potential impact category.
- measured in *carbon dioxide equivalents* (CO_2-eq) a measure of greenhouse gas (GHG) emissions (carbon dioxide, methane, nitrous oxide, fluorinated gases)

Hot Spot

- an area that has significant potential impact on a given environmental aspect
- generally agreed upon by experts
- helps understand where to focus improvement initiatives (in context of product)

Overview of the Carbon Footprint

Project Goals

Industry Goals

- Drive industry sustainability improvement
- Assess the state of the industry
- Develop science-based tools
- Identify opportunities for improvement
- Track and measure improvement
- Communicate performance

Individual Company Goals

- Identify process improvements
- Evaluate and communicate company and product carbon footprints

Project Overview

Goal & Scope Workshop

- Defined project objectives with industry stakeholders
- May 2011

LCA

- Worked with CA vineyards and wineries to collect data
- Built LCA model
- Shared results with stakeholders
- Dec 2011 – Nov 2013

Tool Integration

- Integrate learnings of LCA into Metrics Center
- Feb 2012 – May 2014

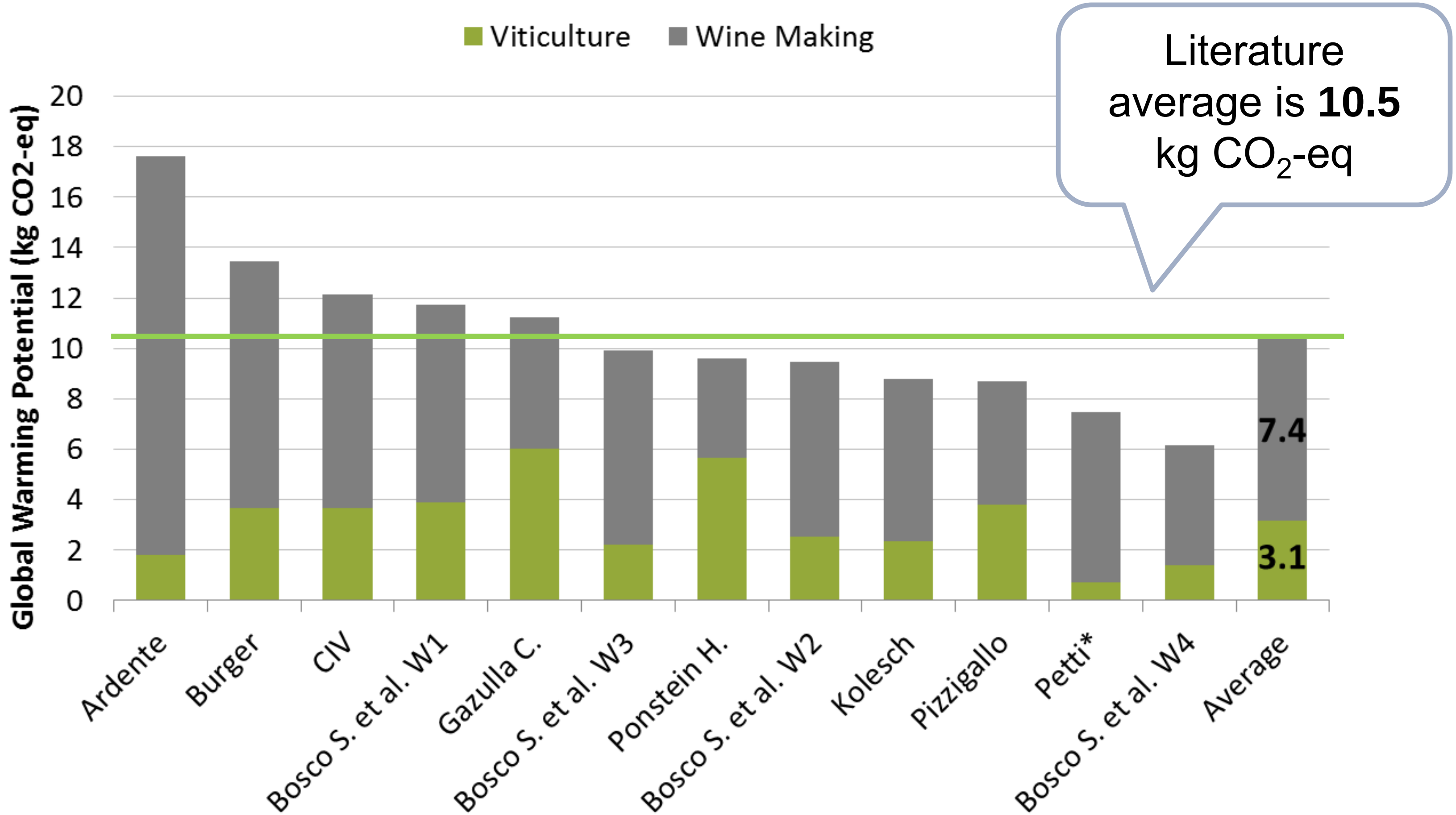
Industry Outreach

- Hold workshops for stakeholders
- Spring 2014

Funded in part by a CA Department of Food and Agriculture Specialty Crop Block Grant

Project Drivers & Approach

Literature Benchmarking 9L of Wine



Life Cycle of California Wine

- Cradle-to-Retail Gate

- 9 liters of packaged wine
  - a case of 12 750 ml glass bottles with cork closures
  - grapes grown in California
  - wine produced in California
  - wine shipped in US for retail sale
- Based on 2011 data

Life Cycle Phases

Vineyard

- Raw materials, fuel combustion, electricity consumption, field emissions

Winery

- Grape transport from field edge to winery, 100 mi in open truck, diesel production, driving emissions.
- Raw materials incl. transportation, fuel combustion, electricity consumption, packaging operations, waste handling

Packaging

- Raw materials incl. transport, processing of packaging waste

Distribution

- Truck and rail transport, fuel production, driving emissions

Inclusions/Exclusions (Cradle-to-Retail Gate)

- ✓ Grape Cultivation (diesel combustion, fertilizer application, N_2O emissions, soil carbon storage, infrastructure)
- ✓ Winery operations including waste disposal
- ✓ Raw materials production (fertilizers, pesticides, packaging, chemicals)
- ✓ Transport of raw materials
- ✓ Energy supply chain (upstream burden of fuels and electricity)
- ✓ Distribution in US market

- ✗ Warehousing and retail
- ✗ Use phase of wine (e.g. human biological processes, wine refrigeration)
- ✗ End-of-life for packaging (recycling, landfill)
- ✗ Capital equipment (barrels)
- ✗ Maintenance and operation of support equipment
- ✗ Manufacture and transport of packaging materials not associated to final product
- ✗ Transportation of employees
- ✗ Emissions from land use change

Data Collection & Analysis

Data Representativeness

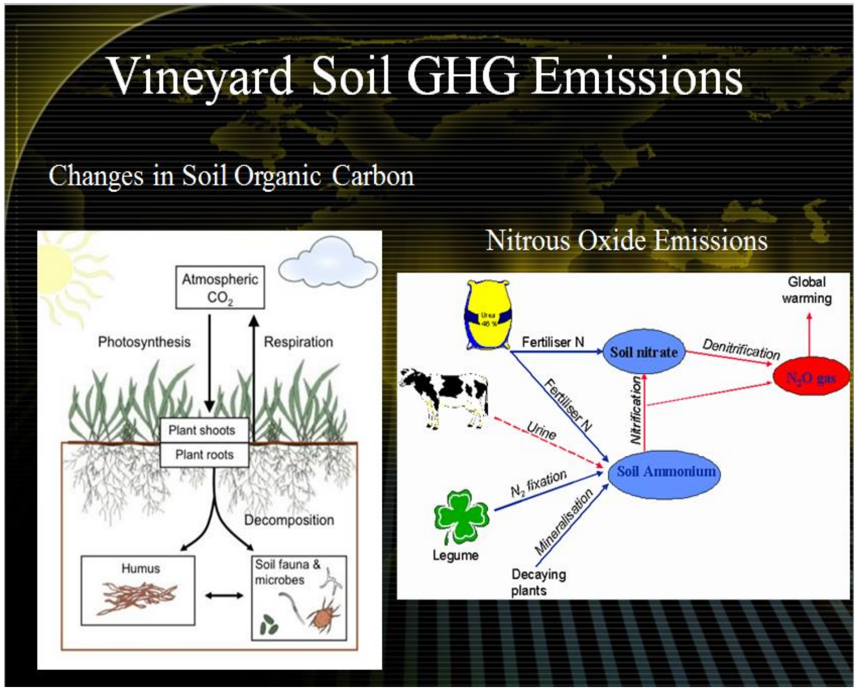
- 11 companies: 32 vineyards, 23 wineries
- Non-field emissions data at vineyard represents for 4-5% California acreage/yield
- Field emissions for California state average modeled using DNDC – highly representative
- Winery data represents 84% of cases produced in California

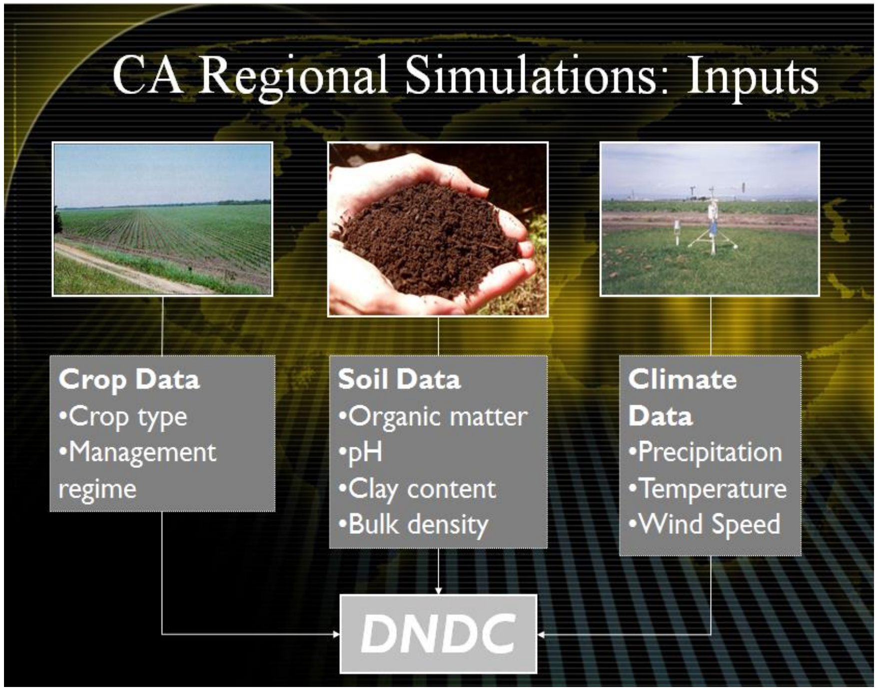
Data Analysis

- ✓ Compilation of all data provided
- ✓ Applied a production weighted average for each data point
- ✓ Checked data for outliers
- ✓ Benchmarked data with literature and industry knowledge

Vineyard Field Emissions from DNDC Project

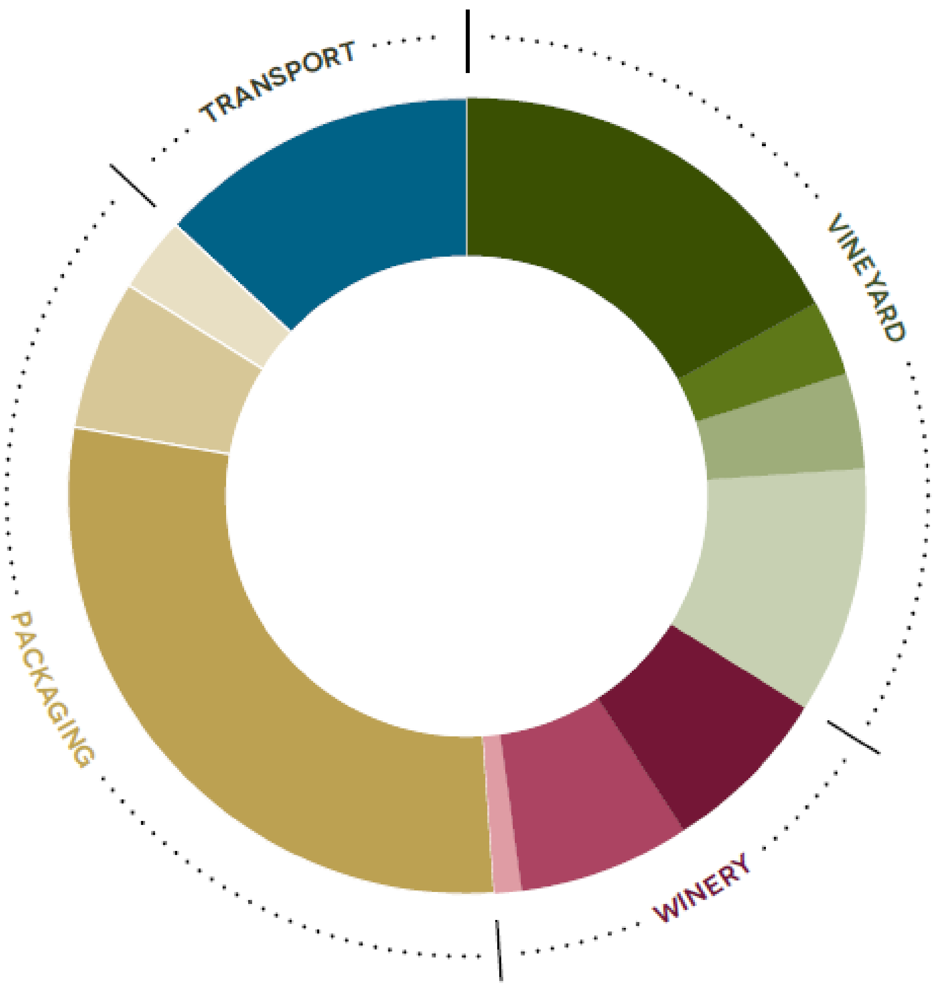
- Customized **De**nitrification-**Dec**omposition model for vineyards
- Important for understanding overall vineyard carbon footprint
- Generated regional results for CA vineyards
- Driven by local crop, soil and climate data and management scenarios





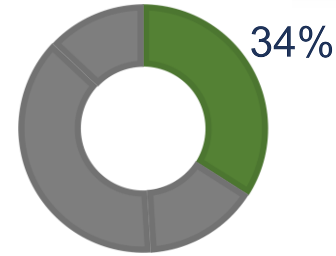
Results & Improvement Opportunities

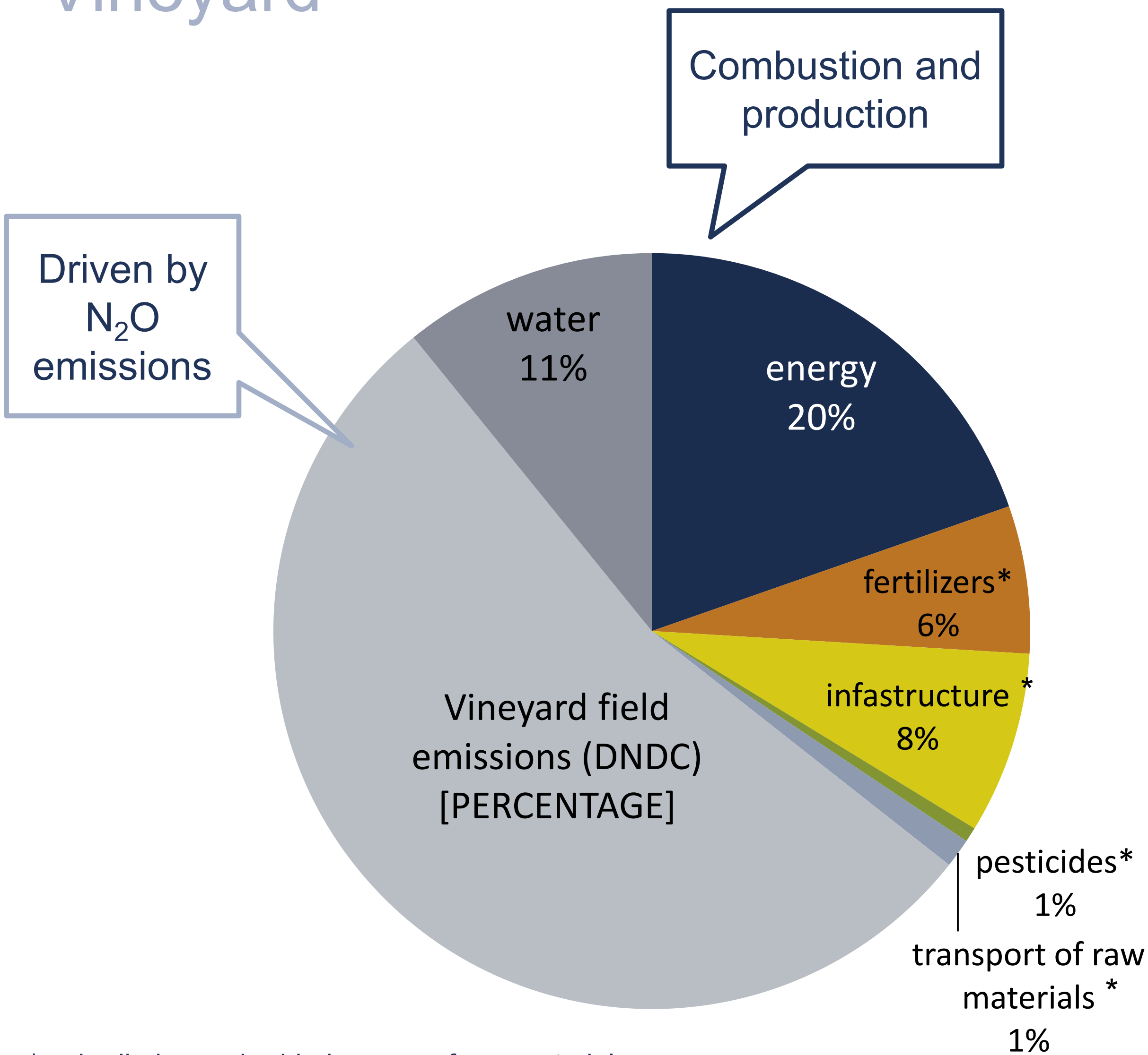
Relative impacts of wine life cycle carbon footprint, cradle-to-retail gate



VINEYARD		
17%		Bio-geochemical field emissions[1]
3%		Fuel production & combustion
4%		Electricity consumption
10%		Raw materials production[2]
WINERY		
7%		Fuel production & combustion
7%		Electricity consumption
1%		Other winery[3]
PACKAGING[4]		
29%		Glass bottle
6%		Corrugate case box
3%		Other packaging[5]
TRANSPORT		
13%		Transport of bottled wine[6]

Vineyard

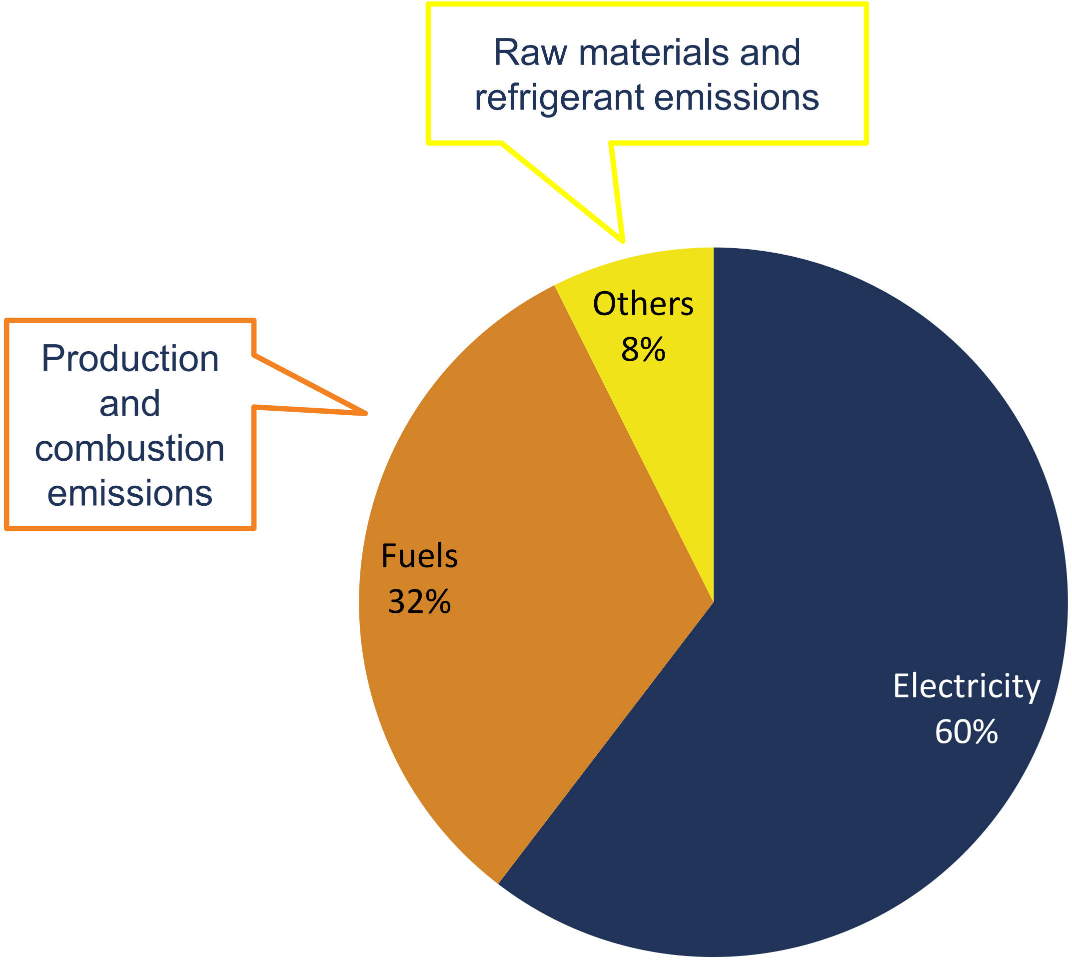


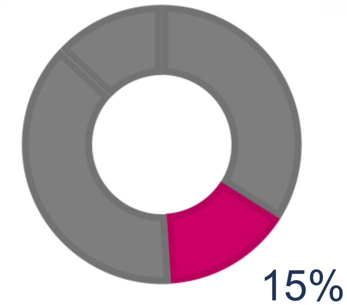


- Optimize nitrogen management plan
- Implement energy and fuel efficiency measures

*embodied or embedded energy of raw materials

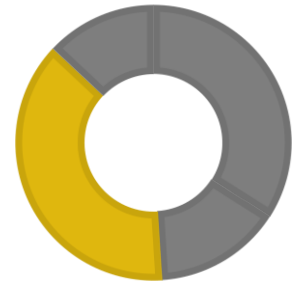
Winery



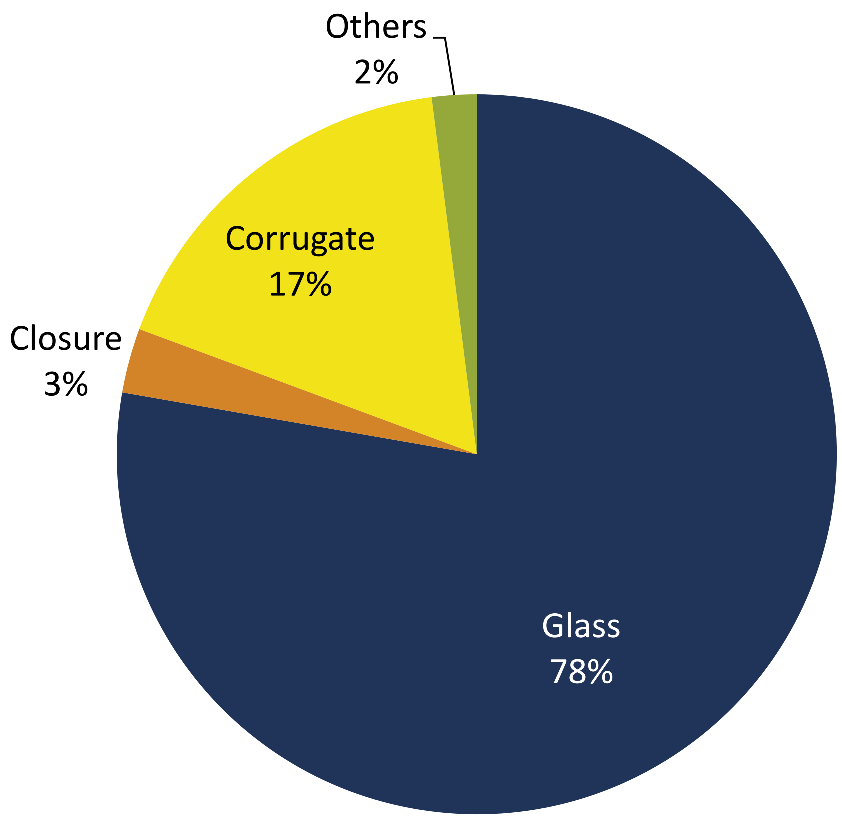


- Conduct an energy audit
- Implement energy efficiency measures
- Install on-site renewable energy)

Packaging Carbon Footprint

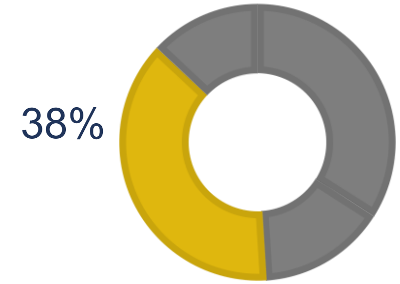


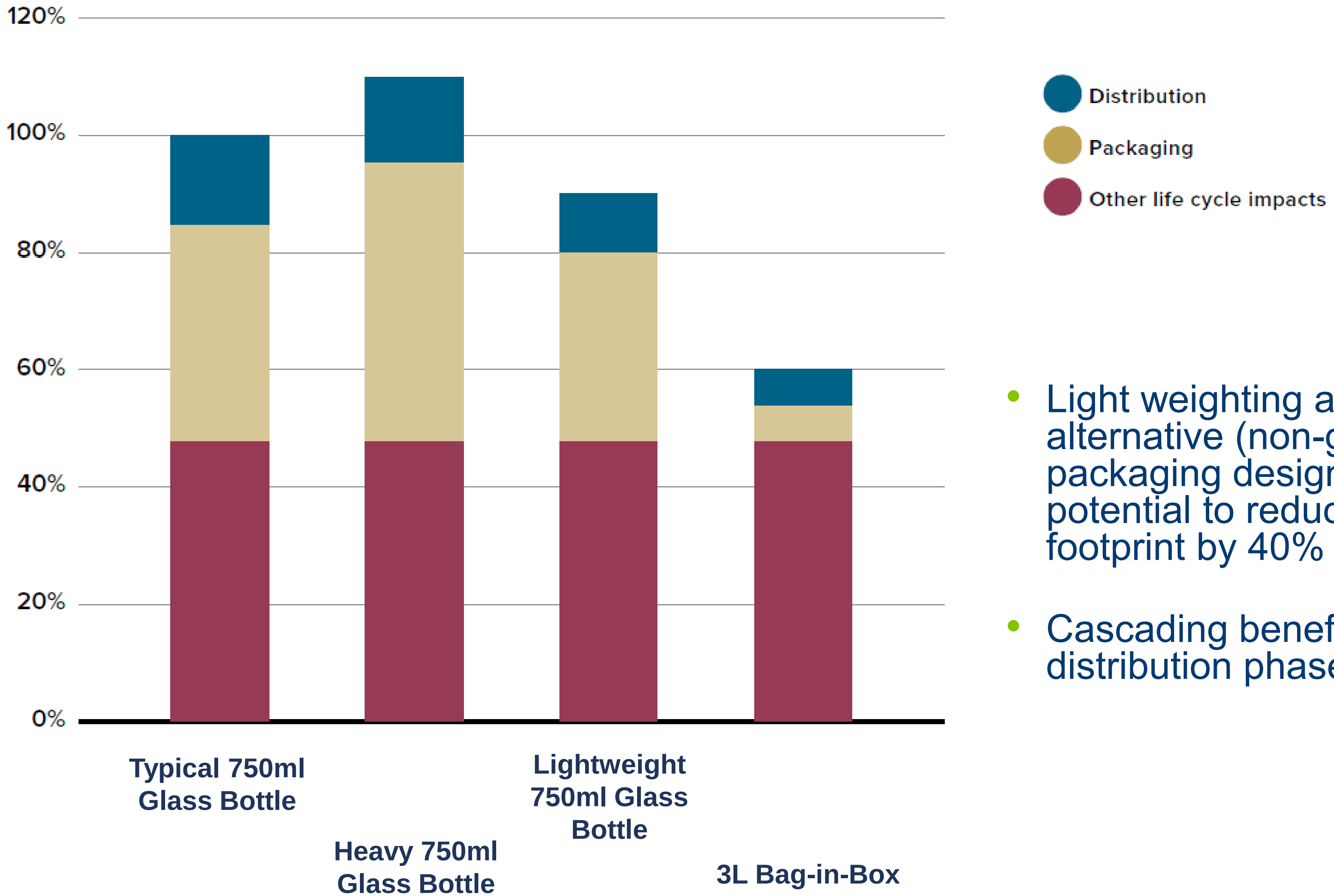
750 ml glass bottle in 9L case with natural cork closure



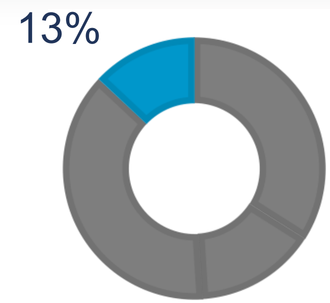
- Light weight glass bottles
- Consider alternative packaging (e.g., bag-in-box, plastic bottles)

Packaging Scenario Analysis





- Light weighting and alternative (non-glass) packaging design has potential to reduce wine footprint by 40%
- Cascading benefits in distribution phase



Distribution

- Optimize distribution network (transport by train is more efficient than by truck)
- Increase percentage of rail transport
- Switch to a low-emissions fleet
- Discuss carbon footprint reduction options with your distribution partner(s)

Conclusions & Next Steps

Summary of Improvement Opportunities

Hot Spot	Improvement Opportunity
Packaging	• Lightweight glass bottles • Switch to alternative packaging designs (e.g. bag-in-the box, plastic bottles)
Vineyard Field Emissions	• Optimize nitrogen management plan
Vineyard and Winery Energy Use	• Conduct an energy audit of the vineyard and/or winery • Implement energy efficiency measures • Install on-site renewable energy
Distribution	• Optimize distribution network • Increase percentage of rail transport • Switch to a low-emissions fleet • Discuss carbon footprint reductions options with your distribution partner(s)

Conclusions

By understanding the carbon footprint of the California wine industry, individual growers, vintners, and distributors can consider how to best use their resources to target GHG reductions.

- Representative California wine carbon footprint is aligned with European studies.
- Data collection for the industry was difficult and required resources.
- There is wide variation in data by vineyard, winery, and packaging allowing for industry members to distinguish themselves from the baseline case.
- Small changes at the facility level can have a large impact on the overall industry footprint if adopted across the industry.
- Updated online facility carbon footprint calculator can be used to look at company specific impacts around water, energy, packaging and distribution.

Potential Future Work

- **Refinement of data collection** to enable deeper understanding of variation by product, operation and scale of facilities.
- **Consumer use habit surveys** to understand use phase (e.g., storage and refrigeration)
- **Water consumption and water footprint analysis** for California vineyards and wineries.

Thank you!

- Vineyards and wineries who shared time and data!
- Wine Institute Environmental Working Group
- California Department of Food and Agriculture Specialty Crop Block Grant Program

cdfa
CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

- Project Team

WINE INSTITUTE

Kennedy/Jenks Consultants
Engineers & Scientists

SureHarvest
SUSTAINABILITY SOLUTIONS

Laura Morrison
PE INTERNATIONAL
l.morrison@pe-international.com
www.pe-international.com

Metrics and Footprinting Using the SWP Metrics Calculator

Carbon Footprinting Workshops

Andrew Arnold - SureHarvest

June 3-5, 2014

Overview of the SWP's Performance Metrics and Demonstration of the Online Tool

LCA Study Recap

Vineyard

Consumer

CALIFORNIA
SUSTAINABLE WINEGROWING
ALLIANCE

Summary of Recommendations

- Vineyard and winery fuel and energy consumption (upstream burden)
- Packaging (glass and corrugate)
- Wine distribution (mode and distance)

Hot spots that vineyards and wineries can influence

For energy, there are two types of emissions:

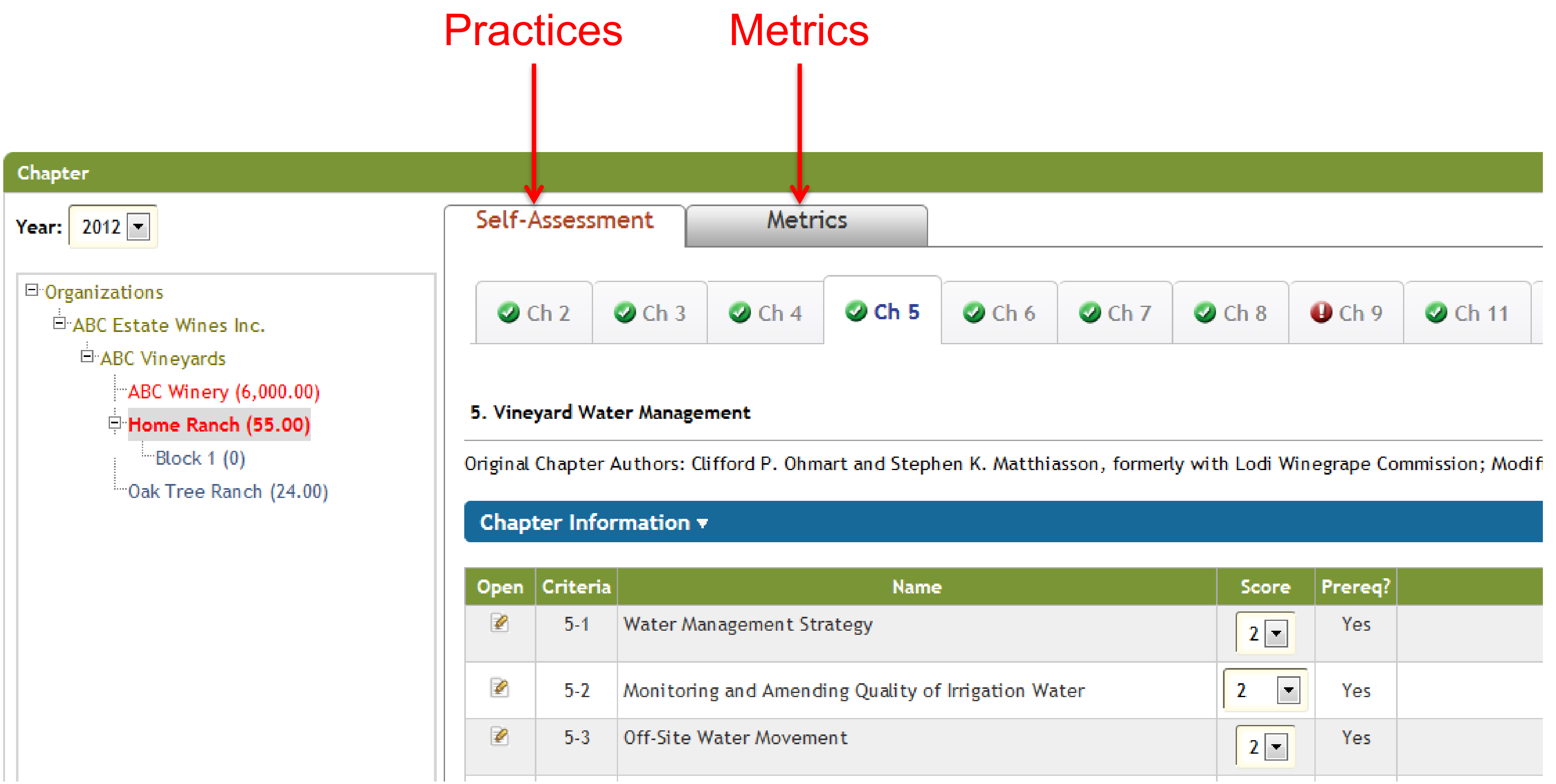
1. Direct combustion emissions
2. Emissions associated with the upstream extraction of raw materials and processing of fuels so that they can be used in boilers, fork lifts, etc. (embedded emissions or Scope 3 emissions)

Energy efficiency measures reduce direct emissions but also require less fuel and therefore reduce embedded emissions.

Calculator Updates

CALIFORNIA
SUSTAINABLE WINEGROWING
ALLIANCE

Online SWP Application



CALIFORNIA SUSTAINABLE WINEGROWING ALLIANCE

Practice Self-Assessments

Ch 2 | Ch 3 | Ch 4 | **Ch 5** | Ch 6 | Ch 7 | Ch 8 | Ch 9 | Ch 11 | Ch 13 | Ch 14 | Ch 15 | Ch 16

5. Vineyard Water Management > 5-4. Irrigation System

Expand All | Collapse All

Previous/Save

4 of 11

Next/Save

My Assessment ▲

Criteria	Category 4	Category 3	Category 2	Category 1	N/A
5-4. Irrigation System	An engineered* micro-irrigation system (including drip irrigation or micro sprinklers) was installed in the vineyard.	A low-flow engineered* sprinkler irrigation system was installed in the vineyard.	A high-flow engineered* sprinkler irrigation system was installed as the only method of irrigation in the vineyard.	A non-engineered or flood irrigation system was present in the vineyard. *(Select N/A if the site was dry farmed during the assessment year)*	
Your Assessment	◉	○	○	○	○
Previous Assessment 2012	◉	○	○	○	○

*A well-engineered irrigation system consists of components such as flow meters, back-flow prevention devices, flow controls, flush valves, and filtration and injection equipment. The system should have energy efficient features to accommodate for site variation and may have engineered pressure compensation devices where needed.

CALIFORNIA SUSTAINABLE WINEGROWING ALLIANCE

Practice Self-Assessments (cont.)

Certification Information ▲

Guidelines	Category 4	Category 3	Category 2	Category 1
Prerequisite Category 1 or N/A **Mandatory** No **Audit Priority** Medium **Timeframe** Current assessment season	Internal Testimonial: Verify that an engineered micro-irrigation system was installed. Direct Observation: Vineyard irrigation system. Written Document/Plan: Verify the system was engineered.	Internal Testimonial: Verify that a low-flow sprinkler irrigation system was installed. Direct Observation: Vineyard irrigation system.	Internal Testimonial: Verify that a high flow sprinkler irrigation system was the only method of irrigation. Direct Observation: Vineyard irrigation system.	Direct Observation: Verify that there was a flood irrigation system.
Prerequisite Rationale Significant environmental impact				

My Notes ▼

My Documents ▲

Add

Download Action Plan Template

Name	Type	Public	Document	
Irrigation System Map	Map	No	Irrigation System Map.docx	Update

Action Plan Notes ▲

Use this section to create specific action plans for improvements you want to implement. These action plan notes will be summarized on your homepage and can be gathered into an Excel document by using the "Action Plan Notes Report" within the Reports section.

Add

No Action Plan Notes found

Online Metric Calculator

Edit Metrics Information

Year: 2012

- Organizations
  - ABC Estate Wines Inc.
    - ABC Vineyards
      - **ABC Winery (6,000.00)**
      - Home Ranch (55.00)
        - Block 1 (0)
      - Oak Tree Ranch (24.00)

Self-Assessment | Metrics

Name: ABC Winery
Enterprise: ABC Vineyards
Type: Winery
Year: 2012
Size: 16,676.12 Gallons
7,014 Cases
Display in: Pounds Tons

Collect Data
Required Vineyard Data
Required Winery Data

Create Yearly Profile
Create or edit a profile
for your operations

Go to Metrics Center

- Enter data
- Calculate Metrics
- View Results
- Save Summary Sheet

Calculated Metrics | Totals
Energy Intensity Take Action
GHG Intensity Take Action
Water Use Efficienc Take Action

Calculated Metrics			Totals
	Energy Intensity Take Action	29.19 kWh per gallon 69.39 kWh per case	486,701.77 kWh
	GHG Intensity Take Action	**Direct Emissions** 33.2 lbs CO_2e per gallon 79.0 lbs CO_2e per case **Embedded Emissions** 10.9 lbs CO_2e per gallon 26.0 lbs CO_2e per case **Total Emissions** 44.1 lbs CO_2e per gallon 104.9 lbs CO_2e per case	735,983.6 lbs CO_2e
	Water Use Efficiency Take Action	0.00 Gallons per gallon 0.00 Gallons per case	0.00 Gallons

Online Metric Calculator

Metrics	Vineyard	Winery
Energy + GHGs	X	X
Water	X	X
Nutrients	X	

Winery Energy + GHG Page

ENERGY + GREENHOUSE GASES edit

Energy Intensity:
29.19 kWh per gallon
69.39 kWh per case

GHG Intensity (Direct Emissions):
33.208 lbs CO_2e per gallon
78.955 lbs CO_2e per case

GHG Intensity (Embedded Emissions):
10.926 lbs CO_2e per gallon
25.976 lbs CO_2e per case

GHG Intensity (Total):
44.134 lbs CO_2e per gallon
104.931 lbs CO_2e per case

WATER edit

Water Use Efficiency:
0.00 Gallons per gallon
0.00 Gallons per case

TOTALS

Energy: 486,702 kWh
GHG: 735,983.614 lbs CO_2e
Water: 0.00 Gallons

Print

GHG Factors

FUEL USAGE

Enter the amount of each fuel used in your operation over the calendar year. Select the first fuel used from the drop down menu, enter the amount consumed, and then click "Add" to enter the amount for the next fuel used. Repeat for additional fuel types.

Fuel Type Diesel **Quantity** **UOM** gal Add

	Fuel Type	Quantity	UOM	
1.	Natural Gas	15,000.0	therm	
2.	Propane (LP)	170.3	gal	

WINERY REFRIGERANT

Select the refrigerant type used in your operation from the drop down menu. Then enter the quantity of refrigerant lost over the calendar year and needed for recharging. If you know the amount of refrigerant needed for recharging, select "Known." If not, select "Estimated."

**Note: There are no GHG emissions associated with Ammonia-based systems*

Known Estimated

Refrigerant Type R-11 (CFC **Quantity** **UOM** lb Add

	Fuel Type	Quantity	
1.	R-11 (CFC-11)	100.0 lb	

ELECTRICITY CONSUMED

Enter the amount of kilowatt hours (kWh) of electricity used in your operation over the calendar year by checking utility bills or an online utility account. Enter this amount into the "Purchased Electricity" box.

Purchased Electricity
42560 kWh

On-Site Generated Electricity

Enter the amount of kilowatt hours (kWh) of electricity used.

Source Type Solar **Quantity** **UOM** kWh Add

	Source Type	Quantity	UOM	
1.	Solar	100.0	kWh	

PACKAGING & DISTRIBUTION

Packaging Purchases

Enter total pounds purchased of each of the packaging elements.

Glass
166,500.0 lbs

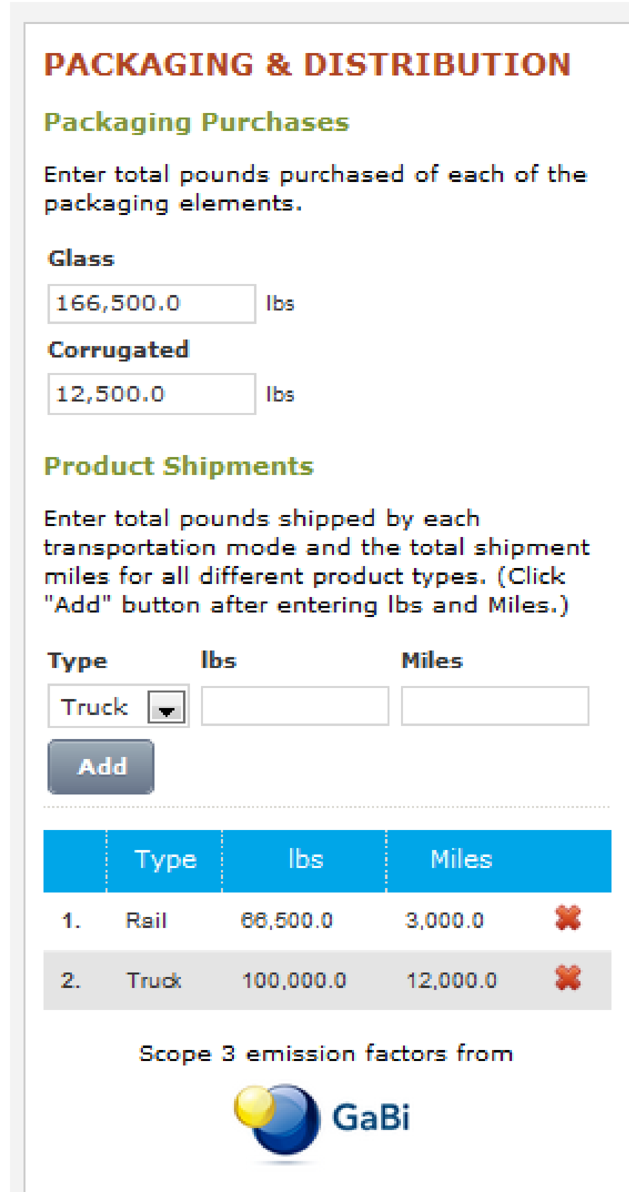
Corrugated
12,500.0 lbs

Product Shipments

Enter total pounds shipped by each transportation mode and the total shipment miles for all different product types. (Click "Add" button after entering lbs and Miles.)

Winery GHGs – Packaging & Distribution

- Pounds glass used
- Pounds corrugated used
- Shipments of product
  - By mode
  - Pounds & miles shipped



Winery Energy + GHG Calculator Results

- Scope 3 added
  - Packaging & Transportation
- Direct & Embedded

Calculator Results

Name: ABC Winery
Enterprise: ABC Vineyards
Display in: Pounds Tons

Energy

Take Action

Fuel	Electricity	Total kWh	Energy Intensity
444,041.77 kWh	42,660 kWh	486,701.77 kWh	29.19 kWh per gallon 69.39 kWh per case

Greenhouse Gas

Take Action

	Direct Emissions	Embedded Emissions	Total
Fuel	47,838.007 lbs	27,894.658 lbs	75,732.665 lbs
Electricity	30,950.151 lbs		30,950.151 lbs
Refrigerant	474,999.995 lbs		474,999.995 lbs
Packaging		351.455 lbs	351.455 lbs
Transportation		153,949.347 lbs	153,949.347 lbs
Total CO_2e	553,788.153 lbs	182,195.460 lbs	735,983.614 lbs
GHG Intensity	33.208 lbs CO_2e per gallon 78.955 lbs CO_2e per case	10.926 lbs CO_2e per gallon 25.976 lbs CO_2e per case	44.134 lbs CO_2e per gallon 104.931 lbs CO_2e per case

General Purpose of Calculator Additions

- Primarily an **educational tool** where approximate values may help show relative contributions by different LCA components
  - Not a detailed LCA analysis tool
- Support overall industry objectives to **drive change by individual operations** with some level of aggregation of results for industry reporting and potential benchmarking and peer comparison reporting.
- Balance the data entry burden & educational opportunity

CALIFORNIA
SUSTAINABLE WINEGROWING
ALLIANCE

Thank You! Keep Collecting Good Data…

CALIFORNIA
SUSTAINABLE WINEGROWING
ALLIANCE

U C D A V I S
Department of Food Science and Technology

SICILIAN-STYLE OLIVE FERMENTATION

FINDINGS AND RECOMMENDATIONS

Dr. Maria Marco, Professor, Department of Food Science and Technology

Dr. Kyria Boundy-Mills, Curator, Phaff Yeast Culture Collection, Department of Food Science and Technology

Charlotte Tyler, Graduate Student Assistant, Department of Food Science and Technology

Jose Zaragoza, Junior Specialist, Department of Food Science and Technology

Dan Flynn, Executive Director, UC Davis Olive Center, Robert Mondavi Institute

Funding provided by the California Department of Food and Agriculture, United States Department of Agriculture and California Sicilian-Style olive processors

• One Shields Avenue, Davis, CA 95616 • telephone: 530-752-1516 • mmarco@ucdavis.edu

Sicilian-style olive fermentation: findings and recommendations

General properties of raw olives

Sicilian-style olive curing typically begins with green olive fruits. Raw green olive fruits are extremely firm, bitter, and come in different varietals and sizes.

Phenolic compounds are responsible for the bitter taste of olives. Oleuropein is one such compound and is generally thought to be the most abundant bitter compound in olives. Phenolic compounds are removed from olives during fermentation either by diffusion out of the olive into the brine or by degradation of this compound by microorganisms. The highest levels of oleuropein are found in raw olives collected at early harvest times as compared to midway or late in the harvest season -- 13.69 g/kg olive (early) vs 0.82 g/kg olive (mid) and 0.02 g/kg olive (late).

Olive texture and firmness is determined by the polysaccharide polymers that comprise the olive cell walls. These polymers consist of cellulose, hemicellulose, and pectin. Pectin is the most abundant polysaccharide. The cell walls are degraded (soften) as the fruit ripens and during fermentation.

There are a variety of microbes on olives including yeast, mold and bacteria. They are found in very low quantities (10 to 100 culturable cells per olive). The abundance and types of microorganisms on the olives increases during fermentation.

Properties of normal Sicilian-style olive fermentations

In Sicilian-style olive processing, olives are submerged in brine and fermented for several months to debitter the olives. Common additions to the fermentations can include lactic acid, acetic acid, as well as mother-brine from a prior fermentation.

Olive fermentations are acidic and typically are in the range of pH of 3.2 to 3.8

Titratable acidity (total acid) concentrations vary from 0.4 to 1 %.

Salt (NaCl) concentrations are maintained at 40 to 50 parts per thousand (PPT).

Low oxygen levels (redox potential) in olive fermentations stimulate the growth of the fermenting microorganisms. This can be achieved by limiting circulation in the tanks.

Temperature can affect the rates of olive fermentations. Incubating olives at temperatures above 70 ºF (21 ºC) and lower than 100 ºF (38 ºC) is the normal range for fermentation.

Lactic acid bacteria (LAB) and yeasts are the most abundant microbes in olive fermentations.

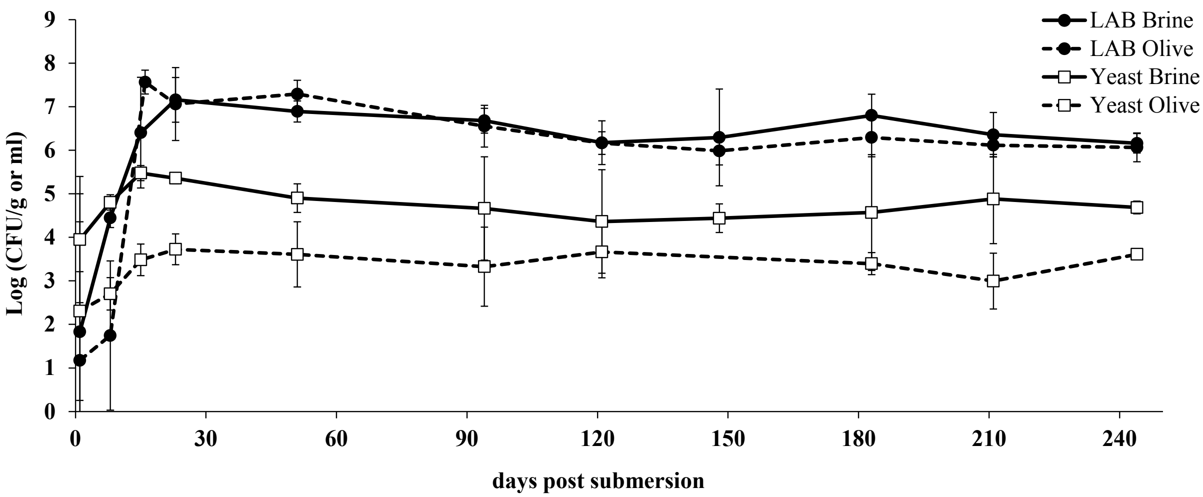
- Fermentations contain higher amounts of LAB than yeast.
- The dominant LAB found in olive fermentations include species of Lactocacillus, Leuoconostoc, Pediococcus and Streptococcus. Lactobacillus plantatrum, Leuconostoc pseudomesenteroides, Leuconostoc mesenteroides, Pediococcus pentosaceus and Pediococcus ethanolidurans have been isolated from Sicilian style olive fermentations.

The dominant yeast found in olive fermentations include species of Saccharomyces, Pichia, Candida, Debaryomyces, Kluyveromyces and Rhodotorula.

- LAB are found in similar amounts in and on olives and in brine. There are typically between 10^5 (=100,000) to 10^8 LAB cells (per gram) in or on the olives. There are between 10^5 to 10^8 LAB cells (per ml) in the brine.
- Yeasts are more abundant in brine than in or on olives. There are typically between 10^3 to 10^5 yeast cells (per gram) in or on the olives. There are between 10^3.33 to 10^6 yeast cells (per ml) in the brine.

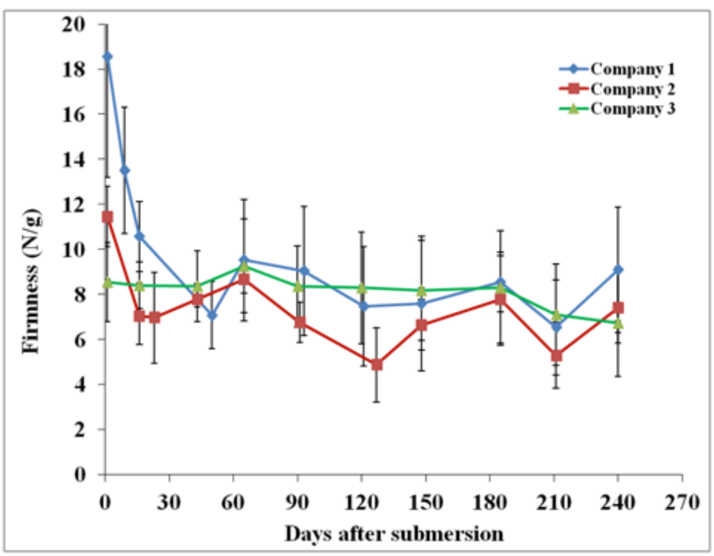
As shown in Chart 1, initial LAB and yeast amounts are very low in the fermentations (either below detection or up to 1000 cells per ml brine). Within 15 days after the start of fermentation, yeast numbers increase to 10^4 to 10^5 cells (per ml) brine and within 30 days LAB numbers to 10^5 and 10^8 cells (per ml) brine. Microbes are typically first found in the brine and then shortly later in or on the olives.

Chart 1. Changes in LAB and yeast during fermentation



As shown in Chart 2, firmness declines during the first two weeks of fermentation. Thereafter, olives have a firmness ranging between 6-12 Newtons/gram.

Chart 2. Firmness diminishes quickly during first weeks of fermentation



Properties of defective Sicilian-style olive fermentations

A variety of factors might result in defects in Sicilian-style olives, including low salt, high pH (> pH 4), over-ripe or bruised olives, or altered microbial populations in the fermentations.

Gas pockets and stem-end damage are the two most common spoilage defects observed in pilot and commercially fermented Sicilian-style olives in California.

Gas pockets

Gas pockets are the most obvious and destructive type of defect. The firmness of olives that develop severe gas-pockets is below 3 Newtons/gram. These defects have been found within 5 weeks after the start of fermentation, but can also develop later. Gas pockets can be associated with higher-than-normal numbers of yeast in the fermentation, however, this is not always true. Pectin-degrading yeasts are a major cause of gas-pocket formation.

Stem-end damage

Stem-end damage is a more localized defect on the olives. These defects can develop as early as two months into fermentation. The cause of stem-end damage is unclear, but it is likely that, as with gas-pocket defects, pectin-degrading yeasts contribute to the damage.

Recommended measurements to monitor Sicilian-style olive fermentations

Chemical Monitor salinity, pH, and titratable acidity

Microbial Use standard plating techniques to enumerate the amount of yeast and LAB present in the brine and associated with the olives during the fermentation.

Texture Monitor texture (and gas-pockets) either by hand or using a texture analyzer. The firmness of high-quality olives is in the range 6 to 12 Newtons/ g.

Pectinase Use plating techniques for pectinolytic activity to enumerate the amount of yeast and LAB present in the brine and associated with the olives during the fermentation.

Glossary

Cellulose A linear polysaccharide (chain of monosaccharides) comprised of D-glucose. It is an important structural component of the primary cell wall of green plants. Cellulose configures into rod-shaped molecules that bind together to form larger structures called microfibrils. Microfibrils contribute to the cell wall's tensile strength.

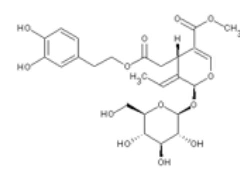
Defects Defects in Sicilian-style olives primarily relate to degradation of the olive's cell wall. The most common defects are gas pockets and stem-end damage.

Hemi-cellulose A branched polysaccharide comprised of a variety of sugar monomers including xyloglucans, xylans, mannans and glucomannans, and beta-(1-->3,1-->4)-glucans. It has less overall structural strength compared to cellulose.

Lactic-acid bacteria Gram-positive bacteria that produce lactic acid as the major metabolic end-product of carbohydrate fermentation.

Newton A unit used to measure force. Specifically, the amount of force needed to accelerate 1 kilogram of mass at a rate of 1 meter per second squared.

Oleuropein phenolic compound found in olives and olive leaves and has a characteristic bitter taste.



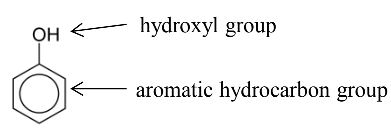
Oleuropein

Pectin A structural heteropolysaccharide (non-repeating units of monosaccharides) in the primary cell walls of plants. It consists mainly of esterified D-galacturonic acid resides in an alpha-(1-4) chain, although many forms of pectin exist containing other types of sugars.

Pectinase A group of enzymes that cleave the different bonds that comprise pectin molecules.

Pectinolytic activity The cleaving of bonds which hold pectin molecules together.

Phenolic compounds Class of chemical compounds consisting of a hydroxyl group bonded to an aromatic hydrocarbon group and can contribute to characteristic flavors and smells.



Phenolic compound

Polysaccharide polymers Sugar molecules bound together to form larger sugar molecules, such as pectin and cellulose.

Redox potential Measure of the tendency of a chemical species to acquire electrons and thereby be reduced (measured in volts).

Yeast Eukaryotic microorganisms classified in the kingdom Fungi.

Prepared by Dan Flynn at project meeting in Corning, CA on April 23, 2014.

Best Practices:

1. **Avoid accepting late-harvest (i.e., turning color) fruit.** Late-harvest fruit is too soft to ensure high-quality processing and will likely result in poor-quality, unmarketable product.
2. **Do not mix olives that are of good quality with defective olives or the brine from such olives.** The defective olives will expose the good-quality olives to pectinolytic yeasts that will ruin most of the good olives.
3. **Use a pectinase assay of brine for early diagnosis of pectinolytic yeasts that are associated with softening defects.** (NOTE: Developing a rapid assay is a component of a 2014 Specialty Crop Block Grant proposal being considered by CDFA. The assay currently available is not practical for commercial use.)
4. **Intervene when an assay indicates the presence of pectinolytic yeasts.** (NOTE: The meeting discussed interventions such as increasing the temperature of fermentation tanks or adding sorbic acid but more research is needed.)
5. **Use starter cultures to prevent softening defects and to accelerate fermentation and debittering.** (NOTE: Identifying starter cultures, which are commonly used in other food and beverage processing, is a component of a 2014 Specialty Crop Block Grant proposal being considered by CDFA.)
6. **Sanitize tanks and equipment with each use.** Food-grade sanitation is essential to avoid exposing fruit to pectinolytic yeasts that cause softening defects.

The following survey was sent to the largest three CA commercial fermented olive processors by email on April 28, 2014. All three processors responded and specifically the following individuals from each of the companies replied:

Delallo	Joe Gleason, plant manager
Musco	Matt Koball, plant manager
West Coast	Dan Vecere, owner

SURVEY

This brief survey will take an estimated five minutes. Please return to me by Wednesday April 30th.

1a. In the CDFA project, our goals were to determine (1) the baseline characteristics of commercial olive fermentations, (2) the effects of pectinolytic yeast on fermenting olives, and (3) test microbial additions to the fermentations (non-pectinolytic yeast antagonists and beneficial fermenting bacteria). In your view, how would you rate the project in achieving these aims? (circle 1, 2, 3, 4, or 5, with 1 being poor and 5 being excellent)

Responses:

Delallo	5
Musco	5
West Coast	5

1b. If you circled less than 5, how could this project have been improved?

Responses:

Delallo	not applicable
Musco	not applicable
West Coast	not applicable

2a. To what extent were the microbial management recommendations in the "guidelines" document helpful? (circle 1, 2, 3, 4, or 5, with 1 being poor and 5 being excellent)

Responses:

Delallo	5
Musco	4
West Coast	5

2b. In what ways could we improve the guidelines?

Responses:

Delallo	"The guidelines for microbial management are fine. Most of us already do chemical and texture examinations. Personally, I'm excited about utilizing the plating techniques when they become available."
Musco	"Having specific procedures for monitoring and performing the various tests."

West Coast	"I think the guidelines will evolve as the study evolves. It is very helpful a significant benefit to Sicilian style processors."

3. Dan Flynn provided a list of "Best Practices" that came out of our meeting discussion this week. To what extent were these Best Practices useful? (circle 1, 2, 3, 4, or 5, with 1 being poor and 5 being excellent)

Responses:

Delallo	5
Musco	4
West Coast	5

3b. Do you have any additions or modifications to provide to those "best practices"summary?

Responses:

Delallo	"An excellent list of BMP's"
Musco	
West Coast	"We will adopt the findings and recommendations as well as the best practices outline into our method."

4. To what extent will your company adopt any of our existing or proposed guidelines and best practices? (none, some, all)

Responses:

Delallo	All
Musco	Some
West Coast	All

5. What was the most valuable aspect of the project to your business?

Responses:

Delallo	"Identification of the source(s) of spoilage and the promise shown of developing mitigating solution"
Musco	"Determining the cause of the defective fruit – finding a method of detection – and the ultimate would be providing a method of prevention"
West Coast	"The basic understanding of how the many different yeast compounds effect our fermentation process. There was an abundance of useful information in these studies"

Australia – Market Briefing

D.W. Block Associates, LLC
800 NW 6th Ave, Suite 312
Portland, OR 97209 USA

June 21, 2012

Australia – Market Briefing

June 21, 2012

Table of Contents

Key Findings	*2*
Market Potential	*2*
U.S. Frozen Blueberry Exports	*4*
Demand Trends	*7*
Opportunities for California Suppliers	*9*
Market Segments	*10*
Obtaining Market Access for U.S. Blueberries	*12*
Appendices	
Retailer and Food Service profiles	*13*
Population Density and Major Cities	*14*
Australian Blueberry Industry	*15*

Key Findings

- **Per capita Australian blueberry consumption ~ ½ of U.S.: <u>Growth opportunity</u>**
- **Fresh blueberries essentially unavailable April-July: <u>Key shipping period for California blueberries</u>**
- **Leading retailers looking to for blueberry supply to fill this gap: <u>Receptive market with motivated buyers</u>**
- **Preliminary estimate of <u>1.6 million lbs</u> if U.S. market access is granted**
- **Market access can be achieved by industry-wide effort to work with food inspection agencies in U.S. *and* Australia**

Market Potential

Australian domestic blueberry consumption totaled nearly 16 million pounds during the 2011-12 crop year. Of this total, approximately 7.9 million pounds were consumed fresh, with 7.1 million pounds consumed in processed (primarily frozen) form.

Australian blueberry production in 2011-12 is estimated at 8.1 million pounds, with fresh imports contributing an additional 1.7 million pounds. The top-growing state of New South Wales has seen substantial increases in production as plantings continue to mature.

Frozen imports accounted for an additional 6 million pounds.

The Australian blueberry market received a shock in 2011, when top trading partner Japan banned Australian blueberries due to concerns over the Mediterranean fruit fly. This development, combined with the large increase in production, has altered the established balance of supply and demand: Japan has historically represented between 1 and 2 million pounds of Australian exports. Australian producers are anxious to reopen the Japanese market, though progress on the effort at this time is uncertain. The Japanese quarantine on Australian blueberries resulted in a sharp drop in fresh exports, which are estimated to have fallen under one million pounds.

In 2011-12, domestic fresh consumption is estimated at 65 percent of total disappearance, with domestic processed use accounting for 20 percent, and exports accounting for 15 percent. Major export markets aside from Japan include Western Europe and other Asian countries.

New Zealand is essentially the only current supplier of fresh blueberry imports in Australia. The U.S. has not exported fresh highbush blueberries to Australia since 2009, and has never been a major supplier to the Australian fresh market.

The supply and demand balance for Australian blueberries is detailed in the table below:

Australia: Blueberry Supply and Use, 2011

Supply	**Metric Tons**	**Million Lbs**
Domestic Production	3,674	8.10
Fresh Imports (New Zealand)	747	1.65
Frozen Imports	2,722	6.00
Total Supply	**7,143**	**15.75**

Use	**Metric Tons**	**Million Lbs**
Domestic Fresh	3,571	7.87
Export Fresh	357	0.79
Processed (domestic+export)	3,214	7.09
Total Use	**7,143**	**15.75**

Sources: ABGA, news reports, trade estimates

Average retail pricing for fresh berries over the past year was approximately AUS $3.98 per 125-gram (4-oz clamshell), or AUS $15/lb. (Note: the Australian dollar is currently trading near parity with the U.S. dollar)

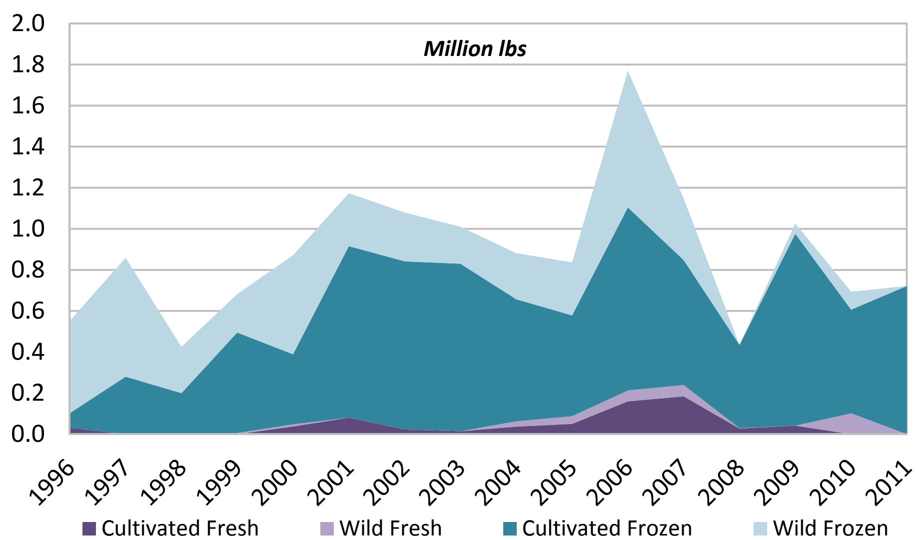
Bottom line: per capita consumption of blueberries in Australia is estimated at 10 ounces per year (5.7-oz. fresh, 4.3-oz. frozen). This figure is slightly less than half of per capita consumption in the United States and Canada, the world's two-largest consumers of blueberries. Due to the fact that no official statistics exist for blueberry imports and production, it is believed that actual frozen blueberry demand may be higher, and further inquiry will be necessary to obtain a more accurate estimate.

U.S. Frozen Blueberry Exports

U.S. blueberry exports (fresh and frozen) to Australia reached a high of 1.8 million pounds in 2006, 83 percent of which was frozen. The U.S. has never been a major supplier of fresh berries to Australia, while frozen exports have largely held steady over the past fifteen years. However, since 2008, exports of dried blueberries have risen considerably, and on a fresh basis (1 lb dried = 6.5 lbs fresh), make up the largest proportion of U.S. export volume.

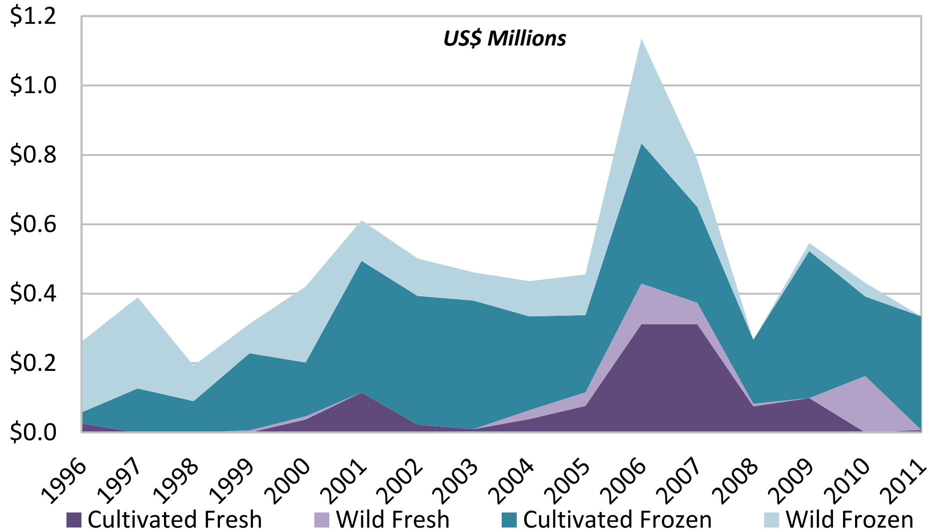
The total value of U.S. blueberry exports in 2011 (at customs) was $609,080 in 2011, with fresh berries representing $7,698, frozen representing $327,041, and dried representing $274,341.

U.S. Fresh/Frozen Export Volume by Crop



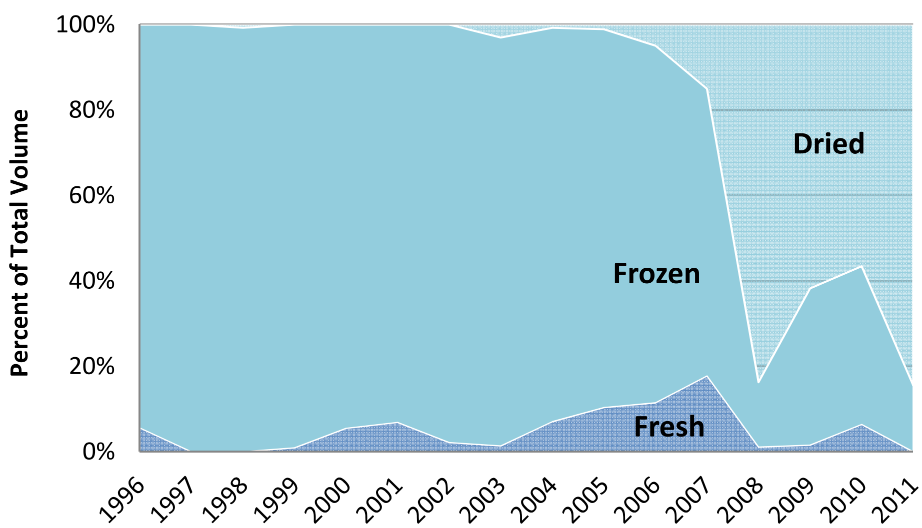
Source: USITC

U.S. Fresh/Frozen Export Value by Crop



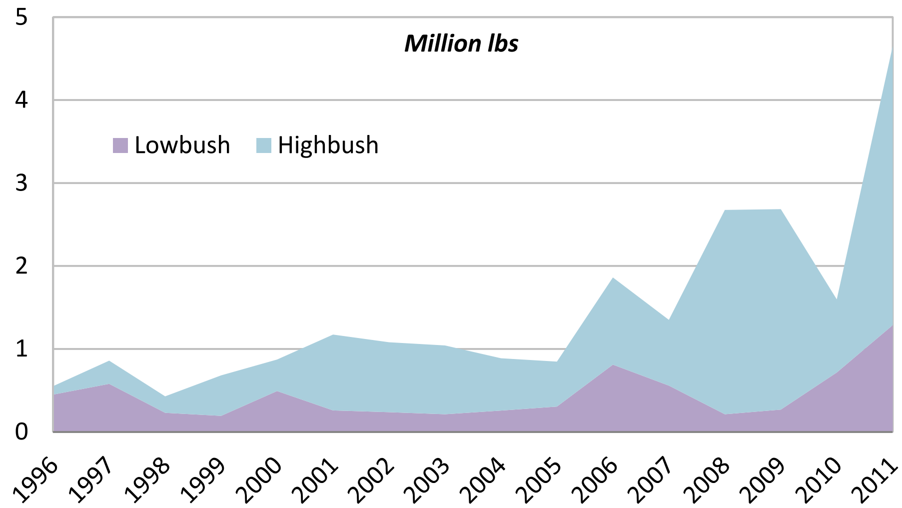
Source: USITC

Percentage of U.S. Exports by Type



Source: USITC

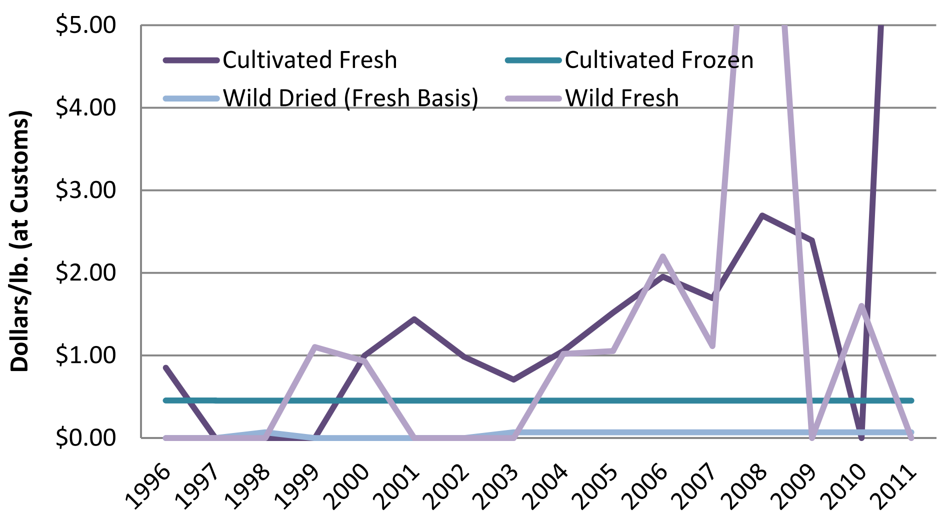
Highbush vs. Lowbush Export Volume (Fresh, Frozen, & Dried)



Source: USITC

U.S. blueberry export pricing has been erratic over the years. A combination of low export volume (in some years, no exports were recorded for some categories) and the quarantine on fresh product makes it difficult to identify any clear trends in market pricing. As would be expected, fresh product commands a significant premium over frozen and dried.

Fresh/Frozen Blueberry Value at Customs



Value at customs, including CIF. Source: USITC

Demand Trends

Industry segments with notable growth potential currently include:

- Major retail chain stores: Coles, Woolworths
- Discount and mass merchants: Aldi, Costco
- Take-home food service
- “Upscale” QSR / fast casual dining

Demand trends are driven by a combination of demographic and economic factors, in addition to ever-changing consumer preferences. Key factors are noted below.

Demographic

- The current population of Australia is approximately 23 million
- Currently, about 85% of the country’s population lives in urban areas.
- Australia’s population growth is slightly greater than one percent per year. This trend is expected to continue throughout the remainder of the decade.
- More than half of population growth comes from net immigration:
  - The current proportion of native-versus-overseas-born is approximately 75%-25%
  - More than 20% of overseas-born residents are from the UK, followed by 9% from New Zealand, 5% from China, and 4% from India.
  - In terms of country-of-origin, Western Australia, New South Wales, and Victoria are the most diverse states, while Tasmania and Northern Territory are home to the largest proportion of native-born residents.
- Western Australia remains the fastest-growing state in the country, growing by 2.4% in 2011. Victoria and Queensland, the second- and third-largest states, have also grown at a faster rate than the country as a whole.
- Australia continues to grow older as a country. The median age increased to 37.1 years, compared to 32.4 years in 1991, according to the Australian Bureau of Statistics.
  - The youngest states are Northern Australia, Australian Capital Territory (Canberra), and Western Australia, all with median ages less than 36 years.
  - The oldest states are Southern Australia and Tasmania, both of which have median ages of nearly 40 years.
  - The proportion of the population over the age of 65 has been steadily growing over the past twenty years, reaching nearly 14 percent in 2011. This figure is forecast to increase to 17 percent by 2020, and over 25 percent by the end of the century.

- Average household size is less than 2.5 people and steadily decreasing
    - Single-person households make up 25 percent of all Australian households, up five percentage points over the last 20 years.
    - Family households are projected to make up less than 67 percent of all households in the next decade, down from 72 percent in 2001.

Economic

- The Australian economy is projected to grow at a rate of 3 percent annually over the next 5 years
- Australian household debt has grown in recent years due in large part to high housing prices, and is comparable to levels in the U.S.
- The Australian dollar remains strong compared to the U.S. dollar, due in large part to a sustained boom in the country's mining sector. In the short term, this has resulted in greater purchasing power with regards to imported goods, though longer-term changes in exchange rates may pose a risk to potential exporters to the Australian market.

Consumer preferences

- In recent years, several U.S. companies have experienced high-profile failures in the Australian market, including Starbucks, Krispy Kreme, and Baskin-Robbins. In the case of Starbucks and Krispy Kreme, Australian competitors were already established in the marketplace.
- Some U.S. companies have misjudged Australian consumer preferences on the basis of superficial similarities with the U.S. market According to the USDA Foreign Agriculture Service, "Any brand which requires market domination in order to be financially viable should probably reconsider entering the Australian market."
- On the other hand, Australian-launched ventures based on U.S.-originated concepts have performed relatively well.
- The country is also seeing a growth in gourmet-oriented foods, such as upscale versions of pizza and burgers. McDonald's has had notable successes in its recent upscale offerings.
- Competition is growing in the take-home food market from convenience stores (e.g. 7-Eleven)
- On the other hand, Australia is reportedly the most "obese" nation in the world. This has led to calls for government action, such as ingredient labeling requirements and taxes on certain foods

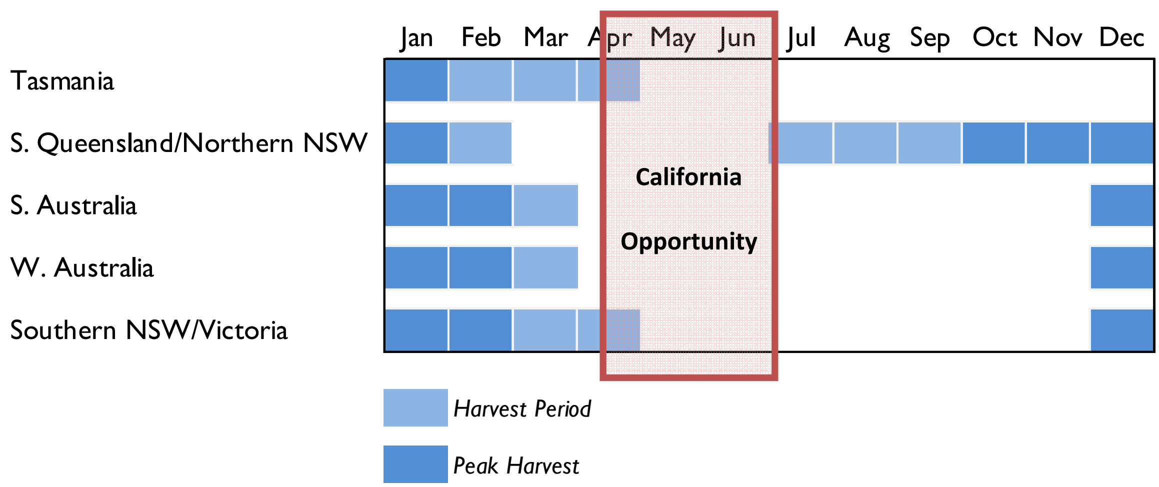
Bottom line: Australia's moderately-growing economy and strong purchasing power are key drivers in the country's potential as an export market for U.S. products. In addition, over the past five years, the country has become a significant net importer of fruit. This fact has not been lost on other fruit exporting countries, such as Chile and New Zealand, both of which are well situated to supply the Australian market.

Opportunities for California Suppliers

Neither Chile nor New Zealand compete directly with U.S. blueberry producers in the fresh market, however, Chile's strong blueberry processing sector remains a formidable competitor in the frozen segment, which is at this time the only avenue available to U.S. blueberry exporters.

Australia is still a net exporter of blueberries, and with a ten-month shipping season, **U.S. product is likely to be most viable in the April-through-June period, a fact that may favor early season producers in the northern hemisphere, such as California**.

Australian Blueberry Harvest Calendar



Potential demand for blueberries in the two-month gap is estimated in the table below. Assuming that Australian fresh blueberry consumption goes to zero during May and June of each year, and assuming that consumption during the remaining ten months is constant at 0.57 oz. per month, potential consumption can be calculated as follows:

Preliminary Calculation of Fresh Market Potential for California Blueberries			
Per capita annual consumption	5.70	oz	*Assumptions:*
Per capita monthly consumption	0.57	oz	• *Consumption is constant throughout the year*
# months California blueberries ship to AUS	2		• *No current consumption in May and June*
Per capita consumption: May+June	1.14	oz	
Australia population	23	million	
	=26.22	million ounces	
Potential Australian blueberry consumption: May + June	**1.64**	**million lbs**	

According to industry representatives, California blueberries have two particular advantages over Florida, the only other early-producing state: the timing of California's crop is slightly later than Florida, which better fits the gap in Australian production. In addition, Florida blueberries need to be fumigated, whereas California berries do not.

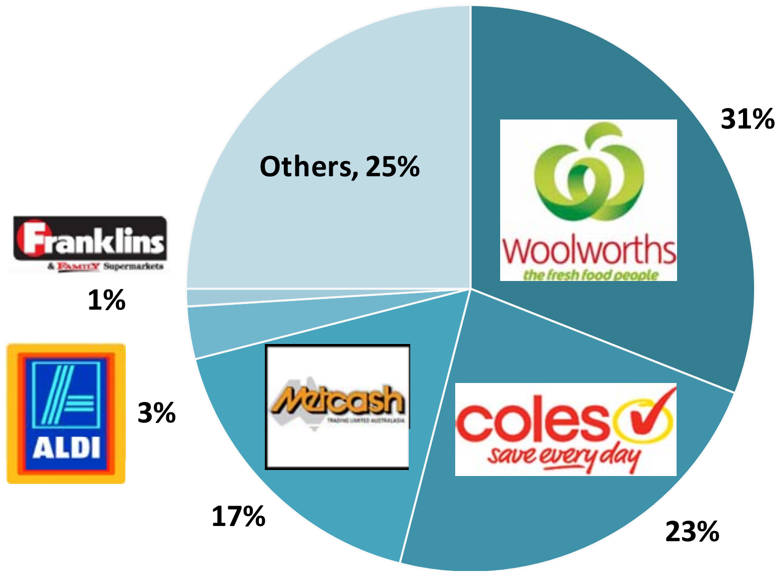
Ironically, stronger counter-seasonal U.S. consumption growth of Chilean fresh blueberries could provide additional opportunities for exports of frozen U.S. exports to southern markets, as fewer Chilean berries would be destined for the freezer.

Market Segments

Retail

According to some observers, the Australian retail market is undergoing a structural shift similar to the changes that occurred in the U.S. over the past decade. In the U.S., this change was exemplified by the dominance of Walmart and the response to its growth by other major grocery retailers. The lessons learned by produce growers and shippers in the U.S. during that period may be instructive for those interested in the Australian market today. **In this iteration, Australian retailers Coles and Woolworths are the dominant players, as shown in the chart below**.

Retail Grocery Market Share in Australia: 2011



Source: McKinna, et al.

Retail sales growth slowed to two percent in 2010, down from five percent in previous years , as Australian disposable income was constrained by higher interest rates and the end of domestic economic stimulus programs.

Mirroring trends in the U.S., discount retail channels are faring better than mid-to-high end outlets.

Costco entered the Australian market in 2009, and currently has stores in Melbourne, Canberra, and Sydney. Another big player in this area is Metcash Trading, Ltd. (dba Campbells Wholesale).

Aldi is expanding its presence, and has been particularly successful in recent years. Up to two-thirds of its product lines are revamped or reformulated per year.

Premium private label products are gaining in popularity.

Overall, the retail outlook is a similar story as elsewhere: smaller chains are disappearing, and larger chains are consolidating.

Food service / Hospitality, Restaurant, Institutional (HRI)

The foodservice sector saw three percent growth in 2010, the lowest annual rate in the past 10 years. Upscale QSR and fast casual restaurants (e.g., gourmet pizza and hamburgers) were especially strong. Food-to-go from restaurants and grocery stores has also been especially popular.

McDonald's remains relatively more popular in Australia than in other parts of the world. The company's McCafe concept and "Healthy Choice" menu were both tested or originated in Australia, and have remained popular.

Chains represent approximately one-third of consumer foodservice sales, and continue to grow. Franchises in particular are showing strong growth. Not all chains have been successful, however, such as previously-mentioned Starbucks and Krispy Kreme.

Obtaining Market Access for U.S. Blueberries

The barriers for U.S. blueberry exports to Australia are entirely related to sanitary and phytosanitary concerns; the two countries otherwise have a relatively free trading relationship.

USDA's Animal and Plant Health Inspection Service (APHIS) and Biosecurity Australia (BQA) are the respective agencies responsible for granting market access.

Blueberry industry marketing representatives in Australia began discussing access for U.S. blueberries with BQA in 2008. Reportedly, BQA and APHIS have limited scope to review new crops due to internal resource constraints. In addition, the bilateral agreement between APHIS and BQA allows for a limited number of U.S. products to be reviewed at any one time.

Currently, BQA is evaluating apples from New Zealand and the U.S., ginger from Fiji, and Pineapples from Malaysia. The U.S. apple evaluation, however, has been on hold since March 2010.

BQA is reportedly open to the possibility of blueberries replacing any of the products currently under review. Apparently, they believe that allowing blueberries would be easier for both scientific and political reasons compared to other crops.

Australian industry representatives believe a strong effort by the U.S. industry will be needed to lobby USDA/APHIS to get blueberries onto the BQA review list.

Considering that it took over seven years for U.S. (i.e., Oregon) blueberry producers to gain access to South Korea, it appears that much work lies ahead. Lessons learned from that effort, which was spearheaded in part by the North American Blueberry Commission/U.S. Highbush Blueberry Council and state agriculture departments, could lead to a shorter time frame for this effort. Additionally, a dedicated export association may be able to devote more resources to facilitating the process, compared to the NABC and USHBC, which had multiple priorities.

Appendix 1: Retailers and Food Service profiles

Top 5 Supermarkets (2011)

Company Name	Sales US$ bil.	Market Share	# Outlets
Woolworth's Australia	26.0	31%	867
Coles Group (Wesfarmers)	19.3	23%	745
Metcash/Campbells Wholesale	14.3	17%	30
Aldi Stores	2.5	3%	200
Franklins Supermarkets	0.8	1%	80
Others	21.0	25%	1,958
Total	84.0		3,880

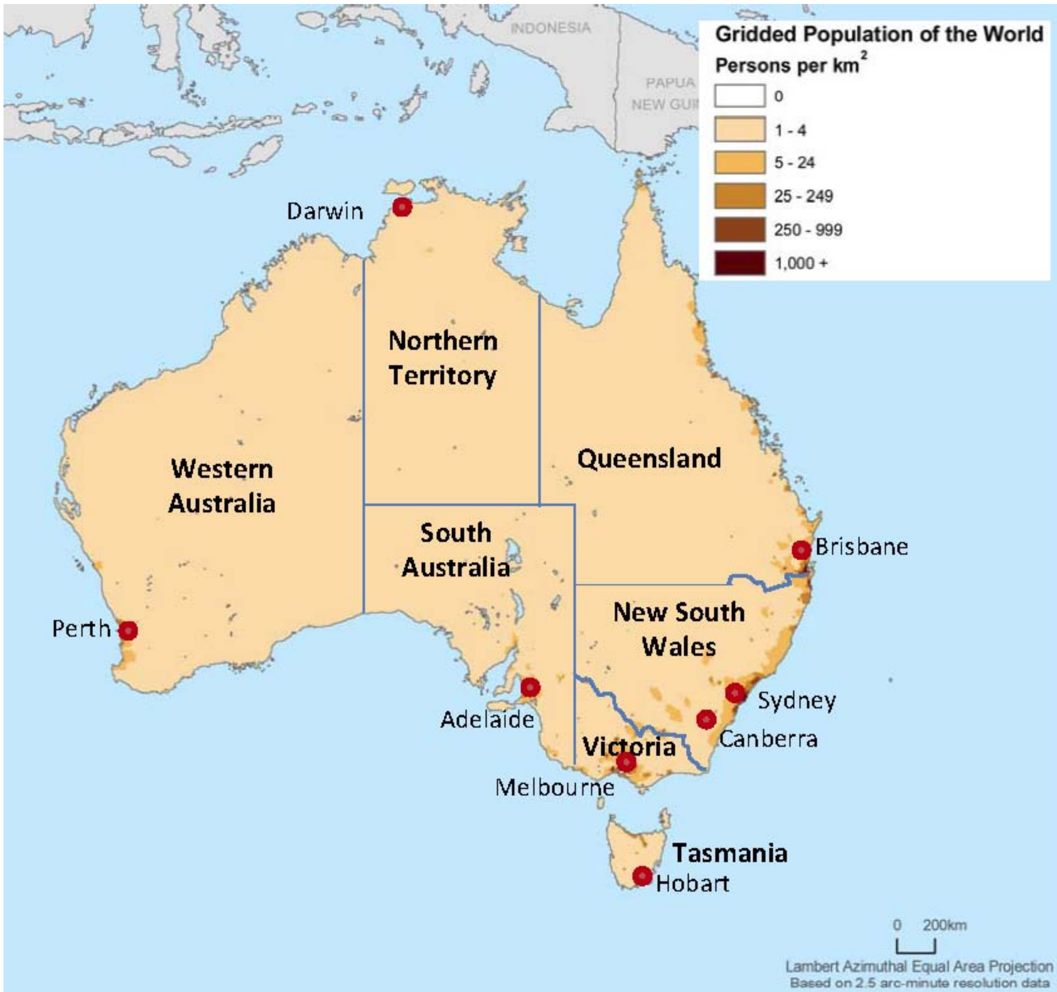
Sources: Euromonitor –Retailing Australia 2011, IBISWorld, McKinna et al.

Top Restaurant Chains (2010)

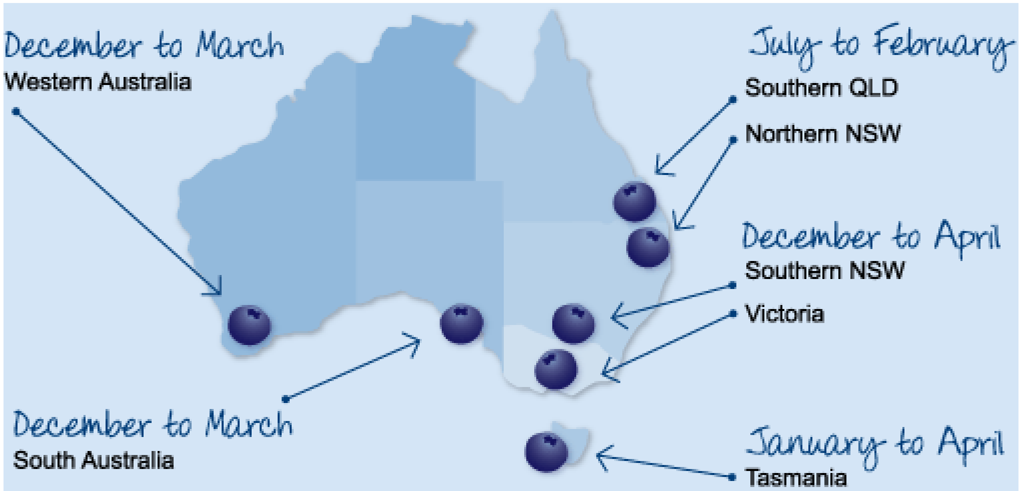
Company Name	Sales US$ mil.	Brands	# Outlets
McDonald's	3,200	McDonald's, McCafe	1,620
Competitive Foods Australia	1,000	Hungry Jack's	306
Doctor's Associates	800	Subway	1,246
Yum! Brands	670	Pizza Hut, KFC	463
Quick Service Restaurant Holdings	234	Red Rooster, Chicken Treat, Oporto	600
Others	10,696		9,765
Total	16,600		14,000

Sources: Euromonitor, company reports

Appendix 2: Population Density and Major Cities



Appendix 3: Australian Blueberry Industry



Source: Australian Blueberry Growers Association (ABGA)

Queensland and New South Wales primarily grow Southern Highbush varieties, while Northern Highbush varieties tend to be planted in Victoria and Tasmania, the most significant producing area in southern Australia.

According to the AGBA, approximately 80 percent of Australian blueberry plantings are Southern Highbush/low chill varieties.

2011 Estimated Production by State	**NSW**	**QLD**	**SA**	**TAS**	**VIC**	**Total**
Production (million lbs)	7.1	0.0	0.0	0.2	0.7	**8.1**
Total area (acres)	1,265	5	25	70	287	**1,651**
Yield (lbs)/acre	5,622	242	1,175	3,245	2,443	4,888

Potential to Increase Sales of California Blueberries in the UK Marketplace

A research project carried out for
The California Blueberry Committee
by The Garden

November 2011

The Garden
Marketing Consultants 4th Floor, 2 Thames Avenue, Windsor, Berkshire, SL4 1QP, United Kingdom
t +44 (0)1753 851 910 f +44 (0)1753 827 657 gate@comeintothegarden.co.uk comeintothegarden.co.uk

INTRODUCTION

At the request of Todd Sanders of the recently formed, California Blueberry Commission,
The Garden has pleasure in supplying a report on the market and opportunities that exist for the Commission and its members in the UK market.

The report has focussed purely on the fresh market and related opportunities in retail, wholesale and food service channels.

The Garden interviewed senior members of three groups across retail and food service companies who are key to unlocking the potential in the UK Blueberry market.

For further information, please contact:
Iain Forbes, The Garden, 4th Floor, 2 Thames Avenue, Windsor, Berkshire, SL4 1QP, United Kingdom
iain@comeintothegarden.co.uk
44(0) 1753 851 910

THE UK BLUEBERRY MARKET

The UK market for fresh blueberries has seen a huge increase over the last few years. The growth spurt has seen blueberries become the second most popular berry on the UK supermarket shelves, usurping raspberries in the process.

According to Kantar Worldpanel figures, in the 52-week period to May 15, 2011, 15.2 million kilograms of blueberries were sold by UK retailers, with a value of £136.4 million ($218.5m). Those figures represented year-on-year rise of 14.9% in value and a huge jump of 28.6% in volume sales.

Blueberries accounted for 18.1% of the sales in the £751.9m ($1,204m) berry category in the same period and 11.6% of the volume (131m kg).

The big rise in demand has come on the back of a massive surge in sales across the berry category, driven first by strawberries and then raspberries in the last decade. Strawberries currently represent 58.4% of the category's value and 74% of the volume of berries sold and the corresponding figures for raspberries are 19% and 10.8% respectively.

The three major berries therefore account for 96.4% of volume and 95.5 of the value of the retail berry market in the UK.

A UK strawberry production boom was the initial cause, backed up and boosted by marketing campaigns for home-grown and imported fruit that highlighted the health benefits of berries, in particular blueberries, as 'superfruits' with high antioxidant levels which may help fight cancer, memory loss and the ageing process.

During the last decade, the establishment of a new body to promote berries - first under the banner of National Summer Fruits and now known as Seasonal Berries because it also encompasses imported fruit - has had a major impact on sales. Modelling itself on the previously successful Banana Group, it brought together every significant importer and the major supermarket chains in a united effort to increase sales in the category in a way that benefited everyone in the chain.

Seasonal Berries now works with exporters into the UK market from all around the world to develop the category on a 12-month basis and was involved in initial discussions and planning when Chile, Uruguay and Argentina launched their blueberries from the South campaign three years ago. The Blueberries from the South initiative was the most ambitious to date to promote off-season berries in the UK, with a TV advertising campaign supporting a heavy promotional spend in media titles and in-store. It has been disbanded this season - largely for political reasons, and Chile and Argentina have both announced plans to continue unilateral activities in the UK, Germany, Denmark and the Netherlands. Chile will work with Seasonal Berries on its UK programme. Uruguay has not yet announced any plans to work alone to promote its fruit.

A familiar cycle has been followed, however, and as volume sales have expanded, the pressure has been ramped up on suppliers to reduce prices in order for the supermarket chains to compete on the high street. In the blueberry sector, after several years of exponential growth, that pressure has been gradually applied in the last 24 months.

In response, punnet sizes have generally gone from 225g to 200g to keep the cost down and encourage higher volume sales, while the emphasis has switched to securing larger volumes of fruit from sources closer to home - ie. Europe.

However, the figures to May this year illustrate the fact that there is still an upward movement in price at retail level, with the overall berry category worth 13.9% more in the 52 weeks than in the previous year, on a volume rise of just 9.3%. As the earlier figure suggests, though, blueberries are now falling roughly in line with the value expectations the retailers have for the category, rather than a shining light capable of driving margin growth at premium on-shelf prices, which was the case in previous years.

While the UK does not therefore feature the peaks and troughs in blueberry markets that characterize other European markets and the North American market, it offers a certain amount of stability. Returns have narrowed and the supply options have consolidated in recent years, but the blueberry market continues to grow and, being relatively mature, it is better understood by buyers and well served by importers who are more comfortable with the 12-month supply and demand patterns.

Tesco has by far the largest retail share in soft fruit, with 28.1% of the overall market (against a 27.2% overall grocery market share according to Kantar - 52 weeks to April 18, 2011). Sainsbury's (16.8%/14.7%) and Morrisons (11.8%/11.3%) also index amongst the top four, whereas Asda is an underperformer in soft fruit (11.9%/14.4%).

Below the upper echelons, The Co-op (7.4%/6.7%), Waitrose (6.3%/3.8%) and Marks & Spencer (5.5%/3%) all have a larger share of the berry category than overall, while even the hard discount chains (5.6%/5.1%) back up the perception that berries are very much seen as an integral part of a successful and profitable produce department across the retail sphere.

There is of course a large swathe of the year that cannot be covered by European production and the traditional import season begins with blueberries from Argentina and Uruguay via air in October then move to sea transport in November, this is followed by imports from Chile lasting until the beginning of April when the northern hemisphere production kicks in with Spain, followed by Morocco and France then the UK.

Australia and Poland tend to fill the gap until the South American season begins again, with product from Germany, the Netherlands, New Zealand, South Africa, Canada and the US all seen on shelf at some point in the calendar, depending on availability and seasonal changes.

While there has been talk in recent months of sources such as Mexico and Kenya becoming larger sources for the UK retail sector, only small volumes have been seen from those two sources to date. Any significant expansion is expected to be some years down the line and would compete largely with supplies from South America.

ECONOMY

The state of the world economy is having a major effect on the UK market and on food prices. The concern of a double dip recession is not going to disappear while there is so much uncertainty in the eurozone. It is inevitable that, as economies around the world weaken, spending on food is affected to a degree, though there has been no significant sign of that yet in the UK.

Although the UK economy continues to grow sluggishly, the road to recovery is likely to be long and hard. The impact on sales will most likely be seen when the Bank of England eventually begins to raise its interest rates from the record low level of 0.5% they have been at since early 2009. Government spending cuts, high inflation and the prospect of higher interest rates will all have a negative impact on consumer confidence, even if they do generate recovery.

Although food is an essential purchase and many would argue the food industry is to a large extent protected from the economic turmoil, consumers do have a choice over the food they buy. As it is discretionary spending that often suffers at times of tight budgets, prices for blueberries have been pushed downwards and there has been a far higher dependency on promotions to shift volumes. Whether in the retail or foodservice sectors, the competitive environment obliges businesses to simultaneously offer extremely good value and demonstrate that their products remain of the highest quality.

Relationships with reliable growers have therefore arguably never been more important, as the importer looks to gain secure access to a reliable source of fruit when there are shortages or prices are high. Increasingly, retailers are seeing to establish a strong message about their own access to and relationship with growers around the world, with Tesco, Morrisons and Asda, in particular, leading the way with their own direct sourcing models. While middlemen are being squeezed, however, there is still a well-established supplier base that will not change dramatically for some time to come.

The rising input costs being felt by all global producers, alongside additional pest and disease pressure as production expands and seasonal boundaries are stretched to meet demand, are making the job of competing on price more difficult for shippers, particularly when they are thousands of miles from the destination market. Add the scarcity of water and labour in some areas into the equation, as well as the changing climatic conditions being experienced by many growers and the need for a secure supply chain, underpinned by strong working relationships is highlighted.

The foreseeable future will undoubtedly prove difficult in economic terms and the food price rises that have continued to occur in the UK despite the downturn may well grind to a halt in the short-term. After 60 years of progressively lower food prices in relation to the proportion each household has available to spend on food products, the fact that food becomes relatively more expensive will pose a significant challenge to the industry.

KEY PLAYERS

The leading importers of blueberries in the UK are (in alphabetical order) as follows:

- Angus Soft Fruits, Arbroath, Scotland
- BerryWorld Ltd, Hertfordshire, England
- Berry Gardens, Kent, England
- Chingford Fruit, Kent, England
- International Produce, Yorkshire, England
- M&W Mack, Kent, England
- Morrison Supermarkets, Bradford, England - direct sourcing
- Total Berry, Surbiton, England
- T&JB Produce, Cornwall, England

TRADE INTERVIEWS

The following are exerts from interviews conducted with representatives of three of the key players in the UK trade.

Berry World

Laurence Olins - Chairman of Poupart Group and of Seasonal Berries Ltd
Adrian Olins - Director of BerryWorld and also Vitalberry BV, the company's Dutch-based firm that supplies berries to retailers across Europe

We have tried to introduce California Blueberries into UK customers over last few years - as have our competitors, but it has never quite come off.

Until recently, there was a small potential window in June that was interesting. However, Spanish availability - which has traditionally ended in the 3rd or 4th week of May - is going later and the French season is capable of beginning slightly earlier, so that window has closed up unless there are weather difficulties. This year, there was a gap, but there is no guarantee that it will reappear in the next few seasons. In the second two weeks of June, the first blueberries from Holland and Germany are beginning to come on stream, as both of those countries are now producing more volume and extending their seasons earlier. Poland tends to come into play in the third week of July and then the market is tied up until.

The Dutch had taken out some of their earlier fruit, but 300ha has just been planted in northern Holland, which will mainly be aimed at the Dutch and German markets. The central European and Scandinavian consumer has a more natural connection with blueberries, but that is their own home-grown fruit that they have been used to picking wild. Until now, it has proved difficult to build an off-season market in these countries, but there are signs that it is beginning to happen in a small way. The Chileans for instance are promoting 'winter' blueberries in Germany, Holland, Russia and Denmark, as well as the UK.

The Spanish region of Huelva grows about 8,000 tonnes of blueberries and then France comes in with a short 3-4 week window and around 1,000t. Strategically, it's difficult to see the US being able to compete with these sources on price - we could do some containers, but there is risk involved and historically the quality has not been quite what we needed.

There is a lot of support from the UK retailers for home-grown fruit at the moment and the British blueberry sector is increasing production with every season. This year, UK supermarket chains sold 1,200 tonnes of domestic blueberries from the beginning of June through the summer - which equates to around 50% of the fruit sold by supermarkets during that period. The total value of sales of British blueberries was just over £1 million for the first time in 2011.

As well as attempts to expand production (projections range from 3,000t to 5,000t a year within the next five years) there is an emphasis on bringing the season forward.

There is not enough British fruit to service every retailer. This year M&S sold 30% of British blueberries; Waitrose sold 25% and Tesco 20%. Asda, Sainsbury's and the Co-op sold just 3% of the crop each and that disparity is largely explained by the make-up of each retailer's supply chain and its access to British-grown fruit.

Varieties and production regimes need to be right for the UK market - There seems to be a much greater awareness of varieties these days - most UK supermarkets prefer Duke. Assurance schemes are vital and GlobalGAP is a must for the retail sector. Most supermarket chains also require suppliers to adhere with a separate standard specific to them. This has proved problematic when attempting to grow US soft fruit sales in the UK previously - two years ago for instance a large amount of fruit was rejected on arrival because it did not conform to European pesticide MRLs.

This precludes shippers from taking advantage of short-notice retail opportunities.

Programmes - speculative sendings to the UK would be too risky, as the prices are extremely volatile and can and do change by €10 a box in a week. Every 'x' number of years, opportunities will arise due to weather problems in Europe, but unless US shippers were able to respond quickly and effectively, those windows of opportunity quickly close up.

There is another short window from September 25th, when the northern hemisphere crop (Dutch, German, Polish) has dried up and the market begins to run into early Argentinean and South African fruit. Any good Northern Hemisphere fruit at the right price would be looked at around that time and Canada has been explored.

One fruit that has worked from California is cherries, because there is a specific window it every year. Even there, problems with spraying regimes caused a lot of fruit to be rejected on arrival in one recent season. This year though, was a very successful season - the cherries were excellent and the market opened up for them at decent prices.

Blueberries is the classic case of the mantra - if there's no market, don't ship, as the fruit is expensive to produce and no-one can afford to speculate, particularly when sending the fruit overseas.

The frozen market has gone through the roof in the last 24 months, as weather conditions have made it difficult to store fruit for ingredients for muffins, pies, yoghurts, drinks and smoothies.

Foodservice sales are increasing, but from a very small level and certainly not at the sort of level there is in the USA.

The wholesale sector is too risky to commit to. The blueberry job is extremely volatile and one box too many can cause huge swings in price from day to day. No trader is going to buy at a fixed price from California and risk that fruit on the open market.

Seasonal Berries has just been asked to manage the Chilean blueberry promotional campaign in the UK for 2012. They will agree spend in advance, devise a promotional plan and work alongside the key importers (who are all on the committee) and their retail customers. This is arguably a step backwards from the blueberries from the South campaign, which also included Uruguayan and Argentinean blueberries and ran a TV advert in the last two seasons on prime terrestrial channels across the UK.

UK retailers are really strong on backing British. The in-store signage and packaging in the soft-fruit aisles is beginning to mirror what the top-fruit sector has seen in recent times, with union jacks, shelf barkers and banners fairly standard. With the Olympics and Queen Elizabeth II's Golden Jubilee in 2012, as well as the traditional peak around Wimbledon fortnight, you can expect to see even more activity around British blueberries and probably more shelf space, depending on the volume available.

The first job with Californian fruit is to get it a place on the UK shelves and the only way to do that would be to commit to a long-term strategy and be prepared to pay in some way for the fruit to get on shelf in the first place.

At this point, there is no way that Waitrose, M&S or Tesco, with their British emphasis, will look at including an annual programme of US Blueberries in their mix. They have the fruit available to them that means they don't need it.

Sainsbury's might be a good option - they have had a shake-up of their supplier base and the two new suppliers - Mack and Chingford Fruits - are not traditionally strong in soft fruit and therefore struggling to source the volume of fruit they need. Sainsbury's is still also served by Berry Gardens, Angus Soft Fruits and Total Berries, but none of them will give Sainsbury's preferential treatment with their British fruit because they are being squeezed out by the retailer and they have other, better options.

Sainsbury's has just launched an initiative to increase the proportion of British products on its shelves but it will not be able to do too much with blueberries in the next few seasons. Sainsbury's will therefore be relative minnows on British fruit for some time and will need fruit to compete on shelf.

Another retailer worth considering is Costco, which favours US product over British and makes its procurement decisions centrally from the US. They are open to promotions and like to create theatre around their products. Everything goes through a company called PML.

Total Berry - Part of the Total Produce Group of companies
Ian Waller - Managing Director

There are no obvious windows for California Blueberries, although there is a potential gap in some years in the late-March and April period and perhaps September into October.

No retailer is more conducive to buying imported blueberries than any other - they all openly support home-grown fruit but there is nowhere near enough to go around. M&S and Waitrose are the only UK retailers who arguably have a big enough volume and even they want more.

The problem for some retailers is that they just don't have access to British blueberries, so they tend to hold on until the price is at its peak. There is therefore a lot more frit being stored in the UK, so it misses the peaks of the Polish season. It is an expensive fruit to grow in the UK and therefore needs a certain price level to justify the investment.

It is already becoming questionable whether that can be maintained across the year for imported fruit. There is some fairly significant growth in the blueberry category, but it is largely being driven now by deep-cut price promotions. This year, for instance, Spain had a big crop, which was heavily promoted, the Polish fruit was aggressively promoted throughout the summer and we will see more of the same when Argentinean and Chilean fruit comes on stream later this year and in early 2012.

Where there are possible windows for California, the key question will be whether they can be competitive on price or whether they want to be.

To get shelf space, you have to be competitive and prepared to promote, particularly if you want to be in store and compete with the UK and European crop. Everything in the UK retail sector is being promoted to death and that situation is not going to change anytime soon.

The over-riding issue for California fruit at this point is residues, with more pest and disease pressure on growers, they have turned to new pesticides to deal with them and they don’t have set MRLs in Europe. We’ve been a supplier of US fruit for many years and we had a chance four or five times this year to go to the US for fruit, but at no stage were we able to because of the sprays being used on the fruit.

California has only recently come onto our radar for blueberries, we used to start in Florida, and go up through Carolina, Georgia and New Jersey, before ending with BC. But we are aware that there are massive plantings out there and we have been trying to work with growers.

Unless things change, the only real place for California Blueberries is as a distress purchase, when the market is short. They have always been the bridesmaids rather than the bride in that respect - there is no issue with quality, but the issues of price and residues would need to be ironed out.

It could theoretically be possible for California to compete at the back end of the Chilean season, when the Elliot variety is not such good quality, but that would require growers committing early fruit to the UK business. No one has been willing to do that before and they obviously want fixed programmes to do it, which are not available at this point in time.

From the UK importer’s point of view, we will buy blueberries from wherever we can, as out first priority is to fill the shelves with high quality product. Because most countries are growing similar varieties, there is no significant point of difference, although we have some new varieties out of Morocco and there are some new strains being planted in Spain. I don’t think the UK retail buyer has either a positive or negative attitude towards California or US Blueberries. The varieties are similar everywhere now, so if any source can meet the specs, there is no bias towards anywhere in particular.

There is definitely some market penetration to be achieved in the UK. The key buying groups are the older consumer (50+) who have bought into the health benefits of the fruit and are the most health conscious category of consumer; and the younger consumer, whose parents are giving them blueberries. We believe there is a lot of growth potential in young families and as Seasonal Berries the industry is pushing that.

In Europe, the potential for growth is phenomenal - if the continental consumer ever wakes up like the UK consumer has then it could be a huge opportunity for California. The vast majority of the blueberries eaten in Germany are still home-grown, their import market has not taken off and the Spanish eat virtually none of their own blueberries, it’s just not consumed there as a fruit. It hasn’t been done yet to any great degree, but investment in promotion in the rest of Europe along the lines that has been done successfully in the UK may have good results.

If you are to promote, I'd say any spend would be best placed alongside that of the Seasonal Berries campaign. We've seen from experience that working alongside imported fruit has doubled the payback for the money invested. It would be difficult to justify that spend without a market though.

Reynolds Catering Supplies Ltd

Matthew Wale - Head of Procurement

Paul Collins - Commercial Director

The dominant force in the marketplace today is shifting towards competition among buyers for suppliers. As global demand for food continues to rise, emerging economies are beginning to compete against countries such as the UK for supply. Not only are foodservice companies competing against each other when they buy supplies, they are also increasingly competing against retail buyers. There is now access to a wider range of products, but there are greater challenges to have dedicated supply arrangements in place to reduce risk.

Because of our customer profile, we agree six-month fixed-price contracts from November 1 to May 1 and May 1 to November 1. That does not always fit in perfectly with people's seasons, but it is done to level out the peaks and troughs in prices for our customers, who can then create menus in advance that will not be subject to massive price fluctuations.

The benefit of that though, is that when our customers are signed up to that contract, they are committed to taking that product and we can guarantee volumes - once a product is on the menu, it's on the menu and as many of our customers are national chains, there is potential just by getting a product onto their menus to sell large volumes very quickly.

The challenge is how to get US Blueberries on the menu. We have them available 12 months a year and a large chunk of them are Polish. There is no wild price fluctuation with Polish fruit, which would be one of the concerns with US fruit. Our flat contracts cannot cater for that fluctuation. It's vital to work out where US Blueberries can compete and when. Poland will always be a low-cost producer with reasonably high quality fruit.

At this point, blueberries are most widely used as a side garnish for event catering, so the first job would be to change the mindset of our customers with usage ideas and building a greater understanding of the versatility and availability of US Blueberries. If someone is putting 3 berries on a plate for purely presentational purposes, it can look quite expensive in terms of the total plate value if those berries cost 30p. We need to encourage chefs to use the fruit in different ways.

Marketing funds would definitely help with that - we have development chefs who work with our customer base in our kitchens to build awareness and understanding, we also send out category specific brochures every month to catering managers across the country. And first and foremost, we encourage suppliers to work directly with our sales team to build their knowledge of products and what they can add to our customer base - we find this can make a big difference to sales volumes over time.

While many customers talk about buying British, but it actually proves expensive in the fruit category to carry that through, as most producers have focused their production methods and costs on supplying the supermarkets. Provenance is actually more important than the source, so many of them would be open to promoting US Blueberries on their menus - to the extent of including logos on menus. There is an association in the UK of blueberries with the US, so it would resonate with people.

Any effort needs the full commitment of the US shippers and it's important to build a solid relationship with the importer you choose to work with. BerryWorld supplies us at this point in time and they are very good at separating their retail and foodservice business; it is crucial that you understand what the foodservice sector is looking for if you are going to spend time, effort and money promoting your fruit there.

Around 70% of the fruit sold in the UK goes through the supermarket sector to the end consumer, whether that is fresh or it has gone through the wholesale, pre-packing or processing sectors to get there.

The danger of the direct sourcing model for suppliers is this - supermarkets go to California, for instance, and buy a volume of blueberries. They then get them back to the UK and realise they can't sell them for whatever reason - what options do they have? Importers have well-established ways of selling that fruit, rather than rejecting it, supermarkets do not have the diversity of homes for that fruit. Foodservice also has diverse range of customers, from single-unit operators to multi-national chains and everything in between, as well as the hospitality and business sectors.

For a contract beginning in May, work needs to begin in February in order to have the level of influence needed. New ideas, promotional initiatives, educational programmes can all help secure US Blueberries a more high profile presence.

A good example was a promotion we ran with Wagamamas, a chain of Japanese restaurants in the UK. We got micro-cress on the menu at all 300 of its outlets and basically hovered up all of the micro-cress grown in the UK and Holland in the period. It's a relatively new product, but that was a significant volume.

Maybe we could look at different ways of bringing the fruit in - traditionally all in clam shells, but maybe we could look at loose. Different ways of doing things that could drive cost out of the chain could make a difference.

CONCLUSIONS / RECOMMENDATIONS

- The first and most important factor in being successful in the UK supermarket sector is undoubtedly being willing to provide a business model that is aligned to a leading customer (or customers), which can utilize the power of those customers to drive efficiency into areas of the supply chain (logistics, packaging etc…) and also give US firms the stability of returns required to re-invest in their own infrastructure.

- Like all industries in the UK, fresh produce is facing a challenging economic climate and battling to find a balance between the rising costs of production and the supply chain, constantly fluctuating exchange rates and the pressure of little or no inflation in the prices paid by retailers.

- The initial challenge for Californian fruit is to find an annual place in the UK market - either on-shelf or in the menus of foodservice outlets. The obvious way to do that would be to commit to a medium-to long-term strategy and be prepared to pay in some way for the fruit to get on shelf in the first place. A large proportion of fruit is being sold on promotion or at lower prices - there needs to be a will to fit into that framework for California Blueberries to gain a foothold.

- In the supermarket sector, Sainsbury’s and Costco look to have potential for CA shippers, while the foodservice sector may be worth looking at - not for significant volumes initially, but as a way to position the brand within the trade media and consumers and illustrate the ability to deliver consistently high quality fruit over an extended period.

- UK retailers are strategically committed to increasing the volume of all home-grown crops on their shelves. Domestic blueberry production is expected to grow by between 200% and 400% in the next five years and most retailers have plenty of capacity to take that additional fruit.

- There is potential to increase penetration among certain consumer groups - sales are concentrated heavily on the older and younger generations at this point, but CA could piggyback on promotional work already being carried out in the UK to target the middle ground consumers from 18-50.

- Chicken and egg - until growers commit to the UK, fixed programmes will not be on the agenda, but because of the investment required, growers understandably want fixed programmes before they will be prepared to commit. There is no room for speculative sendings - the wholesale markets are deemed by the industry to be too risky for high-value fruit that does not necessarily have a long shelf life

- GlobalGAP certification is a prerequisite for any grower aiming to export fruit to the UK retail sector.

- Increasing pest pressures on the CA industry have necessitated the use of sprays such as Malathion, for which there is no tolerance level set in the UK or Europe. This precludes any sendings to any sector, not only retail.

- There is potential in Europe, but to date no-one has had a great deal of success competing with the obsession with home-grown fruit and the natural blueberry season in Germany or Holland, which both have big new plantations. The southern hemisphere trio of Argentina, Chile and Uruguay have had minimal success with a joint promotional campaign, but volumes are extremely small. Only 12% of Chile’s blueberry exports last year went to Europe and 80% of that went to the UK. If Chile or Argentina, which are now running their own promotional effort, rather than collaborating, can open up a winter sales window in Germany, for instance, the obvious extension of that is that there may be a ‘new’ window in the spring and early summer, before the mainstream European fruit kicks in.

- At this point, the UK leads the way in blueberry consumption in Europe and therefore dominates imports from Europe - takes a huge chunk of the Spanish and Polish crops, for instance. If the central or southern European consumers do begin to eat more blueberries, that supply line for the UK would come under pressure from the largest European markets and the picture could change significantly in a relatively short space of time.

- There is no doubt that the California blueberry industry could create itself a market in the UK, but it would require a joined up approach to growing, shipping, marketing and promoting the fruit.
  That means a commitment to:
  - growing and shipping to a strict regime that adheres to all European legislative and individual supermarket/foodservice company requirements
  - communicating effectively and consistently with the industry both directly and indirectly through the most relevant media channels. Establishing a good rapport with the trade media in particular can still make a big impact over time
  - working with importers and the Seasonal Berries campaign in the UK to develop long-term relationships and strategies to support the fruit
  - being prepared to take the rough with the smooth - some years would definitely work out better than others, but maintaining a presence however the wind blows would be key
  - keeping a watching brief on the way the market is developing and being flexible enough (where possible) to respond to opportunities when they arise unexpectedly
  - planting the desired varieties

California Blueberry Commission

Market Potential for California Blueberries:

Japan and Australia

January 31, 2013

D.W. BLOCK ASSOCIATES, LLC

Topics

1. Japan: Taking exports to a new level
2. Australia: Game-changer for the California industry?
3. In-country visits to Japan and Australia

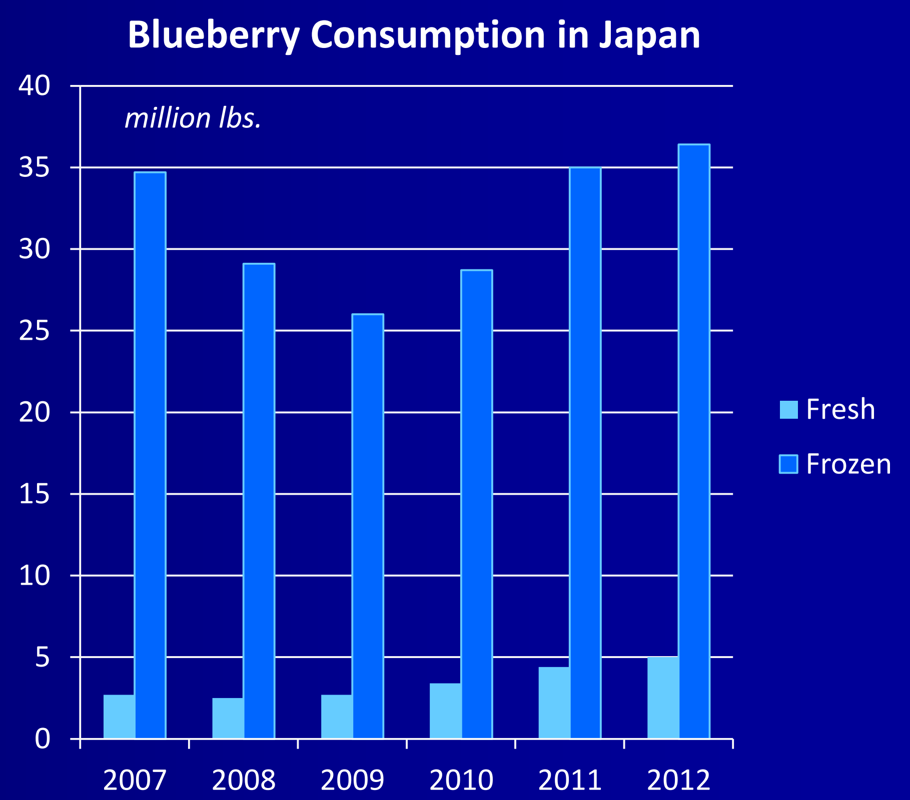
Japan:
Taking Exports to a New Level

Key Findings: Japan

- Per capita Japan blueberry consumption is 5 ounces per year – 15 percent of that in the U.S. and Canada: *Growth opportunity*
- California has potentially strong position due to early harvest and relative proximity vs. U.S. East Coast producers
- Increasing awareness and Japanese consumption of U.S. and California blueberries could be achieved through industry-wide promotional effort

Blueberry Consumption in Japan

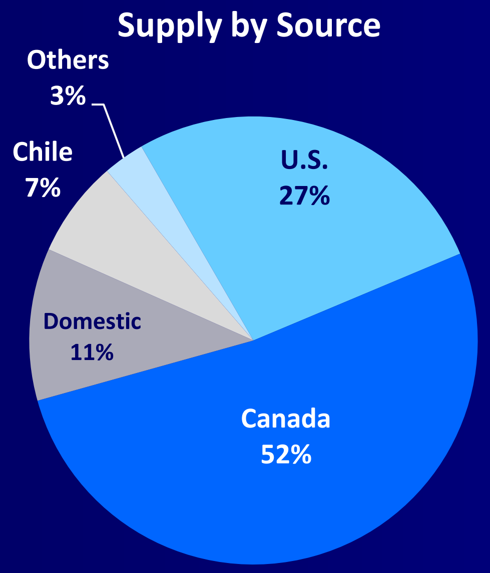
- Consumption rebounded from a brief decline in recent years, returning to record-high levels in 2012
- Frozen currently dominates, but fresh growth is far outpacing frozen
- Annual growth rate:
    - Fresh: +15%
    - Frozen: +3%
    - Dried: -4%

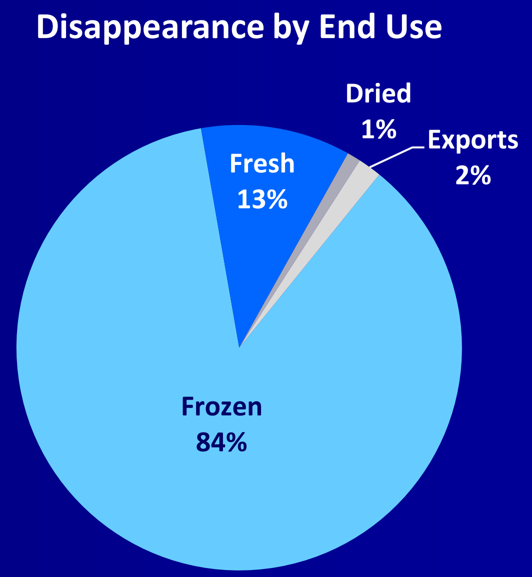


Sources: U.S. International Trade Commission, USDA, Customs Japan

Blueberry Supply and Disappearance

2012 Estimated Supply and Disappearance:
47.1 million lbs.

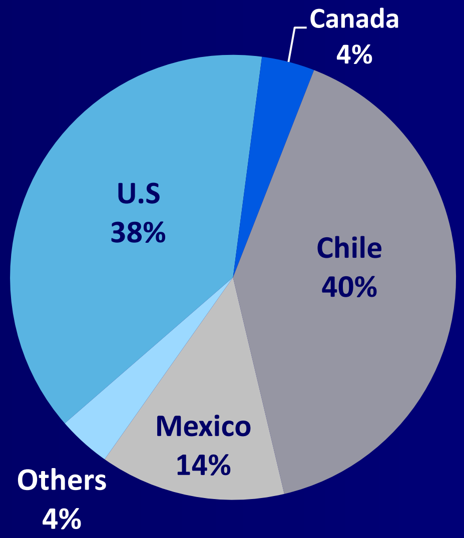




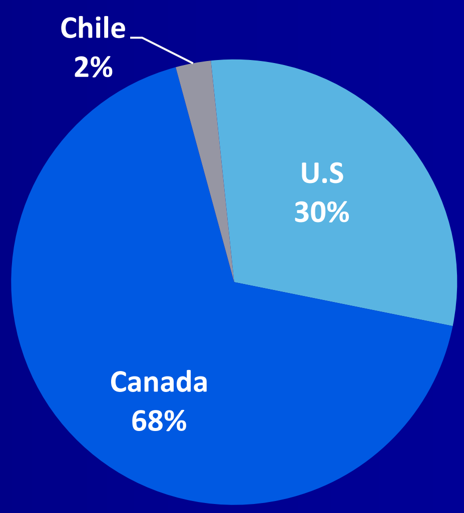
Sources: U.S. International Trade Commission, Brazelton Ag Consultants, Customs Japan

Blueberry Imports by Source

Fresh: 5.0 million lbs.



Frozen: 36.4 million lbs.

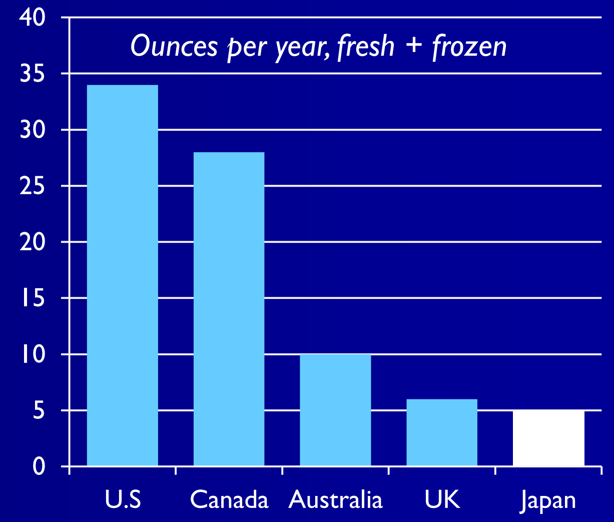


Sources: U.S. International Trade Commission, Brazelton Ag Consultants, Customs Japan

D.W. BLOCK ASSOCIATES, LLC

Per Capita Blueberry Consumption in Japan

- Per capita consumption remains a fraction of that in the U.S. and Canada
- Fresh fruit is not widely seen as an everyday food item in Japan
- Compared to other fruits (e.g., citrus, apples), blueberries do not have a long history of use in Japan



Blueberry Consumption by Sector

Sector	Volume (million lbs.)
Retail	24.8
Hospitality, Restaurant, & Institutional (HRI)	14.3
Food Manufacturing	7.3
Total Domestic Use	**46.4**
Exports (typically dried)	0.7
Grand Total	**7.1**

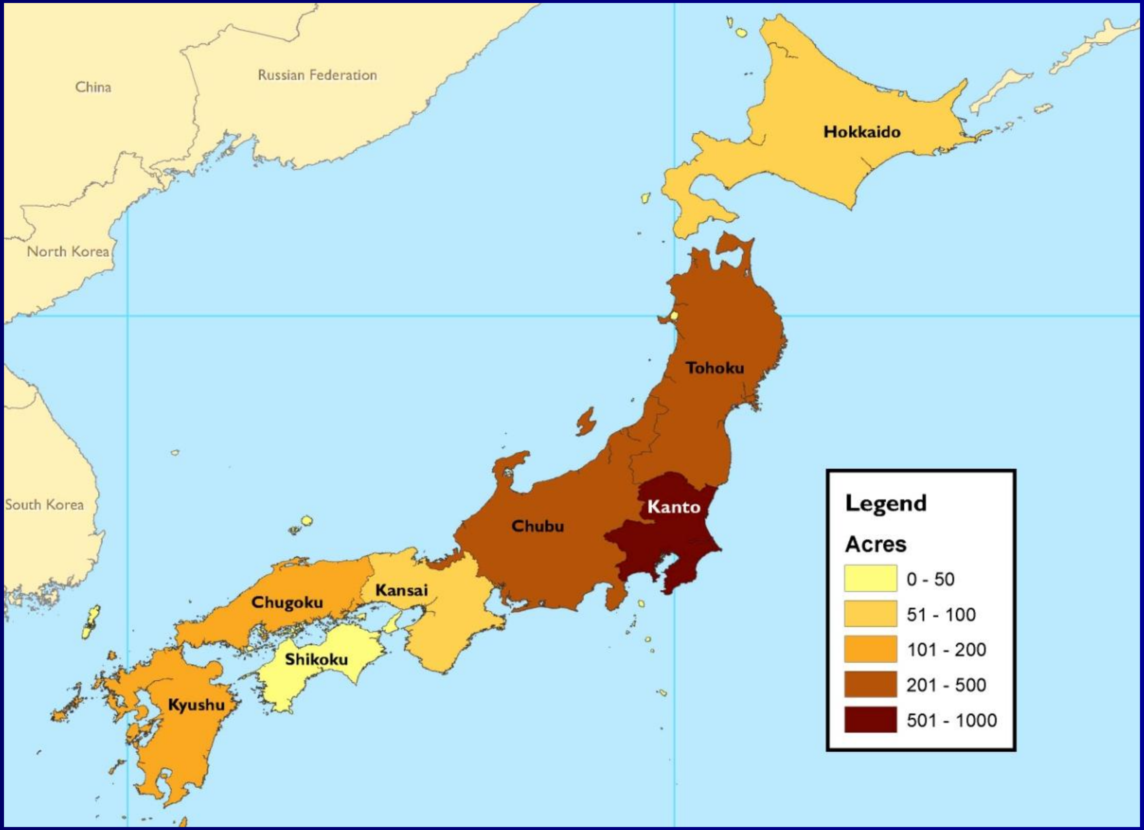
Sources: U.S. International Trade Commission, JETRO, D.W. Block Associates estimates

Japan: Demographic, Economic, and Consumer Trends

- **Demographic**
  - **Population decline**
  - **Steadily-aging**
  - **Growing proportion of single-person households**
- **Economic**
  - **Economy remains sluggish**
  - **Rising energy costs could push country back into recession**
- **Consumer preferences**
  - **Japan remains a trend-setting country, with high interest in new products, functional foods, and healthy eating**

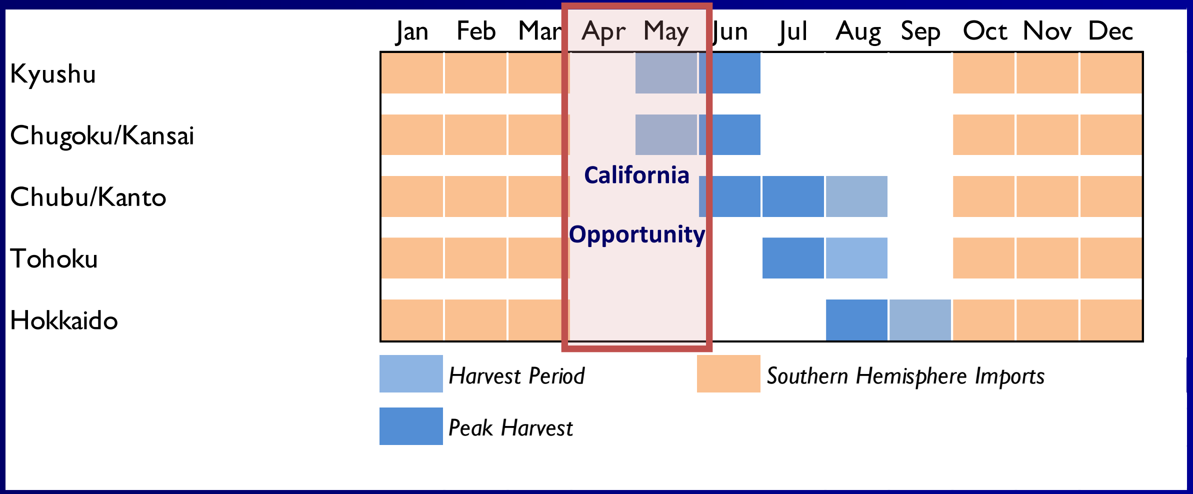
Blueberry-Growing Regions in Japan

Planted Area: 2,100 acres **Production: 5 million lbs./year**



D.W. BLOCK ASSOCIATES, LLC

Opportunities for California Blueberries in Japan: Market Timing



D.W. BLOCK ASSOCIATES, LLC

Opportunities for California Blueberries in Japan: Market Timing

Consumption scenarios	Current	+33%	+66%	+100%
Annual per capita consumption (oz.)	0.6	0.8	1.0	1.2
Per capita consumption: Apr thru May	0.10	0.13	0.17	0.20
Japan population (million)	128.0	128.0	128.0	128.0
Estimated consumption: Apr – May (million oz.)	12.8	17.1	21.3	25.6
Estimated consumption: Apr – May (million lbs)*	**0.8**	**1.1**	**1.3**	**1.6**
Potential California share (million lbs)**	0.5	0.6	0.8	1.0

** U.S. fresh highbush berry exports to Japan totaled approximately 700,000 lbs in April and May 2012*

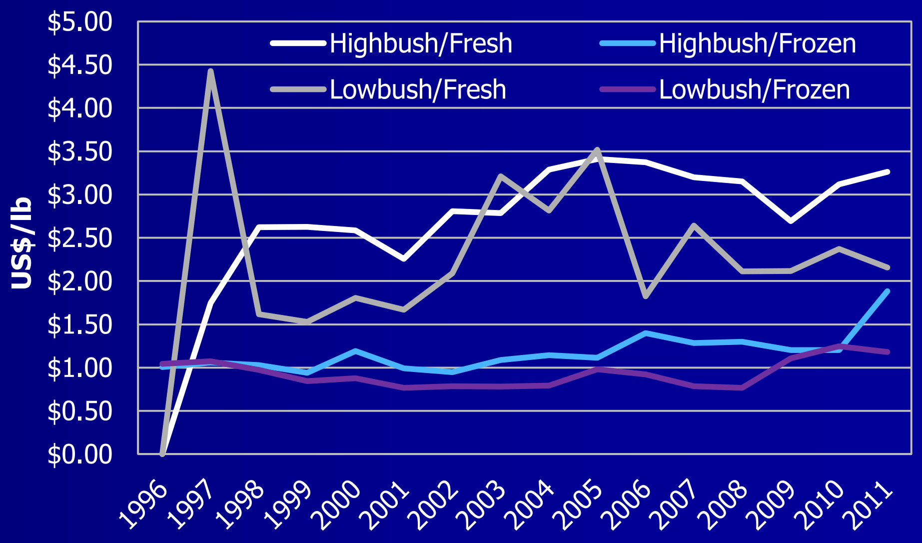
***Assumes CA represents 60% of U.S. fresh shipments in April and May of each year*

Opportunities for California Blueberries in Japan: Product Marketing

- Position blueberries as an everyday snack item in place of confectionery
- Convenience and perceived value are highly important
- Highbush blueberries are highly valued
- Western dietary habits becoming more prevalent
- Chain stores growing more prominent
- Competitive pricing compared to other fruits

Blueberry Pricing at Customs

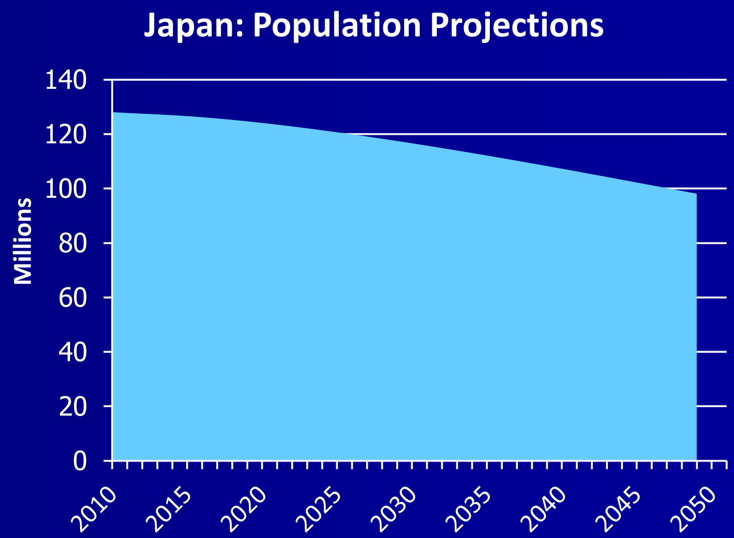
- Highbush blueberries valued more than 50 percent higher than lowbush berries
- Fresh highbush obtained a 73 percent premium over frozen highbush



Source: U.S. International Trade Commission

Japan: Challenges

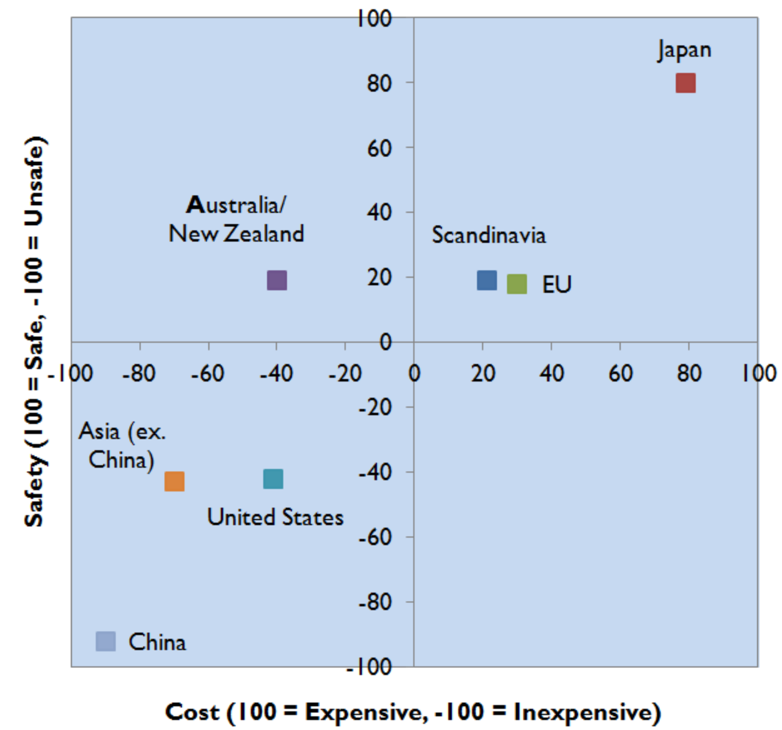
- Demographics: population decline; aging
- Consumer preferences: packaging size and convenience
- Competition from domestic blueberries
- Product standards (e.g., MRLs)



Source: Government of Japan

Japan: Challenges

- Perception of U.S. food products in Japan



Source: Government of Japan

D.W. BLOCK ASSOCIATES, LLC

Australia:
Game-changer for the California industry?

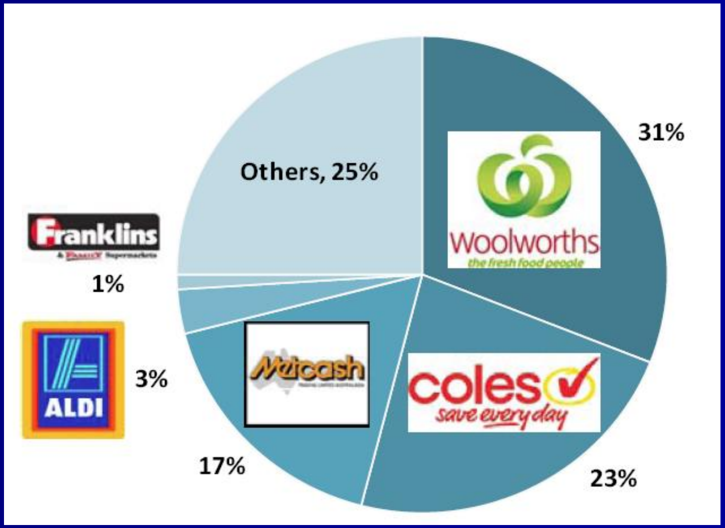
Key Findings: Australia

- Per capita blueberry consumption is 1/3 of that in the U.S.: *Growth opportunity*
- Fresh supply is limited between April and July: *Key shipping period for California blueberries*
- Leading retailers looking for blueberry supply to fill this gap
- New Zealand is the only fresh supplier
- Market access can be achieved by industry-wide effort to work with U.S. and Australian agencies
- Estimated potential for 1.6 million lbs. of California berries if market access is granted

Blueberry Consumption in Australia

- Supermarket chains are largest sellers of blueberries by far (estimated 72% of retail sales)
- Fresh blueberry availability is negligible in May and June

Retailer market share, 2011

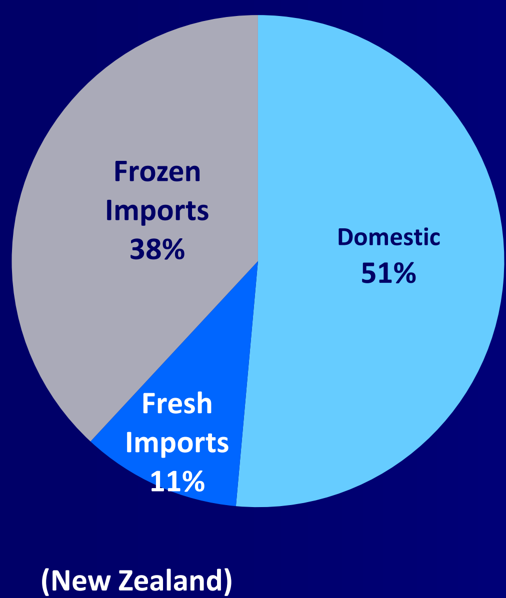


Sources: Australian Blueberry Growers Association, Euromonitor, McKinna, et al., news reports

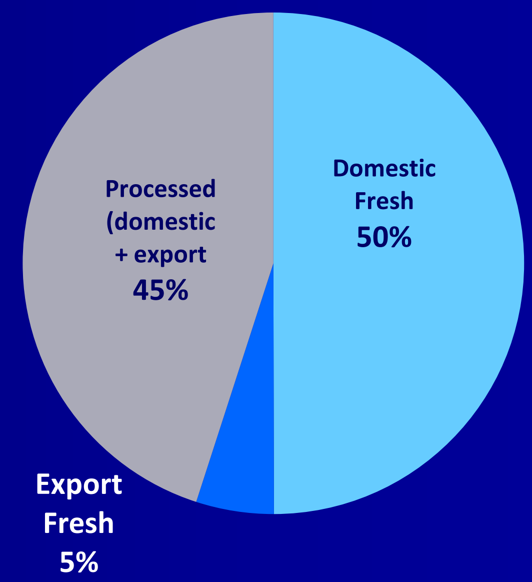
Blueberry Supply and Disappearance

2011/12 Estimated Supply and Disappearance:
15.75 million lbs.

Supply by Source



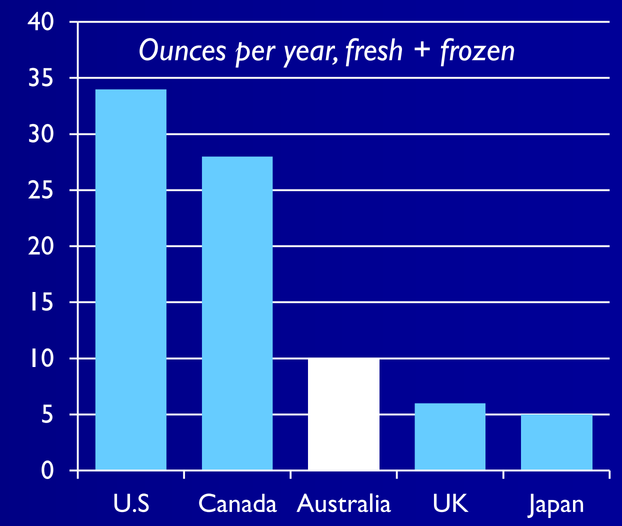
Disappearance by End Use



Sources: Australian Blueberry Growers Association, U.S. International Trade Commission, Brazelton Ag Consultants

Per Capita Blueberry Consumption in Australia

- Per capita consumption remains about one-third of that in the U.S. and Canada
- Limited blueberry availability between April and July indicates strong seasonal pattern of consumption



D.W. BLOCK ASSOCIATES, LLC

Blueberry Consumption by Sector

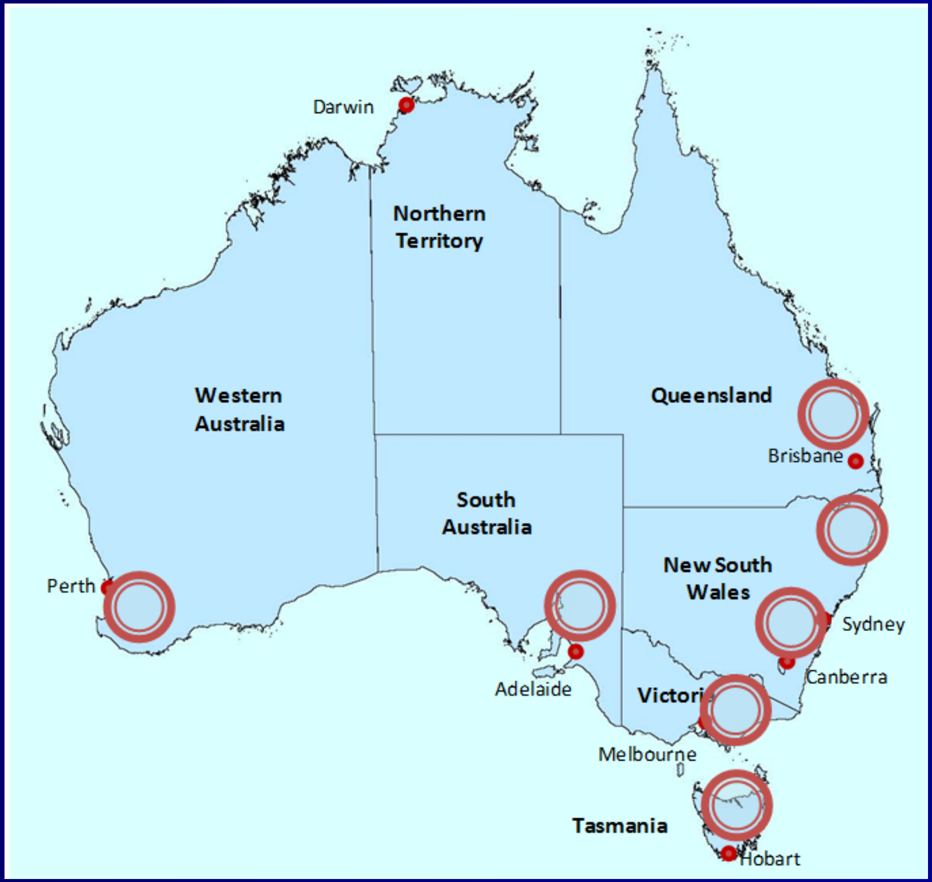
Sector	Volume (million lbs.)
Retail	9.7
Food Service	3.7
Food Manufacturing	1.5
Total Domestic Use	**14.9**
Exports	0.9
Grand Total	**15.8**

Sources: U.S. International Trade Commission, JETRO, D.W. Block Associates estimates

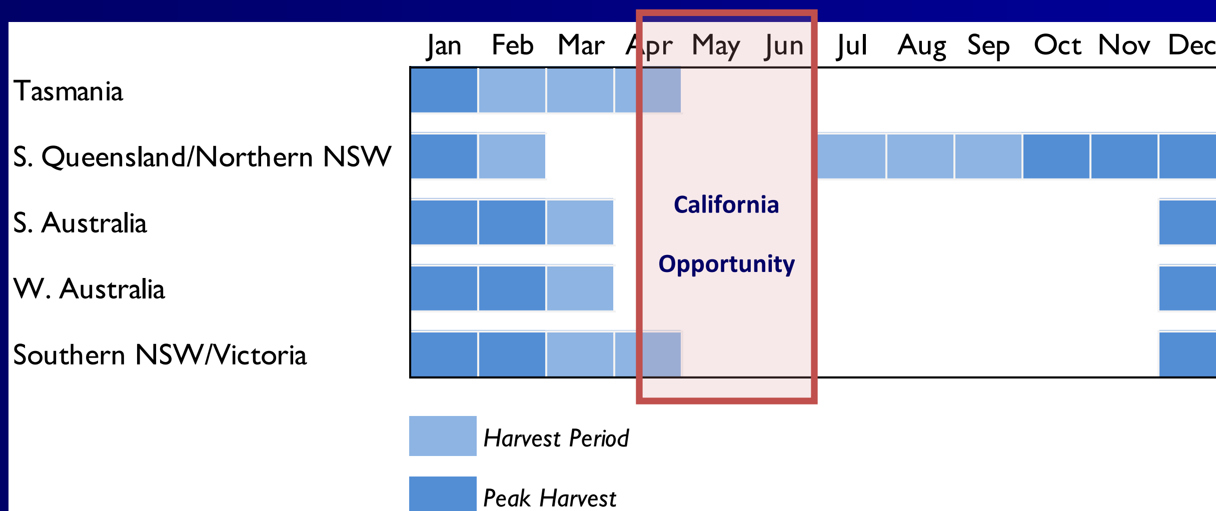
Australia: Demographic, Economic, and Consumer Trends

- **Demographic**
  - Low population growth (+ 1 percent annually)
  - Half of population growth comes from immigration: UK, New Zealand, and south/east Asia are largest contributors
- **Economic**
  - Modest economic growth
  - Strong AUS $ favors imports from U.S.
- **Consumer preferences**
  - Health-consciousness and upscale/gourmet offerings remain popular
  - Some report Australia is the "most obese nation in the world"

Blueberry-Growing Regions in Australia



Opportunities for California Blueberries in Australia: Market Timing



Opportunities for California Blueberries in Australia: Market Timing

Consumption scenario	Current
Annual per capita consumption (oz.)	5.70
Per capita consumption: May + June	1.14
Australia population (million)	23.0
Estimated consumption: Apr – May (million oz.)	*26.22*
Estimated consumption: Apr – May (million lbs)*	**1.64**

Australia: Challenges

- **Quarantine on fresh blueberries**

Obtaining Market Access for U.S. Blueberries in Australia

- Need agreement between USDA-APHIS and Biosecurity Australia
- Biosecurity reviews up to 4 products at any one time. U.S. blueberries are currently 6th on the list
- Effort by U.S. blueberry industry and Australian retail buyers will be required
- Lessons learned from U.S./Korea fresh blueberry agreement:
  - Coordination between industry, state ag depts., and trade partner officials
  - Process took years, and market is still not fully open (Oregon currently the only state permitted to ship to S. Korea)

Now What?

Market Potential for California Blueberries in Japan and Australia

Final Report for the California Blueberry Commission by D.W. Block Associates, LLC

April 2, 2013

The California blueberry industry has rapidly expanded to become a significant producer of high-quality fresh market blueberries. As the industry has grown, the need to develop new markets has become a priority. One of the objectives of the California Blueberry Commission is to facilitate the development of export markets for the California blueberry industry.

The Commission identified Japan and Australia as especially important opportunities, and commissioned D.W. Block Associates, LLC (DWB) to conduct market research to provide its members with the information necessary to help them increase share in Japan and open up the Australian market, which is currently closed to the U.S.

Key findings of the Japan study include:

- A growth opportunity remains due to very low per capita consumption
- California has a potentially strong market position in the April-to-May period
- A preliminary estimate for 500,000 pounds of potential sales of California berries during this period. California exports to Japan during this period in 2012 were estimated at approximately 284,000 pounds, suggesting room for an increase.

Key findings of the Australia study include:

- A growth opportunity exists: per capita consumption is only half that of the U.S. and Canada
- California has a potentially strong market position in April-to-July period due to the low availability of domestic and southern hemisphere product.
- Preliminary estimates were for 1.6 million pounds of potential sales during this period if Australia opens its market to U.S. producers.

This study was conducted between November 2011 and June 2012, with a final draft submitted to the Commission in August 2012. It is based on a combination of primary and secondary research, including personal interviews with blueberry growers and marketers, government officials, industry representatives, and industry publications in the United States, Japan, and Australia.

Project Timeline

November 2, 2011	Project start
November 7, 2011	Initiated contact with in-country officials in Japan and Australia
November 15, 2011	DWB presentation on project at 2011 California Blueberry Day in Visalia
December 6, 2011	Briefing paper on the Japan market delivered to Commission
May 21, 2012	Project update delivered to Commission
May 31-June 1, 2012	DWB in-person meetings with California growers and shippers
June 21, 2012	Briefing paper on the Australia market delivered to Commission
September 17, 2012	Final draft of market studies delivered to Commission
September 18, 2012	Presentation of project findings to Board of Directors meeting in Fresno
January 31, 2013	Presentation of project conclusions at 2013 California Blueberry Day

Japan – Market Briefing

D.W. Block Associates, LLC
800 NW 6th Ave, Suite 312
Portland, OR 97209 USA

December 2, 2011

Japan – Market Briefing

December 2, 2011

Table of Contents

Market Potential	*2*
Demand Trends	*5*
Market Segments	*6*
Distribution	*8*
Competitive Situation	*8*
Broader Business Environment	*10*
Appendix 1: Retailer and HRI profiles	*11*
Appendix 2: Transportation Map	*14*

Market Potential

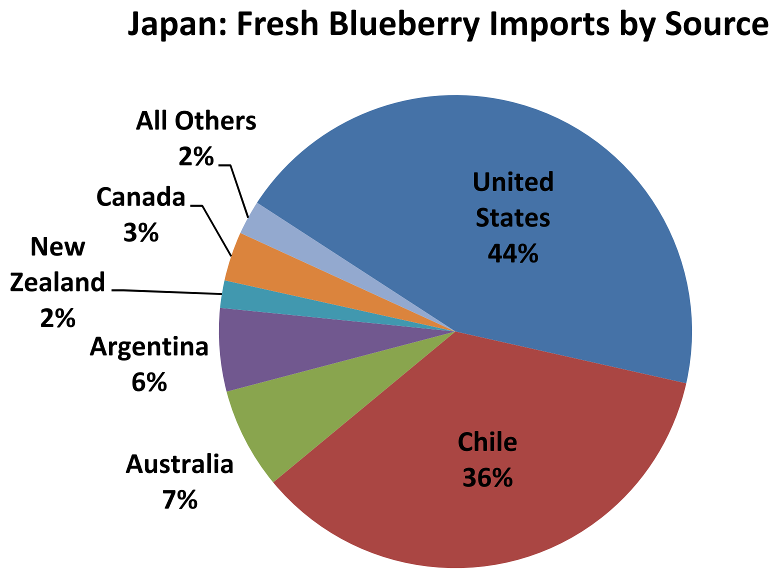
Japanese blueberry consumption totaled approximately 22 million pounds in 2010, a 2 percent increase from 2009, but down 33 percent from levels seen in the middle of the last decade. Of this total, approximately 9 million pounds were consumed fresh, with the remaining 13 million pounds consumed in processed (primarily frozen) form.

The total (customs) value of all blueberries was approximately $46 million, with fresh berries representing $28 million and frozen representing $18 million.

Average pricing for fresh berries at customs was $3.24/lb, while frozen berries received an average price of $1.37/lb.

Customs value is calculated on Cost, Insurance, and Freight (CIF) basis. Subsequently, a 6 percent tariff and a 5 percent consumption tax are levied on fresh and frozen product.

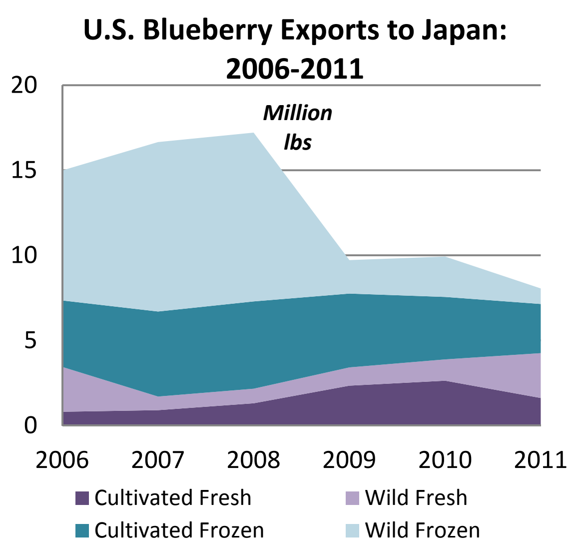
The U.S. accounts for approximately 40 to 50 percent of Japan's blueberry imports (fresh and frozen). Chile is Japan's second-largest supplier, followed by numerous smaller players. Notably, Canada is the only other major northern hemisphere supplier. Japanese imports of fresh blueberries by source are shown in the chart below (reported figures for frozen blueberries are combined with other berries; more work will be required to disaggregate these figures).

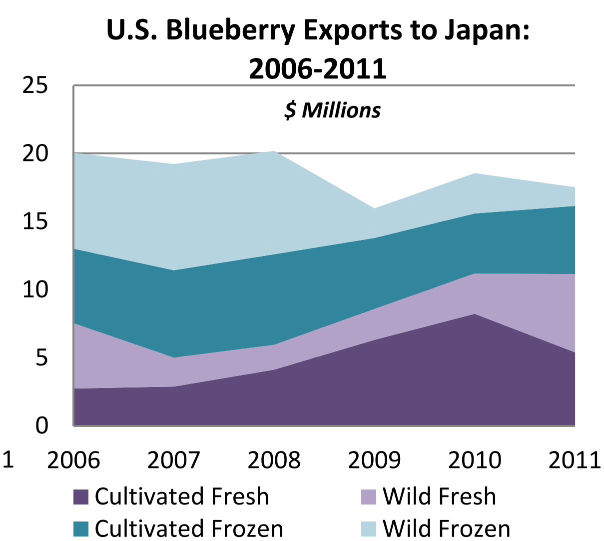


Source: USDA-FAS ATO-Osaka

U.S. blueberry exports to Japan reached a peak of 17 million pounds in 2008, a full 87 percent of which was frozen. A sharp drop off in frozen wild exports in 2009 (solely from Maine) took total exports below 10 million pounds, from which the industry has yet to fully recover.

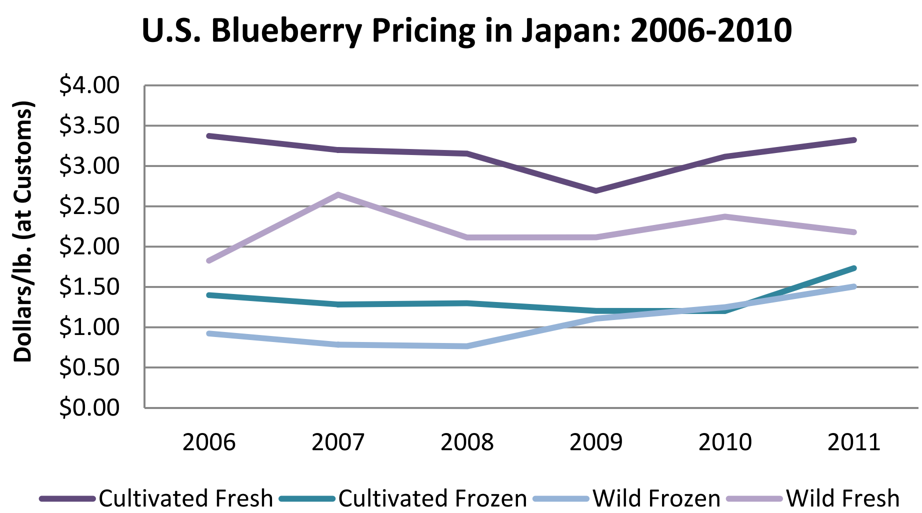
The following charts illustrate the six-year trends in U.S. blueberry exports to Japan (2011 figures are for January-September; additional exports from major producers such as Oregon, Michigan, Washington, and Maine are likely to bring volumes and revenues above 2010 levels):





Source: USITC (2011 figures are for Jan-Sep)

Fresh blueberry volume may well overtake frozen berries by the end of 2011; revenues of fresh product exceeded those of frozen in 2009. Pricing for all types of blueberries has remained stable over the past six years, as shown in the chart below. Fresh highbush blueberries command a significant premium over lowbush varieties, with prices exceeding $3/lb (customs value) in five of the last six years.



Source: USITC (2011 figures are for Jan-Sep)

The following preliminary analysis breaks out blueberry consumption by sector. **These numbers are tentative**, and research is being undertaken to obtain more precise figures.

Sector	Volume (million lbs.)
Retail	11.8
Hospitality, Restaurant, & Institutional (HRI)	6.8
Food Manufacturing	3.5
Total	**22.0**

Sources: USITC, JETRO, D.W. Block Associates estimates

Bottom line: per capita consumption of blueberries is estimated at less than 3 ounces per year (1-oz. fresh, 2 -oz. frozen). This figure is around 10 percent of per capita consumption in the United States and Canada, the world's two-largest consumers of blueberries.

At current levels of consumption in Japan, an increase of one percent could represent an additional 100,000 pounds of demand for U.S. blueberries. Various scenarios will be computed to show the relationship between increased consumption in Japan and the potential for U.S. producers to capture this increase.

This will become one of the metrics used to measure the success of the California Blueberry Commission's export promotion activities.

Demand Trends

Industry segments with notable growth potential currently include:

- Supermarkets and convenience stores (retail)
- Hotels and restaurants – especially fast food (food service)
- Home meal replacement (HMR) (overlapping segments, including retail and food service)

Demand trends are driven by a combination of demographic and economic factors, in addition to ever-changing consumer preferences. Key factors are shown below.

Demographic

- Japan's population has been essentially flat since 2004, with declines in each of the last three years. This trend is expected to accelerate.
- One consequence of this decline is an increasingly-aging population – by the year 2050, 40 percent of the population is expected to be older than 65 years of age.
- There is also a growing proportion of single-person households, as people are choosing to start families later in life.

Economic

- Continued sluggishness in the economy has resulted in consumers spending more time seeking out the best values, including younger buyers. The rise in fast food and convenience store sales has been attributed to this phenomenon.

Consumer preferences

- Despite a relatively slow-growing economy, Japan remains a trend-setting country, with high interest in functional foods and healthy eating overall. Recent food fads have included the "mango boom" and a recent jump in grape imports.

Bottom line: With little-to-no growth in population or purchasing power, increases in demand for food products will be a function of increased product awareness, convenience, and perceived value. If fruit products are easily substitutable in the minds of Japanese consumers, a successful blueberry promotion effort will likely result in taking market share from other fruit categories. The USDA Agricultural Trade Office in Tokyo specifically recommends increased promotion of blueberries.

Market Segments

The market segments in this briefing include those listed in the table below, a more detailed version of the consumption by sector table on page 3. The growth segments mentioned in the Demand Trends section above are highlighted in green:

Sector	Volume (million lbs.)
Retail	11.8
Specialty Stores	7.5
General Merchandise/ Supermarkets	**2.3**
Convenience Stores	**1.4**
Department Stores	0.6
HRI	6.8
Restaurants	**3.6**
Institutions	0.9
Hotel/Travel	**0.9**
Bars/Coffee Shops	1.4
Food Manufacturing	3.5
Total	**22.0**

Sources: USDA, JETRO, D.W. Block Associates estimates

Retailers and suppliers to the HRI sector are described in more detail in ***Appendix 1***. Brief descriptions of each segment follow.

Retail

The retail segment in Japan is highly fragmented. **Specialty stores**, including “mom-and-pop” stores and local groceries, dominate the retail food sales landscape. These stores are typically supplied by secondary wholesalers, who in turn are supplied by larger, primary wholesalers, making them less desirable targets for promotional programs. Moreover, this segment is declining due to competition from convenience store chains and supermarkets.

Convenience stores are notable for their small size (less than 1,000 square feet), high turnover, and advanced supply chain practices. Major store operators often search for novelty items and new concepts, and are major purveyors of food-to-go items, such as bento.

General merchandise/supermarkets resemble their counterparts in the United States; however, food sales make up a somewhat larger share of store sales. These chains have centralized purchasing departments, but do not often purchase directly from offshore suppliers, preferring to buy imported goods from trading companies. As chains compete for consumer attention, there may be opportunities for targeting blueberries for fresh as well as for private label manufactured foods. **Dole Foods** has partnered with Japanese chains on a number of promotions in recent years.

Department store sales are declining with competition from general merchandise stores and supermarkets, and are not considered to be much of a growth opportunity for food sellers, though there may be limited opportunities with high-end and pilot store concepts.

Food service / Hospitality, Restaurant, Institutional (HRI)

This sector, like the others, has seen largely flat sales trends in recent years. **Restaurants** represent the largest proportion of establishments and sales, with the fast food segment showing modest growth. Like their U.S. counterparts, these chains have their own centralized purchasing departments and product development programs, which could present opportunities for U.S. exporters.

Hotels and travel-related facilities also present opportunities for U.S. blueberries. Food offerings are more western-oriented, and food is overall a large part of the travel experience. According to USDA market specialists, having a product used by major upscale hotels provides additional cachet when promoting the product to other (e.g., retail) buyers.

Many **institutional** buyers are oriented toward traditional Japanese cuisine, and are not as likely to be candidates for introducing U.S. products; however, **theme parks** are significant food buyers, and may present opportunities for blueberry promotions.

Food processing

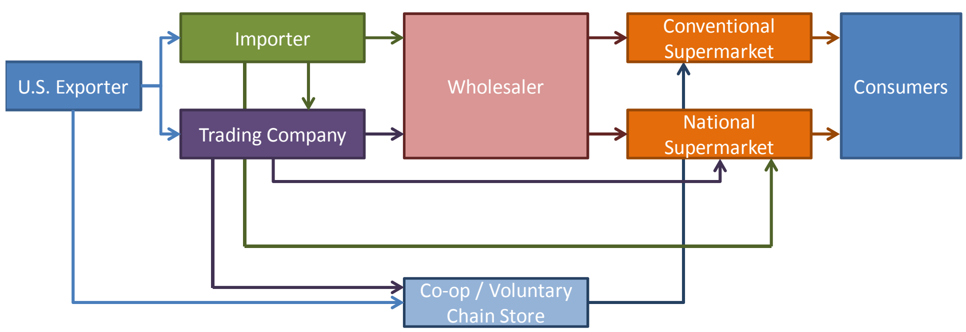
Food processors represent the final sector considered in this market briefing. **Japan has a highly sophisticated, globally-oriented food processing industry**, with many major companies headquartered near Osaka. Total domestic sales for this sector in Japan were $251 billion in 2010. As many food processors do not use fruits (e.g. seafood and meat processors), only selected segments of this industry are examined here. These segments totaled $131 billion in sales in 2010.

Food processors could present viable opportunities for exporters of processed blueberries. They are capable of buying large volumes, have advanced supply chain capabilities, and many, in turn, export their finished product, which means that processor demand is not simply a function of domestic demand. In addition, many companies have operations worldwide, and may already be familiar with U.S. fruit suppliers.

The industry recently faced a number of scandals involving the use of expired raw ingredients in packaged foods. If prospective blueberry exporters can drive home a message that California blueberries are of exceptional quality, inroads could be made in this sector.

Distribution

The retail product distribution system in Japan is illustrated in Figure 1 below. The system for the HRI sector is similar with respect to the position of importers and trading companies in the supply chain, but downstream participants are comprised of primary secondary, and even tertiary foodservice distributors.



From USDA-FAS

Competitive situation

Differential advantages of U.S. products

- U.S. reputation as a reliable supplier of food inputs
- Lower-cost producer of agricultural products than Japan
- Advanced capabilities in producing value-added products such as fruit purees
- Modern U.S. food production & distribution systems (including food safety)

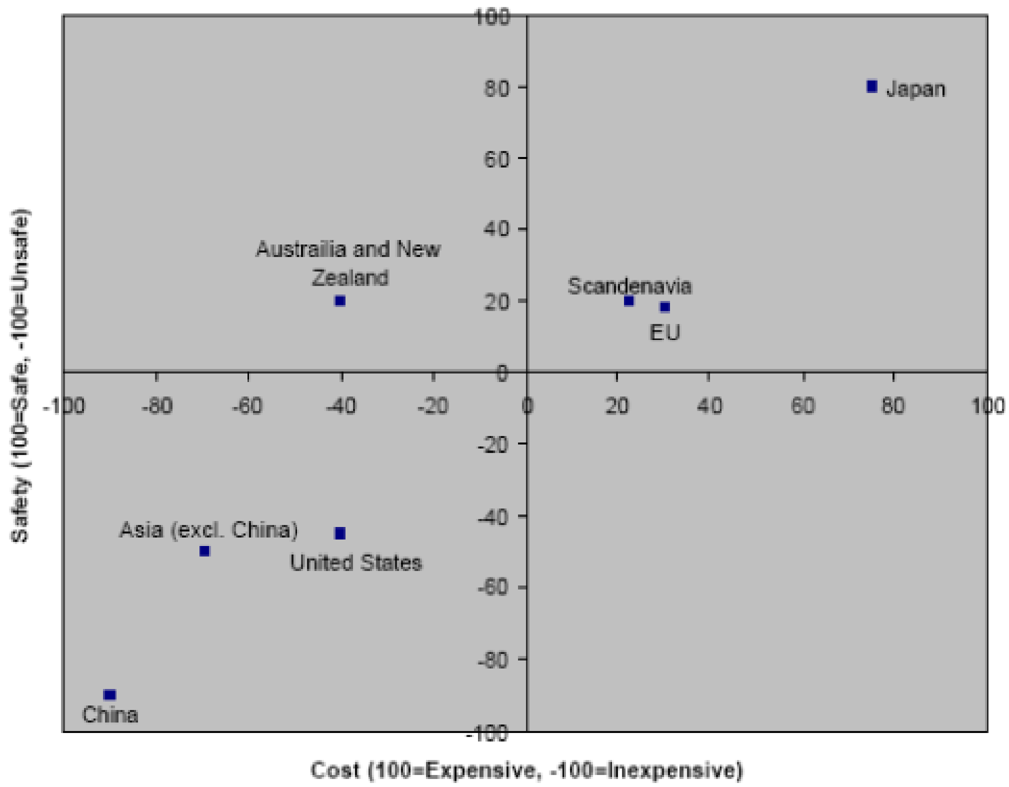
Opportunities

- Expansion of U.S. fast food chains has helped introduce U.S. food products into the general diet
- Other fresh fruits have also remained consistent or have experienced minor growth (e.g. following success of strawberries, confectionery industry is experimenting with other fruits)
- Many supermarkets plan promotions of American products around the import of American products, such as cherries

Challenges

- Perception of U.S. price competitiveness and quality has declined compared to other foreign competitors
- Perception of American food as only "hamburgers and hot dogs"
- Limited processing capacity in California
- Production and freight costs compared to other supplier countries
- Consumers perceive Japanese food as safer than imported food

Japanese public image of foreign products



Source: Government of Japan

Broader business environment

General characteristics

- Largest net importer of food products in the world
- State-of-the-art transportation & communications networks
- Early adopters of new products and technologies
- Spends approximately 38% more per capita on food than U.S., though daily consumption is 1000 calories less
- Growing emulation of U.S. food trends
- Interest in seeking out new ingredients

Economic

- Modest GDP growth is counterbalancing the population decline
- Strong yen vs. dollar favors U.S. exports

Regulatory

- Very stringent food safety and traceability requirements
- Health-based claims must be subjected to rigorous approval process
- Complicated labeling laws

Demographic / social / cultural

- Increasing single-person households
- Time-constrained consumers
- Strong and growing focus on convenience foods
- Declining number of farmers signals increasing reliance on imports
- Uniform market, relatively uniform tastes
- Growing affluence in certain segments
- Value-conscious, quality-obsessed consumers
- Seasonal food & freshness important
- Health-conscious

Political

- Very stable, no political risk anticipated

Appendix 1: Retailers and HRI profiles

Top 10 Supermarkets (2009)

Company Name	Sales US$ bil.	Location	URL
Aeon Retail	19.79	Nationwide	www.aeon.info
Ito-Yokado	14.84	Nationwide	www.itoyokado.co.jp
Uny	12.29	Nationwide	www.uny.co.jp
Daiei	10.58	Nationwide	www.daiei.co.jp
Izumi	5.38	Western Japan	www.izumi.co.jp
Life Corp.	5.07	Kinki, Kanto	www.lifecorp.jp
Heiwado	4.12	Kinki, Chubu	www.heiwado.jp/
Izumiya	3.99	Kinki	www.izumiya.co.jp
Yorkbenimaru	3.77	Tohoku, Kanto	www.yorkbeni.co.jp/
Valor	3.73	Chubu, Hokuriku	www.valor.co.jp/

Source: Nikkei Marketing Journal - Retail Sector Ranking 2009

Top 10 Convenience Stores (2009)

Company Name	Sales US$ bil.	Location	URL
Seven-Eleven (Seven & i Holdings)	29.78	Nationwide	www.7andi.com/
Lawson (Mitsubishi)	17.82	Nationwide	www.lawson.co.jp
Family Mart (Itochu)	13.62	Nationwide	www.family.co.jp
CircleK Sunkus (Uny)	9.11	Nationwide	www.circleksunkus.jp/english/
Mini-Stop (AEON)	3.31	Kanto, Tokai, Kinki	www.ministop.co.jp/
Daily Yamazaki (Yamazaki)	2.29	Nationwide	www.daily-yamazaki.co.jp
Seiko Mart	1.77	Hokkaido	www.seicomart.co.jp
AM/PM Japan*	1.5	Nationwide	www.ampm.co.jp
Three F Co., Ltd.	1.14	Kanto	www.three-f.co.jp/
Popular	1.02	Nationwide	www.poplar-cvs.co.jp/

**Purchased by Family Mart in 2010*

Source: Nikkei Marketing Journal - Retail Sector Ranking 2009

Top 10 Food Wholesalers (2009)

Company Name	Sales US$ bil.	Location	URL
Kokubu	15.26	Nationwide	www.kokubu.co.jp
Ryoshoku	14.81	Nationwide	www.ryoshoku.co.jp
Nippon Access	14.55	Nationwide	www.nippon-access.co.jp
Kato Sangyo	6.99	Nationwide	www.katosangyo.co.jp
Itochu Foods	6.65	Nationwide	www.itochu-shokuhin.com
Mitsui Foods	5.47	Nationwide	www.mitsuifoods.co.jp/
Nihon Shurui Hanbai	5.18	Nationwide	www.nishuhan.co.jp
Asahi Shokuhin	3.89	Nationwide	www.asask.co.jp
Meidi-ya Shoji	3.35	Nationwide	www.meidi-ya.co.jp
Food Service Network	3.35	Nationwide	www.fsnltd.co.jp

Source: Nikkei Marketing Journal - Retail Sector Ranking 2009

Top 10 Department Stores (2009)

Company Name	Sales US$ bil.	Location	URL
Takashimaya	9.39	Nationwide	www.takashimaya.co.jp
Sogou-Seibu	9.29	Nationwide	www.sogo-seibu.co.jp/
Mitsukoshi	5.98	Nationwide	www.mitsukoshi.co.jp
Daimaru*	4.53	Nationwide	www.daimaru.co.jp
Isetan	4.25	Nationwide	www.isetan.co.jp
Hankyu-Hanshin	4.17	Kinki, Kanto	www.hankyu-hanshin-dept.co.jp/
Kintetsu	3.3	Kinki	www.d-kintetsu.co.jp/
Tokyu	2.71	Kanto	www.tokyu-dept.co.jp
Matsuzakaya*	2.5	Nationwide	www.matsuzakaya.co.jp/
Tobu	1.72	Kanto	www.tobu-dept.jp/

**Merged in 2010*

Source: Nikkei Marketing Journal - Retail Sector Ranking 2009

Top 10 Commercial Restaurant Food Service Companies (2009)

Company Name	Sales US$ bil.	# outlets	URL
McDonald's Japan	5.69	3715	www.mcdonalds.co.jp
Skylark	2.64	2295	www.skylark.co.jp
Nissin Health Care Food Service	1.8	4260	www.nifs.co.jp
Zensho	1.68	1405	www.zensho.co.jp/en/
Plenus	1.62	2626	www.plenus.co.jp/
Kentucky Fried Chicken Japan	1.5	1505	http://www.kfc.co.jp/
Monteroza	1.48	1717	www.monteroza.co.jp
Reins International	1.34	1231	www.reins.co.jp/
Duskin (Mister Donut)	1.31	1341	www.duskin.co.jp
Honke Kamadoya	1.15	2155	www.honkekamadoya.co.jp

Source: Nikkei Marketing Journal - Retail Sector Ranking 2009

Top 5 Institutional Food Service Companies (2009)

Company Name	Sales US$ bil.	Location	URL
Nisshin Healthcare Food Service	1.80	Nationwide	www.nifs.co.jp
Aim Services	1.02	Nationwide	www.aimservices.co.jp
Green House	0.86	Kanto	www.greenhouse.co.jp/
Seiyo Food Compass Group	0.83	Nationwide	www.seiyofood.co.jp
Fuji Sangyo	0.68	Nationwide	

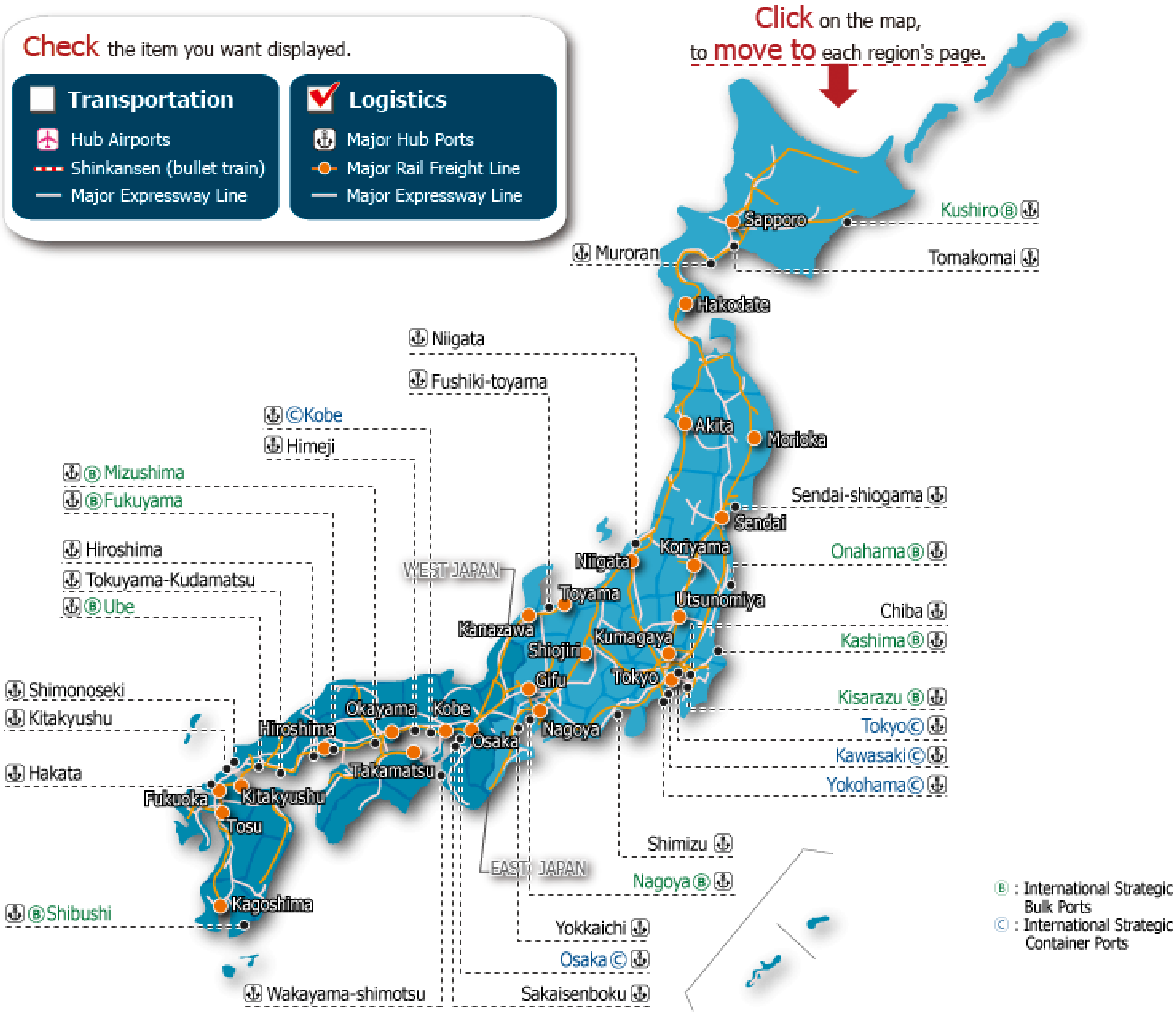
Source: Nikkei Marketing Journal - Retail Sector Ranking 2009

Top 5 Home Meal Replacement and Bento Producers/Marketers (2009)

Company Name	Sales US$ bil.	# outlets	URL
Plenus	1.62	2626	www.plenus.co.jp/
Honke Kamadoya	1.15	2155	www.honkekamadoya.co.jp
Four Seeds (Pizza-La)	0.66	712	www.pizza-la.co.jp
Rock Field	0.5	309	www.rockfield.co.jp/
Origin Toshu	0.49	582	www.toshu.co.jp/

Source: Nikkei Marketing Journal - Retail Sector Ranking 2009

Appendix 2: Transportation Map



Source: JETRO

This survey is for informational purposes only. No personal information or tracking will be identified on or by this survey. Results will be used by the Solano County Agriculture Department for program development and grant extensions. Some results will be used by graduate students at Golden Gate University as input to a research study on local food knowledge and promotion. You have the right to opt out of any and all survey questions, though we would greatly appreciate your time to complete and return this survey.

1. In what Zip Code do you live?
☐ 94533 ☑ 94534 ☐ 94571 ☐ 94589 ☐ 94590 ☐ 94591 ☐ 94592 ☐ 95620 ☐ 95687 ☐ 95688

2. Have you heard a commercial or seen advertisements for produce grown in Solano County?
☑ YES ☐ NO

3. Do you know where to access produce in Solano County?
☑ YES ☐ NO

4. Would you be interested in learning more about local agriculture in Solano County?
☑ YES ☐ NO

5. Have you heard of Solano Grown?
☑ YES ☐ NO

6. If yes, How did you hear about Solano Grown? (check all that apply)
☐ Friend/Family ☐ Facebook/Twitter ☐ Advertisements ☐ News Article (paper/TV) ☑ Signage ☐ Bumper Sticker

7. Have you visited www.SolanoGrown.org?
☐ YES ☑ NO

8. How often do you visit www.SolanoGrown.org?
☐ Daily ☐ Couple times a week ☐ Couple times a month ☐ Couple times a year ☐ Rarely

9. Have you used www.SolanoGrown.org to find products to purchase?
☐ YES ☑ NO

10. Have you purchased anything online?
☑ YES ☐ NO

11. Would you purchase food products such as eggs, meat, produce, or other farm products from an online retailer?
☐ YES ☑ NO

12. How far would you be willing to travel to pick up fresh farm products ordered online?
☐ Wouldn't be willing to travel ☐ 1 Mile or less ☐ 1-5 Miles ☐ Any Distance

13. Are you familiar with the term "Food Desert"?
☐ YES ☑ NO

14. If Yes, do you believe you live in a "Food Desert"?
☐ YES ☐ NO

15. What is the general yearly income level of your household?
☐ Below $30,000 ☑ $30,000-$45,000 ☐ $45,000-$70,000 ☐ Over $75,000

LOCALLY GROWN

www.SolanoGrown.org/shop

SOLANO GROWN

FARMSTANDS
A LOCAL EXPERIENCE

Many stands feature heritage varieties and fruits and vegetables picked that day for your enjoyment. Often there are recipes to be had and growing tips to be shared. Sometimes it is just a nice way of enjoying the hidden beauty of Solano County as you drive out to explore.

The Farmers and Ranchers of Solano Grown.

Brazelton Ranch
Hours: Call for hours and type of fruit available
Phone: 707-448-1707
Address: 3628 Gates Canyon Rd.
Vacaville, CA

Castaneda Bro's Produce
Hours: 9AM - 6PM Daily
July - Nov
Address: 2875 Rockville Rd.
Suisun Valley, CA

Erickson Ranch
Hours: Wed - Sun 9AM-6PM
June to November
Address: 2482 Cordelia Rd.
Suisun Valley, CA
www.ericksonranch.com

Glashoff Farms
Hours: 9AM - 4PM Daily
April - Oct - Self Serve Stand
Address: 5353 Williams Rd.
Fairfield, CA

Good Earth Produce
Hours: Summer 9:30AM-7:30PM
7 Days a week
Address: 7335 Oday Rd, At Midway Exit
Vacaville, CA

Grabish Farmstand
Hours: 10-4PM Sundays
From Mothers Day
through the end of Sept.
Address: 7131 Batavia Rd.
Dixon, CA

Larry's Produce
Hours: 9AM-5PM Daily
Mid June - Nov
Address: 4606 Suisun Valley Rd.
Fairfield, CA

Ochoverde Farm
Hours: 10AM-5PM
May 15 - Nov 15
Address: 3674 SunnyHills Lane
Pleasants Valley Rd.
Vacaville, CA

The Collins Farm
Hours: Sundays 11AM-6PM
May 21 - Sept 14
Address: Farmstand just off I-80
Kidwell exit on the Northside,
Dixon, CA

The Country Barn
Hours: 9-5PM until sold out
Mid-October-Persimmons
Address: 2678 Rockville Rd.
Fairfield, CA

Robledo Produce
Hours: 9AM-5PM
7 Days a week
Address: 2626 Rockville Rd., At Russell Rd.,
Suisun Valley, CA

Vaca Valley Orchard/
Aliki's Finest
Hours: 10AM-3PM Tues/Thurs/Sat/Sun
Mid June-Labor Day
Address: 369 N.Orchard Ave.
Vacaville, CA

SOLANO GROWN

You can also get fresh produce from our Online Farmers Market at

www.SolanoGrown.org/Shop

Standard Prsrt
US Postage
PAID
Pinnacle Solutions

Solano Grown
P.O. Box 91
Fairfield, CA 94533

Project 37

BUY FRESH BUY LOCAL

FREE

THE EATER'S GUIDE TO LOCAL FOOD

NORTH VALLEY REGION, 2ND EDITION

BUTTE | GLENN | TEHAMA

FARMS
FARMSTANDS
FARMERS' MARKETS
FOOD ARTISANS
ORGANIZATIONS
CSA & U-PICKS
RESTAURANTS
GROCERS

NORTH VALLEY BUY FRESH BUY LOCAL

NORTHERN CALIFORNIA REGIONAL LAND TRUST

a publication of NCRLT
www.landconservation.org

ABOUT THIS GUIDE

We are pleased to present you with the North Valley region's 2nd Edition of the Eater's Guide to Local Food! The Local Food Guide is a tool used by Buy Fresh Buy Local, North Valley to list the many growers in Butte, Glenn and Tehama counties who direct-market their locally grown agricultural products, and the variety of different places where you can find those products. We have nearly 100 members with expanded listings in this guide including farmers, ranchers, restaurants, specialty stores, independent grocers, farmers' markets, caterers and more. We hope you will pick up this guide, keep it in your car or bike basket, and chose to support the many businesses, including the local advertisers, that have chosen to support Buy Fresh Buy Local, North Valley. By choosing locally grown foods you will play a part in supporting family farms, strengthening the local economy and promoting healthy, tasty, food. Feast your eyes on the list below to see all the valuable information contained in this guide:

- **A county by county list of growers who direct market, where to find their products and a message from each of the county Agriculture Commissioners.**
- **A North Valley Seasonality Chart highlighting the diverse fruit, vegetable and nut crops produced in our region.**
- **The schedule and location information on all of the farmers' markets that operate weekly or seasonally throughout the region.**
- **A list of U-Picks and Community Supported Agriculture (CSA) programs.**
- **Articles and farmer profiles showcasing stories, ideas and projects in the region supporting growers and helping to develop a local food system.**
- **A list of organizations throughout the North Valley region that are working to build and support the development of a vibrant, local food system.**

Visit www.landconservation.org for more information about the guide and to learn more about the important work of the Northern California Regional Land Trust.

Food Routes Network

The California Buy Fresh Buy Local program is a project of CAFF in collaboration with the national organization Food Routes Network. For more information, please visit www.foodroutes.org.

NORTHERN CALIFORNIA REGIONAL LAND TRUST

The Northern California Regional Land Trust (NCRLT) was founded in 1990 to assist Northern California landowners and public agencies in the voluntary protection of land and other natural resources. The organization is dedicated to promoting the conservation and preservation of open spaces, agricultural lands and natural resources with cooperation between the community, private landowners, public agencies and other nonprofit groups. In promoting cooperation instead of confrontation, NCRLT recognizes that there must be a reasonable balance between the need for timber, agriculture, and development, while maintaining a high quality of life for generations to come. Through its Farmland Protection program, NCRLT is proud to be the regional partner hosting Buy Fresh Buy Local, North Valley in Butte, Glenn and Tehama counties. We believe that protecting local farmland goes hand in hand with promoting locally grown food and the people who bring it to our tables.

For more information about NCRLT please visit www.landconservation.org or call us at (530) 894-7738.

COMMUNITY ALLIANCE WITH FAMILY FARMERS

The Community Alliance for Family Farmers (CAFF) advocates for California family farmers and sustainable agriculture. CAFF is cultivating strong partnerships between family farmers and their communities by building on shared values around food and agriculture and working together in practical, on-the-ground programs. These relationships create local economic vitality, improved human and environmental health, and long-term sustainability. CAFF manages the California Buy Fresh Buy Local program by coordinating a network of local chapters throughout the state. The BFBL chapters run consumer education campaigns and provide support to growers in accessing local markets. Other CAFF programs include Farm to School, Biological Agriculture, Policy, and Technical Assistance in Sales and Marketing.

For more information about CAFF's programs please visit www.caff.org.

CONTENTS

3 MESSAGE FROM THE DIRECTOR

4 COMMUNITY SUPPORTED AGRICULTURE & U-PICKS

5 FARMERS' MARKET LOCATIONS

6 SEASONAL AVAILABILITY CHART

9 BUTTE COUNTY

23 GLENN COUNTY

29 TEHAMA COUNTY

39 LOCAL FARMSHED MAP & COMMUNITY ORGANIZATIONS

CREDITS & ACKNOWLEDGEMENTS

EDITOR
Noelle Ferdon, J.D.

ASSISTANT EDITORS
Jacob N. Brimlow, Ph.D., Candace Byrne, Ph.D., Amber Drake, Janae Lloyd

CONTRIBUTORS
Lee Altier, Ph.D., Monica Bell, Jacob N. Brimlow, Ph.D., Angie Carpenter, Colleen Cecil, Noelle Ferdon, J.D., Jamie Jereb, Janae Lloyd, Zach Mendes, Marc Nemanic, Richard Roth, Kristina Schierenbeck, Ph.D., Jenny Sharkey

GRAPHIC DESIGNER
Nicole Landini, Studio 22

SPECIAL THANKS TO
The NCRLT Board of Directors for their dedication to the Local Food Systems program, the NCRLT staff, Zach Mendes and Angie Carpenter, for their hard work helping to complete this guide, the BFBLNV members, the organizations listed on page 39 for their dedication to supporting local agriculture, and finally, to all the farmers and ranchers in the North Valley who work hard every day to produce the food we eat.

Production of this guide was made possible with support from the California Department of Food and Agriculture through a 2011 Specialty Crop Block Grant #SCB11037. We are additionally grateful to the businesses that advertised in the guide whose support made printing this guide possible.

CALIFORNIA'S BEST KEPT SECRET…

BUTTE, GLENN AND TEHAMA COUNTY AGRICULTURE!

A MESSAGE FROM THE DIRECTOR

In the fall of 2008, while working on sustainable agriculture issues throughout California, I kept coming across the Buy Fresh Buy Local (BFBL) program at restaurants, grocery stores and farmers' markets in the Bay Area and the Central Valley. Each time I returned home to Chico – traversing first through the beautiful rangeland of Glenn county, along 99 north between Red Bluff and Chico and then into the orchards that flank Butte county on nearly every side – I would think to myself, "Why don't we have a Buy Fresh Buy Local initiative here…we ARE Buy Fresh Buy Local!" Our North Valley region of Butte, Glenn and Tehama counties is one of the most diverse cropping regions in the world. And with so many of our region's growers already engaged in direct-marketing – selling directly to the consumer, restaurant or retailer – a BFBL network seemed like an ideal tool to employ for bolstering the visibility and viability of our emerging local food system.

With my idea in hand, I approached the Northern California Regional Land Trust ("land trust") about partnering to start a Buy Fresh Buy Local program in our region. The land trust's primary mission is to conserve agricultural and wild lands so the partnership seemed like a good one. After all, without local farmland there can be no local food! We officially launched the Buy Fresh Buy Local, North Valley (BFBLNV) initiative in the fall of 2009. Our efforts were welcomed immediately by the community, helping us accomplish many tasks aimed at coalescing growers and buyers around the common goals of developing a local food system, increasing market opportunities and raising the visibility of growers already engaged in direct-marketing their products locally. Over 40 growers and buyers became members in the first few months after BFBLNV began, and during the first year we published the 1st Edition of the Local Food Guide (LFG), received a competitive USDA grant to develop a training program for beginning farmers and ranchers and were profiled in the USDA's national Know Your Farmer, Know Your Food Compass (www.usda.gov/kyfcompass) for our training program. Energized by our momentum, we kept plugging away and working with our new members to advance the goals of the program.

What came as a surprise was the exponential growth that would take place after that first Local Food Guide came off the press. Four years after the inception of BFBLNV and two years since the 1st Edition of the Local Food Guide was published, Buy Fresh Buy Local, North Valley currently boasts nearly 100 members and is growing. We're in the first phase of developing a Food Hub using support we received through a 2012 USDA Agricultural Marketing Service grant. Perhaps most importantly, we've cultivated a unique network of growers, buyers, community organizations and consumers all committed to establishing a vibrant and lasting local food system.

We are currently working under a Specialty Crop Block Grant from the California Department of Food and Agriculture (CDFA) that has enabled us to substantially grow the BFBLNV network and publish the 2nd Edition of the Local Food Guide you have in your hands. With constantly changing markets and demands on growers, expertise provided through lasting partnerships with organizations including 3CORE Economic Development Agency (see "Economies of Food" on page 25), the CSU, Chico College of Agriculture (see "Clearing the Way for a Local Food Economy" on page 32), Chico's Center for Nutrition and Activity Promotion, Cultivating Communities North Valley, Northern California Farm Credit and others, remains crucial to helping us find ways to support our region's smaller growers while continuing to develop a more robust local food system.

The success of our program is a direct reflection of the steadfast and innovative growers and eaters in Butte, Glenn and Tehama counties. Without the dedication of our communities and the blister-forming, dirt-under-the-nails types who make up the North Valley's local food system, we couldn't do this work. For that I say THANK YOU… and let's keep growing together. It is time to unveil California's best kept agricultural secret! By picking up this guide and using it to find locally grown agricultural products, together we will take steps toward building the local food system we want for the North Valley. Share it with friends, family and co-workers, and remember that by choosing local products you will help increase the viability of our region's growers!

Happy Eating!

COMMUNITY SUPPORTED AGRICULTURE

GRUB
3197 W. Sacramento Ave., Chico 95926
530-680-4543 • grubchico.org
grubchico@yahoo.com

Pyramid Farms
12242 Meridian Rd., Chico 95973
530-899-7586 • pyramidfarms.com
pyramidfarms2000@yahoo.com

Sawmill Creek Farms
1590 Sylvan Way, Paradise 95969
530-877-5734 • marshall-n@sbcglobal.net

McLane Farms
10 Second Ave., Orland 95963
530-865-4640 • ericamclane46@gmail.com.

Windmill Farm
535 Obermeyer Ave., Gridley 95948
530-846-3344 • windmillfarmofgridley.blogspot.com
windmillfarm@sbcglobal.net

Comanche Creek Farms
240 Speedway Ave., Chico 95928
530-894-7775

Abundant Harvest
Butte, Glenn & Tehama Counties
530-355-8856 • abundantharvestorganics.com

Turkey Tail Farms
10846 Nelson Bar Rd., Yankee Hill 95965
530-781-4122 • turkeytailfarm.net/v2/

Green Beginnings Farm
596 East Evans Reimer Rd., Gridley 95948
530-208-3276

U-PICKS

Hansen's Blueberry Farm, Corning
530-824-2331

CSU, Chico University Farm, Chico
530-898-6343

Max's Miracle Ranch, Gridley
530-354-7168

Johnson U-Pick Farm, Gridley
530-846-5871 • johnsonupickfarm.com

Pumpkinland Chocolate Company, Red Bluff
530-527-3026

FARMERS' MARKETS

DAY	COUNTY	MARKET	TIME	SEASON	ADDRESS	CITY	CONTACT	WIC/EBT
Tue	Butte	Paradise Alliance Church CFM	7:30AM - 12PM	May 21- Oct 15	6491 Clark Rd	Paradise	530-893-3276 chicocertifiedmarket.com	WIC; FMNP EBT
Tue	Butte	Gridley CFM	5PM-8PM	May-Aug	Daddow Park Downtown Gridley	Gridley	530-846-3687 gridleybid.com	WIC; EBT
Wed	Butte	North Valley Plaza CFM	7:30AM - 12PM	May 22- Nov 27	North Valley Plaza Pillsbury Rd	Chico	530-893-3276 chicocertifiedmarket.com	WIC; FMNP EBT
Wed	Butte	Oroville Hospital's Community FM	10AM - 2PM	June- Sept	2767 Olive Hwy	Oroville	530-532-8004 orovillehospital.com	WIC; EBT
Wed	Glenn	Willows Market Glenn Co. CFM	4PM - 7PM	June-Oct	Downtown Butte & Sycamore St.	Willows	530-934-4601 x.5 glenncountyrcd.org	WIC; FMNP EBT/SNAP
Wed	Tehama	Red Bluff Farmers' Market	5PM - 8PM	June 19- Sept 11	Washington St, 600 block	Red Bluff	530-527-6220 x.301 redbluffchamber.com	WIC
Thu	Butte	Paradise Community Park CFM	5PM - Dusk	June 20- Sept 15	Pearson Rd at Black Olive	Paradise	530-893-3276 chicocertifiedmarket.com	WIC; FMNP EBT
Thu	Butte	Downtown Chico Thurs. Night Mrkt	6PM - 9PM	April-Sept	Broadway btwn 2nd & 5th St	Chico	530-345-6500 downtownchico.com	WIC; FMNP EBT
Fri	Butte	Chapman CFM	2PM - 5:30PM	Year Round	1010 Cleveland Ave.	Chico	530-624-8844 cChaos.org	WIC; EBT
Sat	Butte	Downtown Chico CFM	7:30AM - 1PM	Year Round	2nd & Wall St	Chico	530-893-3276 chicocertifiedmarket.com	WIC; FMNP EBT; FVC
Sat	Butte	Downtown Oroville CFM	7:30AM - 12PM	May 18- Oct 26	Montogomery, btwn Myers & Huntoon	Oroville	530-893-3276 chicocertifiedmarket.com	WIC; FMNP EBT
Sat	Glenn	Orland Market Glenn Co. CFM	9AM - 12:30PM	June-Oct	Library Park 4th & Mill St.	Orland	530-934-4601 x.5 glenncountyrcd.org	WIC; FMNP EBT/SNAP
Sat	Tehama	Red Bluff Farmers' Market	7:30AM - 12PM	June-Sept	100 Main St	Red Bluff	530-527-6220 x.301 redbluffchamber.com	WIC
Sat	Tehama	Frontier Village Farmers' Market	9AM - 1PM	Year Round	645 Antelope Blvd.	Red Bluff	530.526.2843 frontiervillagefarmersmarket.org	EBT

KEY

WIC- Women with Infants and Children
EBT- Electronic Benefits Transfer
FMNP- Farmers Market Nutrition Program
FVC- Fruit and Vegetables Check

WIC is the Special Supplemental Nutrition Program for Women. Infants, and Children; a program of the USDA for low-income pregnant women, breastfeeding women, and infants and children under the age of five.

EBT cards are issued by the USDA's Supplemental Nutrition Assistance Program also known as CalFresh in California (formerly the Food Stamp Program). For more CalFresh information, call 877-847-3663. EBT cards can be used at point of sale locations such as the markets listed above.

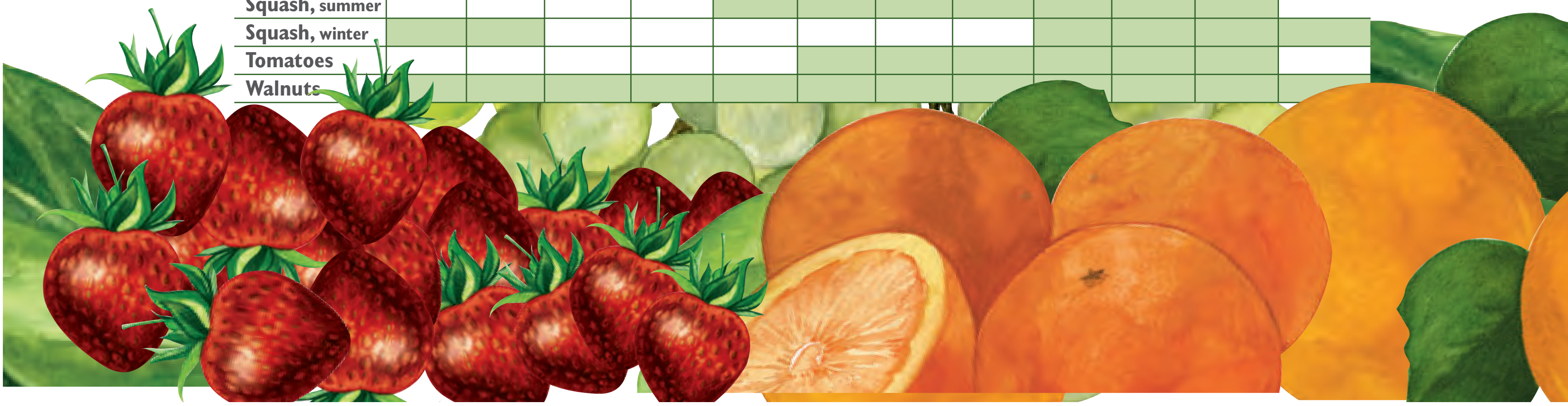
SNC are Senior Nutrition Coupons are a benefit of the USDA's Senior Farmers Market Nutrition Program and can be used at point of sale locations such as the markets listed above.

NOTES: Farmers Markets times and locations sometimes vary due to seasonality, winter hours, and other changes to the availabitltiy of their spaces, please check with market manager to confirm time and location.

WIC and SNC are commonly accepted directly by the farmer, although not all farmers will accept this type of payment.

NORTH VALLEY SEASONAL SPECIALTIES

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Almonds	■	■	■	■	■	■	■	■	■	■	■	■
Apples	■	■	■				■	■	■	■	■	■
Apricots					■	■	■					
Arugula		■	■	■	■	■	■	■	■	■	■	
Asparagus			■	■	■	■						
Basil					■	■	■	■	■	■		
Beets	■	■	■	■	■	■	■	■	■	■	■	■
Blueberries					■	■	■					
Bok Choy	■	■	■	■	■	■	■	■	■	■	■	■
Broccoli	■	■	■	■	■	■	■	■	■	■	■	■
Cabbage	■	■	■	■	■	■	■	■	■	■	■	■
Carrots	■	■	■	■	■	■	■	■	■	■	■	■
Cauliflower	■	■	■	■	■	■	■	■	■	■	■	■
Chard	■	■	■	■	■	■	■	■	■	■	■	■
Cherries					■	■						
Collards	■	■	■	■	■	■	■	■	■	■	■	■
Corn						■	■	■	■	■	■	
Cucumber						■	■	■	■	■	■	
Eggplant						■	■	■	■	■		
Figs						■	■	■	■	■	■	
Garlic	■	■	■	■	■	■	■	■	■	■	■	■
Grapefuit	■	■	■	■					■	■	■	■
Grapes							■	■	■	■	■	■
Kale	■	■	■	■	■	■	■	■	■	■	■	■
Leeks	■	■	■	■	■	■	■	■	■	■	■	■
Lemons	■	■	■	■	■					■	■	■
Lettuces	■	■	■	■	■	■	■	■	■	■	■	■
Melons						■	■	■	■	■		
Nectarines					■	■	■	■	■			
Olives	■	■	■	■	■	■	■	■	■	■	■	■
Onions	■	■	■	■	■	■	■	■	■	■	■	■
Oranges	■	■	■	■	■	■				■	■	■
Peaches					■	■	■	■	■	■		
Pears	■						■	■	■	■	■	■
Peas				■	■	■	■	■				
Peppers, bell							■	■	■	■	■	■
Persimmons									■	■	■	■
Plums						■	■	■	■			
Pomegranates									■	■	■	■
Potatoes	■	■	■	■	■			■	■	■	■	■
Radish	■	■	■	■	■	■	■	■	■	■	■	■
Raspberries					■	■	■	■	■	■		
Rice	■	■	■	■	■	■	■	■	■	■	■	■
Spinach	■	■	■	■	■	■	■	■	■	■	■	■
Strawberries			■	■	■	■	■	■	■	■		
Squash, summer					■	■	■	■	■	■	■	
Squash, winter	■	■							■	■	■	■
Tomatoes						■	■	■	■	■	■	
Walnuts	■	■	■	■	■	■	■	■	■	■	■	■



FARMER PROFILE

GRUB

BY JANAE LLOYD

GRUB CSA was created in Chico, California, in the summer of 2007 by Francine Stuelpnagel, Lee Callender, and Max Kee. They all had the desire to grow good food free from toxic chemicals. With no professional experience, they started gardening in 9 Chico backyards. A year later they had grown to a 12-person CSA and were farming 2 large plots. By 2009, they were working non-stop. "We can do this," they said, "and this is exactly what we want to do with our lives right now." So Lee and Francine quit their day jobs and became full-time farmers. They also moved to a larger property on Dayton Road and expanded to 80 CSA customers.

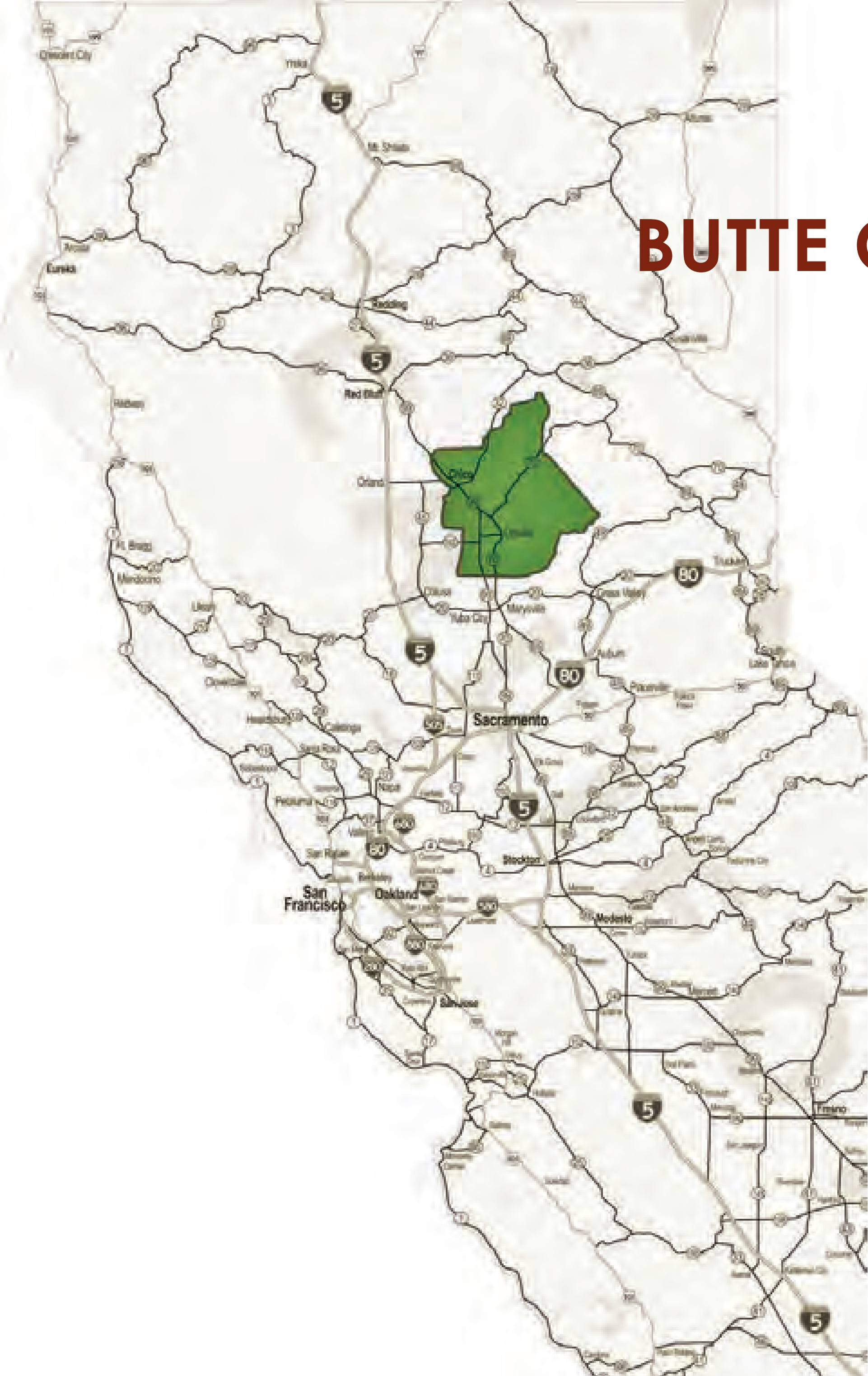
photo courtesy of MAALIS

In 2010, when Max left the farm to pursue his own ventures in perennials, Michael Shaw appeared on the scene. Fresh from Sauvie Island Organic, a CSA in Portland, Michael brought valuable experience to GRUB. "We didn't even know what harvesting knives were," says Francine, "We had just been buying knives from the thrift store. Michael brought professionalism and really tailored the farm." This is part of what makes GRUB CSA special: everyone brings something different to the table. Francine says that Lee brings efficiency and Michael brings attention to detail. "I'm the communicator," she says, "and I grow the flowers."

GRUB CSA grows 50 types of vegetables in over 290 varieties. Recently, Michael started growing and packaging heirloom dry beans, which is a first for the CSA. Francine says that their diversity makes them unique. While many farms practice monoculture, the farmers at GRUB are growing more and more different crops. They grow according to organic standards and follow the OMRI (Organic Materials Review Institute) List. Their entire approach to the CSA is special; only distributing locally, creating as little waste as possible, and focusing on the people involved. In fact, the people are what Francine enjoys most about her job. "I love talking to people in our CSA and at the farmers' market," she says, "I especially love sharing recipes."

At the end of 2012, Lee, Francine, and Michael made the decision to move the farm to a new 10 acre property in north Chico just 4 miles from downtown and close to the Sacramento River. They were also able to get a 10 year lease, ensuring that they can make a long-term commitment to the land. The first CSA pick-up at the new property is scheduled for mid-April of 2013.

You can find GRUB CSA at Chico's Saturday, Wednesday and Thursday farmers' markets, as well as at Chico Natural Foods Cooperative. They will also be providing the Associated Student's Food Service with vegetables for their Local Lunch. For more information on the CSA, contact Lee, Francine, and Michael at 530-680-4543 or e-mail grubchico@gmail.com.



- VEGETABLES
- NURSERIES
- FRUITS
- MEAT
- NUTS, OIL, HONEY, GRAINS
- EGGS
- DAIRY
- WINE

BUTTE COUNTY

A message from the Butte County Agricultural Commissioner…

Butte County is home to the "heart of agriculture production" in the northern Sacramento Valley. With an annual agricultural crop production value of over $644 million, Butte County ranks in the top 20 out of California's 58 counties.

Over the past 25 years, Butte County agriculture has seen some major transitions from producing field crops to more nut crops. There are twelve major commodity varieties in Butte County, including fruit and nut crops and nursery plants that are shipped to nearly 50 countries worldwide.

Butte County has also been developing "niche markets" for smaller producers. The county has 11 certified farmers markets, with over 110 certified producers, with an annual vegetable value of over $850,000. There are also 84 farms on 19,000 acres that produce $8.4 million dollars of registered organic commodity. In recent years, we've seen a rise in the sales of "value added" agriculture with the production of olive oils, specialty nuts, lavender products, all kinds of jams, jellies and spreads and local wines and beers, just to name a few.

Be sure to visit our local farm stands, farmers' markets specialty food markets, beer, wine and olive tasting rooms, farm trail events and other local food venues that make our produce local and fresh! There is never a shortage of places with local agricultural commodities to visit or new things for the palate to enjoy in Butte County.

Richard Price moved to Chico and has been the Butte County Agricultural Commissioner since 1988. A native of Eureka he has agricultural "roots" in 4-H, raising cattle and as an agricultural Pest Control Advisor after he graduated from UC, Davis. For the past 24 years, he has enjoyed working with his staff, and local and state agricultural interests to promote, protect and enhance Butte County agriculture.

GROWERS & FARMSTANDS

7 Diamonds Orchards
Phyllis Bond
31 Floating Cloud Drive
Chico, CA 95928
530-343-5776
530-513-3195
sevendiamondsorchards@yahoo.com
Seven Diamonds Orchards is located a few minutes from downtown Chico. We sell organic, non-pasteurized almonds certified by CA Certified Organic Farmers. We also offer organic almond butter, creamy and crunchy, and raw honey. "Like" Seven Diamonds on Facebook! Seven Diamonds Orchards is a proud supporter of Buy Fresh Buy Local.

Baja Vaca Ranch
available at
Long Creek Winery & Ranch
Bertagna Son Kissed Vineyards
530-701-7100
info@bajavacaranch.com
www.bajavacaranch.com
Baja Vaca Beef is 100% NATURAL, which means that we use NO growth hormones, NO steroids, and NO animal by-products or hormones in the feed. Beef is available as a whole or half and is custom packaged to fit your needs. Individual cuts are available. We demand a top quality product for our families and yours, taste the difference today. Baja Vaca Ranch is a proud supporter of Buy Fresh Buy Local.

Berkeley Olive Grove 1913
Darro Grieco
8 Rocky Drive
Oroville, CA 95965
530-533-1814
darro@berkeleyolivegrove.com
www.berkeleyolivegrove.com
Berkeley Olive Grove 1913 olive oil is certified organic, certified extra virgin, award winning, and very antioxidant rich. Following research begun in 1900, University professors established the Butte County olive grove in 1913. Today it's dry farmed, using sustainable, organic, manual practices. Berkeley Olive Grove 1913 is a proud supporter of Buy Fresh Buy Local.

Bonds Family Garden
Gerald Bonds and family
1115 Glenwood Ave
Chico, CA 95926
530-343-1226

California Olive Ranch
2675 Lone Tree Rd
Oroville, CA 95965
530-846-8000

Chaffin Family Orchards
Kurt and Carol Albrecht
606 Coal Canyon Rd
Oroville, CA 95965
530-533-8239

Cinquini Farms
Rick Cinquini
3986 Morehead Ave
Chico, CA 95928
530-891-4771

Cole Farm
Linda and Gary Cole
7399 Hwy 99 E
Oroville, CA 95965
530-343-0916
colefarm@shocking.com
Cole Farm is a proud supporter of Buy Fresh Buy Local.

Comanche Creek Farms
240 Speedway Ave
Durham, CA 95938
530-894-7775

Dragon's Lea Farms
Eileen Burke-Trent
738 Justeson Rd
Gridley, CA 95948
530-846-4444

Durham Valley Apples
Bud and Christine Keaney
2243 Durham Dayton Hwy
Durham, CA 95938
530-343-8077

Floral Native Nursery
Germain and Zeb Puterbaugh
2511 Floral Ave
Chico, CA 95973
530-892-2511

Gaea's Garden
Wade and Bettie Ann Hough
1866 South Villa Ave
Palermo, CA 95968
530-345-2849

Geffray's Gardens
Claude Geffray
2790 Alamo Ave
Chico, CA 95973
530-345-2849

GRUB CSA Farm
Lee Callendar
3197 W. Sacramento Ave
Chico, CA 95926
530-680-4543
grubchico@yahoo.com
Offering only local produce grown right here on the farm, GRUB CSA Farm is entering its 4th year of providing year-round quality vegetables grown in an environmentally conscious manner. Our produce can be found at local farmers markets, Chico Natural Foods, S&S Produce or through our CSA. GRUB CSA Farm is a proud supporter of Buy Fresh Buy Local.

Halus Tree Farm
Beverly Halus and Ross Jones
52 Pleasant View Ln
Oroville, CA 95966
530-589-2200

Isern & Sons
Antonio Isern
1080 E. Lassen Ave #47
Chico, CA 95973
530-518-6325

Jim's Jamin' Inc.
Jim and Karen Bock
PO Box 1298
Gridley, CA 95948
530-846-1484

LOCAL FOOD AND FITNESS | CROSSFIT NORCAL

FRESH. LOCAL. FIT.

BY JAIME JEREB

Send an 11 year old to the grocery store with a twenty in hand, she's bound to return with something disgusting. I remember walking in the door, so proud. Dad commended me on the bread, coffee, milk, yogurt, but when it came time to explain the mystery jar of gelatinous muck, he was less than impressed. "Dad, it's Goober Grape! It has the peanut butter and jelly mixed in together. That way you save time AND money. Pretty smart, huh?"

"Yep, too smart for us, take it back."

Ahh man……

Twenty years later, as a health and fitness coach at NorCal Strength and Conditioning, you couldn't double dog dare me to eat that stuff. A sugar laced hydrogenated bomb? No thanks, I'm good. These days, I shop a little differently, sticking to local veggies, fruits, meats, nuts and quality fats. Why? I simply look, feel, perform better, both in the gym and in life. It's a message we convey to our clients over and over again. Eat real, local food. Stay away from processed stuff. If you can't pronounce it, don't eat it! More than anything, we want our clients to be successful. That could mean a 300-pound deadlift, to lose 40 pounds or to simply keep up with their kids on the playground. Regardless of their goals, healthy eating is a must and without optimal nutrition, you'll never reach optimal health, wellness or fitness. This idea sounds simple and I believe that it is. However, marketing is a strong tool. If you've ever braved the aisles at the grocery store, you know what I'm talking about. Practically *everything* is jumping out at you proclaiming to be the next best healthy thing.

"Pick me, I'm full of antioxidants!"

"Pick me, I now have 25% more fiber!"

"Pick me, I'm colorful and have an adorable monkey on my box!"

Possibly true, but why not take the guessing game out of it starting with knowing who at least grew your food. Shopping at local farmers' markets and CSAs will not only give you a chance to ask questions directly to the producers, but you're supporting local business and boosting your immediate economy. Farmers' markets sell the biggest variety of seasonally appropriate and locally produced foods that also make eating nutritiously more affordable. Not to mention that buying local and fresh ensures that those vital nutrients aren't dying off somewhere between New Zealand and the checkout line. It makes sense that the fresher the food, the better tasting the food. The better the food (fuel) the better you look, feel, perform.

Keep in mind that you can control what your body looks and feels like 10x more with diet and exercise than with exercise alone. So use this Local Food Guide to help you find more of the local foods you love that will also help you feel great. Eat fresh.

Eat local. Be fit. Stay well.

Jaime Jereb studied kinesiology as CSU, Chico and the Institute for Integrative Nutrition. Passionate for helping others achieve a healthy lifestyle, she currently works with clients as a health and fitness coach at NorCal Strength and Conditioning in Chico, CA.

Johansen Ranch

Rich Johansen
415 1st St. Orland, CA 95963
johansen@gv.net
www.johansenranch.com

Family-owned and operated since 1910, Johansen Ranch grows Satsuma and Clementine mandarins, blood and navel oranges, Meyer lemons and olive oil. Our fruit is tree-ripened and certified organic by CCOF. Johansen Ranch is a proud supporter of Buy Fresh Buy Local.

Johnson's Farm

Mark Johnson
113 Higgins Ave
Gridley, CA 95948
530-846-5871

Kaki Farms

Nicasio Soria
171 Wright Ave
Gridley, CA 95948
530-846-5706

Kelso's Black Gold Ranch

Richard and Paul Kelso
1161 Mt. Ida Rd
Oroville, CA 95966
530-589-1648

Lee's Produce

Cha Lee
Chico, CA
530-342-8525

Llano Seco Rancho

Charlie Thieriot
8969 Hugh Baber Lane
Chico, CA 95928
832-723-0352
charles@llanoseco.com
www.llanoseco.com

Family-owned since 1861. Agriculture on the ranch has included raising cattle, horses, sheep and hogs, and farming many crops. Since 2005, we have practiced organic farming. Llano Seco Organic Pork culminates our goal to provide delicious organic products for our customers while caring for the people, animals and the land here on the ranch. Llano Seco Rancho is a proud supporter of Buy Fresh Buy Local.

Lodestar Farms

Jamie Johansson
3719 Foothill Blvd
Oroville, CA 95966
530-534-6548
jamie@lodestarfarms.com
www.lodestarfarms.com

At Lodestar Farms we have been producing award winning olive oil since 1993. Visit our tasting room on the farm in Oroville and discover what it takes to preserve California's oldest olive oil tradition since 1898. Committed to Buy Fresh Buy Local, we participate in many of Butte county's farmers' markets. Lodestar Farms is a proud supporter of Buy Fresh Buy Local.

Lundberg Family Farms

5370 Church St
Richvale, CA 95974
530-882-4551

Morning Glory Organics

Roger and Kaye Diefendorf
NW Corner of Hwy 191 & Butte Campus Dr.
Butte Valley, CA 95965
916-212-3262
rkdiefendorf@att.net
www.morninggloryorganics.com

Our farm, Morning Glory Organics, is a budding organic farm located in Butte Valley, dedicated to growing nutritious and flavorful heirloom and specialty fruits and vegetables the old-fashioned way without the use of commercial fertilizers. We want the very best to satisfy our customers! Watch us grow! Morning Glory Organics is a proud supporter of Buy Fresh Buy Local.

Mt. Ida Mandarin Ranch

Bill Jones
845 Mt. Ida Rd
Oroville, CA 95966
530-589-5799

Noble Orchards

Jim and Laurie Noble
7050 Pentz Rd
Paradise, CA 95969
530-877-4784

Pyramid Farms

Matthew Martin
12242 Meridian Road
Chico, CA 95973
530-899-7586
pyramidfarms2000@yahoo.com
www.pyramidfarms.com

Pyramid Farms, established in 1990 as a one-acre organic hobby garden, now occupies eleven fertile acres "down in hollow" off Meridian Road. Our wide variety of quality produce is available at farmers' markets, through our home delivery CSA, and natural food stores. Pyramid Farms is a proud supporter of Buy Fresh Buy Local.

Red Bear Ranch

Glen Hoffman
9606 Jones Ave
Durham, CA 95938
530-345-1808

Sawmill Creek Farms

Brian Marshall and Nancy Heinzel
1590 Sylvan Way
Paradise, CA 95969
530-877-5734

Selby Apiaries

Carole Pavlik-Selby
615 Bidwell Dr
Chico, CA 95926
530-345-6559

Sierra Cascade Blueberry Farm

John and Armen Carlon
P.O. Box 613
Forest Ranch, CA 95942
530-894-8728
info@sierracascadeblueberries.com
www.sierracascadeblueberries.com

We farm nine acres of certified organic blueberries in the foothills east of Chico, CA. Available from June-July at farmers' markets and local grocers. We started in 1989, certified organic in 1993. Sierra Cascade Blueberries is a proud supporter of Buy Fresh Buy Local.

Sierra Farms Lamb

Mel & Mary Thompson
2360 Cox Ln
Oroville, CA 95966
530-532-4226

Skylake Ranch Inc.
Gail Brown
10588 Chayote Dr.
Durham, CA 95938
skylakeranch@aol.com
www.skylakeranch.com
We are local pomegranate growers in Chico. We have a 20-acre family owned orchard. We make pomegranate products from our fresh squeezed juice and sell these products at the Saturday farmers' market in Chico along with our fresh pomegranates. We also sell in local stores listed on our website. Skylake Ranch is a proud supporter of Buy Fresh Buy Local.

TJ Farms Estates
Dave Moss
3600 Chico Ave
Chico, CA 95928
530-343-2294

Towani Organic Farm
Guy Baldwin and Sharon Casey
Bangor, CA 95914
530-679-2729

Windmill Farm
Frank and Paula Carli
535 Obermeyer Avenue
Gridley, CA 95948
530-846-3344
windmillfarm@sbcglobal.net
Windmill Farm is a family-run small 5-acre farm that raises exceptional vegetables, fruits, flowers and herbs using sustainable farming practices. We provide educational classes on canning, drying and raising chickens. Find our products through our CSA, any special customer requests for small or large gift baskets or special events. Windmill Farm is a proud supporter of Buy Fresh Buy Local.

Wookey Ranch
Christine Hantelman and Richard Coon
4181 Wookey Road
Chico, CA 95973
530-343-2479
wookeyranch@gmail.com
www.wookeyranch.com
Wookey Ranch grows grass-fed lamb and chicken seasonally on rolling grasslands 15 miles north of Chico. Frequent moves onto fresh grass sustains the vitality of our animals and results in delicious, gourmet-quality meat that reflects our unique landscape. Buy direct from us at the ranch and at Chico and Paradise certified farmers' markets. Wookey Ranch is a proud supporter of Buy Fresh Buy Local.

Wyles Family Farm & Rabbitry
Jeff and Diana Wyles
123 Spring Creek Road
Oroville, CA 95966
530-589-4063
wylesfarm@sbcglobal.net
We raise quality rabbits for meat, breeding stock, pets and meat pens and farm pomegranates, Fuyu persimmons and several apple varieties in early production, herbs, winter squashes and gourds. Only organic and sustainable principles utilized. Wyles Family Farm is a proud supporter of Buy Fresh Buy Local.

Yamashita's Japanese Maples
Tim Hanson and Phyllis Yamashita
Chico, CA
530-345-9651

WINERIES & VINEYARDS

Bertagna Son Kissed Vineyards
Berton and Carol Bertagna
3363 Hegan Lane
Chico, CA 95928
530-343-8014
info@bertagnawine.com
www.bertagnawine.com
Bertagna Son Kissed Vineyards is a local Chico winery. We grow our own grapes which are CCOF Certified Organic. We specialize in Italian (some French) varieties of handcrafted wine made in small batches. We are happy to carry Baja Vaca Ranch All Natural Beef as well. We pride ourselves in always farming responsibly for your health. Bertagna Son Kissed Vineyards is a proud supporter of Buy Fresh Buy Local.

Gale Vineyards
Steve and Cresia Gale
9345 Stanford Ln
Durham, CA 95938
530-891-1264
steve@galevineyards.com
www.galevineyards.com
At Gale Vineyards we produce wines that are rich and fruity while having soft tannins making a delicious wine that is ready to drink today. Our grapes are grown using organic farming practices and are dry farmed, which produces rich, concentrated fruit. We prune our vines using the Old-world technique of "head pruning" to protect the fruit and yield a fuller, richer flavor. Gale Vineyards is a proud supporter of Buy Fresh Buy Local.

LaRocca Vineyards
Phillip LaRocca and Phaedra LaRocca Morrill
PO Box 541
Forest Ranch, CA 95942
800-808-9463
wine@laroccavineyards.com
www.laroccavineyards.com
LaRocca Vineyards is family-owned and operated. We farm 150 acres of organic wine grapes and produce 25,000 cases of USDA/CCOF certified organic wines with no sulfites. Now open in downtown Chico, LaRocca Local Wine Tasting Room is located at 222 W. 2nd Street. Visit the website for hours of operation. LaRocca Vineyards is a proud supporter of Buy Fresh Buy Local.

Long Creek Winery & Ranch
233 Ward Boulevard
Oroville, CA 95966
530-701-7100
info@longcreekwinery.com
www.longcreekwinery.com
Come by the tasting room to enjoy our Long Creek and Vaquero Brand wines. Sample our estate grown olive oil, tour the working ranch & walk the vineyards, mandarin and olive orchards with your family. We host special events at the winery or in the Oak grove bordering the pond. Open most weekends from Noon to 5 pm. Long Creek Winery & Ranch is a proud supporter of Buy Fresh Buy Local.

Odyssey Winery & Vineyards
Norm Rosene
6237 Cohasset Road
Chico, CA 95973
530-891-9463
odysseywinery@aol.com
Award-winning wines made from local and estate grapes. Wine tasting, tours and special events. Gourmet foods and wine accessories. Picnic area. "SummerLive" Jazz Series. Wine Boot Camp for aspiring winemakers in the Spring. Rotating art exhibit. Available for group functions and corporate meetings. Hours: May through December, Saturdays 1 PM to 6 PM. Odyssey Winery is a proud supporter of Buy Fresh Buy Local.

Quilici Vineyards & Winery
Gary and Judy Quilici
72 Quail Hill Place
Oroville, CA 95966
530-589-5088

SPECIALTY RETAILERS & GROCERY STORES

Chico Natural Foods Cooperative
Liza Tedesco, General Manager
818 Main Street, Chico, CA 95928
530-891-1713
www.chiconatural.com
CNFC is Chico's only consumer-owned food cooperative! We are dedicated to supporting local foods and work with many local farmers to bring their products to your table. Anyone can shop, anyone can join! Come by for the freshest variety of organic, local and sustainable products. CNFC is a proud supporter of Buy Fresh Buy Local.

S&S Produce and Natural Foods
Emily Dehnke, Store Manager
1924 Mangrove Avenue
Chico, CA 95926
530-343-4390
info@ssproduce.com
www.ssproduce.com
S&S Organic Produce and Natural Foods has been family-owned and operated since 1968. We offer local organically grown produce, natural meats, seafood, vitamins and supplements, natural foods, bulk foods and natural skin care. We also have a BBQ and deli. Come check us out! S&S is a proud supporter of Buy Fresh Buy Local.

Maisie Jane's California Sunshine Products
1324 Dayton Road
Chico, CA 95928
530-899-7909
nuts@maisiejanes.com
Maisie Jane's California Sunshine Products, Inc. is the grower, processor, and packer of almond and other nut products. We sell our branded, added value nut products to distributors, wholesalers, and direct to the consumers through our website and our own retail store. Maisie Jane's is a proud supporter of Buy Fresh Buy Local.

Zucchini & Vine
204 Main St
Chico, CA 95928
530-345-3551

RESTAURANTS & CAFES

Bellachinos
800 Bruce Rd
Chico, CA 95928
530-892-2244

Farmstar Pizza
2359 Esplanade
Chico, CA 95926
530-343-2056
www.farmstarpizza.com
Farm Star Pizza...Awesome pies where the farmer is the star. Using fresh, local, organic ingredients and hand stretching our crust creates the best tasting Neapolitan-style pizza around...and it's better for you and the planet! We are a family-owned & friendly spot with beer, wine and delicious salads too! Look us up on Facebook. Farmstar Pizza is a proud supporter of Buy Fresh Buy Local.

Grana Wood Fired Foods
198 E. 2nd Street
Chico, CA 95928
530-809-2304
www.granachico.com
Grana specializes in Osteria style dining, small plates, seasonal and locally grown foods, traditional Neapolitan pizzas, boutique wines and craft beers. As a locally owned and operated restaurant, Grana is enlivened by the opportunity to bring to town such a unique dining experience. We look forward to serving you! Grana is a proud supporter of Buy Fresh Buy Local.

Leon Bistro
817 Main Street
Chico, CA 95928
530-899-1105
contactus@leonbistro.com
www.leonbistro.com
Leon Bistro serves distinctive soups, salads, meats, sauces, and fine desserts using locally-grown products that express the best of contemporary California cuisine. Leon Bistro is a proud supporter of Buy Fresh Buy Local.

Monk's Wine Lounge & Bistro
128 West 2nd St
Chico, CA 95928
530-343-3408

Red Tavern
1250 Esplanade
Chico, CA 95926
530-894-3463
dine@redtavern.com
www.redtavern.com
Red Tavern is a well-known Chico favorite that offers locally grown, seasonal, organic ingredients in their thoughtfully prepared dishes. They offer a cozy upscale dining experience, where you'll find an extensive wine list, full bar and a beautiful outdoor patio featuring a Bocce ball court. Red Tavern is a proud supporter of Buy Fresh Buy Local.

Sicilian Cafe
1020 Main St
Chico, CA 95928
530-345-2233

Sierra Nevada Taproom & Restaurant
1075 East 20th St
Chico, CA 95928
530-893-3520
www.sierranevada.com
We offer award winning ales and lagers combined with exceptional food. Come sample one of 19 beers on tap accompanied by gourmet dishes made with local, seasonal ingredients. From fresh produce grown in our Estate Garden and bread baked on site with spent brewer's grain to artisanal meats, cheeses and our own beef, you can expect only the greatest taste from farm to table. Sierra Nevada Taproom is a proud supporter of Buy Fresh Buy Local.

Tannins Wine Bar & Bistro
234 W. 3rd Street
Chico, CA 95928
530-636-4468

Upper Crust Bakery & Eatery
130 Main St
Chico, CA 95928
530-895-3866

Wild Oak Cafe
196 Cohasset Rd., Suite 150
Chico, CA 95926
530-343-6848
Wild Oak Cafe is a local restaurant that strives to support our environment and community while maintaining a healthy responsibility to our customers through the food we serve. We use local and organic ingredients whenever possible. Wild Oak Cafe is a proud supporter of Buy Fresh Buy Local.

CATERERS

Bacio Catering & Carry Out
1903 Park Avenue
Chico, CA 95928
530-345-7787
www.baciocatering.com
Thoughtfully prepared dishes offered deli-style by the pound or piece from our retail counter. Sourcing locally grown ingredients, our dishes are fresh, beautiful and delicious. We also feature weekly specials, prepared platters, and of course, full service catering for life's big events. Come in for lunch and bring home dinner! Bacio Catering is a proud supporter of Buy Fresh Buy Local.

Blush Catering
Jen Cartier
28 Bellarmine Ct
Chico, CA 95928
530-222-4895

Roots Catering
Kelly Gomez
3221 Esplanade
Chico, CA 95973
530-891-4500
supportinglocalgrowth@rootscatering.com
www.rootscatering.com
Roots catering is known for its authentic, world dishes made from locally sourced meats and produce. We also offer breakfast and lunch M-F and Sundays 8-2PM at our 3221 Esplanade site. See our website at www.rootscatering.com for a catering menu and service options and our restaurant menus. Roots Catering is a proud supporter of Buy Fresh Buy Local.

DISTRIBUTOR

ProPacific Fresh
Nate Parks
P.O. Box 1069
Durham, CA 95938
530-893-0596
www.propacificfresh.com
ProPacific Fresh is a specialty foodservice distributor serving retail and institutional customers from Medford, OR to Fresno, CA. PPF is a produce specialist, but carries a variety of products. PPF endeavors to expand its locally produced items and currently purchases from local producers including, but not limited to Comanche Creek Farms, Rumiano Cheese and Mooney Farms. ProPacific Fresh is a proud supporter of Buy Fresh Buy Local.

COMMUNITY & ORGANIZATION MEMBERS

Slow Food Shasta Cascade
Lori Weber
645 Antelope Blvd, Suite #40
Red Bluff, CA 96080
530-228-6660
slowfoodshastacascade@yahoo.com
Slow Food Shasta Cascade is a chapter of Slow Food USA. We've operated as an official chapter since 2005. Our purpose is to support Slow Food USA in its mission for "good, clean and, fair food." We emphasize several priority areas: 1) access to food, 2) support for urban agriculture, 3) education about our food system. SFSC is a proud supporter of Buy Fresh Buy Local.

Chico Peace & Justice Center
Chris Moore-Backman
526 Broadway Street
Chico, CA 95928
530-893-9078
chico-peace@sbcglobal.net
The Chico Peace and Justice Center is a community-based non-profit 501(c)3 organization committed to working for peace, social and economic justice through the power of nonviolence. The center works for social change through education, community building, and direct action and has a store selling local and fair-trade items reflecting its mission. CPJC is a proud supporter of Buy Fresh Buy Local.

Cultivating Community Advocates
Sue Hildebrand
1161 East Avenue
Chico, CA 95926
602-481-9506
sue@ccadvocates.org
Cultivating Community Advocates administers a specialty crops-based competitive grants program to support food localization and food security within Butte County's farming area, specifically within communities with historic and systemic barriers to healthy food. Award range: $3-10k. Non-profit and for-profit entities eligible to apply. CCA is a proud supporter of Buy Fresh Buy Local.

Chico Grange
2775 Nord Ave
Chico, CA 95973
530-895-1976
www.chicogrange.org
The historic Chico Grange promotes healthy local agriculture and environmental stewardship in our vibrant community. We invite you to attend out monthly meetings on the 1st Tuesday of each month with a community potluck and environmental topics from 6-7:30PM. The rural setting provides parking for 80 and accommodates indoor and outdoor events.The Chico Grange Hall is a proud supporter of Buy Fresh Buy Local.

Chico Chamber of Commerce
441 Main Street, Suite 150
P.O. Box 3300
Chico, CA 95927
530-891-5556
heather@chicochamber.com
www.chicochamber.com
The Chico Chamber of Commerce is one of the largest business advocacy organizations in Northern California. Mission: Chico Chamber of Commerce...The Voice of Chico Business. Our mission is to be the unified voice of the businesses we represent. Our vision is to influence decision makers on behalf of the business community. The Chico Chamber of Commerce is a proud supporter of Buy Fresh Buy Local.

College of Agriculture
CSU, Chico
400 West First Street
Chico, CA 95929-0310
530-898-5844
www.csuchico.edu/ag
The CSU, Chico College of Agriculture supports vibrant food systems through education, research, and service to the North State community. The 800-acre University Farm serves as a living laboratory for students enrolled in agriculture. For more information please visit our website at www.csuchico.edu/ag or give us a call. The COA is a proud supporter of Buy Fresh Buy Local.

FARMERS' MARKETS

Chico Certified Farmers' Market
P.O. Box 455
Chico, CA 95927
530-893-FARM
managerccfm@gmail.com
www.chicofarmersmarket.com
The Chico Certified Farmers' Market (CCFM) brings fresh, quality, and locally produced foods, and handmade artisan products to Northern California communities at five different markets in Chico, Oroville and Paradise. See the farmers' market list in this guide for details about each market! The CCFM is a proud supporter of Buy Fresh Buy Local.

CULTIVATING COMMUNITIES TO HEALTHIER FOOD ACCESS

HEALTHY, LOCALLY GROWN PRODUCE FOR ALL

BY MONICA BELL

With enough cooperation and ingenuity, our region has the capacity to provide healthy, locally grown food to its residents. Cultivating Community North Valley (CCNV) is a partnership of non-profit organizations with projects increasing food system participation and capacity in the northern Sacramento Valley. Partners provide education, consultation, networking and targeted resources toward cultivation, processing, preservation, and consumption of fruits and vegetables. They serve students, small-scale and low income farmers, and under-resourced populations.

CCNV is currently funded by a California Department of Food and Agriculture (CDFA) Specialty Crop Block Grant, awarded to the CSU Chico's Research Foundation, and directed by Dr. Lee Altier. Its objective is to increase food security by enhancing the availability of local vegetables, fruits, and nuts, as well as addressing food system needs of low-income residents, local growers, and community service agencies.

In this effort, the project has formed a stakeholder coalition of like-minded people and organizations to cooperatively address food security needs. This group includes educators, nutritionists, farmers, businesses, and community agencies devoted to enhancing our local food system.

At the hub of CCNV are four core projects: the Chico State Organic Vegetable Project, GRUB Education Program, Center for Nutrition and Activity Promotion (CNAP), and cChaos (Collaboratively Creating Health Access Opportunities & Services). These partners are implementing opportunities for community members to contribute to our local food system by:

- **Training students and community members in sustainable, practicable technologies for small-scale gardening and farming;**
- **Teaching about nutrition and skills for preparing and processing fresh specialty crops;**
- **Promoting local food production at home, in community gardens, and on small farms;**
- **Supporting businesses that produce, process and preserve local produce (small, locally-owned urban and rural farms and cottage food industries)**
- **Promoting the use of CalFresh benefits (known as EBT or Food Stamps) at farmers' markets; and**
- **Supporting farmers' markets that sell specialty crops.**

The Chico State Organic Vegetable Project offers students an experiential education in diverse vegetable production, provides workshops for the community, and conducts research on the viability of new cultivars for commercial production in the northern Sacramento Valley.

The GRUB Education Program is facilitating the development of a minimum of 15 new community gardens for low income neighborhoods. It also offers onsite workshops on organic gardening in urban environments.

CNAP provides cooking demonstrations at workshops and farmers' markets from under the canopy of a bicycle-powered, mobile kitchen cart. The "Edible Pedal" interactive culinary exhibitions demonstrate nutritional, low-cost methods to prepare fresh fruits and vegetables.

cChaos is promoting the use of CalFresh benefits at all Butte County Farmers' Markets. They partner with farmers' markets serving low-income growers and areas by assisting with operating costs and offering incentive programs to bring CalFresh recipients to farmers' markets and to local community-supported agriculture (CSA) programs.

To learn more about Cultivating Community North Valley, join the coalition to increase access to healthy, locally grown produce for all, or to find out how to participate in any of our programs, please visit cultivatingcommunitynv.org.

GOOD EATS | BUTTE COUNTY FARM BUREAU

BUYING IN-SEASON, LOCAL & CALIFORNIA-GROWN FOR MY FAMILY

BY COLLEEN CECIL

Deciding what food to buy for my family can be tough. "Buy local, buy organic, only buy from farmers you know," the list goes on and on. All are great suggestions but not always easy to accomplish. I could spend all my time researching farms, food, farmers, stores, farmers' markets, coupons, weekly sale ads, and reading the numerous blogs, tweets, and posts that exist on the topic. The truth is I don't have time and if I had to guess, neither do you. I choose to spend my time being a wife, a mom and a working professional.

Now I will admit I do relish in a good trip to the grocery store; so much so that my husband will not go with me. He prefers to start on one side of the store and make his way down every aisle getting what he wants in a very logical order. I on the other hand take a random path getting what we need, what looks appetizing, comparing prices and perusing the cheese display. Nothing can a put smile on my face like a creamy California blue cheese. I love cheese! Going to the grocery store and the farmers' markets are treats for me. But that is not my point here.

My point is this, I have found a food buying strategy that can be utilized in any shopping environment – grocery store, membership warehouse or farmers' market – that works for my family and I want to share it with you.

Buy in season first, buy local second, buy California-grown third and if all else fails buy American-grown.

It's simple and straight forward and I can do this at any place I want to buy my food. This strategy also works for me because I trust the farmers who are producing food for my family and me. Furthermore, I know when buying my food anywhere in the United States, that I have the privilege of buying food from the safest and most affordable food supply in the world.

If I am buying in season, then I know I am buying when food is at its most abundant and freshest.

My definition of local is the growing region that you and I live in – for me that is the Central Valley of California. If I am buying local, I know that the distance the food traveled to get to me is an advantage for the environment and the quality of the food. Your definition of local might be something different and that's okay. That is a personal decision that you should make after you have determined what is important to you.

If I'm buying California-grown then I know I am supporting the state's economy. (And odds are if you are doing the first and the second, you are also doing the third at the same time and you didn't have to think about it.)

And if I am buying American, I am putting my hard-earned dollars to work in our country.

You might ask yourself, "How can I trust these farmers who I don't know?" I would then ask you, "How can you not trust these people?" It's impossible to live our day-to-day lives without a little trust. I trust the paper will be there each morning in the driveway. I trust the person changing my oil will put the cap back on the oil pan. I trust my hairdresser is not going to turn my hair blue. And I trust farmers. After all they too are feeding their families with the food they produced.

I will acknowledge that living in California does come with its advantages - more than 350 advantages. That is the number of crops we grow here. But the strategy can work in any state and in any growing region.

This simple approach allows me to do less worrying and more of what is important – living life to the fullest and enjoying the simple pleasures like taking in-season local cucumbers and apricots and turning them into preserved delights to enjoy all year long!

Colleen Cecil is the wife of a farmer, the mother of two adorable little boys and the Executive Director of the Butte County Farm Bureau. Colleen and her husband, Jake, live in Chico with Clayton and Dalton and when they are not working on their new walnut orchard in Orland, they enjoy cooking for family and friends and camping in their 5th wheel.

FARMER PROFILE

BERKELEY OLIVE GROVE

BY NOELLE FERDON, J.D.

When the Griecos began producing Berkeley Olive Grove 1913 extra virgin olive oil from the historic mission olive in 2008, their goal was to make "the best and most healthful olive oil we can," says Darro Grieco.

It appears he and his wife, Olivia, have accomplished exactly that.

Their oil - produced from hand-picked, certified organic, sustainably farmed Mission olives – won "Best of Show" at the Los Angeles International Extra Virgin Olive Oil Competition in April 2012.

Berkeley Olive Grove's sustainable farming methods include returning chipped prunings to the soil as mulch, working with specialists to cultivate mushrooms that thrive on an olive orchard floor rich in organic matter; and utilizing goats that enthusiastically assist in orchard management of the edibles not needed for olive production.

The Mission variety produces the one olive oil that is exclusive to the New World. Butte county became recognized as the perfect "California Mediterranean." Early California newspapers and Butte county historians have reported that Berkeley Olive Grove was the largest single planting of Mission olives in the world. "Such a traditional agriculture environment might not happen again, or until we as a culture remember that sustainable agriculture provides nutritional food," Darro says. "This is a unique place, and with the entire estate one day under conservation it will continue as a place where people can experience a historic grove."

photo courtesy of Nicole Landini

Darro and Olivia of Berkeley Olive Grove 1913 are committed stewards of California olive oil and California history! The Berkeley Olive Grove produces three different flavor intensities for versatility: Delicate (California Mission Reserve), Medium (California Mission Gold) and Robust (California Mission Classic) and is a proud member and supporter of Buy Fresh Buy Local, North Valley!

Visit www.berkeleyolivegrove.org for more information on where to find Berkeley Olive Grove 1913 olive oil.

FARMER PROFILE

MAISIE JANE'S CALIFORNIA SUNSHINE PRODUCTS

BY JANAE LLOYD

When Maisie Jane Hurtado talks about her namesake almond business, the conversation continually comes back to the importance of family. "Family is the most important thing to me," she says, and her business could not exist without it.

Maisie Jane's great-grandfather came to Chico from northern Italy. Outside of his work as a gardener and landscaper, he planted several "hobby" almond trees. His son (Maise Jane's grandfather), Ben Bertagna, was the one who truly learned the trade. By the time he was in high school, Ben knew enough about almonds and had saved enough money to buy his first piece of land and plant an orchard. Maisie Jane is carrying on the family tradition and is a fourth generation almond farmer.

photo courtesy of Isidro Hurtado

Maise Jane and her husband, Isidro, have 60 acres of almonds in the Chico and Durham area. They sell raw, roasted, sliced, flavored, candied, and chocolate covered almonds along with almond butter and honey from the bees in their orchards. Their products can be found nation-wide and in Canada. All the almonds come from either her own orchards or her father's, brother's, or sister's.

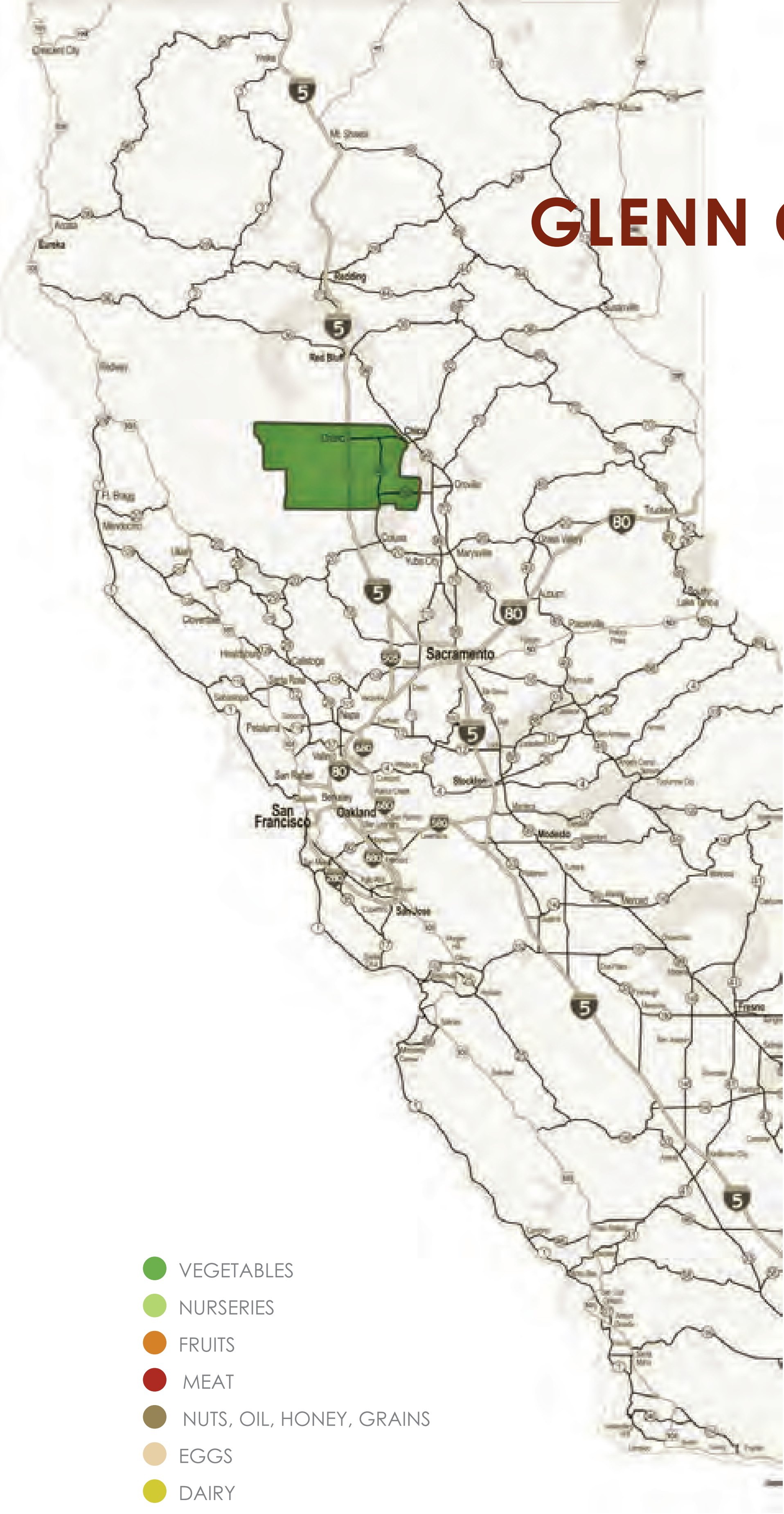
The business of flavoring almonds started as Maisie Jane's project for Future Farmers of America when she was 17 years old. The very first flavors were tamari (inspired by her mom), cinnamon glaze, caramel corn, and coffee glazed (no longer available). She knew it was what she wanted to do with her life right away. "I was taught by my parents that life is too short and you have to really love your career! I'm doing that!" she says, "I'm grateful that I started at the young age that I did. " Maisie Jane likes to encourage young adults to not be afraid to tackle their dreams early. "They've got nothing to lose and they'll never know if they don't try!"

Another thing Maisie Jane is passionate about is sustainability and organics. She has always prioritized the decrease of synthetic materials in her orchards, such as using chicken manure instead of synthetic fertilizer and using Integrated Pest Management instead of pesticides. In 2002, the business came out with their first batch of Certified Organic almonds. They go above and beyond by actively working to create a better environment. This includes bee-keeping in the orchards to promote healthy pollination and re-introducing native plants to encourage insects.

The thing Maisie Jane loves most about her job is the ability to promote the local economy and share the bounty of the land. She looks forward to offering the community educational tours of her business, covering the processing of her almonds from beginning to end. She also looks forward to creating new products. She is continually listening to customer suggestions, watching trends, and experimenting on her own.

Outside of the almonds, Maisie Jane enjoys country living with her husband and three daughters (Isabel, Natalia, and Lilia). They love to bake, cook, sew, and ride bikes. Their property is also home to ponies, a horse, cows, chickens, and a year-round garden. Her parents live by the orchard across the street and her brothers are close by too. "I enjoy the simple things in life! This is a dream come true." Maisie Jane says.

You can find Maisie Jane's almonds locally at Chico Natural Foods Co-op, S&S, Raleys , Safeway and Holiday Foods. Maisie Jane also has her own store located at 1324 Dayton Road in Chico where you can purchase all her products as well as gift baskets and a variety of other locally-produced goods. They're open Monday through Friday from 9am-5:30pm and Saturday from 10am-4pm. Make sure to say "Hi" to Maisie Jane's mom and aunt, who work in the store!



VEGETABLES
NURSERIES
FRUITS
MEAT
NUTS, OIL, HONEY, GRAINS
EGGS
DAIRY
WINE

GLENN COUNTY

A message from the Glenn County Agricultural Commissioner…

Glenn County is located in the heart of California's fertile Sacramento Valley half way between Sacramento and Redding. Mendocino National Forest is on the county's west side, and the Sacramento River borders the east. The county was named after Dr. Hugh Glenn, who was known as California's Wheat King. With over 1,188 farms, agriculture remains the primary source of Glenn County's economy. Major commodities include rice, almonds, walnuts, milk products, corn, and livestock. The Glenn County farmers' markets offer an opportunity to purchase locally grown produce.

In 2011, Glenn County ranked 18th out of the 58 California Counties for Agricultural Production. The following commodities ranked within the top 5 crops in California: Rice (3rd), Corn Grain (5th), Dried Plums (5th), Vegetable and Vine crop Seeds (5th), Oil and Table Olives (3rd), and Blueberries (5th).

There are world class salmon and shad in the Sacramento River, which is easily accessible by boat or shore throughout Glenn County.

Due to the great tracts of land set aside exclusively for duck sanctuary, duck hunting in Glenn County is considered world class. This abundance of ducks available for hunting brings hundreds of hunters from around the world to Glenn County.

Jim Donnelly has been Glenn County Agricultural Commissioner, Sealer of Weights and Measures, APCO, CUPA director since March 2011 and worked previously as the Lassen County Agricultural Commissioner, Sealer of Weights and Measures, APCO, CUPA director from January 2008 – March 2011. Before this he worked in the Imperial County Agricultural Commissioner's Office for 25 years. Jim graduated from San Diego State University with a BA in Botany, Liberal Arts and Spanish.

ECONOMIES OF FOOD

LOCAL FOOD SYSTEMS: WHY THEY MATTER TO YOU & ME

BY MARK NEMANIC

Communities in Butte, Glenn, and Tehama counties are enjoying healthier food grown by local producers. These same producers are beginning to reap better returns and are keeping these returns here at home where they deepen the local economy.

According to a recent study, there are 5,042 total farms in the tri-county region, including 223 family-held farms and 141 farms with organic production. Total acreage is 1,395,178 with $743,307,000 in annual crop sales—of this amount, $7,884,000 in crops sales are direct sales to consumers.

Demand for healthier, more sustainably produced food is a two-edged sword: the returns are better than commodities, but the business models and related infrastructure may not be able to fulfill demand as it continues to grow—broadening our approach to creating shorter supply chains between producers and end users is a key development driver for our local farmers and ranchers.

This is particularly true given the distribution of small and medium-sized farms and ranches in the tri-county region—of the total 5,042 operations, 3,035 or 60% have operations of less than 50 acres.

By creating better ways to connect the producer with the consumer, we, as a community, can meet a number of positive goals including:

- **Increasing producer incomes to retain current operations and encourage beginner farmers and ranchers to enter the field.**
- **Greater wealth retained and circulated by our communities.**
- **New jobs that involve food production, processing, distribution, and retailing.**
- **Healthier, more diverse foods that can prevent obesity and diet-related diseases.**
- **Increased supply of local food to underserved people.**

Local food systems can support different and varied farming operations while contributing to the local community economy. Back in the 1940's studies looking at California farming communities showed that, in towns surrounded by smaller family farms, incomes circulated among local businesses, creating jobs and adding to the community's prosperity. This multiplier effect led to more community wealth, businesses and community amenities such as paved streets, sidewalks, schools, parks and the like.

Food grown close to the consumer can ripen to peak flavor. The produce harvested at its best is often more nutritous and better tasting. Producers who sell directly to the consumer get immediate feedback on quality and desired varieties. Likewise, consumers who have access to local food networks can influence the choice of food that is available and can know where and how the food they consume is grown.

All these factors are driving us in the economic development field to rethink our strategies—focusing more on sustainable local systems that capture and recycle wealth for healthier communities. Recently, Rabobank seeded 3CORE and the Northern California Regional Land Trust (NCRLT) to test the feasibility of creating a local food hub.

An NCRLT grower survey showed that they would produce more goods if the market could be expanded—this finding is critical since it suggests that many growers are operating or selling at less than full capacity. By expanding sales, incomes could rise without expanding the land base.

Another key finding was access to cold storage to extend the market. Fifty-two (52%) of producers said that more cold storage was important—more importantly, 63% of the respondents said they needed less than 100 cubic feet.

What is clear through this feasibility study is that simple, on-line aggregation services to connect producers and consumers, as well as small, mobile cold-storage solutions that limit product loss, are where we need to go.

NCRLT recently received USDA funding to develop and implement an on-line aggregation network. 3CORE will be working with the NCRLT to bring this important new tool into being over the next 2 years.

3CORE is a private non-profit community development financial institution helping public and private partners to address social, economic, and employment needs through-out Butte, Glenn, and Tehama counties by cultivating healthy businesses because people matter. Marc Nemanic has been the 3CORE Executive Director since 1991.

GROWERS & FARMSTANDS

Ainsworth Orchards
Jim Ainsworth
4298 County Rd K ½
Orland, CA 95963
530-865-3200

Alston Farms
Linda Alston
1010 Hwy 99W
Orland, CA 95963
530-865-2666

Ariza Farms
Mike and Debbie Ariza
7641 Cutting Ave
Orland, CA 95963
530-781-2195
debariza@gmail.com
www.arizafarm.com
Ariza Farm is a family run business. We have been in operation for 30 years. Some of our winter produce include Kiwi, mandarins, guava, pomegranates, and persimmons. Summer items include peaches, nectarines, plums, cucumbers, cantaloupe, and eggplant. Ariza Farms is a proud supporter of Buy Fresh Buy Local.

Buttermore Rancho Costa Lota
Staci Buttermore
7068 County Rd 24
Orland, CA 95963
530-865-3504

Cowgirl Eggs
Carol Avellino
6584 County Road 22
Orland, CA 95963
530-864-5514
avellino@clearwire.net
Cowgirl Eggs is a small farm providing fresh eggs from pastured-raised chickens. We started Cowgirl Eggs to share the wonderful experience of fresh eggs with the community. Eggs are available from the farm, Chico, Orland and Willows farmers markets' & the Rusty Wagon. A home delivery service is available in Chico and Orland. Cowgirl Eggs is a proud supporter of Buy Fresh Buy Local.

Douglass Ranch
Kelly and Shannon Douglass
Orland, CA 95963
530-865-5905
shannondouglass@hotmail.com
www.douglassranch.com
We raise Black Angus cattle and select our best calves for our direct-market program. They are raised naturally on grass, finished on grain and with no added hormones or antibiotics. The beef is aged and then cut and wrapped for custom orders. Sold at the Saturday Chico farmers' market and by the half and quarter direct to our customers. Douglass Ranch is a proud supporter of Buy Fresh Buy Local.

Embrey Family Farms
Gene and Janice Embrey
4716 County Rd N
Orland, CA 95963
530-865-2092

Glenn Organics
John Shovein
7249 Road 24
Orland, CA 95963
530-513-0160
jrshovein@gmail.com
Specializing in organic tomatoes. Glenn Organics is a proud supporter of Buy Fresh Buy Local.

Heath Ranch Organics
Ron and Melanie Heath
4814 County Rd 99W
Orland, CA 95963
530-865-3472

J & G Farms
Gary and Janice Shields
4038 County Rd FF
Orland, CA 95963
530-865-0891

Jasper's Nursery & Orchards
Chuck and Christina Jasper
7122 Hwy 32
Orland, CA 95963
530-865-2888

Linzy Mandarins
Clark and Peggy Linzy
7444 Cutler Ave
Orland, CA 95963
linzy33@earthlink.net
We offer three varieties of Satsuma Mandarins: Okitsu Wase, Owari, and Dobashi Bene and are open mid-October through December. Linzy Mandarins is a proud supporter of Buy Fresh Buy Local.

Martin's Navel Oranges
Ira, Sharon & Rick Martin
6364 County Rd 18
Orland, CA 95963
530-865-3637

Massa Organics
Greg Massa and Raquel Krach
PO Box 535
Hamilton City, CA 95951
530-519-8628
greg@massaorganics.com
www.massaorganics.com
Owners Raquel Krach and Greg Massa take an ecological approach to food production. Massa Organics grows and direct markets organic brown rice, organic almonds and almond products, organic hay, and organic pastured pork and lamb. Available at 14 farmers markets in Northern California, select distributors, and direct from the farm. Massa Organics is a proud supporter of Buy Fresh Buy Local.

McLane Farms
Erica McLane
10 Second Ave
Orland, CA 95963
530-865-4640

Patti Sexton Livestock
Patti Sexton
PO Box 4
Artois, CA 95913
530-865-2319

Pedrozo Dairy & Cheese Co.
Tim Pedrozo
7713 Rd 24
Orland, CA 95963
530-514-3837

Shuey Family Farms
Sue Shuey
6340 County Rd 21
Orland, CA 95963
530-865-1330

Sierra Nevada Cheese Company
6505 County Road 39
Willows, CA 95988
530-934-8660
meghan@sierranevadacheese.com
www.sierranevadacheese.com
Sierra Nevada Cheese Company handcrafts Certified Kosher award-winning Natural and Organic fine dairy foods in Willows, California sourcing local milk free from antibiotics and synthetic hormones. We use no fillers, artificial ingredients, or rennet. We seek farmers whose practices support animal welfare, pasture grazing, and sustainable local agriculture. Sierra Nevada Cheese Co is a proud supporter of Buy Fresh Buy Local.

St. John Family Farms
Marlene Shoop
19400 Newville Rd
Orland, CA 95963
530-865-5206

Stokes Family Blueberries
Kevin and Teresa Stokes
6974 County Rd 6
Orland, CA 95963
530-865-5560

Ten Point Farm
Thomas & Angie Blume
4340 County Rd Q
Orland, CA 95963
530-865-4780
tenpointfarm@digitalpath.net
Our small farm is chemical free and sustainable. We grow navel oranges, Blenheim apricots, fresh vegetables and herbs available in season. Shelled and vacuum packed pecans and walnuts. All products carefully hand processed and inspected. Direct sales to customers. Call or email for delivery arrangements or visit our farm. Ten Point Farm is a proud supporter of Buy Fresh Buy Local.

The Divide Ranch
Mike and Kathy Landini
P.O. Box 99
Elk Creek, CA 95939
530-968-5601
divideranch@gmail.com
www.thedivideranch.com
We are a family-run cow/calf operation in Elk Creek, CA. We raise cattle on our ranch primarily for the commercial beef industry but also raise some of our steers as grass-fed, all natural (no hormones or antibiotics) beef for direct sales and local farmers' markets. Divide Ranch is a proud supporter of Buy Fresh Buy Local.

The Dream Catcher Ranch
Kimberly and Richard Nicholes
6210 County Rd 3
Orland, CA 95963
707-321-0941 or 707-322-7993
www.thedreamcatcherranch.com
We currently sell pastured Berkshire pork, grass fed beef, lamb and goat. We sell at the Santa Rosa, Orland, Willows and Red Bluff farmers' markets, and The Rusty Wagon in Orland. Find us on the menu at Farwood Bar and Grill in Orland as well. The Dream Catcher Ranch is a proud supporter of Buy Fresh Buy Local.

The Garden Guys Nursery and Gardens
854 Plumas Street
Willows, CA 95988
530-934-9580
beargardenguy@yahoo.com
The Garden Guys Nursery and Gardens grows heirloom tomatoes, natural peppers, egg-plant, basil, corn, okra, a variety of seasonal fruits, as well as annual and perennial vegetable starts, flowers and shrubs. The Garden Guys Nursery and Gardens is a proud supporter of Buy Fresh Buy Local.

West Coast Products
Mark DeCamilla
717 Tehama St
Orland, CA 95963
530-865-3379

Yancy's Produce
Greg Yancy
6235 County Rd 23
Orland, CA 95963
530-865-3210

SPECIALTY RETAILERS & GROCERY STORES

The Rusty Wagon
420 Walker Street
Orland, CA 95963
530-988-9132

Sav-Mor
32 East Walker St
Orland, CA 95963
530-865-2112

RESTAURANTS & CAFES

Alta Marie's Bakery & Soup Shop
Steve & Kristine Monck
807 4th St
Orland, CA 95963
530-865-1577

Farwood Bar & Grill
705 5th St
Orland, CA 95963
530-865-9900

CATERER

Country Gal Catering
Vicki Nolta
Willows, CA
530-934-3932

FARMERS' MARKETS

Glenn County Certified Farmers' Market
Glenn County Resource Conservation District
132 N. Enright Ave., Suite C
Willows, CA 95988
530-934-4601 x5
www.glenncountyrcd.org
Glenn County Certified Farmers' Market is entering its fourth season! The market provides customers and tourists with an opportunity to purchase local, fresh foods and crafts. Certified fruits and vegetables are available, as well as local meats, cheeses, nuts, breads, art, prepared food, and entertainment. For more information, visit www.glenncountyrcd.org. The GCCFM is a proud supporter of Buy Fresh Buy Local.

HOW CONSERVATION FARMING ADDS VALUE & BENEFITS LOCAL FOOD SYSTEMS

BUFFER STRIPS IN FARMING SYSTEMS

BY KRISTINA SCHIERENBECK, Ph.D.

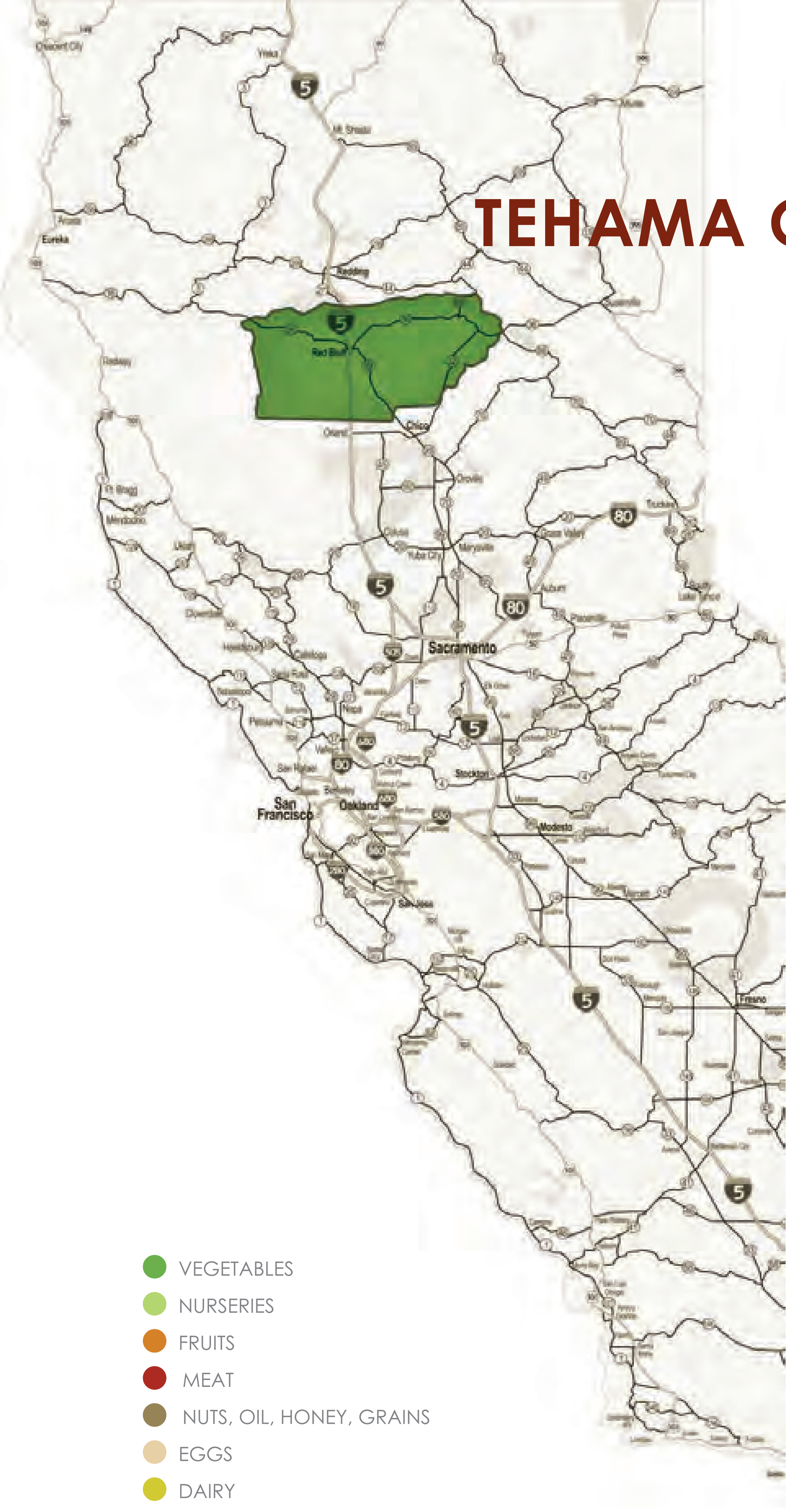
Buffer strips are areas of permanent vegetation around an agricultural field that have the purpose of reducing soil erosion and water run-off and increasing habitat value. There are different kinds of buffer strips: a riparian ("along the river") buffer strip is vegetation along a watercourse that provides protection of the waterway from agricultural pollutants, sediment and overland water flow while increasing habitat value for native species; and field border strips enhance crop productivity through providing beneficial insect and bird habitat, reducing wind erosion, preventing chemical drift, and increasing soil conservation.

Along waterways, trees are particularly useful in land stabilization with their deep root systems and provide critical shade to aquatic organisms. In addition to their many beneficial effects, trees in buffer strips can also provide a tree crop that can be harvested for building materials. Shrubs and deep rooted native grasses are especially useful in taking up excess phosphorus, nitrates and water. In the California Central Valley more than 225 species rely on riparian habitat, yet only *two* percent of our riparian vegetation remains since California was settled. Much of the upper Sacramento Valley within a few *miles* of some of our large rivers and streams were formerly vegetated with riparian species. Buffer strips provide nesting material, shelter and food for many songbird species. When connected with other buffer strips or natural areas, they can provide a corridor in which species can move safely. Native tree species in the Central Valley that are excellent in riparian buffer zones include the Valley oak, Fremont's cottonwood, California sycamore (be careful not to get the invasive London Plane tree by accident!), and box elder. Large shrubs include California buckeye, elderberry, willow, and understory species include California poppies (be sure to get the native Sacramento Valley perennial, not the horticultural annual!), lupines, purple owl clover, and goldfields. The National Resource Conservation Service recommends a minimum of 30 ft of a buffer zone along a waterway.

A healthy, vibrant local food system includes maintaining a local, healthy ecosystem. Field border strips are useful for farms or gardens of any size and done correctly, will positively impact an ecosystem. Buffer strips can be of any width, but ideally they should be a minimum of 6 feet wide. It is important to use a variety of sizes of plants and different species to maximize the benefits. The use of deep-rooted native species such as bunch grasses will provide strong competition against non-native weeds such as yellow star thistle and annual grasses. Along field borders, if shade is not desired, native grasses provide a good food source for quail and songbirds. Lupines, Lotus, Gilia, Astragalus, Salvia, Phacelia, Layia, Epilobium, and Monardella species are all exceptional pollinator attractants. In addition to providing increased pollination, pollinators will also help compete against pest-insects. Lupine and Ceanothus species have the added benefit of providing extra soil nitrogen. Shrub species that attract a variety of pollinators include coyote bush, buckwheat, yarrow, manzanita, and California lilac. Your local college botanist, native plant vendor, or California Native Plant Society can advise you on the most appropriate species for your particular site. Native vegetation does exceptionally well when planted in the fall or winter. If planted in the spring, it may require irrigation. Planting native vegetation in the summer is not recommended and will have a high failure rate.

There are a number of educational programs regarding buffer strips and in some cases, financial incentives through the Farm Bill, National Resource Conservation Service and the California Department of Fish and Game.

Kristina Schierenbeck has been a botanist since 1985 and a professor of botany since 1994. Her expertise is in the conservation and genetics of native plant communities, researching invasive non-native species, and enjoying the great outdoors of Northern California! Dr. Schierenbeck also serves on the board of the Northern California Regional Land Trust.



TEHAMA COUNTY

A message from the Tehama County Agricultural Commissioner…

Tehama County is located approximately midway between Sacramento and the Oregon border and is bisected by the Sacramento River. The fertile soil along the river valley hosts the county's top three commodities, walnuts, prunes and almonds, which cumulatively account for almost 60% of the total agricultural production. The total gross value for agricultural production in 2011(most recent year available for data) was $245,670,000.

Tehama County is annually ranked among the top three table olive producing counties within the state. Over 6,300 acres of table olives are harvested annually. Planted acreage of olives for oil production continues to increase. 1,707 acres of these varieties were harvested in 2011.

Small vineyards and licensed wine tasting rooms continue to populate Tehama County encouraging visitors to explore not only the New Clairvaux monastery in Vina, but higher elevations in the Manton area as a stop-off destination for travelers on their trek to Mount Lassen.

Registered organic production has increased to over 12,600 acres of registered organic land within Tehama County, ranging from small gardens catering to our local certified farmers' markets to large-scale livestock and commercial crops.

Rick Gurrola is the Tehama County Agriculture Commissioner and a lifelong local resident. He has been employed by the Tehama County Department of Agriculture for almost 26 years and has served as the agricultural commissioner for 8 years to date.

- VEGETABLES
- NURSERIES
- FRUITS
- MEAT
- NUTS, OIL, HONEY, GRAINS
- EGGS
- DAIRY
- WINE

GROWERS & FARMSTANDS

Bianchi Orchards
Annie and Becky Bianchi
10245 61st Ave
Los Molinos, CA 96055
530-527-9157

Big Bluff Ranch
Tyler Dawley
Red Bluff, CA
530-529-2291

Burlison Fruit Stand
Aldon and Elen Burlison
11390 HW99E
Los Molinos, CA 96055
530-209-2108

Chris' Egg Farm
Chris Copley
1314 Solano St
Corning, CA 96021
530-824-5211

Corning Olive Company
721 Fig Ln
Corning, CA 96021
530-824-5447

Eidman Family Farm
Mark and Mary Jayne Eidman
15640 W. Wallen Rd
Red Bluff, CA 96080
530-528-0568
info@discoverearth.us
Eidman Family Farm raises beef cattle, lamb, and chickens on the incredible irrigated pastures of the Bend District in Red Bluff. They are proud to use environmentally friendly practices, making their farm an amazing place for people, wildlife, and livestock. Eidman Family Farm is a proud supporter of Buy Fresh Buy Local

Farmelot
James Brock and Bruce Balgooyen
P.O. Box 285
Vina, CA 96092
530-392-2640
Farmelot@gmail.com
www.farmelot.org
Farmelot grows sustainable food, utilizing regenerative land practices on a vintage farm in Northern California, 175 miles NE of San Francisco. Dr. Bruce and Farmer James worked collaboratively to create Farmelot. Our heirlooms and old world varieties are a main attraction at the vibrant downtown Chico Saturday farmers' market. Farmelot is a proud supporter of Buy Fresh Buy Local.

Hansen's Blueberry Farm
Richard & Anna Lee Hansen
3325 Houghton Ave
Corning, CA 96021
530-824-2331

Herb Blossom Express
Marshall Loskot
1 Mushroom Ln
Platina, CA 96076
530-352-4224

Homegrown Enterprises, LLC
Sue Lawing
15530 Paskenta Rd
Flournoy, CA 96029
530-833-0119

Julia's Fruit Stand
Kathy & James Brandt
11475 Hwy 99E
Los Molinos, CA 96055
530-528-8754

Lima Huli Lavender Farm
Kendra Howell
PO Box 403
Manton, CA 96059
530-474-1584

Lucero Olive Oil
Dewey Lucero
2120 Loleta Avenue
Corning, CA 96021
530-824-2190
mail@lucerooliveoil.com
www.lucerooliveoil.com
California's most award winning olive oil company. Enjoy local olive oil tasting, tapenades, olives, and mustards. Open 7 days a week from 9:00am to 5:00pm, tastings and tours daily. Call ahead to schedule a tasting and tour. Lucero Olive Oil is a proud supporter of Buy Fresh Buy Local.

Maywood Farms
Robert Steinacher
3635 Mt. Shasta Ave
Corning, CA 96021
530-824-4216

McKenzie Ranch
Cody McKenzie
17950 Jellys Ferry Rd
Red Bluff, CA 96080
530-527-3294

Mi Vida Loca Enterprises
Natalie Peterson
19779 Callahan Rd
Red Bluff, CA 96080
530-351-4698

Nickler Acres
Mindy Nickler
22521 Rodeo Ave
Gerber, CA 96035
530-526-9943

North Valley Farms Chevre, Inc.
Mark and Deneane Ashcraft
P.O. Box 698
Cottonwood, CA 96022
530-347-7151
nvchevre@hotmail.com
Single source farmstead goat cheese-all milk/curd single source with no milk purchased or curd purchased from either domestic or foreign sources, hand certified organic. Pastured free range goat herd, cheese guaranteed to be completely "field to fork" grown in and a product of Tehama County. North Valley Farms Chevre is a proud supporter of Buy Fresh Buy Local.

WINERIES & VINEYARDS

Pacific Sun Gourmet
Leslie Stone
22880 Gerber Rd
Gerber, CA 96035
530-385-1475

Redwood Organic Farm
PO Box 431
Manton, CA 96059
530-524-5537

Springfed Farm & Nursery
Wolfgang Rougle
16395 Ridgewood Rd
Cottonwood, CA 96022
530-721-0164
springfedfarm@yahoo.com
Our cool-season CSA runs January-June, delivered weekly to Redding. In season, find us at Redding's Saturday farmers' market for gourmet greens and root veggies, plus nursery plants: culinary and medicinal herbs, perennial vegetables & native/insectary plants. Special nursery orders welcome. CCOF certified organic. Springfed Farms is a proud supporter of Buy Fresh Buy Local.

Striking A. Livestock
Amber Leininger
PO Box 332
Vina, CA 96092

Sugar Pine Farm
Abby LaPointe and Gary Lawless
32288 Rock Creek Rd
Manton, CA 96059
530-474-1298

Tehama Angus Ranch
Bryce and Linda Borror
23820 Tehama Ave
Gerber, CA 96035
530-385-1570

Triple Z Ranch
Linda Ezzat
23311 Hamilton Ave
Gerber, CA 96035
530-508-NUTS

Turri Family Farms
Tony Turri
PO Box 2158
Flournoy, CA 96029
530-570-1276
marianne@turrifamilyfarms.com
www.turrifamilyfarms.com
We raise all natural grass-fed and finished beef and lamb. All of our animals are hormone and antibiotic free. We have a variety of products including traditional meat cuts and a variety of jerkeys and beef snacks. Please visit our website to learn more about our operation and where our products are available. Turri Farms is a proud supporter of Buy Fresh Buy Local.

Whittenberg Farms
Zach and Hannah Whittenberg
18870 Reeds Creek Rd
Red Bluff, CA 96080
530-529-0866

Wolf Ranch
Dan & Teri Wolf
5925 Hwy 99W
Corning, CA 96021
530-824-5291

Alger Vineyard & Winery
31636 Forward Rd
Manton, CA 96059
530-474-WINE

Burnsini Vineyards
Tom Burnham
19535 Hammers Ln
Cottonwood, CA 96022
530-347-4765

Cedar Crest Vineyards
Cory Livingston
32505 Forward Rd
Manton, CA 96059
530-474-1387

Indian Peak Vineyards
31559 Forward Rd
Manton, CA 96059
530-474-5506

Mount Tehama Winery
Alain Teutschmann
32165 Forward Rd
Manton, CA 96059
530-474-3304

New Clairvaux Vineyard
26240 7th St
Vina, CA 96092
530-839-2200

Ringtail Vineyards
32055 Forward Rd
Manton, CA 96059
530-474-5350

CLEARING THE WAY FOR A LOCAL FOOD ECONOMY

IDENTIFYING CAPACITY, BREAKING DOWN BARRIERS & IMPLEMENTING SOLUTIONS

BY JACOB N. BRIMLOW, Ph.D. & NOELLE FERDON, J.D.

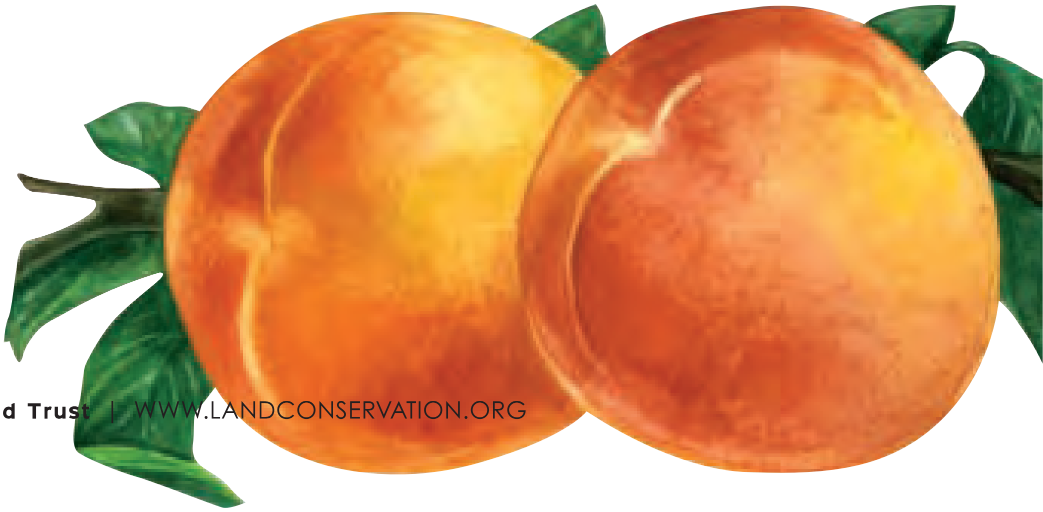
With thriving farmers' markets full of people happily buying local meats, dairy, fruits, vegetables, plants, flowers and other products, it's easy to assume our region is reaping the benefits of a fully developed local food system. And while we certainly do have successes worth celebrating, some recent local research points to opportunities to increase the size and scope of our local food system that could stimulate the economy, benefit the environment, and increase the viability of small- and mid-sized local farmers.

In 2011, the Northern California Regional Land Trust ("land trust") received a Specialty Crop Block Grant from the California Department of Food and Agriculture to enhance and promote regional specialty crops, defined by the USDA as fruits, vegetables and tree nuts, by using the Buy Fresh Buy Local, North Valley marketing program. Buy Fresh Buy Local kicked off in the North Valley in late 2009 and has been working since then with small- and mid-sized growers, retailers, and restaurants to find and create innovative new markets for local food. Using the CDFA grant as a guide, we explored the extent and growth potential of the local food system in Butte, Glenn, and Tehama counties (the "tri-county" region) with the goal of establishing a baseline of local food production and consumption. We conducted surveys and interviews with local consumers and growers, analyzed USDA production and consumption data, commissioned a financial feasibility study, and reviewed case studies from local food systems in other regions. So, what have we learned, and how can we use it to make a more robust regional food system a reality?

LESSON 1

There is room for growth in the local food economy.

Our surveys and interviews with consumers and other food buyers in the tri-county region showed strong and growing interest in high quality, affordable, nutritious, local food. Fortunately, we live in a region with abundant and diverse production capable of meeting a large portion of local demand: using production and consumption estimates from USDA Census of Agriculture data, we estimated that the tri-county region has the capacity to supply up to 70% of the food we eat with food grown here at home. Based on estimates from successful and diverse cropping regions similar to ours, we suspect that local food currently accounts for less than 5% of tri-county consumption, so our high regional capacity estimate coupled with the strong interest we heard from consumer, commercial, and institutional buyers, seems to indicate plenty of room for growth. But wait, might our local food consumption be so far below its theoretical maximum of 70% because selling locally just isn't profitable for producers?



Lesson 2

Producers and other food buyers see potential benefits too.

It is true that many agricultural producers – especially larger ones – have bulk market channels that are established and profitable, and for whom local markets are not feasible for logistical, financial, or other reasons. However, according to the USDA over 75% of farms in the tri-county region have gross revenues of less than $100k, and many fall into an endangered category of "agriculture-of-the-middle" farms that are too big to rely on direct marketing to consumers, but too small to successfully market in bulk. The message we heard from these growers in our surveys and interviews was clear: existing direct markets are insufficient to accommodate full production and maximize income for many local growers, who say they would benefit from increased access to commercial and institutional channels such as restaurants, distributors, and school districts. It isn't surprising to hear that growers want access to more markets (good businesses are always searching for new opportunities, right?) but we also heard from commercial and institutional buyers that they are looking for increased access to safe, reliable local food to meet growing consumer demand. So, if producers see potential profits, and buyers are waiting, why aren't these market channels already established?!

Lesson 3

Barriers to a more robust local food system are significant, but can be overcome.

We discovered locally what others around the country have also found: small- and mid-sized growers interested in capitalizing on local market opportunities face significant challenges related to cold storage, aggregation, marketing, and packaging. In other regions, full-service "food hubs" have been developed to address these post-harvest logistical challenges, but have had mixed success. With a grant from Rabobank's Community Development Fund, the land trust and 3CORE Economic Development Agency commissioned a study to explore the feasibility of a food hub that could service tri-county growers and buyers. The study found that a full-service food hub is not yet financially viable in our region, but that an online food hub could provide initial help to the region's small and midsized growers, and increase the viability of a full service hub by building relationships and infrastructure. Using what was learned during the feasibility study and with support from a USDA Farmers' Market Promotion Program grant, the land trust is currently developing a food hub website as the first phase toward developing a full-service food hub.

So, the evidence from our work suggests we can support our economy, increase the viability of local farms and satisfy local demand for local products by continuing to find and implement creative solutions to some long-standing barriers to our local food system. The challenge and opportunity seem (relatively) clear, so let's get back to work!

Jacob N. Brimlow, Ph.D. is an assistant professor in the College of Agriculture at CSU, Chico. Dr. Brimlow earned his doctorate at North Carolina State University, where he studied agricultural and natural resource economics. He teaches courses in agricultural business and economics, and conducts research exploring the interaction between small farmer land use decisions, ecosystem service production, and local food markets.

Noelle Ferdon has a background in law and policy and has worked on food and agriculture issues in California for a decade. She manages several USDA grant-funded projects including Buy Fresh Buy Local, North Valley, a farmer training program and is facilitating the development of a food hub in rural Northern California. Ms. Ferdon has a J.D. from Golden Gate University's School of Law with certificates in Public Interest and Environmental Law.

FARMLINK

CONNECTING FARMERS & RANCHERS WITH AVAILABLE FARMLAND IN THE NORTH VALLEY

BY ZACH MENDES

Nationwide, the average farmer is 58 years old, and half of them are expected to retire in the next 10-15 years. At the same time however, there has been a rise in the number of people interested in entering an agricultural profession.

A recent survey of beginning farmers and ranchers in the North Valley identified the primary barrier to a career in agriculture as access to land. To that end, developing innovative land-linking opportunities between those looking to start farming and farmers who are either retiring or have available land, is a crucial step toward breaking down the land access barrier in the North Valley. The Northern California Regional Land Trust ("land trust") and California FarmLink have developed such an opportunity through a collaborative partnership aimed at matching North Valley landowners with aspiring farmers and ranchers in Butte, Glenn and Tehama counties.

With the goals of protecting farmland, strengthening independent family farms, and building sustainable food systems, the Land Trust and California FarmLink hope to help a new generation of aspiring farmers and ranchers find opportunities for accessing farmland.

Contact the Land Trust at 530-894-7738 or ncrlt@landconservation.org if you would like to learn more about getting connected with a farmer interested in raising food on your land or if you're an aspiring farmer looking for available land.

For more information:
www.landconservation.org
www.californiafarmlink.org

Zach Mendes is the Land Projects/Stewardship Coordinator for the Northern California Regional Land Trust. Born and raised in the North Valley, he takes great pride in assisting with the voluntary protection of land and other natural resources in the region.

FARMER PROFILE

FARMELOT

BY NOELLE FERDON, J.D.

Farmelot, a play on Camelot, is a diversified specialty crop farm business marrying the hard work of James Brock & Bruce Balgooyen, and their families, who farm 15 acres in the town of Vina and 2 acres in Chico's Riparia, respectively. A short jaunt west off highway 99, Farmelot's Tehama County location in Vina embodies the pastoral romance that its namesake implies. The property is flanked with historic farm buildings, some restored and some reminiscent of an earlier era. The sounds of clucking chickens greet you along with a couple of farm dogs eager to assess their visitors.

Dr. Bruce, as he is known, attended Cornell University where he received a Ph.D. in agriculture. He spent some time in the academic and commercial farm business but mostly Dr. Bruce has been a life-long farmer, cultivating the soil with heirloom varieties of tomatoes, lettuce, squash and hundreds of other unique crops. If you aren't sure who he is, just think of the tall, willowy gentleman with the most beautiful, sometimes ugly, but always delicious heirloom tomatoes at Chico's Saturday farmers' market and you'll know who I'm talking about. Farmer James has also been a farmer most of his life. Having previously owned a farm in Oregon's Applegate Valley, Farmer James spent much of his life in politics. When asked what he loves most about farming he says, "It is the independence of being a small farmer. It is the spirit of the American dream to be able to farm."

Together these two farmers have created a farm business that produces some of the finest and most delicious fruits and vegetables you can imagine. Farmelot specializes in heirloom varieties, produces 70 kinds of lettuce, and creates many of their own varieties. They also save and start their own seeds in the greenhouse and grow a portion of their crops in two large cold-frames that they built out of reclaimed materials. They also produce English walnuts and are refurbishing part of their orchard to bring back some older varieties.

Growing in the cold-frames enables Farmelot to have summer crops available in the shoulder seasons – early spring and late fall –making them more profitable and able to meet the demand of different market channels, like restaurants and grocery retailers. Dr. Bruce and Farmer James are committed to increasing their profitability through innovation and due to increasing demand for their products, are now hoping to increase production. A good problem for a farmer to have!

While not quite ready, Farmelot hopes to soon become a site for the region's growing interest in agritourism – an agriculturally-based operation or activity that brings visitors to the farm. They support sustainable agriculture and hope to share their land stewardship values with future visitors.

Farmelot sells at the Chico Saturday and Wednesday farmers' markets, the Tuesday market in Paradise, the Red Bluff market and Chico Natural Foods Coop. You can also sometimes find their products on the menu at Grana Wood Fired Foods and Monks Wine Lounge.

Shasta Daisy Vineyard
Carroll & Lorna Knedler
35100 Forward Rd
Manton, CA 96059
530-474-5262

Tehama Oaks Vineyard & Winery
Bob & Jackie Douglas
14494 Warren Avenue
Red Bluff, CA 96080
530-529-2356
www.tehamaoakswine.com
tehamaoaks@gmail.com
Tehama Oaks Winery is nestled in the oak-studded hills 5 minutes west of Red Bluff. Bonded in 2010, our family owned winery specializes in handcrafting quality red and white wines from our own small vineyards and from premium vineyards throughout Northern CA. We currently produce award-winning red and white blends. Tehama Oaks Vineyard is a proud supporter of Buy Fresh Buy Local.

SPECIALTY RETAILERS & GROCERY STORES

California Kitchen & Company
645 Main St
Red Bluff, CA 96080
530-529-2482

North State Grocery, Inc.
Rick Rutte
PO Box 439
Cottonwood, CA 96022
530-347-4621x109

RESTAURANTS & CAFES

Country Haven
Sharon Druey
10098 Hwy 99E
Los Molinos, CA 96055
530-384-0345

River House Bed & Breakfast
826 Rio St
Red Bluff, CA 96080
530-529-0687

FARMERS' MARKETS

The Olive Hut
3487 Hwy 99W
Corning, CA 96021
530-824-5920

The Olive Pit
2156 Solano Street
Corning, Ca 96021
530-824-4667
1-800-OLIVE PIT
www.olivepit.com
Family owned and operated since 1967. Open daily at 7am. The huge tasting bar features olives, olive oil, balsamic vinegar, nuts, and more. The café serves breakfast & deli sandwiches, burgers and espresso drinks. NEW Wine and Craft Beer tasting room features an array of local wine and beer. The Olive Pit is a proud supporter of Buy Fresh Buy Local.

DISTRIBUTOR

Happy Valley Fresh Fruit Company
Steve Westaby
15999 Butterfield Road
Anderson, CA 96007
530-941-7072
swestaby@gmail.com
Happy Valley Fresh Fruit Company distributes local fresh fruit grown in the far northern region of Sacramento Valley. HVF distributes to stores featuring local fruit and school cafeterias. HVF has the goal of helping smaller farms without the volume necessary to provide for typical commercial packing houses. HVFFC is a proud supporter of Buy Fresh Buy Local.

Frontier Village Certified Farmers' Market
Sandy Burkett
24675 Clement Ave
Los Molinos, CA 96055
530-526-2843
sandraburkett@hotmail.com
www.frontiervillagefarmersmarket.org
A local, community farmers' market sponsored by Slow Food Shasta Cascade, which sells and promotes local producers and local food. We believe that given the choice, people will choose to shop local and eat healthier. This benefits all members of the community. The FVCFM is a proud supporter of Buy Fresh Buy Local.

Red Bluff Certified Farmers' Market
Jason Bauer
PO Box 850
Red Bluff, CA 96080
530-527-6220 ext 301
jason@redbluffchamber.com
www.redbluffchamber.com
Come experience the Red Bluff-Tehama County Chamber of Commerce Certified Farmers Market, June through September. Local produce as well as numerous vendors are at each market. Our Wednesday Night Market has live music Downtown. It's season is June 19th - September 11th from 5:00 to 8:00p.m. Saturday is 7:30 - Noon. The RBCFM is a proud supporter of Buy Fresh Buy Local.

FARMER PROFILE

TURRI FARMS

BY JANAE LLOYD

Tony Turri was born a cattle rancher. In fact, his family has been ranching in Flournoy, California, since 1954. Like his father and grandfather, Tony is keeping it in the family. His wife Marianne, son Andrew (15), and daughter Alexandra (3) all have their roles on the ranch. On Sunday evenings, the whole Turri clan comes over for family dinner. When asked why he wanted to be a farmer, Tony simply responded, "Who wouldn't?"

photo courtesy of Kyle Delmar

Eight years ago, Tony took over Turri Farms from his father and started the process of converting the cattle to grass fed/grass finished. Today he runs the 6400 acre property with 150 cattle and 80 Dorper sheep. His goals include maintaining the healthiest soil possible and having positive impacts on the area. Tony and his family take pride in their all-natural meat. They take the time and care to make sure they are offering the best product possible. "I like challenges," says Tony, "the challenges of getting grass to grow and cows to finish well." His patience and hard work are paying off and Turri Ranch beef is in high demand; so high that they will be doubling their production next year.

Tony and his family are excited about this growth. In addition to expansion, they dream of someday becoming a fully integrated ranch by owning their own processing facility. Marianne would like to offer on-farm tours to help provide education to consumers and make the "farm-to-table" ties even stronger. "Getting to meet directly with customers is one of the things I enjoy most about our business," says Tony.

What's Tony's favorite way to cook up Turri Ranch beef? Steak in a frying pan. "Grass-fed beef cooks different," says Tony, "so here's what you need to do. The key thing is to get it out of the fridge about 30 minutes before cooking so it can reach room temperature. Then get a cast iron frying pan and get it really hot 'til where it would just about burn the butter. Season the steak with a little salt and a little pepper and throw some butter in the pan. Let the steak sizzle in the pan for about 2 to 2 ½ minutes. Take it off, add more butter, flip the steak and cook the other side for 2 minutes. Take it out of the pan and let it rest for 10 minutes. This sears the steak but keeps in all the juices."

He adds in "My other favorite way to eat beef is however Marianne cooks it!"

Turri Ranch products are available in Chico at Chico Natural Foods Cooperative, Chico Locker & Sausage Co., S&S Butcher Shop, and the Thursday Night farmers' market (seasonal). You can also find their beef being served at Leon's Bistro, Monks Wine Lounge, Johnny's Restaurant, The Hunter & The Farmer Food Truck, and Farwood Bar & Grill. Outside of Chico, their beef is sold at Tops Market in Redding & Weaverville.

LOCAL FOODSHED MAP

BY CATHIE BENJAMIN

Ever wondered where the fresh seasonal fruits, vegetables and local meats on your plate were grown and who grew it? The answers to these questions can be found via "foodshed" mapping that depicts the source of locally grown foods here in the North Valley. The lessons of sustainability make us all more aware of where our food comes from, how it is grown, and how far it travels. Local agricultural endeavors here in the Northern Sacramento Valley offer a myriad of food choices. For those who want fresh food that is locally grown, a helpful tool is now available online, created by CSU, Chico faculty and staff in partnership with Buy Fresh Buy Local, North Valley.

With funding from the National Science Foundation, the Geography and Planning Department partnered with the Northern California Regional Land Trust to build a custom online map showing the location of Buy Fresh Buy Local, North Valley members, complimenting the printed "Local Food Guide" which is available throughout the year at member businesses. The interactive webmap aids direct marketing efforts and helps the community find local farmers and producers. View this online map at www.landconservation.org (click on the BFBLNV logo). The foodshed map was developed by Cathie Benjamin, IST for the department, with assistance from Curtis Page, geography student. The Academic Technologies in Education grant supported collaboration between Shasta College and CSU, Chico to promote geospatial education.

Local products shown on the foodshed map include seasonal vegetables and fruits, local wine, olive oil, grass-fed beef, goat cheese, and pastured chickens. Many members sell right from their farms and at local markets. Explore their offerings, and enjoy the wealth of the seasons in our California's North Valley!

Cathie Benjamin is from the Geography and Planning Department at CSU, Chico.

Cathie assists the department with all things relating to GIS and mapping, and she can be contacted at cbenjamin@csuchico.edu.

ORGANIZATIONS & RESOURCES

Butte County RCD	buttecountyrcd.org
Glenn County RCD	glenncountyrcd.org
Tehama County RCD	tehamacountyrcd.org
Butte County Farm Bureau	buttefarmbureau.com
Glenn County Farm Bureau	glenn.cfbf.com
Tehama County Farm Bureau	tehamacountyfarmbureau.com
Butte, Glenn & Tehama Counties Farm Service Agency	fsa.usda.gov
Farm City Celebration	farmcity.org
Sierra Oro Farm Trail	sierraoro.org
Tehama Trail	tehamatrail.com
Edible Shasta Butte Magazine	ediblecommunities.com/shastabutte/
California Women in Agriculture	northvalleycwa.org
Center for Nutrition and Activity Promotion	csuchico.edu/cnap
Cultivating Communities North Valley	cultivatingcommunitynv.org
Farm Bureau Young Farmers & Ranchers	cfbf.com/programs/yfr/profiles.cfm
Sacramento River Preservation Trust	sacrivertrust.org

TEHAMA TRAIL

TEHAMA CO. CALIFORNIA

Century-Old Olive Groves, Volcanic Vineyards, and Plenty of Small-Town Charm in Between...

Local farmers will host a weekend of wine tasting and farm-fresh food sampling on June 1-2, 2013, at the Third Annual Tehama Trail Passport Weekend.

The Passport Weekend will be a chance for visitors to tour the farms and wineries of the Tehama Trail, tasting and shopping along the way...

Presented by our Featured Partners

Tehama Oaks Winery | Julia's Fruit Stand | Bianchi Orchards | Lucero Olive Oil | Olive Pit
Shasta Daisy Vineyards | Cedar Crest Vineyards | Country Haven | Burnsini Vineyards

- WWW.TEHAMATRAIL.COM -

Tours • Tasting • Shopping • Dining

TEHAMA COUNTY, CA

Project 39

A project of the Rural-Urban Connections Strategy (RUCS)

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT

Prepared by:

Applied Development Economics, Inc.

In partnership with:

Foodpro International, Inc.
The Hatamiya Group
DH Consulting

FINANCIAL FEASIBILITY TOOLKIT

July, 2014

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT TEAM

APPLIED DEVELOPMENT ECONOMICS, INC.:

TRISH KELLY
Principal

DOUG SVENSSON
President

THE HATAMIYA GROUP:

LON HATAMIYA
President & CEO

FOODPRO INTERNATIONAL, INC.:

BILL WASHBURN
President

OLGA OSIPOVA
Vice President of Technical Services

JOEL SVENDSEN
Project Engineer

DH CONSULTING:

DAVE HARZOFF
Principal

SACRAMENTO AREA COUNCIL OF GOVERNMENTS (SACOG):

DAVID SHABAZIAN
RUCS Program Manager
dshabazian@sacog.org

GARETT BALLARD-ROSA
Planner 1
gballard-rosa@sacog.org

AMY LEE
Planner 1
amylee@sacog.org

www.sacog.org

The Rural-Urban Connections Strategy (RUCS) is the region's rural economic and sustainable strategy complementary to the Blueprint, the region's overall growth strategy (http://www.sacog.org/rucs/)

APPLIED DEVELOPMENT ECONOMICS

FOODPRO INTERNATIONAL, INC. FOOD PROCESSING AND DISTRIBUTION SPECIALISTS

Hatamiya Group

DH Consulting
Planning • Economic Development

TABLE OF CONTENTS

I. INTRODUCTION 1

II. OVERVIEW OF THE TOOL KIT SPREADSHEET 2

III. PRO FORMA ANALYSIS 3

IV. INITIAL YEARS – SCALING UP THE OPERATION 6

V. FULL SCALE OPERATIONS 8

VI. REVENUE AND COST DATA 10

FINANCIAL FEASIBILITY TOOLKIT

I. INTRODUCTION

This user manual accompanies the Tool Kit pro forma spreadsheet for the Sacramento Valley Food Hub. The Tool Kit is contained in a single Excel workbook, with multiple worksheets that provide the various elements of the analysis. The Tool Kit contains the data used for the feasibility analysis of the Food Hub to help illustrate how the model works. It is helpful to read the Food Hub Business Plan in conjunction with the user manual in order to better understand the operating and design assumptions that are incorporated in the spreadsheet. This user manual provides guidance on how to read the financial indicators in the Business Plan's recommended model. However, there are various business models that could be employed to develop a Food Hub, so the user manual also describes how the reader can conduct a customized analysis to test alternate operating assumptions.

To summarize the development scenario in the Food Hub Business Plan, the feasibility analysis started with identifying the level of operations needed to sustain a stabilized, profitable level of operation, which is projected to occur in Year 5. The Hub is envisioned to start in an existing building with minimal expenditures initially for equipment and supplies. Therefore, Years 1-3 are treated more generally in the Tool Kit, but it provides modules to help the reader scale up operations to the optimal level for her particular planned facility. The spreadsheet model provides more detail beginning in Year 4 as the permanent building comes on line. The user manual describes each worksheet and the functionality that may be used to customize the analysis for the type of operation envisioned by the user.

II. Overview of the Tool Kit Spreadsheet

The Tool Kit includes the following worksheets:

- Project Life
- Product Mix Scenarios
- Years 1-3
- Year 4 – 2 Lines
- Year 5 – 2+ Lines
- Year 6 – 3 Lines
- Year 7 Onward– 4 Lines
- COGS (Cost of Goods Sold) and Sales Prices
- Customer Price Library
- Op Costs
- Labor
- Capital

The **Project Life** worksheet is the master pro forma analysis, extending to Year 20 and calculating the key financial indicators such as the annual net operating income (Earnings Before Income Taxes, Depreciation and Amortization - EBITDA) and the Internal Rate of Return (IRR). This sheet also provides a function to test the effects of increasing or decreasing revenues or costs on a global level.

The **Product Mix Scenarios** worksheet provides a place for the operator to model alternate crop mixes and levels of production in the first few years as the project scales up. The **Years 1-3** worksheet summarizes the outcomes of these early scenarios for purposes of inserting the financial data onto the **Project Life** pro forma analysis.

The worksheets labeled Years 4 through 7 provide matrices to model crop mixes and levels of production for each operating line as they are added in subsequent years. These worksheets are also tied to the **Project Life** worksheet and feed directly into the main pro forma analysis.

The remaining worksheets provide inputs to the annual operations analyses, including crop prices and finished product sales prices, operating costs by year, labor requirements and costs by year, and capital investments and financing costs, also phased by year.

In the following, each worksheet is described in full.

III. Pro Forma Analysis

The Project Life worksheet depicts the summary pro forma analysis for the Food Hub. All of the cells in the upper portion of the worksheet are linked to other worksheets related to the various operating years during the development of the Food Hub, as well as to specific worksheets for labor costs, operating costs and capital costs. The user should not enter data directly into any portion of this worksheet except the in table in the lower part of the worksheet labeled Sensitivity Analysis. This is described further below.

The revenue generated by the Hub is shown in the upper portion of the pro forma analysis, including gross sales revenue from the operating lines and other revenue from other services, such as produce brokering or technical assistance the Hub staff might provide to other organizations. This line is blank in the Tool Kit spreadsheet.

The expenditures are in the second section of the pro forma in light blue. The Cost of Goods Sold (COGS) represents the price paid by the Hub to farmers for their raw produce, plus the packaging costs incurred by the Hub. Secondly, labor costs are shown by year and represent a summary of the more detailed costs shown on the **Labor** worksheet. The **Labor** worksheet shows the number of positions employed for each year but generally the amount of production labor needed is a function of the volume of production in each year, which is shown on line 19 of the worksheet under Operating Characteristics (Total Tons Processed).

Operating Costs consist of facility and equipment rental in the early years, along with maintenance, utilities, and operating supplies. These costs are detailed on the **Op Costs** worksheet.

The difference between revenues and costs for each year is the Net Operating Income, which is calculated by the worksheet and also represented as a percent of sales or revenue.

The Debt Service on Capital Costs is calculated at the bottom of the **Capital** worksheet and carried over to the **Project Life** worksheet. These figures represent the annual payments for loans to build the Food Hub facility and to buy major equipment. These costs extend out to year 16 when the building and equipment are projected to be paid off. However, it is assumed the Food Hub operator will be required to fund a portion of the facility construction and equipment with her own cash, or equity capital from other sources. This is part of the amounts shown on the line labeled “Annual Equity Investments.”

In the first few years, however, the Annual Equity Investment line also reflects operating capital the Hub operator would need to invest to cover initial operating losses. The **Project Life worksheet** begins with year 0 to reflect the initial operating capital needed to start the Food Hub. The figure of $353,731 shown in Year 0 is 50 percent of the amount needed to operate the business in year 1 ($707,462 total expenditures including COGS, labor and operating costs). This provides initial capital to start operations before sales can begin to occur and it provides a cushion for the $248,400 operating loss in the first year. The excess $105,300 ($353,731 minus $248,432) provides for continuity of cash flow from one year to the next. Subsequent annual equity investments include operating losses for years 2 and 3 and the equity portion of the capital costs, such as land costs and 20 percent of building and equipment costs. These costs continue through year 7 when the full capacity of the facility is developed.

The revenue and expenditure section of the **Project Life** worksheet are tied to the individual operating worksheets by year, until year 8 when they simply carry the stabilized operating level forward.

SACOG AGRICULTURAL INFRASTRUCTURE PROJECT - FINANCIAL FEASIBILITY TOOLKIT
20 Year Annual Operations - Project Life

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Revenue		**$459,030**	**$858,000**	**$1,248,000**	**$4,609,774**	**$8,828,863**	**$12,980,958**	**$18,257,245**	**$18,257,245**	**$18,257,245**
Processing Lines		$459,030	$858,000	$1,248,000	$4,609,774	$8,828,863	$12,980,958	$18,257,245	$18,257,245	$18,257,245
Add'l Services Revenue										
Expenditures		**$707,462**	**$1,113,213**	**$1,500,862**	**$4,211,981**	**$7,530,961**	**$10,989,236**	**$16,004,295**	**$16,004,295**	**$16,004,295**
COGS (w/pkging)		$383,609	$734,448	$1,068,288	$2,644,131	$5,018,658	$7,625,788	$11,642,894	$11,642,894	$11,642,894
Labor		$271,863	$324,643	$368,368	$894,823	$1,305,793	$1,678,306	$2,094,198	$2,094,198	$2,094,198
Operating Costs		$51,989	$54,122	$64,206	$673,027	$1,206,511	$1,685,141	$2,267,204	$2,267,204	$2,267,204
Net Op. Inc. (EBITDA)		**($248,432)**	**($255,213)**	**($252,862)**	**$397,794**	**$1,297,902**	**$1,991,722**	**$2,252,950**	**$2,252,950**	**$2,252,950**
Percent of Sales		-54%	-30%	-20%	9%	15%	15%	12%	12%	12%
Debt Serv. on Capital Costs			**($103,578)**	**($484,660)**	**($541,354)**	**($601,457)**	**($698,523)**	**($744,935)**	**($744,466)**	**($744,466)**
Annual Equity Investments	**($353,731)**	**($255,213)**	**($695,434)**	**($664,297)**	**($105,140)**	**($105,531)**	**($169,796)**	**($82,369)**	**$0**	**$0**
Net Cash Flow	**($353,731)**	**($503,645)**	**($1,054,225)**	**($1,401,820)**	**($248,700)**	**$590,915**	**$1,123,403**	**$1,425,646**	**$1,508,484**	**$1,508,484**
Internal Rate of Return							**-20%**	**-3%**	**6%**	**11%**
Operating Characteristics										
Total Tons Processed		312	572	832	2,038	4,076	5,830	7,787	7,787	7,787
Revenue per lbs		$0.74	$0.75	$0.75	$1.13	$1.07	$1.11	$1.17	$1.17	$1.17
COGS per lbs		$0.61	$0.50	$0.50	$0.65	$0.61	$0.65	$0.75	$0.75	$0.75
Gross Margin		$0.12	$0.25	$0.25	$0.48	$0.46	$0.46	$0.42	$0.42	$0.42
Percent of Sales		16%	33%	33%	43%	43%	41%	36%	36%	36%
Total Cash Investment	$3,562,120									
Operating Capital	$2,350,112									
Capital Investments	$1,212,009									

The net operating income minus the annual equity investments and debt service equal the net cash flow. The annual net cash flow turns positive in year 5 and the project begins to show a positive return on investment (Internal Rate of Return - IRR) in year 8, after the full build-out of the facility capacity is complete. It takes several years of positive cash flow to recoup the initial investment in the project, which is why the IRR lags behind both the EBITDA and the net cash flow. By year 20 the IRR reaches 24 percent as net revenues are unencumbered by debt service or other capital costs. The Tool Kit is concerned with testing the feasibility of developing and operating the facility, but it does not address an exit strategy for the project. Presumably, the developer/operator could sell the facility once stabilized operations are achieved. The net proceeds from the sales transaction would add to the financial return on the project, but this would require a separate calculation.

The **Project Life** worksheet also summarizes operating characteristics of the project for each year, including tons of produce processed, the revenues and COGS per lbs. of produce and resulting gross margin.

Finally, the **Project Life** worksheet calculates the cash investment required to start the project, labeled Total Cash Investment. The total figure of $3.56 million equals the sum of the Net Cash Flow through year 4. Beginning in year 5, the facility generates a positive net cash flow and can pay for additional capital costs from operating revenues. However, up through year 4, the operator will need to cover the operating losses plus the equity investments needed for capital expenditures. The capital investments include the equity required through year 4 from the **Capital** worksheet and the operating capital is equal to the balance of the operating losses through year 4.

Underneath the pro forma table in the worksheet is a separate table labeled Sensitivity Dial. This allows the reader to test the effects of global changes to any of the revenue or cost categories in the analysis for any of the first 7 years of operation (with the subsequent years tied to the changes made in year 7). The default setting for all of these categories is 1.00, meaning that the detailed revenues and costs provided on the individual worksheets for each operating year and cost category are taken at face value. However, if for example the operator suspects that in the early years the Hub may have to pay farmers higher prices due to the smaller volumes, she can increase the COGS by 10% or 20% by inserting a 1.1 or 1.2 in the COGS cells for the first few years. This will have an immediate effect on the **Project Life** worksheet as well as the detail sheet for **Years 1-3**. Similarly, wholesale increases in labor costs or operating costs can be tested in the same way.

If the reader has more detailed information about specific cost or revenue changes, this information can be input on the individual worksheets where it applies, as described further in the user manual. The Sensitivity Dial allows for quick hypothesis testing on a more global scale.

Sensitivity Dial

Revenue/Cost Component	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Market Sales Prices	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cost of Goods Sold	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Labor Costs	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Operating Costs	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Capital Costs	1.00	1.00	1.00	1.00	1.00	1.00	1.00

IV. Initial Years – Scaling Up the Operation

Product Mix Scenarios/ Years 1-3

The primary purpose of the **Product Mix Scenarios** worksheet is to allow the user to develop operating scenarios for the first couple years of hub operations. The default figures in the worksheet reflect the projected year 1 volume of production for the hub, at 312 tons. As alternate scenarios are developed for year 1 or for subsequent years, the upper portion of the right hand column in the worksheet (cells O5 to O11)can be copied over (using the Excel Paste Special, Values Only function) to the **Years 1-3** worksheet in the appropriate years to adjust the overall project pro forma. The **Years 1-3** worksheet is tied into the **Project Life** worksheet for this purpose. If the user does not need the detailed monthly analysis, then summary annual operating levels can be plugged directly into the **Years 1-3** spreadsheet to model the financial performance during the early years.

SACOG AGRICULTURAL INFRASTRUCTURE PROJECT - FINANCIAL FEASIBILITY TOOLKIT
Annual Pro Forma Based on Monthly Crop Mix - 2 processing lines

		Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*
Revenue		$43,795	$39,763	$36,186	$24,206	$33,986	$35,700	$37,361	$44,019	$64,650	$35,80
Processing Lines		$43,795	$39,763	$36,186	$24,206	$33,986	$35,700	$37,361	$44,019	$64,650	$35,80
Add'l Services Revenue											
Expenditures		$63,106	$57,213	$54,240	$47,781	$58,599	$60,906	$63,016	$71,754	$70,578	$53,51
COGS (w/pkging @		$36,118	$30,225	$27,252	$20,793	$31,611	$33,918	$36,029	$44,766	$43,590	$26,53
Labor		$22,655	$22,655	$22,655	$22,655	$22,655	$22,655	$22,655	$22,655	$22,655	$22,65
Operating Costs		$4,332	$4,332	$4,332	$4,332	$4,332	$4,332	$4,332	$4,332	$4,332	$4,33
Net Op. Inc. (EBITDA)		($19,311)	($17,450)	($18,054)	($23,574)	($24,613)	($25,205)	($25,655)	($27,735)	($5,928)	($17,713
Percent of Sales		-44.1%	-43.9%	-49.9%	-97.4%	-72.4%	-70.6%	-68.7%	-63.0%	-9.2%	-49.5%
Debt Serv. On Cap											
Net Cash Flow		($19,311)	($17,450)	($18,054)	($23,574)	($24,613)	($25,205)	($25,655)	($27,735)	($5,928)	($17,713
Operating Characteristics											
Revenue per lbs		$0.84	$0.76	$0.70	$0.47	$0.65	$0.69	$0.72	$0.85	$1.24	$0.6
COGS per lbs		$0.69	$0.58	$0.52	$0.40	$0.61	$0.65	$0.69	$0.86	$0.84	$0.5
Gross Margin		$0.15	$0.18	$0.17	$0.07	$0.05	$0.03	$0.03	-$0.01	$0.40	$0.1
Percent of Sales		18%	24%	25%	14%	7%	5%	4%	-2%	33%	26%
Total Tons Processed		26	26	26	26	26	26	26	26	26	2
Crop Mix for Individual Operating Lines											
Line 1	1										
Revenue		$28,501	$24,314	$22,199	$14,747	$26,794	$30,798	$23,674	$23,765	$43,636	$17,636
Loss Rate	92%										
COGS		$20,374	$14,816	$13,176	$8,546	$20,392	$23,408	$19,466	$19,657	$28,086	$11,686
Margin Percent		29%	39%	41%	42%	24%	24%	18%	17%	36%	34%
Total lbs		28,000	28,000	28,000	28,000	36,000	40,000	24,000	24,000	24,000	28,00
Target lbs Year [1]		28,000	28,000	28,000	28,000	36,000	40,000	24,000	24,000	24,000	28,00
Iceberg Lettuce											
Input lbs		4,000	4,000	4,000	4,000	4,000	4,000				4,00
Farmgate Price (per lbs)		$0.40	$0.28	$0.41	$0.18	$0.15	$0.21	$0.00	$0.00	$0.00	$0.3
Market price (per lbs)		$0.68	$0.86	$0.63	$0.29	$0.20	$0.29	$0.00	$0.00	$0.00	$0.4
Green Leaf Lettuce											
Input lbs		4,000	4,000	4,000	4,000	4,000	4,000				4,00

This worksheet, and the subsequent worksheets for later years, provides the opportunity to vary crop inputs and pricing monthly. The farmgate price and market price for each crop are linked to the **COGS and Sales Prices** worksheet. Any changes in prices should be input to that spreadsheet, which is discussed in more detail later in the manual. In the **Product Mix Scenarios** worksheet, the user need only change the input lbs. for each crop by month to create the overall desired crop mix and level of production. This worksheet includes two operating lines, one for tender produce and one for firmer products. This flows from the design of the permanent facility, which would start operations in year 4, but may not be relevant to operations in the temporary facility during the early years. The worksheet allows the user to "turn off" each line by deleting the "1" in the yellow box on rows 25 and 84.

The row labeled Target lbs. Year [1] should be input manually by the user to match the annual desired production level. This row provides a convenient indicator to judge whether the individual crop input levels are meeting the desired goal on a monthly basis.

The **Product Mix** worksheet has built-in factors for loss rates of produce during processing. For tender produce, it is assumed 92 percent of raw produce is shipped out as finished product for sale (row 27) and for firmer produce the retention rate is 95 percent (row 86). These factors were developed for the analysis of the permanent facility and may need to be adjusted based on actual experience at a temporary facility.

The revenue and COGS w/packaging costs in the upper portion of the worksheet will calculate automatically based on the input lbs. provided by the user. However, the packaging materials costs shown in row 25 of the **Years 1-3** worksheet are based on the projected volumes from the Food Hub analysis and would have to be adjusted if different volumes are projected by the user. The user can simply overwrite the figures in the Packaging Cost row in the **Year 1-3** worksheet if different packaging costs are desired.

SACOG AGRICULTURAL INFRASTRUCTURE PROJECT - FINANCIAL FEASIBILITY TOOLKIT
Start Up and Years 1-3 Annual Operations

	Year 0	Year 1	Year 2	Year 3
Revenue		**$459,030**	**$858,000**	**$1,248,000**
Processing Lines		**$459,030**	$858,000	$1,248,000
Add'l Services Revenue				
Expenditures		**$707,462**	**$1,113,213**	**$1,500,862**
COGS (w/pkging)		$383,609	$734,448	$1,068,288
Labor		$271,863	$324,643	$368,368
Operating Costs		$51,989	$54,122	$64,206
Net Op. Inc. (EBITDA)		**($248,432)**	**($255,213)**	**($252,862)**
Percent of Sales		-54%	-30%	-20%
Debt Serv. On Cap			**$103,578**	**$484,660**
Annual Equity Investments	**($353,731)**	**($255,213)**	**($695,434)**	**($664,297)**
Net Cash Flow	**($353,731)**	**($503,645)**	**($847,069)**	**($432,500)**
Internal Rate of Return				
Operating Characteristics				
Total Tons Processed		312	572	832
Revenue per lbs		$0.74	$0.75	$0.75
COGS per lbs		$0.61	$0.50	$0.50
Gross Margin		$0.12	$0.25	$0.25
Percent of Sales		16%	33%	33%
Packaging Supplies		$88,608	$162,448	$236,288

The labor and operating costs are linked to the cost figures for year 1 in the **Op Costs** worksheet and the **Labor** worksheet. If the user is developing scenarios for Years 2 or 3, the cell references in the Labor and Operating costs rows will need to be changed to pick up the year 2 or 3 costs from the **Labor and Op Costs** worksheets, rather than year 1. In the **Years 1-3** worksheet, operating and labor costs for each year are already linked to the proper columns and rows in the **Op Costs** and **Labo**r worksheets.

The operating expenses in **Years 1-3** include space rent, parking and utilities. There would be additional expenses to rent a forklift and to purchase pallets and containers. For each initial year in the analysis, we assume the facility would need sufficient pallets and containers to hold two days' worth of production volume.

V. Full Scale Operations

Year 4 – 2 Lines

The permanent building for the Hub would be built in year 3, and be available for operations in year 4. This worksheet is very similar to the **Product Mix Scenarios** worksheet, except that it is connected directly to the **Project Life** worksheet as part of the overall pro forma analysis. The operating and labor costs are linked to the year 4 figures on the **Op Costs** and **Labor** worksheets, respectively.

Based on the Food Hub feasibility analysis, most of the operating costs are figured as a percent of revenue and the packaging costs are calculated at 3.5 percent of the COGS.

This worksheet allows the same ability to vary crop mixes and production levels as does the **Product Mix Scenarios** worksheet. The following worksheets for years five, six and seven also allow the same user customization of crop mix and production levels.

Year 5 – Two+ Operating Lines

In year 5, the third operating line, which freezes the product, comes online. We assume in year 5 that most of the crop throughput will be on Lines 1 and 2 while Line 3 provides a more deep processing option as operations scale up. The equipment for Line 3 is flexible and designed to run on either Line 1 or Line 2. In this scenario, Line 3 functions as a “safety valve” for the Hub operator, allowing diversion of crops from Lines 1 and 2 and purchase of surplus crops during months when prices are low. Operating adjustments are made on Lines 1 and 2 to keep to the two tons per hour total processing volume. The labor and operating costs are tied to this total volume assumption. In addition, the worksheet has built-in assumptions that a certain percentage of produce culled from Lines 1 and 2 can be diverted to Line 3 for freezing. For each crop on Line 3, there is a row labeled Diverted from Lines 1 & 2. For Line 1 produce the diversion rate is 3 percent while for Line 2 it is 2 percent. These percentages can be changed by the user for each crop type based on actual experience.

Regarding Line 3, there are months in which the finished frozen prices for certain crops are lower than the fresh farmgate price, particularly when factoring in the added loss rate from the freezing process (the frozen weight as a percent of fresh weight is in Column B shown for each crop in Line 3). However, the COGS for the diverted fresh crops are accounted for under Line 1 and 2, so they are assumed to be free in Line 3. Therefore, the farmgate price in Line 3 is a weighted average of diverted produce (at $0/lbs.) and fresh produce (at the normal farmgate price). Even so, we only add fresh purchased produce into Line 3 during months when the blended price is low enough to allow for some gross margin underneath the market price.

The market prices in Line 3 have been adjusted to reflect the difference in retail frozen and fresh prices by crop, and are found in the lower portion of the **COGS and Sales Prices** worksheet. We have assumed that the finished product from Line 3 would be sold during non-harvesting months for each crop, and therefore would command a premium price (but discounted for the fact that it is frozen and not fresh). As a result, the revenues produced from Line 3 occur during different months than the costs of production for each crop. This results in some months showing a negative operating income, but the annual contribution of Line 3 is very positive. The user will need to manually manipulate which months to assume raw product is available for freezing and when it can be sold.

Year 6 – 3 Lines

This worksheet shows the scenario in which Line 3 is operated at a full one ton per hour and Lines 1 and 2 are not reduced while Line 3 is operating. This results in a throughput of three tons per hour and a total annual processing of 5,830 tons (not counting the 3% of produce diverted from Line 2 to Line 3). This worksheet includes an additional sensitivity analysis section that allows the user to model operations using different combinations of lines (columns P-T). This allows the user to record how each line contributes individually or in combination to the bottom line of the operation. To use this function, turn on the desired line(s) and Copy Paste Values Only from cells O12 and O13 to the appropriate locations in columns P-T. Then turn on a different combination of lines and copy those results in the same way. Columns P-T include every possible combination of Operating Line and the operator can see how different Lines contribute to the overall financial performance of the Hub

Year 7 Onward – 4 Lines

This worksheet shows the result of adding an Individual Quick Frozen (IQF) Line to the other 3 Lines. The additional capital cost for this is provided in the Cost Estimate Analysis and is shown in the **Capital** worksheet. With this additional Line, the Hub would operate at 4 tons per hour and process 7,787 tons of produce per year. We have assumed this Line would use all newly purchased raw product and any diversion of product from Lines 1 and 2 would go only to Line 3, which is also a freezing line. The price structure and operating model for Line 4 is similar to Line 3. Raw produce would be purchased for Line 4 during months when the crops are plentiful and farmgate prices are relatively low. The finished product would be warehoused and sold during non-peak months at the highest price available for each individual crop. Even so, since Line 4 does not benefit from “free” diversions of produce off the other Lines, the gross margin is lower than for Line 3. Further research is needed to determine to what extent prices for IQF products are higher than for standard frozen products, such as those from Line 3. However, Line 4 does contribute in a positive way to the overall bottom line of the Hub, and the EBITDA at full operation in Year 7 is more than $2.25 million.

This level of operation represents full capacity of the Food Hub as designed in the Cost Estimate Analysis. However, the Cost Estimate Analysis provides capital costs for other types of Operating Lines such as dehydration, aseptic packing for fruit or vegetable purees, boiler systems and other costs for jams and purees. The **Capital** worksheet provides additional cells in year 8-20 to add other capital costs as desired. However, it should be noted that if the number of Operating Lines is expanded, the building itself would also need to be expanded, or a second building constructed to house the additional production capacity. In addition, information about operating costs and pricing would need to be developed and incorporated into the spreadsheet in order to evaluate the financial feasibility and performance of the expanded operations.

VI. Revenue and Cost Data

COGS and Sales Prices/Customer Price Library

The Food Hub feasibility analysis used price data from the US Department of Agriculture (USDA), which are shown by month for each crop on the **COGS and Sales Prices** worksheet. Shipping Point (farmgate) and Terminal Market (wholesale) prices are derived from the Monthly Averages as reported by the USDA, Agricultural Market Service's (AMS) Market News. The prices are reported for typical shipping containers for each type of crop and are converted in the worksheet to uniform prices per pound for use in the pro forma worksheets discussed above. Notes are provided under each crop type section indicating the size of the cartons for which prices are quoted. As the user updates the price information, carton sizes should be checked and the calculation to per pound prices may be need to adjusted if the container sizes vary.

The prices per pound are linked directly to the Operating Line worksheets for Years 4-7. If crop types are changed and this sheet becomes re-arranged, it is important to check that the cell references are properly lined up in those worksheets.

SACOG AGRICULTURAL INFRASTRUCTURE PROJECT - FINANCIAL FEASIBILITY TOOLKIT
Monthly Crop Prices for COGS and Sales

Shipping Point and Terminal Market prices are derived from the Monthly Averages as reported by the United States Department of Agriculture, Agricultural Market Service's (AMS) Market News. (*See discussion below)

Shipping Point prices are f.o.b. (free on board) prices that represent open market (spot) sales by first handlers at point of production or port of entry on product of generally good quality and condition.
Terminal Market prices represent sales at first receivers to retailers or other large users of wholesale lots generally of good quality and condition.

LINE 1: TENDER FRESH PRODUCE

#	Crops	*January*		*February*		*March*		*April*		*May*		*June*	
	Monthly Average Prices, 2013	*Shipping Point*	*Terminal Market*	*Shipping Point*	*Terminal Market*	*Shipping Point*	*Terminal Market*	*Shipping Point*	*Terminal Market*	*Shipping Point*	*Terminal Market*	*Shipping Point*	*Terminal Market*
1	**Leafy Greens**	X	X	X	X	X	X	X	X	X	X	X	X
	Lettuce												
	**iceberg*	$ 19.92	$ 33.92	$ 14.20	$ 42.99	$ 20.65	$ 31.25	$ 9.07	$ 14.54	$ 7.34	$ 10.07	$ 10.26	$ 14.54
	Per Pound	$ 0.40	$ 0.68	$ 0.28	$ 0.86	$ 0.41	$ 0.63	$ 0.18	$ 0.29	$ 0.15	$ 0.20	$ 0.21	$ 0.29
	**green leaf*	$ 22.33	$ 35.22	$ 12.92	$ 23.24	$ 8.79	$ 24.43	$ 6.89	$ 14.39	$ 6.61	$ 13.38	$ 7.96	$ 13.61
	Per Pound	$ 0.45	$ 0.70	$ 0.26	$ 0.46	$ 0.18	$ 0.49	$ 0.14	$ 0.29	$ 0.13	$ 0.27	$ 0.16	$ 0.27
	**red leaf*	$ 22.55	$ 43.02	$ 12.92	$ 24.81	$ 7.82	$ 24.10	$ 6.80	$ 14.29	$ 6.34	$ 13.19	$ 7.18	$ 13.38
	Per Pound	$ 0.45	$ 0.86	$ 0.26	$ 0.50	$ 0.16	$ 0.48	$ 0.14	$ 0.29	$ 0.13	$ 0.26	$ 0.14	$ 0.27
	*romaine	$ 29.25	$ 40.63	$ 28.46	$ 35.11	$ 24.60	$ 34.80	$ 8.86	$ 17.64	$ 7.87	$ 15.50	$ 9.91	$ 15.86
	Per Pound	$ 0.59	$ 0.81	$ 0.57	$ 0.70	$ 0.49	$ 0.70	$ 0.18	$ 0.35	$ 0.16	$ 0.31	$ 0.20	$ 0.32
	Spinach	$ 23.58	$ 34.06	$ 11.79	$ 29.31	$ 12.54	$ 26.41	$ 9.24	$ 21.59	$ 10.92	$ 15.01	$ 10.30	$ 23.50
	Per Pound	$ 1.12	$ 1.62	$ 0.56	$ 1.40	$ 0.60	$ 1.26	$ 0.44	$ 1.03	$ 0.52	$ 0.71	$ 0.49	$ 1.12
	Notes:												
	Lettuce prices are per carton, minimum of 50 lbs.												
	Spinach prices are per carton, bunched, 20-22 lbs.												
2	**Brassica Vegetables**	X	X	X	X	X	X	X	X	X	X		
	Broccoli	$ 22.81	$ 40.00	$ 11.27	$ 25.09	$ 9.08	$ 25.69	$ 10.17	$ 15.23				
	Per Pound	$ 1.14	$ 2.00	$ 0.56	$ 1.25	$ 0.45	$ 1.28	$ 0.51	$ 0.76				
	Kale	$ 19.93	$ 22.41	$ 25.39	$ 30.11	$ 21.12	$ 25.17	$ 11.67	$ 21.01	$ 10.08	$ 22.36		
	Per Pound	$ 0.95	$ 1.07	$ 1.21	$ 1.43	$ 1.01	$ 1.20	$ 0.56	$ 1.00	$ 0.48	$ 1.06		
	Notes:												
	Broccoli prices are per 20 lb. carton, loose.												

Prices are likely to vary across individual farmers to some extent, and across different classes of customers to a greater extent. The **Customer Price Library** worksheet provides a space for the user to collect price data from different types of customers. It is anticipated that institutional customers such as universities, school districts and hospitals may be an important customer base for the Food Hub. Different price sheets for these customers can be developed on this worksheet and then copied over to the **COGS and Sales Price** worksheet for use in calculating financial returns from selling to different customers. Given the potential complexity of maintaining individual price sheets for multiple customers, this worksheet is not fully developed but simply provides an initial guide and place holder for the user to develop more customized sales price information.

Operating Costs

The operating costs for the facility have been estimated by Foodpro based on their facility design (See Cost Estimate Report). The projected costs for the early years are shown by line item on this worksheet. Beginning in year 4, these costs have been converted to percentages of revenue on the assumption that they are generally related to the volume of operations. Equipment maintenance, however, is related to the specific equipment installed in the hub and is tied to the relevant portion of the Capital worksheet (row 9). If the equipment inventory is different for the facility planned by the user, this maintenance factor may need to be re-estimated. Any of the operating costs can be revised by changing the dollar costs or percentage factors in the **Op Costs** worksheet.

SACOG AGRICULTURAL INFRASTRUCTURE PROJECT - FINANCIAL FEASIBILITY TOOLKIT
Non-Personnel Operating Costs - Worksheet

Year 1				
Annual Costs	**Bldg. Sq.Ft.**	**Lease Rate**	**Monthly**	**Annual**
Building lease, parking and utiliti	3,000	$0.55	$1,650	$19,800
Forklift rental			$1,150	$6,900
Truck Rental				$3,250
Subtotal				$29,950
One-time Costs	**Quantity**	**Unit Cost**	**Tax/ Freight**	**Annual**
Forklift battery	1	$3,800	$570	$4,370
Forklift bat. charger	1	$1,400	$210	$1,610
Pallet Jacks	1	$250	$38	$288
Pallets	16	$80	$12	$1,472
Pallet bins	16	$271	$41	$4,977
Plastic crates, collapsible	213	$25	$4	$6,011
Plastic crates, non-collapsible	192	$15	$2	$3,312
Subtotal				$22,039
Year 2 - Additional				
Annual Costs	**Bldg. Sq.Ft.**	**Lease Rate**	**Monthly**	**Annual**
Forklift rental			$1,150	$13,800
Truck Rental				$3,250
Subtotal				$17,050
One-time Costs	**Quantity**	**Unit Cost**	**Tax/ Freight**	**Annual**
Pallet Jacks	1	$250	$38	$288
Pallets	7	$80	$12	$638
Pallet bins	7	$271	$41	$2,157
Plastic crates, collapsible	92	$25	$4	$2,605
Plastic crates, non-collapsible	83	$15	$2	$1,435
Subtotal				$7,122

Labor

The **Labor** worksheet lists the anticipated positions needed to run the Food Hub and provides sections to calculate the labor costs for each year of operation through year 5. Columns B and C show the estimated hourly wages and benefits costs for each position. Then subsequent columns allow projections of staffing for each year of operation. For the first three years, the staffing requirements are expressed in annual hours, since a number of the positions may be filled part time. Starting in Year 4, the positions are expressed as Full Time Equivalents (FTE). The year 5 section allows calculation of labor costs on a weekly or monthly basis, if desired, in addition to the annual estimates.

In the Operating Line worksheets, the monthly labor costs are estimated in two sections. The management and professional staff in the upper portion of the **Labor** worksheet are simply divided equally into twelve months. The laborers in the lower portion of the worksheet are estimated based on monthly production volumes, using the labor cost per ton factors in row 34. The analysis assumes that additional management and professional staff are not needed after year 5 but that the production worker labor costs continue to increase with higher levels of production in years 6 and 7.

SACOG AGRICULTURAL INFRASTRUCTURE PROJECT - FINANCIAL FEASIBILITY TOOLKIT
Personnel Cost by Employment Class - Worksheet

			Year 1		Year 2	
	Hourly Rate	Workers Comp, Benefits, etc. @ 0.40*	Total Annual Hours	Annual Cost	Total Annual Hours	Annual Cost
Management Staff						
Facility/Marketing Manager	$27.00	$10.80	2,080	$78,624	2,080	$78,624
Supervisor	$20.00	$8.00	910	$25,480	1,820	$50,960
Professional Staff/Services						
Buying Agent	$20.00	$8.00	2,080	$58,240	2,080	$58,240
Sales and Marketing	$20.00	$8.00	2,080	$58,240	2,080	$58,240
Bookkeeper	$20.00	$8.00	780	$21,840	1,560	$43,680
Administrative Assistants	$12.00	$4.80		$0		$0
Agricultural Advisor	$20.00	$8.00		$0		$0
Outside Accountant	$60.00		96	$5,760	96	$5,760
Subtotal Mgmt/Prof.				$248,184		$295,504
Skilled Labor						
Operator-Receiving Station	$15.00	$6.00		$0		$0
Truck Driver(s)	$15.00	$6.00	260	$5,460	520	$10,920
Misc. Skilled	$15.00	$6.00		$0		$0
Unskilled Labor						
Full Time Class 1	$12.00	$4.80		$0		$0
Full Time Class 2	$10.00	$4.00		$0		$0
Part Time Class 1*	$10.00	0.1056/$100	1,820	$18,200	1,820	$18,200
Workers Comp Class 1				$19.22		$19.22
Part Time Class 2						
Workers Comp Class 2						
Subtotal Labor				$23,679		$29,139
Total Estimated Personnel Costs				$271,863		$324,643
Labor Cost per Ton		Total		$871.36		
		Labor only		$75.89		

Capital

This worksheet contains all the costs associated with building and equipping the permanent Food Hub facility. The first line item is the cost of the site. We have assumed a 35 percent lot coverage ratio, which requires a 1.5 acre site for the 22,000 sq.ft. building. At urban industrial land prices in the Sacramento region ($175,000 per acre), this would cost $262,500. There would be advantages to having more extensive yard space and if the facility were located in a more rural setting, presumably a larger site could be purchased within this budget.

The construction of the permanent facility and the related machinery has been estimated by Foodpro (see Cost Estimate Report). For the present analysis, we have shifted some of the early machinery and pallet costs to the **Op Costs** worksheet and also increased the contingency to 10 percent to allow for a performance bond and other insurance during the construction period. The costs have been phased over the 6 year development period. Some of the equipment would actually be purchased in year 2 for use in the temporary building and then moved to the permanent building in year 4.

The worksheet calculates an annual and cumulative grand total construction and site cost and then calculates annual debt service. We have assumed the land would need to be purchased outright and there would be a 20% equity investment for capital purchases, including building and equipment. The assumed financing terms are shown in the box in rows 31-33 and the debt service is calculated in row 29. Under these assumptions, the debt service would continue into Year 16 and the **Capital** worksheet shows the payments, which are also tied into the **Project Life** worksheet.

SACOG AGRICULTURAL INFRASTRUCTURE PROJECT - FINANCIAL FEASIBILITY TOOLKIT
Capital Cost Estimator and Schedule

Cost Investment Category[1,2]	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total Costs
Real Estate		$262,500									$262,500
Building Improvements[3]			$1,425,521			$392,000					$1,817,521
Refrigeration			$555,012								$555,012
Processing Equipment		$498,482		$144,966	$245,150	$48,000					$936,598
Other Equipment and Systems[4]		$59,200	$528,490	$275,880	$2,000	$240,000	$328,000				$1,433,570
Produce Handling/Storing Equipment					$175,480						$175,480
Fire Protection			$193,602								$193,602
											$0
Hard Costs Subtotal		$557,682	$2,702,625	$420,846	$422,630	$680,000	$328,000	$0	$0	$0	$5,111,783
Permits and Testing			$153,893	$2,353	$2,113	$3,400	$3,765				$165,524
Engineering (@8% of capital cost)		$260,825		$33,668	$33,810	$54,400	$26,240	$0	$0	$0	$408,943
Construction Management (@5%)			$163,015	$21,042	$21,132	$34,000	$16,400				$255,589
Capital Investment Total		$818,507	$3,019,533	$477,909	$479,685	$771,800	$374,405	$0	$0	$0	$5,941,839
Contingency (@10%)		$81,851	$301,953	$47,791	$47,968	$77,180	$37,441	$0	$0	$0	$594,184
Project Grand Totals		$1,162,857	$3,321,487	$525,700	$527,653	$848,980	$411,846	$0	$0	$0	$6,798,523
Cumulative		$1,162,857	$4,484,344	$5,010,044	$5,537,697	$6,386,677	$6,798,523	$6,798,523	$6,798,523	$6,798,523	
Estimated Equity Investment		$442,571	$664,297	$105,140	$105,531	$169,796	$82,369	$0	$0	$0	$1,569,705
Debt-Financed Capital Costs		$720,286	$2,657,189	$420,560	$422,123	$679,184	$329,476	$0	$0	$0	$5,228,818
Cumulative		$720,286	$3,377,475	$3,798,035	$4,220,158	$4,899,342	$5,228,818	$5,228,818	$5,228,818	$5,228,818	
Estimated Debt Service Costs[5]		$103,578	$484,660	$541,354	$601,457	$698,523	$744,935	$744,466	$744,466	$744,466	

Finance Interest Rate:	7%
Fees:	1%
Loan Amortization Period (yrs):	10

A project of the
Rural-Urban Connections Strategy
(RUCS)

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT

Prepared by:

Applied Development Economics, Inc.

In partnership with:

Foodpro International, Inc.
The Hatamiya Group
DH Consulting

SACRAMENTO VALLEY FOOD BANKS AND FOOD HUB DEVELOPMENT

August, 2014

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT TEAM

APPLIED DEVELOPMENT ECONOMICS, INC.:

TRISH KELLY
Principal

DOUG SVENSSON
President

THE HATAMIYA GROUP:

LON HATAMIYA
President & CEO

FOODPRO INTERNATIONAL, INC.:

BILL WASHBURN
President

OLGA OSIPOVA
Vice President of Technical Services

JOEL SVENDSEN
Project Engineer

DH CONSULTING:

DAVE HARZOFF
Principal

SACRAMENTO AREA COUNCIL OF GOVERNMENTS (SACOG):

DAVID SHABAZIAN
RUCS Project Manager
dshabazian@sacog.org

GARETT BALLARD-ROSA
Planner 1
gballard-rosa@sacog.org

AMY LEE
Planner 1
amylee@sacog.org

www.sacog.org

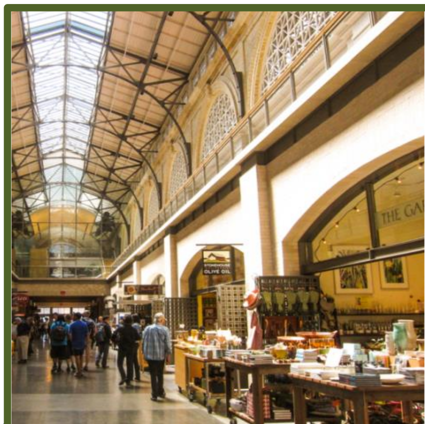
The Rural-Urban Connections Strategy (RUCS) is the region's rural economic and sustainable strategy complementary to the Blueprint, the region's overall growth strategy (http://www.sacog.org/rucs/)

APPLIED DEVELOPMENT ECONOMICS

FOODPRO INTERNATIONAL, INC. FOOD PROCESSING AND DISTRIBUTION SPECIALISTS

Hatamiya Group

DH Consulting
Planning • Economic Development



SACRAMENTO VALLEY FOOD BANKS AND FOOD HUB DEVELOPMENT

I. INTRODUCTION

This document discusses food banks and their role in food hub development in the Sacramento region. It is a component of the **Sacramento Regional Agricultural Infrastructure Project** sponsored by the Sacramento Area Council of Governments (SACOG) through its Rural-Urban Connections Strategy (RUCS). SACOG is an association of local governments in the six county Sacramento region providing transportation planning and funding serving as a forum for regional issues, including linking land use, transportation and air quality (see map on the following page). The Blueprint, a signature SACOG project, is the region's long-term growth strategy. RUCS is the region's rural economic and environmental sustainability strategy complementary to the Blueprint.

Over the past several years, RUCS has identified the need for expanded regional "agricultural infrastructure" to strengthen the local and regional food system and the region's many rural communities. **Agricultural infrastructure commonly is defined to encompass aggregation, packing, processing, marketing and distribution capacity and facilities, including "food hubs."** Overall, agricultural infrastructure:

- Improves the efficiency and sustainability of the local food system;
- Increases access to healthy foods in underserved communities;
- Supports the viability of agriculture;
- Creates new jobs and economic opportunities; and,
- Helps preserve valuable farmlands.

SACOG obtained funding from the California Department of Food and Agriculture, the California Strategic Growth Council and the U.S. Department of Housing and Urban Development to assess the feasibility and costs of models for development of new agricultural infrastructure, focusing primarily on food hubs. Food hubs help connect locally produced and source-identified foods to local markets and customers, especially by creating new market channels between smaller and medium-sized growers and larger institutional and business buyers. SACOG contracted with a consulting team (Project Team) led by Applied Development Economics, Inc., in partnership with Foodpro International, Inc., the Hatamiya Group, and DH Consulting, to assess the market and financial feasibility of development regional agricultural infrastructure

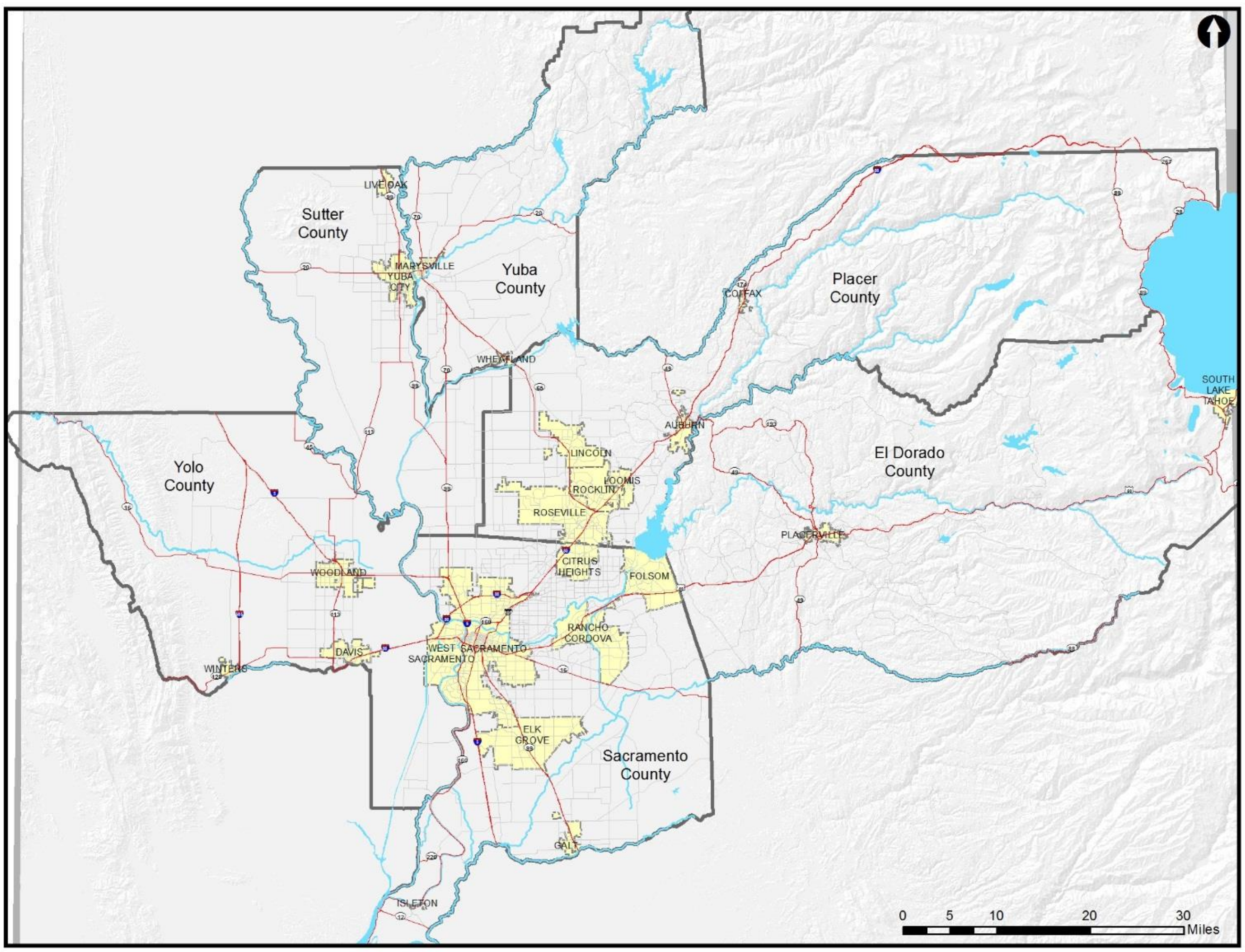
Part of the project's effort was to look at the potential for the region's food banks to serve as food hubs or to incubate and/or partner with new food hubs in developing the region's capacity to source more fresh local produce to markets within the region, including underserved communities. Throughout the project, the Project Team worked with three of the region's major food banks – Placer Food Bank, Sacramento Food Bank and

Family Services, and Yolo Food Bank, to identify and address the challenges and opportunities related to their role in the region's evolving food system. The Project Team also conducted research on innovative food hub models, including food banks that are expanding their missions and activities to play a proactive role in transforming their local food systems to one emphasizing consumption of fresh locally grown produce.

Other project components included research on trends in local and sustainably grown foods, trends in food hub operating characteristics and financial performance, and assessment of local fresh produce aggregation and distribution capacity in terms of connecting smaller growers with larger institutional and business customers; a cost estimate analysis for a hypothetical food hub facility; and preparation of a hub business plan including market analysis and financial feasibility analysis. These activities provided context and guidance for the development of recommendations for a Sacramento Valley Food Hub and shaped the consideration of the food banks' roles, capacities and interests. The analysis focuses on hub operations for specialty crops, defined by the U. S. Department of Agriculture (USDA) as fruits, tree nuts and vegetables.

The map below shows the SACOG six county planning region.

MAP OF THE SACRAMENTO REGION



II. PROJECT ACTIVITIES

SACOG and the Project Team worked closely with the food banks over the course of the project. The Sacramento Food Bank and Family Services and the Yolo Food Bank were members of the Project Advisory Team and thus provided ongoing consultation and guidance. The following is a list of key activities the Project Team conducted with or on behalf of the two food banks as well as Placer Food Bank, as part of the overall project research and analysis and development of the recommended food hub model and business financial tools.

- Conducted multiple site visits at the food banks; visited their aggregation, packing, warehouse, and storage distribution facilities; and reviewed facility and operations expansion plans. The Sacramento Food Bank and Family Services will be renovating its main distribution center and the Yolo Food Bank bought a new industrial building which will be retrofitted for a variety of uses. Both projects are underway to expand the capacity of the food banks to receive, handle and deliver locally grown fresh produce at a much higher level than today, work more strategically with local growers, and increase the provision of fresh produce to the communities they serve. The Project Team provided information on engineering requirements, facility planning, and capital and operating costs, including for varied food processing lines (described later in this document).

- Assisted the Sacramento Food Bank and Family Services in preparation for and participation in a site visit with the Secretaries of the California Health and Human Agency Secretary and the California Department of Food and Agriculture in October 2013, which explained the Food Bank's activities and work as fresh produce aggregators and distributors and mobile food distribution to clients, and to discuss ideas for possible funding sources for the building renovation.

- Researched innovative hub models, including food banks that are increasing their capacity and scope of services to foster fresh produce, by sponsoring food hub activities that are part of transforming their regional food systems and serving their mission to improve health and increase self-sufficiency of residents in the communities they serve. Collaborated with the National Good Food Network which is working on the development of food hubs nationally to identify good models of food banks adopting food-hub like activities. Information was provided to the food banks on these models to assist them as they are redeveloping their facilities and expanding their programs.

- Connected the Sacramento Food Bank and Family Services with the National Good Food Network and assisted in the development of a session for a national webinar in December 2013 on "Food Banks as Regional Good Food Partners." SACOG also participated in the presentation along with the Food Bank. It was one of the mostly highly rated webinars that the National Good Food Network has sponsored. http://www.ngfn.org/resources/ngfn-cluster-calls/food-banks-as-regional-good-food-partners

- Shared information with the food banks on an ongoing basis regarding project findings, best practices, and potential funding sources, and obtained input and guidance.

- Prepared a cost engineering estimate for a food processing line for the Yolo Food Bank retrofit which will be used to help develop a budget for the Food Bank's capital campaign.

- Consulted with the Sacramento Food Bank and Family Services on development of a budget for hub start-up costs and comparative analysis of a stand-alone operation vs. incubation of the hub within the Food Bank. The Food Bank provided input regarding required cost items and operating variables. The analysis helped to identify the cost structure to determine the financial benefit of the hub being incubated in a food bank.

The next sections describe the role of the food banks in the regional food system, facility expansion plans, and the discussion of whether or not food banks can incubate and/or serve as food hubs. This includes a review of a cost comparison analysis regarding food bank incubation of a hub facility start-up, and the estimated engineering costs for addition of processing capabilities for a food bank.

III. FOOD BANK ACTIVITIES

ROLE OF FOOD BANKS IN THE REGIONAL FOOD SYSTEM

The Placer Food Bank, Sacramento Food Bank and Family Services and Yolo Food Bank have been instrumental in moving their organizations toward increasing procurement of fresh locally grown produce, purchasing produce from local growers, working with partners who are seeking to build more robust local food distribution channels and improve food literacy, and educating their clients on how to use the fresh produce. As such, they are playing an important role in catalyzing the transformation of the regional food system. In addition to providing more sources of locally grown food to clients and fostering new attitudes about eating fresh produce which hopefully will affect purchasing and consumption patterns into the future, the food banks are an important partner and resource for local growers.

The food banks are planning to expand their capacity to receive, handle, store, pack, package and distribute fresh produce. The food banks have strong logistics capacity and have plans to increase both operating equipment and transportation capabilities, including through the addition of more refrigerated trucks, to handle larger volumes of fresh produce. The following is an overview of the focus and activities of the three food banks.

Placer Food Bank	- Leading hunger-relief charity in Placer, El Dorado and Nevada counties, and a Feeding America-certified food bank - Distributes more than 6 million pounds of food to more than 50 hunger-relief partners - Receives donated food from Feeding America, food retailers, manufacturers, growers, USDA, community food drives, then sorts, packs and distributes food to partners; beginning to purchase and contract with local growers for fresh produce - Other programs include BackPack program providing children with food for weekends and holidays when school is not in session, Placer Community Gardens, CalFresh outreach, and education on healthy food choices - Participating with regional partners on strategies to improve food access and Placer County food systems - Expanding warehousing, storage and distribution capacity - In June 2014 launched its first mobile pantry unit with support from Placer Community Foundation
Sacramento Food Bank and Family Services	- Collects and distributes over 4 million pounds of food annually, ability to expand to 6 million pounds after renovation of existing facilities - Has more than 500 donation drive collection site, regular donations from established partners including food vendors, produce companies and farms. Relationships with over 20 vendors including grocery stores, farms and produce companies - Food is distributed through direct distributions and supplements distributions with 22 partner agencies. The 13 distribution sites include churches, schools, and community centers, in a mobile market model - Growing the level of fresh produce poundage every year, currently about 1.5 million pounds of produce, with goal to increase to 2 million by the end of 2014 and 3 million by 2016, depending on facility expansion; currently leases some warehouse space away from Food Bank; growers also hold crops in cold storage for them until pick up

Yolo Food Bank	- Distributed almost 3 million pounds of food in 2013, with 800,000 being fresh produce - Coordinates the solicitation, storage and distribution of food from an established network of growers, manufacturers, distributors, wholesalers and grocery stores, while cultivating new sources of food -The Enough to Eat program provides food to 70 nonprofit agencies through Yolo County; also has 9 direct distribution sites - Several programs to foster fresh produce consumption, including the Kids Farmers Market involving elementary schools and new program – Children's Harvest - with First Five to deliver fresh produce to families through various Yolo Family Resource Centers - Has a demonstration garden, programs that includes rural food delivery, and emergency food distribution program among others

All of the food banks purchase fresh produce from a variety of local growers, to varying levels. Rather than relying on donations, Sacramento and Yolo Food Banks purchase approximately 60 percent of their produce, although the growers also provide donations to the food banks. The food banks use a variety of pricing strategies for purchase of fresh produce, including:

- Purchasing at wholesale market prices.
- Purchasing at a mutually agreed upon price that is lower than what the market is offering, mainly due to the farmer having an excess of a crop that they are either unable to sell or because they want to offer the food bank a lower price to support their mission.
- Purchasing at a heavily discounted price to ensure labor and box costs are covered, so that the farmer is not losing money. Items comprise a huge excess from a harvest that a farmer cannot sell on the open market and "unsellable" produce due to the farmer's inability to sell to wholesale customers.
- Shared maintenance fee, where the food bank purchases food at an extremely low price, to help with the transportation of the products.
- Contracting with growers for specific crops and levels of production.

These transactions are very valuable. They provide a certainty for growers on specific crops and levels of income, so that even with lower prices, the farmers have some guaranteed revenue streams, or can increase production of certain crops under contract. This process helps with their business and crop planning, and also provides a gateway for new growers, such as graduates of the Center for Land-Based Learning's Farm Academy growing under contract for the Yolo Food Bank, to develop experience and market relationships.

FACILITY EXPANSION PLANS

All three food banks have expansion plans. This added capacity will help the food banks meet their goals to provide more fresh produce to clients, especially to help improve health outcomes, and support local growers and the development of the food system. It can also help them to support their own financial sustainability by providing the opportunity for additional revenue streams, and in the case of the Yolo Food Bank, owning rather than leasing a facility. Placer Food Bank has expanded its warehousing capacity. The other food banks are undergoing major facility and equipment expansions:

- The Sacramento Food Bank and Family Services is renovating its main distribution center to create over 15,000 S.F. of dry storage space and more than 2,500 S.F. of cold storage space and upgrade all facilities for increasing its capacity to handle, process and store fresh produce. The warehouse and cold storage spaces will be professionally racked for high storage of bins and pallets. Processing will include repacking/bagging. The renovation will allow the Food Bank's capacity to increase its fresh produce from 1.5 million pounds in 2013 to 2 million pounds by the end of 2014. The Food Bank also plans to upgrade and add equipment such as forklifts.
- The Yolo Food Bank purchased a 36,500 S.F. industrial building in 2013 adjacent to existing Food Bank operations, to expand capacity to access, co-pack, store and potentially process fresh produce, and to develop financial self-sufficiency by owning instead of leasing facilities and potentially generating some revenues streams. The building has been gutted and will be reconfigured for the following uses: half of the building will be for food bank operations (office, warehouse, distribution); other parts will be for a commercial kitchen for culinary training for low income residents and/or for leasing space to potential entrepreneurs, and a processing line for co-packing, jams, sauces, freezing and other activities to extend the season, reduce waste and provide nutritious food in the winter. The goal is to provide activities that will help create jobs and job training, and foster additional volunteerism. The Food Bank is preparing engineering cost estimates for a capital campaign to raise funding for the retrofit and expansion. The Food Bank also is looking to expand with 3-4 refrigerated trucks. The building is being planned as a green building.

As noted, these expansions will greatly enhance the capacity of the Food Banks regarding fresh produce handling, processing, storage and distribution.

IV. FOOD BANK HUB INCUBATION/HUB-RELATED ACTIVITIES

This section looks at the question of whether or not the food banks would be able to incubate the start-up of a food hub and/or serve as a food hub within their service area.

FOOD HUB INCUBATION ANALYSIS

The food banks considered the possible incubation of a hub within their facilities. The recommended hub model is a for-profit enterprise, for reasons related to the level of scale of operations and financing needed for the hub to address the market niche (see the *Sacramento Valley Food Hub Business Plan* for an explanation of the model). Currently, the Sacramento Food Bank and Family Services and the Yolo Food Bank have no physical capacity to incubate a hub. Any co-location for a hub start-up could not occur until their facilities were renovated and space and equipment expanded. It is possible that expanded food bank operations which are planned also may not provide the amount of space needed by the hub, especially as it will be scaling up operations and levels of produce handled rather quickly (see the *Business Plan*).

The following is a summary of the analysis that the Project Team prepared to identify the potential start-up costs for the Sacramento Valley Food Hub and a comparison of costs if the hub were to be incubated in a food bank, thereby receiving logistical and operating support and the potential for reduced costs in areas such as leasing of space and equipment.

Overview

The *Sacramento Valley Food Hub Cost Estimate Analysis* provided information for each operational phase for a newly constructed food hub facility. Costs and investments were estimated for each phase of the project, except for the year 1 start-up costs, since the assumption was that the hub initially could be incubated within an existing facility. The *Cost Estimate Analysis* showed the overall level of investment and scale of operations that would be required for the hub to reach a viable and stabilized level of operation, which was projected to occur in Phase III(Years 5-7).

A key aspect of the overall project analysis was to explore the potential for the hub to be incubated by a partner organization such as a food bank. In theory, this approach would be more cost effective than leasing or building and operating a stand-alone facility during the start-up phase. As noted, both the Sacramento Food Bank and Family Services and the Yolo Food Bank are retrofitting buildings to accommodate expanded aggregation and distribution functions to meet their needs, are already working with local growers, have existing distribution networks and trucks, and expressed a possible interest in supporting the hub's start-up. This type of approach could allow for shared activities and costs that would benefit both the hub and the partner organization as experience is gained, market relationships are developed with growers and customers, and the partner organization obtains products for its own growth.

To provide hub start-up cost estimates, in March 2014 the Project Team developed initial budget estimates for the first year of operations. Start-up activities would encompass basic repacking operations for fresh produce aggregation and distribution. They do not include value-added processing activities, which would occur in subsequent phases of the enterprise as operations scale up. The format below shows areas where hub costs possibly could be reduced based on partner organization offsets and contributions, which would affect the calculations and bottom line for the start-up phase. Core operating costs are estimated for a volume of production that is considered feasible from the standpoint of initiating and maintaining operations, developing market relationships over the course of the year, and purchasing produce. Consistent with other hub models nationally, the project's focus is to leverage existing capacity within the region, especially to help reduce barriers to entry for a start-up operation.

The hub enterprise also could be incubated within a for-profit such as an existing distribution company or wholesaler – especially one looking for a customized, source-identified locally grown market channel – or other type of non-profit entity that could provide access to space, trucking, and distribution networks. This approach would likely have a different cost structure than incubating within a food bank (or other social enterprise entity). With either approach, the incubation phase would provide the foundation for scaling up operations over the next several years, with the hub moving to a larger facility, existing or new, during Phase II (Years 2-3).

Production Volumes and Cost Estimates

Information is provided below for potential production volume and the estimated cost of supplies, labor, outside services, facilities and purchase of produce for Year 1 of hub start-up and operations. Table 1 shows the assumptions for the volume of produce to be handled, including the labor required and the level of production. The volume of production could be adjusted based on how much produce would be required for the hub's customers (an outside market) versus the food bank's clients, and the cost structure adjusted accordingly to see the impact on the bottom line.

In terms of operations, the fresh produce would be delivered to the facility or picked up by the hub staff or partners and repacked, changing from an "as received" package into an "as shipped package." The produce then would be repackaged manually into five pound bags for customers, on basic grading tables provided by the food bank/partner facility. The higher the skill level of the workers, the shorter the time required to pack the produce. The estimate of time per worker includes time to: pick up an empty bag; collect a full case; transfer the product from the case into a single bag (2 each); place a full bag into a carton; and remove sub-grade product. In the tables shown below, the numbers that are underlined in blue are the variables that are inputs. The numbers that are highlighted in yellow are the result of the inputs.

TABLE 1. HUB PRODUCTION VOLUME, YEAR 1				
Time per worker	45	seconds		
Number of workers*	2	persons		
Packout	5	lbs per person		
Total packout	**13.33**	**lbs per minute**		
Number of work hours per day	6	hours		
Work days per week	5	days		
Total daily packout	*4,800*	lbs/day	2	tons/day
Total weekly packout	*24,000*	lbs/week	12	tons/week
Work weeks, Inception Year	26	weeks		
Total Annual Packout	***624,000***	**lbs/year**	**312**	**tons/year**

** part-time, no fringe benefits*

Cost estimates are shown in Table 2 for packaging supplies, and in Table 3 for labor, outside services (accounting, etc.) and facilities. The higher the production capabilities, the lower the cost of supplies. The estimates do not include staffing for management, marketing expenses, or travel and truck leases. These costs can be better estimated with guidance on whether or not the hub "enterprise" is separate from or a part of the partner organization's organizational and business structure.

These cost estimates are for operations of the hub separate from the food bank or other partner organization, presented to show the costs if the hub were to function as a stand-alone operation. The tables have a column that can be used to identify where costs might be shared, or where the food bank could reduce or subsidize hub costs. Changes will affect the bottom line for the hub and help determine the level of start-up costs and funding gaps for Year 1.

TABLE 2. SUPPLIES, YEAR 1				
			TOTAL COST	FOOD BANK OFFSET
Packaging materials	$0.02/lb $0.12 /lb	bags cartons	$12,480 74,880	
Bag Ties	$0.0010 /lb		624	
Case tape & label	$0.0010 /lb		624	
Annual packout	624,000	lbs/year		
Cost of Packing Materials			***$88,608***	

TABLE 3. LABOR, OUTSIDE SERVICES AND FACILITIES COSTS, YEAR 1				
			TOTAL COST	FOOD BANK OFFSET
LABOR, PART TIME:				
Unskilled labor compensation	2 person	@ $10.00 /hr		
Bookkeeper	1 person	@ $20.00 /hr		
Annual work hours for part-timers	780	hrs/year-person		
Total Part Time Labor Annual			***$31,200***	
LABOR, FULL TIME:				
Buying Agent (produce supplies)	1	@ $20.00 /hr		
Selling Agent (produce)	1	@ $20.00 /hr		
Marketing/Advertising Manager	1	@ $27.00 /hr		
Annual Full Time Hours	2080	hrs/year-person		
Fringe Benefits	35%			
Total Full Time Labor Annual			***$ 188,136***	
OUTSIDE SERVICES:				
Accountant, outside services	1 person	@ $60.00 /hr		
Months	12			
Hours per month	8			
Total outside service accounting			***$5,760.00***	
FACILITIES:				
Space rented	3,000	Sq. Ft		
Lease rate	$0.60 /sq.ft			
Add-on for share for utilities & employee parking	$0.30 /sq.ft			

Annual Lease Cost			***$32,400***	
Total Labor, Outside Services, and Facilities Costs			***$257,496***	

The total estimated Year 1 supplies, labor, outside services, and facilities start-up costs are $346,104, not including the costs of purchasing produce. The startup operation would be able to handle and have to be open to any type of crop at this point so as to establish itself as a business entity and start acquiring customers. Initial capital for the operations will be necessary to purchase produce from farmers and other available local sources.

Averaging between the crop types, the farm price can be assumed at this point to be $0.50 per pound. Therefore, $312,000 in capital would be needed to meet this purchasing goal. However, as the sales begin, a revenue stream will be generated that will partially offset the costs of purchasing. Assuming an average sale price of $0.75 per pound, the net revenue comes to $0.25 per pound. Hence, an annual revenue of $156,000 may be expected, leaving a net of $156,000 required in capital for purchasing of produce.

Adding $156,000 for the cost of purchasing produce to the Year 1 costs summarized in Tables 2 and 3, **the total overall estimated Year 1 start-up costs (seed capital) for the hub are $502,104.** As noted above, there will be additional costs for marketing expenses, travel and truck leases, and the hub manager which will also need to be factored into the overall costs. Costs which could be shared or offset by the food bank would improve the cost structure, as well as, possibly, increased production volume. Table 4 shows a summary of costs and revenues for Year 1, before offsets or shared costs are calculated.

TABLE 4. YEAR 1 START –UP, PROFIT AND LOSS ESTIMATE			
Costs and Revenues:			
Total Costs	$658,104	**Food Bank Shared Costs, Offsets:**	$ 0
Revenues	156,000	**Increased Production:**	$ 0
Net Profit/Loss	***($502,104)***		

As a start-up, the first year's operation will show a loss of $502,104. This loss estimate could be lowered based on contributions and offsets from the food bank/partner organization. As the *Cost Estimate Analysis* shows, the hub is projected to reach a stabilized operating level in Phase III, when the scale of operations, based on increased volume, markets, and value-added activities, begins to show a positive cash flow. The hub shows a positive rate of return on investment by Year 8.

SACOG and the Project Team met with the Sacramento Food Bank and Family Services in March 2014 to review the analysis and discuss the potential for incubation of the hub start up and cost sharing areas. Several areas were identified by the Food Bank staff as cost areas to add to the analysis, such as management costs, inventory systems, supplies, and other requirements such as insurance and training, as well as assumptions regarding labor. Staff subsequently provided a detailed commentary of both the start-up cost estimates and the overall Cost Estimate Analysis. The Team also consulted with the Yolo Food Bank on the analysis.

During these consultations, both Food Banks raised concerns about incubating a for-profit enterprise, for a variety of reasons. They include perceptions regarding lack of alignment with their core mission to provide hunger relief through donated food to clients versus a for-profit enterprise, even with committed to social enterprise values, and the impact on the branding and integrity of the food banks; and concern about the food hub competing with the food banks for food currently received from their growers, either from donations or reduced purchase costs, as the food hub likely would be paying a higher price to the grower for food purchases. Another concern was that they did not want to take on the management of the hub, but also were not sure about having another enterprise being separately managed in their space, given planned facility space configurations. Finally, the food banks, especially in Sacramento, may not ultimately have enough space to lease to an outside entity, as their volume of fresh produce handling is increasing rapidly for their own operations.

These are very realistic and valid concerns. It was apparent to the Project Team, as it conducted additional research on food hub and food bank as food hub models, that food banks do not generally incubate for-profit food hubs, nor serve as a food hub for buying customers such as institutions and businesses, unless they are meeting a gap in the regional food system and are taking on this role to fill the gap and generate revenue streams. The priority for the food banks in the Sacramento region is to renovate, upgrade and expand their existing aggregation, storage, packaging and distribution infrastructure to increase their ability to handle greatly increased levels of fresh produce for distribution to clients directly and through many partner organizations.

The Project Team used the feedback provided by the Food Banks to refine the estimated start-up costs for the food hub for the first three years. This updated information is now contained in the *Business Plan*, financial feasibility analysis and pro forma prepared for the food hub enterprise. Essentially, the Project Team determined that even if the food hub were able to be incubated within one of the food banks, it would not be a determining cost factor for the success of the hub, because the primary costs during the first year are the Costs of Goods Sold (purchased fresh produce) and the labor and packaging materials.

There would be a clear benefit to the hub from being able to share space and equipment such as forklifts, but the hub can lease such equipment. All the food banks are very interested in working with the hub on logistics and transportation activities, and possibly to serve as aggregation and transfer stations for a fee.

As part of the hub feasibility assessment conducted by the Project Team, the Project Team also prepared an estimate for the Yolo Food Bank of the costs of adding equipment lines for processing such as bottling, freezing and preparing sauces, as the Food Bank develops its engineering cost estimate for the renovation of its new facility. This information is included in Appendix A. It is a corollary to the overall hub facility *Cost Estimate Analysis* that provides information for the overall facility, of which the processing line included here would be an added component.

SUMMARY

As can be seen from the description of the activities and expansions being conducted by the Sacramento region food banks, they are playing a vitally important role in the development of the regional food system infrastructure, but are doing it in the way that best meets their organizational and capacity needs, consistent with their missions. Their activities have had and will continue to major impact on the delivery of fresh produce to consumers throughout the region, especially those most in need, while helping to support the growers, including entry-level, small and mid-sized growers, with a ready market for their produce, and extend the delivery of fresh produce to underserved communities, especially through their rich network of partnerships. The food banks are playing an additional role by educating clients about fresh produce, potentially opening up new markets for local growers in the future. They may be able to help farmers get their products into non-traditional grocery stores and help with outreach and promotion.

The addition of expanded food bank capacity will include processing of fresh produce to extend seasonality, handle large volumes during harvest time, and provide co-packing facilities for the use of the food banks and partners. These activities also will provide job training and job creation opportunities as their own fresh produce handling, processing and distribution systems scale up. This will help provide some revenue streams and opportunities for financial sustainability of the food banks over the longer term.

In terms of their own role in serving as a regional food hub, the food banks affirmed that their first mission is to serve existing clients and partners to expand consumption and distribution of fresh produce. While they want to partner with a food hub enterprise, currently they do not see it as their mission to run a food hub that serves a broader set of institutional and business markets.

All food banks want to add activities that might provide additional revenue generation. Strategies could include a shared maintenance fee for supplemental distribution partners; serving as a mini-aggregation site for local growers for produce which would then be transferred to the main hub; partnering on transportation and logistics; and leasing space and/or equipment for value-added processing activities, co-packing, storage, and so forth. In the interim, the most likely area of cost sharing and collaboration is for transportation and logistics. This is a strategy that is being deployed successfully in other regions, leveraging the strong assets that the food banks have developed along with grower relationships and inventory systems to track local produce. As noted, the food banks could also serve as mini-aggregation sites and transfer stations to get fresh produce from their areas and their growers into the broader regional marketplace.

Appendix A. Cost Estimate for Food Bank Processing Line

Job-Cost-Center Category	Capacity	Qty	Units	Unit-Cost	Total Cost
O1. EQUIPMENT COST					**$ 573,682.50**
PROCESSING EQUIPMENT					
Slicer Dicer		*1*	*ea.*	*38,000.00*	$38,000.00
Cooking kettle, jacketed for steam	50 gal working cap.	2	ea.	20,000.00	$40,000.00
Cooking kettle, jacketed for steam	150 gal working cap	2	ea.	25,000.00	$50,000.00
Cooking kettle, jacketed for steam	200 ga working cap	2	ea.	27,878.00	$55,756.00
Product pump, PD, SS, estimate	3-5 GPM	2	ea.	12,000.00	$24,000.00
Flex hose for pump connection, estimate		4	ea.	850.00	$3,400.00
High Shear Mixer	30HP	1	ea.	33,300.00	$33,300.00
PACKAGING EQUIPMENT					
Loading platform	48" DIA	2	ea.	$1,400.00	$2,800.00
Unscrambler	1200 jars per 8 hours = 150 jars/hr	1	ea.	$10,230.00	$10,230.00
Transfer Conveyor, empty jars	estimate	1	ea.	$1,200.00	$1,200.00
Jar Washer & Dryer (Option 1)		0	ea.	$195,000.00	$0.00
Jar Washer (Option 2)		1	ea.	$72,000.00	$72,000.00
Jar Dryer (Option 2)	Sonic 70	1	ea.	$5,167.00	$5,167.00
Transfer Conveyor, clean empty jars	estimate	1	ea.	$1,200.00	$1,200.00
TwoHead Volumetric Piston Filler	10-50 cpm	1	ea.	$19,915.00	$19,915.00
Filler Stand		1	ea.	$3,850.00	$3,850.00
Heavy duty casters for the filler stand		1	set	$300.00	$300.00
Filler Automation Kit (factory installed)		1	set	$10,830.00	$10,830.00
Capper		1	ea.	$1,580.00	$1,580.00
Transfer Conveyor, full capped jars	estimate	1	ea.	$1,200.00	$1,200.00
Labeler		1	ea.	$54,000.00	$54,000.00
Transfer Conveyor	estimate	1	ea.	$1,200.00	$1,200.00
Heat Tunnel		1	ea.	$19,500.00	$19,500.00
Transfer conveyor	estimate	1	ea.	$1,200.00	$1,200.00
Inkjet coder		1	ea.	$1,320.00	$1,320.00
Transfer Conveyor	estimate	1	ea.	$1,200.00	$1,200.00
Accummulation table, stationary		1	ea.	$2,964.50	$2,964.50
Stationary table, manual case assembly		3	ea.	$1,400.00	$4,200.00
Rotary accummulation table - OPTIONAL	36" DIA	1	ea.	$9,940.00	$9,940.00
Case packing stations - stationary tables/platforms		4	ea.	$807.50	$3,230.00
Metal detecor	estimate	1	ea.	$4,000.00	$4,000.00
Take away conveyor, full cases	estimate	1	ea.	$1,500.00	$1,500.00
Case taper (sealer)		1	ea.	$2,200.00	$2,200.00
Case coder		1	ea.	$1,320.00	$1,320.00
Accummulation conveyor, full cases	estimate	1	ea.	$1,700.00	$1,700.00
AUXILLIARY EQUIPMENT (assuming none exists)					
Guard Posts	estimate	4	ea.	$120.00	$480.00
Fence enclosure for Steam Generator if outdoors	estimate	1	ea.	$15,000.00	$15,000.00
Steam Generator	est. 1 mlh BTUh	1	ea.	$54,000.00	$54,000.00
Air Compressor set	15-30 HP	1	ea.	$20,000.00	$20,000.00
S1. SHIPPING/TAXES					**$ 59,433.81**
Taxes (unless exempt)		8.25	percent	$647,682.50	$53,433.81
Freight	allowance	3	trucks	$2,000.00	$6,000.00
T1. CONTRACTOR SERVICES					**$ 165,920.63**
Mechanical Installation	estimate (LOW END!)	25	percent	$573,682.50	$143,420.63
Electrical Installation	estimate	300	Amps	$7,500.00	$22,500.00
Y1. ENGINEERING SERVICES					**$ 91,889.25**
Detail dwgs for permit & bidding		7	percent	$799,036.93	$55,932.59
Project management		4.5	percent	$799,036.93	$35,956.66
A1. MOBILIZATION					**$ 62,155.33**
Building permit	estimate				$50,155.33
Equipment rental (lifts, crane, forklift et al)	allowance	4	weeks	$3,000.00	$12,000.00
X1. CONTINGENCY		7.5	percent	$953,081.51	**$ 71,481.11**
				TOTAL	**$1,024,562.62**

A project of the
Rural-Urban Connections Strategy
(RUCS)

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT

Prepared by:

Applied Development Economics, Inc.

In partnership with:

Foodpro International, Inc.
The Hatamiya Group
DH Consulting

SACRAMENTO VALLEY FOOD HUB COST ESTIMATE ANALYSIS

August, 2014

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT TEAM

APPLIED DEVELOPMENT ECONOMICS, INC.:

TRISH KELLY
Principal

DOUG SVENSSON
President

THE HATAMIYA GROUP:

LON HATAMIYA
President & CEO

FOODPRO INTERNATIONAL, INC.:

BILL WASHBURN
President

OLGA OSIPOVA
Vice President of Technical Services

JOEL SVENDSEN
Project Engineer

DH CONSULTING:

DAVE HARZOFF
Principal

SACRAMENTO AREA COUNCIL OF GOVERNMENTS (SACOG):

DAVID SHABAZIAN
RUCS Project Manager
dshabazian@sacog.org

GARETT BALLARD-ROSA
Planner 1
gballard-rosa@sacog.org

AMY LEE
Planner 1
amylee@sacog.org

www.sacog.org

The Rural-Urban Connections Strategy (RUCS) is the region's rural economic and sustainable strategy complementary to the Blueprint, the region's overall growth strategy (http://www.sacog.org/rucs/)

TABLE OF CONTENTS

I. INTRODUCTION 1

II. SACRAMENTO VALLEY FOOD HUB MODEL PROJECT PHASING 6

III. OVERVIEW OF FOOD HUB MODEL COSTS ....

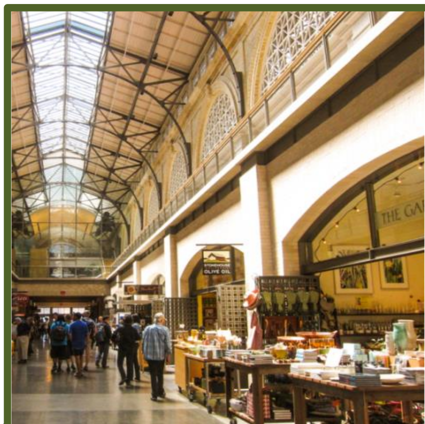
IV. HUB FACILITY PROJECT OPERATIONS 13

V. HUB INVESTMENT BUDGET DETAIL 22

VI. HUB OPERATING EXPENSES 29

VII. SUMMARY 32

APPENDIX A:
REFRIGERATION REQUIREMENTS 33



SACRAMENTO VALLEY FOOD HUB COST ESTIMATE ANALYSIS

I. INTRODUCTION

This Cost Estimate Analysis has been prepared as a component of the **Sacramento Regional Agricultural Infrastructure Project,** sponsored by the Sacramento Area Council of Governments (SACOG) through its Rural-Urban Connections Strategy (RUCS). SACOG is an association of local governments in the six county Sacramento region providing transportation planning and funding and serving as a forum for regional issues, including linking land use, transportation and air quality (see page 2 for a map of the region). The Blueprint, a signature SACOG project, is the region's long-term growth strategy. RUCS is the region's rural economic and environmental sustainability strategy complementary to the Blueprint.

Over the past several years, RUCS has identified the need for expanded regional "agricultural infrastructure" to strengthen the local and regional food system and the region's many rural communities. ***Agricultural infrastructure commonly is defined to encompass aggregation, packing, processing, storage, marketing and distribution capacity and facilities, including "food hubs."*** *Overall, agricultural infrastructure:*

- Improves the efficiency and sustainability of the local food system;
- Increases access to healthy foods, especially fresh produce (fruits and vegetables), in underserved communities;
- Supports the viability of agriculture;
- Creates new jobs and economic opportunities; and,
- Helps preserve valuable farmlands.

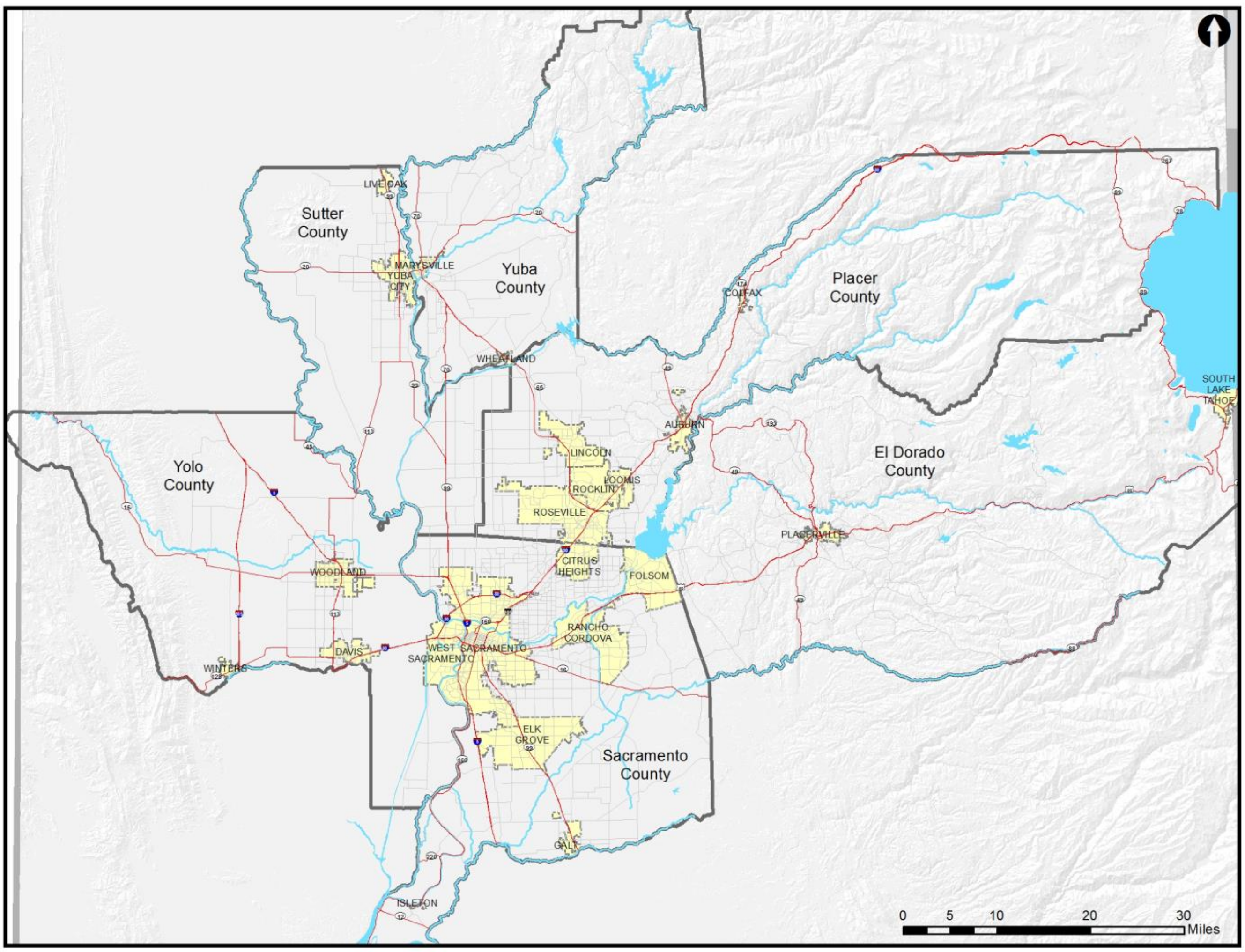
SACOG obtained funding from the California Department of Food and Agriculture, the California Strategic Growth Council and the U. S. Department of Housing and Urban Development to assess the feasibility and costs of models for development of new agricultural infrastructure, focusing primarily on food hubs. Food hubs help connect locally produced and source-identified foods to local markets and customers, especially by creating new market channels between smaller and medium-sized growers and larger institutional and business buyers.

SACOG contracted with a consulting team (Project Team) led by Applied Development Economics, Inc., in partnership with Foodpro International, Inc., the Hatamiya Group, and DH Consulting, to assess the market and financial feasibility of developing regional agricultural infrastructure. As part of the project, this document presents a cost estimate analysis for capital improvements (facilities and equipment) and initial operating expenses for a hypothetical hub model – the Sacramento Valley Food Hub – as well as the description of how the hub would operate. The analysis focuses on hub operations for specialty crops, defined by the U.S. Department of Agriculture (USDA) as fruits, tree nuts and vegetables.

The *Cost Estimate Analysis* was used as a basis for developing a business plan and financial feasibility analysis for the Sacramento Valley Food Hub. The *Business Plan* and *User Manual* (for the Financial Feasibility Tool Kit) also draws upon other analyses prepared by the Project Team and SACOG: the *Research Analysis of Food Hub Trends and Characteristics* which provides market context and examples of successful and promising types of hub business models; *Impediments to Supplying Locally Grown Food* which identifies barriers for both growers and food hubs in building the local food system; and *Food Banks and Food Hub Development* which discusses the potential role of food banks to incubate and/or support a regional food hub. The *Cost Estimate Analysis* was prepared in the fall of 2013 and reviewed with community partners. It was updated in the summer of 2014 to reflect the status of the project.

The map below shows the SACOG six county planning region.

MAP OF THE SACRAMENTO REGION



PROJECT BACKGROUND

The lack of mid-scale specialty crop handling and processing capacity is a constraint in meeting the increasing demand regionally for locally grown foods. Communities and regions across the country are facing similar constraints. In response, many innovative approaches are emerging to address these needs, including diverse models of food hubs which reflect local and regional market conditions and business structures. While the definition and practice of food hubs varies widely across the country, and continues to evolve, the U.S. Department of Agriculture (USDA) provides a working definition of a regional food hub:

A food hub is "…a business or organization that actively manages the aggregation, distribution and marketing of source-identified food products, primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail and institutional demand."
James Barham et al, Regional Food Hub Resource Guide, U.S. Department of Agriculture, Agricultural Marketing Services, April 2012, p. 4.

Food hubs can differ from conventional food distributors by offering more varied services, such as new farmer training, marketing and technical assistance, to producers, buyers and the broader community. They often focus on building relationships with small, mid-sized and/or beginning farmers who often are overlooked by conventional distributors. Food hubs also can include expanded activities along the agricultural "value chain," such as light food processing. One of the distinguishing characteristics of food hubs is their role in maintaining the identity and story of the grower throughout the food chain.

Several types of food hub business models exist, including for-profit, non-profit and cooperative. Whatever their business type, many hubs are explicitly mission-driven around economic, social and environmental values, such as to support local growers and the regional economy, promote sustainably grown food, address community food access issues, and improve health. Food hubs are serving as a catalyst for new market and economic development opportunities by providing important elements of the "infrastructure" needed to strengthen local and regional food systems. They are the subject of a great deal of study nationally and in California, including the report *Establishing A Food Hub for the Sacramento Valley,* prepared by Soil Born Farms and Community Alliance with Family Farmers (August, 2012), which provided the initial feasibility analysis for developing and operating a Sacramento Valley Food Hub. The Agricultural Sustainability Institute at UC Davis also has prepared several research reports on food hubs and aggregation and distribution networks within the Sacramento region and Northern California.

The Project Team drew upon its extensive analysis of this and other research as well as assessment of market drivers for development of the regional food system and existing agricultural infrastructure capacity to help inform the context for the preparation of the *Cost Estimate Analysis* in terms of the focus and scope of the Sacramento Valley Food Hub model, including the target level and scale of operations for a viable, self-sufficient enterprise over the long-term (see the *Research Analysis of Food Hub Trends and Characteristics* for detail).

PROJECT PURPOSE

The purpose of the Sacramento Regional Agricultural Infrastructure Project (Ag Infrastructure Project) is to:

> ***Provide a business model, financial feasibility analytic tools and business plan for a self-sustaining mid-scale aggregation and distribution operation – a food hub with aspects of processing functions – to serve regional specialty crop producers, including small to medium-sized growers, especially those who lack the capacity to access business and institutional markets. The tools and plans have been developed by SACOG as a resource for entrepreneurs, jurisdictions, investors and other interested stakeholders to advance the development of this infrastructure.***

The objectives of the project are to create new market channels and support for small to medium-sized growers, including new farmers, economically disadvantaged farmers, veterans entering agriculture and others. The hub also is intended to be a market resource for growers of any scale. Participation of larger growers, especially in the initial phase of the hub, could help provide the product volumes necessary to achieve economies of scale. In turn, this would help create the capacity to serve larger customers with cost-competitive pricing and reliability of supply, and establish a solid market base for locally grown specialty crops and value-added produce.

COST ESTIMATE ANALYSIS RESEARCH METHODOLOGY

The approach in conducting the food hub cost estimate analysis was to define a reasonable entry point and a path to scaling up in the Sacramento region that would provide a viable level of operations and basis for future expansion, given the size of the region and the desire to focus on institutional, business, government and other markets. Several activities occurred that informed the preparation of the cost estimate by the Project Team; they included:

- Multiple site visits to the Sacramento Food Bank and Family Services, the Yolo Food Bank and the Placer Food Bank to review their facilities, operations, expansion plans, and logistics capacity, and ongoing consultation to review potential start-up costs and variables for incubating a food hub;
- Interviews with partner organizations, local elected officials, agricultural support organizations, economic development representatives, food system providers, prospective food hub project developers, professional associations (grocers, restaurants), distribution companies and those conducting research in California and nationally on food hubs;
- Research on new food hub models and emerging findings nationally, including several new in-depth reports on hub operating and financial characteristics, and feasibility studies and toolkits;
- Data gathering to inventory existing vacant cold storage and freezer space and other food processing-related facilities and sites in the region, including facilities that could be repurposed for a food hub;
- Review of cost analyses previously conducted for the region;
- Analysis of regional crop production (supply) and consumer demand (existing consumption of specialty crops), gaps between supply and demand, and target crops based on a variety of market factors that could be potential crops for a food hub facility;
- Discussions with SACOG and advisory team partners.

Foodpro also drew upon its deep experience in the design and planning of food-related facilities from its many projects conducted over the years.

The analysis took into account existing agricultural infrastructure capacity to grow and distribute fresh produce which currently exists in the region, given the strengths, quality and diversity of our agricultural economy. This includes many direct-to-consumer venues, especially a richness of farmers markets, Community Supported Agriculture (CSA) food box programs, and farm stand retail operations, along with fresh produce aggregation, distribution, and wholesaler businesses. These assets support the capacity for the region – as yet unrealized – to grow, process, and distribute a very diverse and potentially even greater number of crops and products for the local and regional market and beyond.

These are assets that most other regions in the country do not possess. Seeing the market opportunity arising from the increasing consumer demand for fresh and local produce, a variety of hub-type projects are being considered or planned in several locales throughout the region. However, there are persistent gaps and challenges in creating a more efficient and economically viable system to better connect locally grown produce and value-added products to markets within the region. This is especially true for increasing the supply of fresh produce at an economically feasible price and scale for institutions and businesses such as schools, hospitals, food service companies, restaurants, hotels, grocery stores, government, and food banks and other organizations serving underserved communities.

The Project's analysis identified the need and opportunity for the proposed food hub to provide a direct market channel for local source-identified fresh produce geared to distributors and wholesalers serving the institutional, business, government and other customers described above, as well as to larger customers directly if there is a market gap. Thus, the *Cost Estimate Analysis* is geared toward a flexible food hub model that would fill this identified market niche.

The model incorporates a continuum of activities and services beyond a basic hub facility, including light food processing that would provide the potential to capture more of the agricultural "value chain" for the region's growers, workers and the overall economy. It also includes services to help smaller growers increase their capacity to grow for the regional market and participate in the hub, and marketing activities to create a strong brand for the produce and value-added products. These services are described in the *Cost Estimate Analysis* and the *Business Plan*, and a key distinguishing feature of the food hub compared to conventional fresh produce aggregators, distributors, wholesalers and processors.

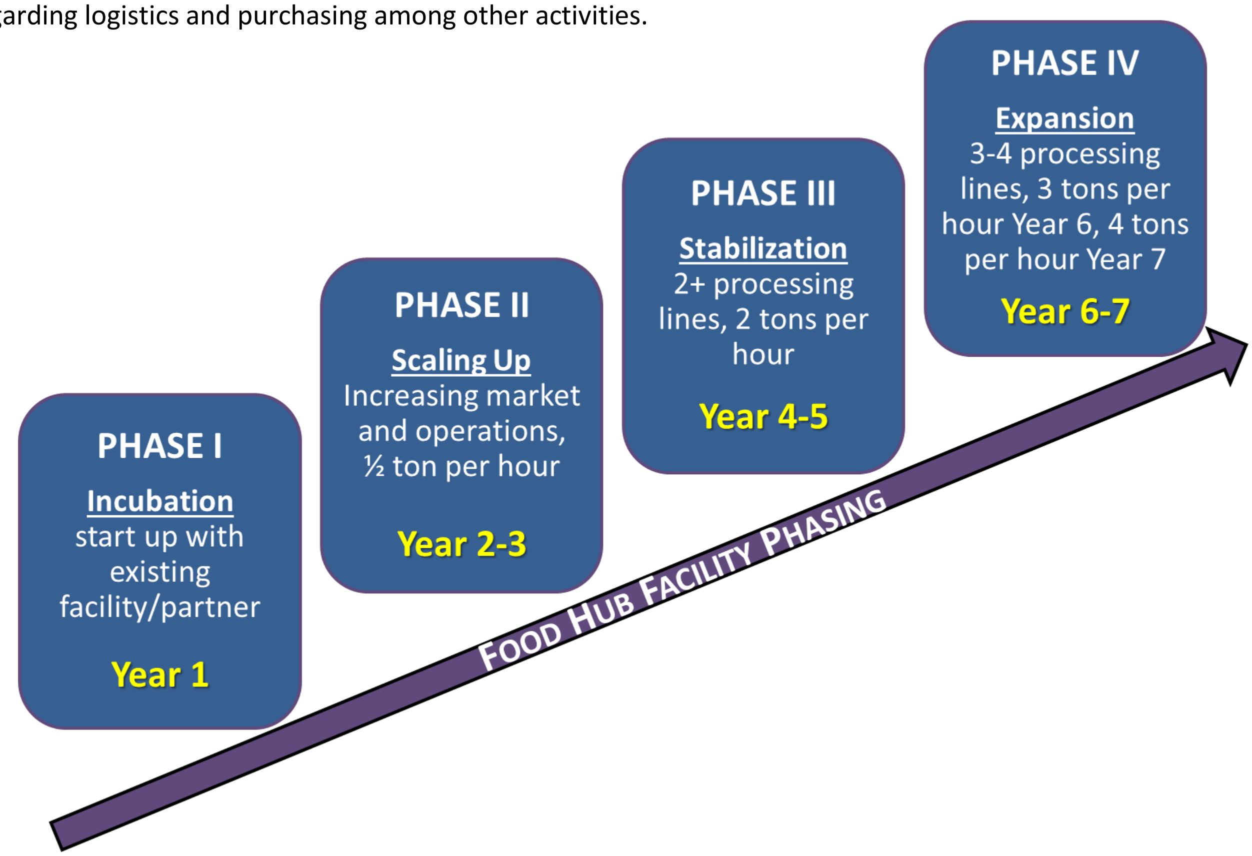
The next sections of this *Analysis* present information and assumptions on estimated project costs and operating expenses for the Sacramento Valley food hub model. They include project phasing, cumulative investments by major cost categories and phases, a description of in-depth operations of the facility, and a detailed budget with specific cost category itemization. It is important to note that the initial operating expenses contained herein have been expanded and updated for the hub pro forma financial feasibility analysis referenced in the *Business Plan*. Project costs are for the construction of a new facility, to provide a benchmark for the cost structure. Costs for retrofit of an existing facility would vary widely depending on existing building conditions and requirements to meet both regulatory requirements and the needs of the hub.

II. SACRAMENTO VALLEY FOOD HUB MODEL PROJECT PHASING

As with any business, a food hub agricultural enterprise will undergo several phases of growth once it is established. This document presents a cost analysis for estimated project investments for construction, equipment and installation expenses through four phases. The conceptual hub facility model is based on the assumption that the operation has a start-up phase (Phase I) and experiences one to two years of growth (Phase II) in a leased facility as it scales up operations. The hub moves into its own facility and adds freezing processing functions during Phase III, gaining the ability to sell consistently to larger institutional buyers with a stabilized level of operation on two+ production lines. The facility reaches full capacity on three production lines during Year 6 and expands in Year 7 with four production lines as the market grows for the hub's services and products, and there is the addition of more processing equipment (Phase IV).

These phases will be considered in determining the feasibility of the operation in terms of cash flow and the internal rate of return (IRR). With this framework in place, the requirements for start-up of the project and the different phases of operations can be estimated, based on market factors.

The graphic below illustrates the four phases of the food hub facility (plant) model and the levels of production (tons of produce per hour) that is the "throughput" for the level of operations encompassing a variety of types of fresh produce. The analysis originally looked at the potential to incubate the hub within an existing facility such as a food bank for at least the first year or two of operations, depending on the capacity and interest of the organization. Based on consultation with the food banks, this option does not appear to be likely, although it is possible that an entity such as an existing fresh produce distribution company could partner with the hub to begin developing the dedicated market channel for locally grown fresh produce. The *Food Banks and Food Hub Development* report discusses this analysis further, along with partnership opportunities with the food banks regarding logistics and purchasing among other activities.



Options for Phase II could include expansion within a partner organization facility, moving to an existing stand-alone facility, or co-locating alongside an existing aggregation/distribution hub operation. During this phase, the total volume of product moved through the hub increases as hub managers develop market and supplier networks. Some equipment is purchased for the operating lines and planning is underway for the development of the new hub facility. In Phase III the hub moves into the new facility, and capacity is added for increased throughput (tons) of fresh produce and a range of value-added activities on two+ production lines, including a variety of light food processing. There is also an increased level of services. Phase IV includes an expansion of throughput and ability to add value through an increased variety of activities on up to four production lines.

As the volume of product throughput increases with the growth of operations, there is potential for the hub to work with medium and large growers or other partners with existing agricultural infrastructure to leverage the use of their facilities as receiving stations and aggregation points for fresh produce throughout the region. This produce then would feed into the hub facility which ideally would be located close to markets and transportation. Phase IV includes expansion of space and increased processing capacity that is more mechanized, along with receiving stations located elsewhere in the region that would increase the level of product going to the facility.

As noted, the baseline cost estimate for reaching a stabilized level of operations by Year 5 in Phase III is calculated for a new building, or "greenfield plant." Options were explored such as leasing or purchasing an existing facility but a suitable facility was not identified which met needed project specifications or which could be retrofitted cost effectively. However, an exhaustive real estate inventory analysis was not conducted and it is possible that a viable facility could be identified. Another option would be to partner with an existing operation which is seeking to increase its access to source-identified locally grown produce. This strategy is finding success in other parts of the country. Analysis and interviews identified at least two local food distribution companies that had appropriate available space with cold storage for leasing.

The hub model is location neutral; however, some location alternatives with varying costs such as for permitting fees were identified which provided input data for the financial feasibility analysis.

Table 1 following provides a summary of the assumptions used to formulate the project development phasing activities that will drive the required cost category expenditures for planning and development of the food hub, including the facility and equipment.

TABLE 1. ASSUMPTIONS FOR THE SACRAMENTO VALLEY FOOD HUB PHASING DEVELOPMENT ACTIVITIES, YEARS 1-7

Year/Phase	Hub Project Development Activity Assumptions
Year 1: Phase I	There will no expenditure of funds on any construction or equipment, as the project will lease facilities and equipment. If co-locating with a partner organization such as a food bank, the hub could have access to facilities and equipment such as conveyors, forklifts, and so forth.
Year 2: Phase II	Some acquisition of basic processing equipment will take place while the project stays in the leased facility, or with a food bank/partner organization. The hub also may choose to move into larger leased space which would have existing cold storage capacities. The planning for the hub's own facility will start, and will include the identification of a site and design of the hub facility and operations.

Year 3: Phase II	Construction work will be carried out during Year 3, and the majority of the needed handling and processing equipment will be acquired and installed. Medium to large scale farmers with existing receiving and cleaning stations would or may be acting, on a contract basis, as receiving stations for the hub. Production will be about one half ton per hour.
Year 4: Phase III	Operations begin in the new facility. Each year additional investment will be made to expand the hub's processing capabilities. There will be two processing lines for tender and firm fresh produce pack and cut, and one line prepared for freezing operations. Production will be one ton per hour.
Year 5: Phase III	In Year 5, the hub reaches a point of stabilization. Produce freezing preparations would be added, with the freezing capabilities already in place due to proper planning of the refrigeration system. The line could also be adapted for drying produce. There would be a trade-off between the three lines, as capacity is scaling up – the hub would actually be using 2+ lines at any one time. Production will be two tons per hour. During the year, due to increased plant productivity, the storage capacities on the raw and finished product sides will be increased by introducing a rack storage system, thus utilizing the building height to gain additional storage space.
Year 6: Phase IV	The need for additional space will manifest itself due to the increase of the throughput (produce); thus some additional equipment would be acquired. The three lines will be running at full capacity. Production will be three tons per hour. To increase the availability of raw material (produce) sources, the use of receiving stations at more distant locations may be required. This process would formalize existing farmer owned (or other) receiving stations, which would enable growers located as far as 90 miles away to sell their produce to the facility. Or additional full-scale hubs could be developed throughout the region, focusing on particular markets niches and contributing to a "network" of hubs.
Year 7: Phase IV	The project will look into expanding its market niche and get into in-depth processing, with the most suitable and profitable options outlined in the next section of this report under "Potential Processing Lines." The Cost Estimate budget includes the most expensive of four potential processing options (freezing line), plus additional auxiliaries in support of that option. With the fourth line for a higher level of freezing capability, the third line blast freezer can be converted to a dryer for dehydration. Other options include adding a jam and sauces line, or an aseptic line for fruit and vegetable purees. Production will be four tons per hour.

Source: Foodpro International, Inc.

The next section of the analysis provides an overview of estimated food hub model costs, by major cost categories and by year as the hub scales up operations.

III. OVERVIEW OF FOOD HUB MODEL COSTS

This section provides a summary of annual estimated project investment costs for the food hub model from start-up through Year 7, and estimated cumulative investment costs required through Year 5 (Phase III), when the hub is targeted to achieve a stabilized level of operations and begins having a positive cash flow (see the *Business Plan*). Detail on facility and project operations is provided in Section IV.

As noted earlier, the Sacramento region has many valuable assets that comprise the regional food system. The proposed food hub is designed to provide a more diverse level of activities and capacity than currently exists and address gaps that would better connect growers and distributors with expanded markets. In particular, this includes distributors, institutional buyers, retailers and wholesalers that require the aggregation of fresh produce to meet their higher levels of need (volume), with some additional processing and preparation of the produce to meet varied customer needs. It also includes a variety of services to support and increase the capacity of growers.

As a point of reference, Table 2 illustrates the types of grower services and activities offered by regional food hubs, to inform the development of the Sacramento Valley Food Hub model along with the information provided in the report *Establishing a Food Hub for the Sacramento Valley*. The cost estimate budget is based on the construction costs of the facility and equipment and installation costs required to provide the desired hub functions and services, which are described in the narrative about hub operations.

TABLE 2. SERVICES AND ACTIVITIES OFFERED BY REGIONAL FOOD HUBS

Operational Services	Producer Services	Community/Environmental Services
Distribution	Actively linking producers and buyers	Increasing community awareness of “buy local” benefits
Aggregation	Transportation, on-farm pick	Distributing to nearby “food deserts”
Brokering	Production and post-harvest handling training	Food bank donations
Branding and market promotion	Business management services and guidance	Youth and community employment opportunities
Packaging and repacking	Value-added product development	SNAP (food stamp) redemption
Light processing (trimming, cutting and freezing)	Food safety and good agricultural process (GAP) training	Health screenings, cooking demonstrations
Product storage	Liability insurance	Transportation for consumers
		Recycling and composting programs

Source: “Regional Food Hub Resource Guide,” USDA Agricultural Marketing Service, April 2012, p. 6

OVERALL HUB FACILITY COST ESTIMATE

The model hub facility is calculated to be approximately 22,150 square feet (SF) of space. Table 3 on the following page provides a cost estimate by major cost center categories by year for the hub for Years 2 through 7. The total estimated project investment through Year 7 is approximately $6.9 million.

TABLE 3: DRAFT SACRAMENTO VALLEY FOOD HUB PROJECT INVESTMENT COST ESTIMATE BY MAJOR COST CATEGORY BY YEAR, YEARS 2-7

Cost Center Category	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total Cost
BUILDING* (160 x 140 SF)		$1,425,521			$392,000		$1,817,521
REFRIGERATION*		$555,012					$555,012
PRODUCTION EQUIPMENT (FRESH & FROZEN)	$498,482		$144,966	$245,154	$48,000		$936,602
PRODUCE HANDLING/STORAGE				$175,480			$175,480
FIRE PROTECTION		$193,602					$193,602
AUXILLIARY SYSTEMS & EQUIPMENT	$59,200	$586,730	$325,730	$2,000		$78,000	$1,051,660
POTENTIAL PROCESSING LINES & AUXILIARIES					$240,000	$675,000	$915,000
PROJECT SUB-TOTAL	**$557,682**	**$2,760,865**	**$ 470,696**	**$422,634**	**$680,000**	**$753,000**	**$5,644,877**
MOBILIZATION (permits, testing,		$48,593	$2,353	$2,113	$3,400	$3,765	$60,224
ENGINEERING & MANAGEMENT	$265,484	$165,927	$61,191	$54,943	$88,400	$97,890	$733,835
PROJECT TOTAL	**$823,166**	**$2,975,385**	**$534,240**	**$479,690**	**$771,800**	**$854,655**	**$6,438,936**
CONTINGENCY (@ 7.5%)	$61,737	$223,154	$ 40,068	$35,977	$57,885	$64,099	$482,920
GRAND TOTAL PROJECT VALUE (CAPITAL TO BUILD & INSTALL)*	**$884,903**	**$3,198,539**	**$574,308**	**$515,667**	**$829,685**	**$918,754**	**$6,921,856**

Source: Foodpro International, Inc.

*Includes structures and general mechanical, engineering and plumbing (MEP). Does not include Traceability and Inventory Software. Sales Tax rate (Sacramento County) – 8%

There are many variables at play which could alter the hub facility cost estimate, including costs of land, permits, and infrastructure. There also is a potential for cost reductions based on possible incentives such as land write-downs by a jurisdiction, permit streamlining, new incentive programs such as sales tax exemptions for the purchase of manufacturing equipment, and energy and utility rebates and incentive programs. This Cost Estimate budget also contains an overview of operating costs that the project would be incurring on a regular basis (see Section IV). This information is expanded upon significantly in the hub pro forma feasibility analysis.

In terms of the first year costs, the Project Team developed an initial budget that included an estimate for a standalone operation and one that could be incubated within a food bank, thereby reducing initial entry and operating costs. It was determined that there were essentially no capital costs incurred in Year 1, whether or not the hub is a stand-alone operation or incubated within a food bank or other operation. However, assuming that the hub is a for-profit entity (see the *Business Plan* for an explanation of the recommended for-profit model), the food banks expressed concerns about keeping brands differentiated due to the different missions of a for-profit and a nonprofit. Another concern was whether or not it would be more difficult for a food bank to receive donations or obtain lower costs for food if the hub were paying growers a higher price for the same crops. Estimated start-up (first year) costs are addressed as one of the variables in the pro forma analysis for the hub.

HUB FACILITY COST ESTIMATE, PHASE III

Phase III is a snapshot of the hub at a stabilized level of operations after scaling up and moving into the new facility. By now, the hub will be operating with three packing and processing lines and a variety of pre-cooler, cooler and freezer space for raw produce and finished produce, with a production of two tons per hour. There is additional space to accommodate dry storage and an outside facility area for outdoor pre-grading as part of a receiving station. This time point was selected as the target scale at which the hub needs to operate to reach a sustainable level of production.

Table 4 provides a summary of the key budget cost categories for the estimated overall project investment through Year 5. The total estimated project investment at the targeted Phase III level of operation is approximately $5,173,000. The project investment estimate is based on construction of a new facility, not including acquisition of land, but including costs of utilities and water and wastewater infrastructure. It includes all costs for equipment, fire protection, auxiliary systems, office and employee space, engineering and permitting costs, and contingencies.

Development costs will vary depending on whether or not the facility is developed at a site that is already serviced with infrastructure, or where infrastructure needs to be provided. For purposes of this analysis, it is assumed that the site will be serviced with existing infrastructure. If not, additional infrastructure costs must be added for water and wastewater treatment; cost categories are provided for these items in the budget estimate detail. Selection of potential sites should differentiate between an acceptable site and a better site based on criteria such as availability of infrastructure and size of site.

TABLE 4. DRAFT PROJECT INVESTMENT BUDGET ESTIMATE BY MAJOR COST CATEGORY AT PHASE III (YEAR 5)

Cost Center Category	*Total Cost*
BUILDING* (160 x 140 SF)	$ 1,425,521
REFRIGERATION*	555,012
PRODUCTION EQUIPMENT (FRESH & FROZEN FRUITS/VEGETABLES/GREENS)	888,602
PRODUCE HANDLING/STORAGE	175,480
FIRE PROTECTION	193,602
AUXILLIARY SYSTEMS & EQUIPMENT	973,660
MOBILIZATION	53,059
ENGINEERING & MANAGEMENT	547,545
CONTINGENCY	360,936
TOTAL	**$ 5,173,417**

**Includes structures and general mechanical, engineering and plumbing (MEP)*
Source: Foodpro International, Inc.

A more detailed construction and equipment investment budget estimate by cost category and year is provided in Section V, Table 5 of the report. Leasing or buying and modifying an existing facility might reduce the investment required, depending on retrofitting needs and other requirements, if an appropriate facility could be located. Incentives, rebates and sales tax exemptions for equipment are or may be available that would reduce capital outlay. Some of these potential opportunities are discussed in the *Business Plan* and *Impediments to Supplying Locally Grown Foods.*

Given the size of the facility and needs for outdoor uses on the site, such as truck parking and circulation, employee and customer parking, waste disposal, external pre-grading station, possible equipment storage and repair, and at least one refrigeration pad, five acres would be sufficient for the site for Phase III operations, allowing room for expansion. More specific site location requirements are discussed later in this report.

Details on operating expenses and assumptions are provided in Section VI. These estimates are refined in the pro forma financial feasibility analysis conducted for the *Business Plan*, but the original estimates are presented in the *Cost Estimate Analysis* to reflect the assumptions regarding the development of the estimates.

IV. HUB FACILITY PROJECT OPERATIONS

OVERVIEW OF HUB OPERATIONS

As described in the previous section of this document, the proposed food hub is designed to undergo several phases of operations, from basic aggregation, packing, packaging and distribution activities during the start-up and early expansion phases, to gradually put in place increased value-added activities such as light processing that will position the hub to develop a viable regional market niche for fresh produce. This section describes functional operations when the hub facility reaches this level of scale during Phase III.

There are five primary functions that will be targeted for the proposed food hub facility model in Phase III. It will be important to select products for this venture that can be marketed either fresh or frozen, to provide flexibility for changing market conditions, and to extend seasonality and shelf life. The *Business Plan* provides an analysis based on a mix of target crops that reflects a variety of market factor and analyses, which are described therein. The flow of operations and labor requirements are addressed for the following functions, which represent a continuum of services:

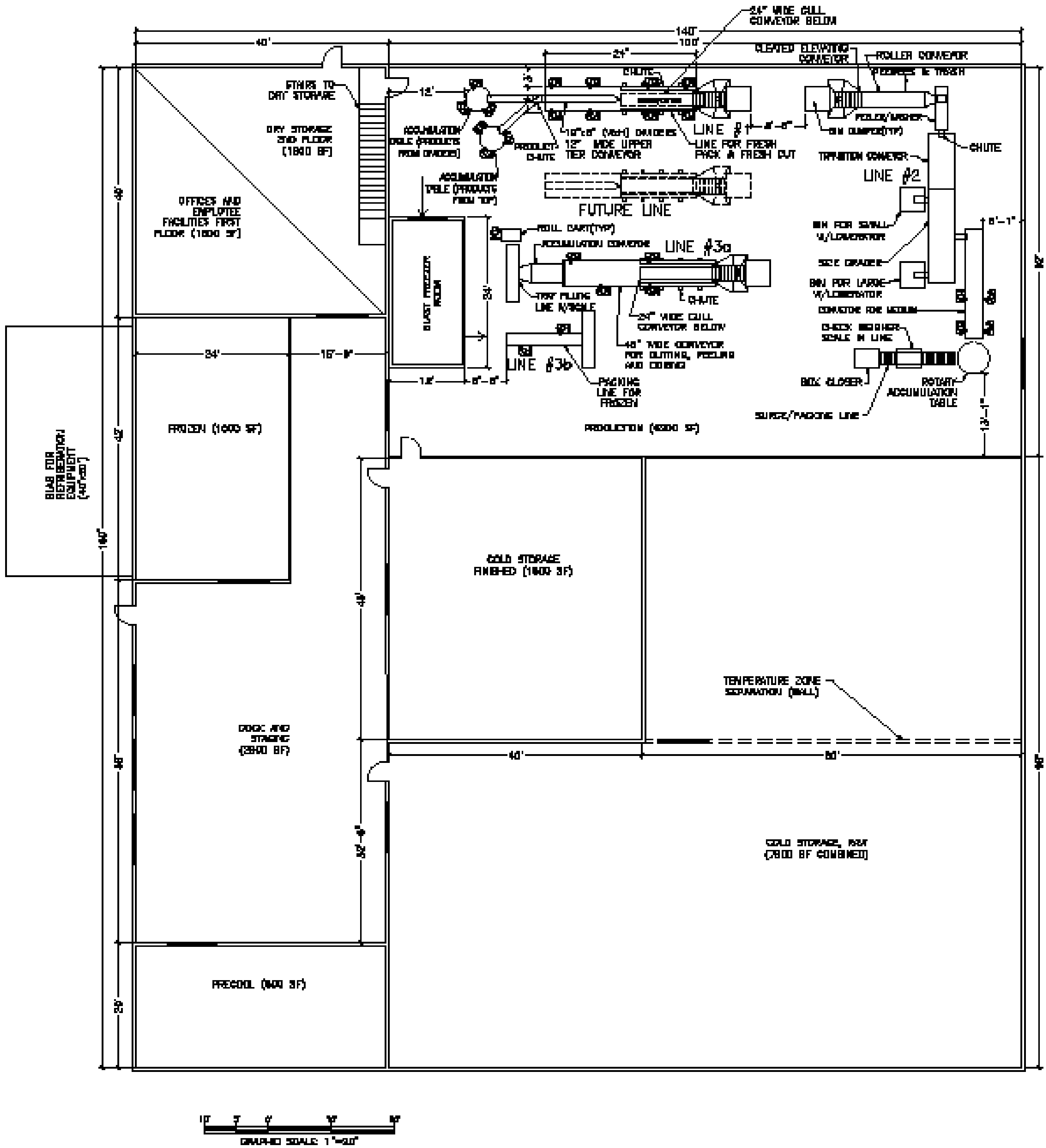
- Receiving and aggregating the produce
- Pre-cooling
- Packaging, packing, and/or adding value such as through peeling and cutting
- Processing
- Storing and shipping

The schematic on page 14 provides a conceptual layout of the hub facility (plant). The plant is designed for flexibility to accommodate diverse types of produce. It illustrates areas for loading docks and staging, various levels of cold storage, frozen storage and packing and processing, office space, and a mezzanine for dry storage, as well as proposed layout for placement of equipment for packaging and other operations. If the operations for Phase III do not immediately require all the storage space, there is potential for this space to be sub-leased until this capacity is needed. There is ability for additional space and equipment to be added in Phase IV.

The plant layout and budget estimates are provided for operations that are estimated to occur between Years 3-5. This would represent an expansion of the plant's capacity for input of product from one ton an hour in Phase II to two tons an hour in Phase III. Installation of additional equipment and development (construction or retrofit) of a large hub facility (more than 22,000 S.F.) would enable the plant to operate at this larger volume in Phase III. There is capacity to increase production for 3 tons an hour on three lines at full operation in Year 6. In Year 7 and beyond, the building could be expanded and additional, more mechanized equipment added in order to double the throughput capacity from Year 5, to four tons per hour (Phase IV), as the market increases for the facility's products and services.

The narrative below provides an overview of some of the key elements for the plant, from the receiving station which is part of the hub, through the different stages of handling produce within the facility. Each element will be important for the food hub's success. The overview will be followed by a more detailed explanation of project operations.

PACKING/PROCESSING CENTER LAYOUT



Receiving Stations

In the early Phases 1-2, the food hub will include a receiving station, which will be the point of entry for produce from the general area where the plant will be located, within approximately a 30 mile radius. This will provide the hub with the volume of produce needed for the projected input of one ton per hour in Phase II. The hub also will rely on informal or smaller "satellite" locations throughout the region, including those hosted by partners such as farmers, processors and other agricultural-related businesses and food banks/non-profits with excess capacity. These smaller locations will have contracts with the hub to receive, wash and store product from smaller nearby producers and transfer the produce to the hub.

As the food hub grows, the satellite receiving stations may become more formalized, with the hub providing capital to increase receiving station capacity and working with larger growers with existing infrastructure capacity throughout the region. The expansion of plant operations in Phase IV assumes an increased volume of produce received from these and additional receiving stations located throughout the region. These receiving stations would be the point of entry for produce from contiguous areas which represent potential expanded input for the plant. They would allow different types of produce that are grown in various parts of the region to be aggregated, packed, stored and processed at the plant, and help gain efficiencies in the transportation of produce throughout the region and beyond. It is estimated that this expansion would provide access to the volume of produce needed to increase throughput from two to three to four tons an hour.

A case study prepared by SACOG for Yuba County contains an expanded cost estimate for a hub facility option that includes a receiving/transfer station function that could increase the hub's access to fresh produce from the northern part of the region. This would include nearby counties such as Butte, Sutter and Colusa Counties.

Perhaps more important will be the inclusion of an agricultural "advisor" to serve the receiving station at the main hub facility, satellite locations, and eventually, the remote receiving stations. This position will help assure that the grower follows through to provide the produce to the plant; that the grower plants the right crops and achieves maximum yield; that waste is reduced; and that the grower receives the assistance needed to participate effectively. The advisor will grade the produce, make sure the field heat is removed and, finally, ensure that the grower is paid promptly for acceptable product delivered. The equipment at the receiving stations will enable the operator to separate the product by attributes such as size, color, quality and grade as needed and move it into cold storage. This will enable the grower to know which of the product meets the procurement standards and the amount of the payment for the grower. Any product not meeting the standards remains the property of the grower.

The design and analysis for the hub is location neutral, but should be in a location central with good transportation networks for receiving produce from the Sacramento Valley, foothills and contiguous areas, and reaching customer markets in the region and beyond. With the hub and some satellite receiving stations, the growers northeast of Sacramento likely would have to travel a bit more than 30 miles to deliver their produce to the hub but most others would be within 30 miles. This would cover a wide swath of the productive area from the Butte County area on the north to the Modesto area on the south, to the Foothills of the Sierra and the eastern part of the Bay Area.

The equipment at the remote stations will be similar to the "outdoor pre-handling" equipment planned for the plant. The plan is to locate the remote receiving stations next to a cold store so that once the produce is classified and the payment to the grower settled, the product can be stored to facilitate the logistics of supplying the plant with raw material (fresh produce).

Pre-Cooling Capacity and Storage

From the beginning of operations, a central component of the success of the food hub will be the use of pre-cooling equipment. The plant will have a modern dock for the receiving and shipping of produce. It is highly recommended that truck pick-up and delivery of product be coordinated and scheduled by the hub staff. Adequate space in the design has been provided on the dock for the pre-staging of product once it has been received or is in preparation for shipping. Arriving product that has not had the field heat removed will be moved to the pre-cooling room to have its internal temperature lowered and thus start the cold chain. This is essential to ensure adequate shelf life, optimize freshness, and reduce food waste. All customers will be pleased with the extended shelf life; some will insist on it.

With the field heat greatly diminished, the produce will be stored in one of two cold stores, depending on the storage needs for that product, in preparation for packing/processing. One room will be maintained at about 50 degrees Fahrenheit (F), while the other will be at about 34 degrees F. As scheduled, the product will be moved to operations for packaging, packing and/or processing. Scheduling the truck pick-up and delivery of the produce will be part of the overall logistics process coordinated and managed by the hub.

Processing Capacity

Basically, the operation is comprised of three lines in Phase III, each with the capacity of processing a ton per hour. While this provides a potential plant capacity of three tons per hour, it is not likely that more than two lines will be operating at any given time until Year 6, when capacity will increase to 3 tons per hour. The lines are described as follows:

Line Number One (Packaging, Packing, Fresh-Cut for Tender Produce): In general, line number one is planned for the packing of and adding value to fruits and vegetables that are more susceptible to bruising and other handling damage. The value added would primarily be limited to special packaging and packing as requested by clients, but could include special slicing and dicing as for fresh cut.

Line Number Two (Packaging, Packing, Fresh-Cut for Firm Produce): This line is planned for all other fruits and vegetables, primarily those that are more rigid or forgiving with respect to handling. Primarily, this line will produce product in special packages to facilitate the needs and desires of customers, but will also add value through peeling (e.g., onions and carrots), slicing and dicing.

Line Number Three (Freezing): The third line will be for adding more value in that the product will be prepared for freezing individual pieces of fruits or vegetables on trays in a blast freeze tunnel. This line can also be used for the preparation of produce for drying when the operation is expanded in a later phase (Phase IV), when additional freezing equipment is added, by converting the blast freezer enclosure to a dryer.

Packing and Storage

Cartons will be set up and dispensed from the dry storage area over the office which is where the fiber for the boxes is stored. The cartons will be set up and fed to each line by gravity which will keep the floor space free for processing and packing rather than for pallets of fiber and boxes. Once the product is cleaned, classified and/or has value added, it will be packed in a carton and unitized on a pallet near the end of each line. As each pallet is filled, it will be moved to storage, either in the fresh finished goods store or the store for frozen product. From storage, the product will be moved to the dock as scheduled for shipping, where it will be pre-staged to await the arrival of the truck.

Pallet racks will be placed in each of the storage rooms so that the plant can take advantage of the 24 feet of clear stacking height available. Initially, there will most likely be sufficient storage capacity without the racks but it will probably be necessary to start adding racks during the first year of operations; all racks will probably be needed by the end of the second year. If the hub is in an existing facility, it would be preferable to have 24 feet clear stacking to facilitate the use of pallet racks and floor drains in the process area.

Other Value-Added Activities

Other things to consider for a future expansion will include a line for the cooking, pulping and finishing of fruits and vegetables to produce a product generally classified as a puree, from which sauces, hummus, jams, jellies and a variety of other products can be made. Also to be considered for the next phase will be the replacement of the blast freeze enclosure with a modern IQF (Individually Quick Frozen) tunnel and the addition of dehydration equipment through conversion of the blast freeze enclosure. The layout for the hub facility shown above includes space for a fourth line, to be added in the future as operations expand. Cost estimates are provided for options such as equipment for the IQF freezer tunnel, the conversion for a dryer, a jams and sauce line, an aseptic line for fruit and vegetable purees, and boiler systems. A cost estimate for a production line for processing and bottling fresh produce was prepared for the Yolo Food Bank and provides another indication of the cost for the types of equipment needed for these other value-added activities. See the *Food Banks and Food Hub Development Report* for this information.

DETAILED PROJECT OPERATIONS

The following section describes in more detail the flow of operations for the plant.

Aggregating and Receiving the Produce

Most product (produce) will be delivered directly to the plant's dock, especially by the larger growers who have equipment to clean and grade the produce. Typically, the produce will be tipped from baskets onto the pre-grading line, but some will be tipped from pallet bins. Any very small produce items (commonly known as "pee-wees"), trash and culls will be removed from the flow of product, which will then be passed over a de-stoner, washed, classified as necessary on a conveyor, and dropped into a pallet bin and weighed. It will then be placed into cold storage to await transportation to the plant.

Meanwhile, based on the weight or the piece count, a settlement will be made with the farmer. Acceptable produce will be delivered to the dock either by growers, by company trucks bringing in produce by satellite locations (or other receiving stations in Phase IV), or by electric pallet jack from the receiving station at the plant.

The dock will be well equipped, with the floor of the dock about 49" above the concrete approach apron. There are three doors, each equipped with seals, a dock leveler, easy lift doors and a light. Product will arrive in baskets unitized on a pallet as well as in pallet bins. Trucks will be unloaded by electric pallet jacks and the pallets of produce will be staged on the deep dock (40') until the truck is unloaded and a receiving slip prepared.

Product will also be staged on the dock by electric pallet jack until all from such lot has been accumulated. It also will be checked and a receiving slip prepared. When product is received - either from the field or other storage facilities - the truck will back up to the dock (or park in front for side loaded trucks), with product either in baskets or in pallet bins. If in baskets, they should be unitized on pallets but if not, this will need to be done as they are received. Providing the growers with plastic crates is an important part of the plan as not only will it make it easier to handle the produce as it is received at the plant but it will be a very important part of the effort to gain the loyalty of the growers. Use of the crates which will be washed every cycle will be an important part of the food safety assurance program.

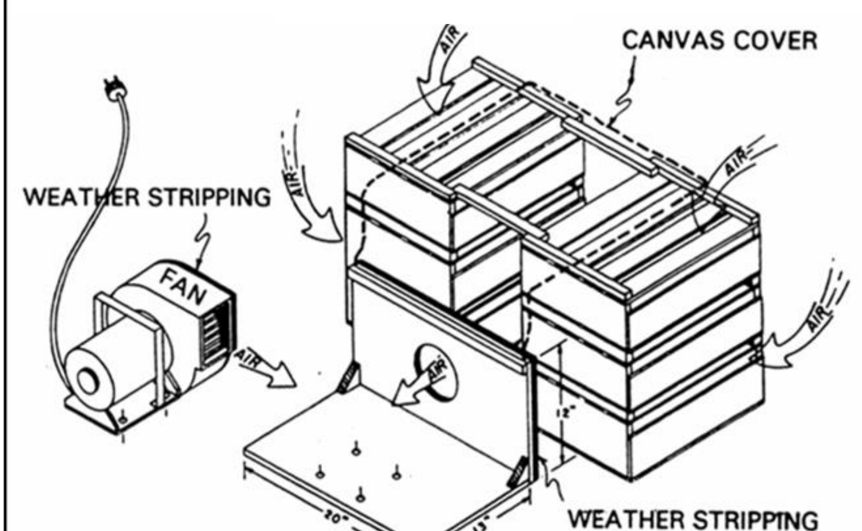
Pre-Cooling

A forklift will then be used to move the palletized produce to either the pre-cooling room, the high temp (48°F.) store or the low temp (34°F.) store. Removal of the field heat takes place in the pre-cooling room where the product is lined up, one pallet deep and two high, on both sides of a slot in the plenum wall. Eight double stacks of pallets are lined up on each side of the slot and a canvas is rolled from the plenum wall along the top of the two lines of palletized product which are separated by about four feet and down over the end of the two rows of product on pallets stacked two high, basically forming a tunnel between the two rows.

The air circulating fan connected to the coil is then turned on causing chilled air to be sucked through the slot in the plenum wall which makes the canvas cover cling to the pallets of product so that no air can by-pass. The air then passes through the coil to an opening in the top of the wall, thereby supplying chilled air to the room. This air has no way to return to the coil except to pass through the product lined up along both sides of the "tunnel" between the two lines of product on pallets.

Once the temperature of the product has been reduced to the proper level, the product is moved by forklift to one of the two raw material storage rooms. This pre-cooling process is essential since it will at least double the shelf life of the produce, giving the end user time to use the product in an orderly manner. It is so important that it needs to be accomplished from the start. Unfortunately, the pre-cooler described above cannot be justified initially. Therefore, the portable unit

Portable Cooler Unit



Source: Parsons, R.A. and Kasmire, R.F. 1974. Forced-air unit to rapidly cool small lots of packaged produce. University of California Cooperative Extension, OSA #272.

shown here is recommended for the initial phase of the operation.

This small system can be used to remove the field heat from produce items during the initial phase of the operation. The produce, either in a perforated box or a perforated pallet bin, is placed against the unit as shown. The canvas cover rolled over the top and open end forces the air to pass through the produce. This must be accomplished in a refrigerated room in order for the air to remove the field heat from the product.

Packaging, Packing and/or Adding Value

As scheduled, a forklift will be used to remove the product from the storage rack in which it was placed and stage it on the floor, to be moved to one of three lines in the process area by an electric pallet jack or a Big Joe forklift, depending on whether the produce is in baskets or a pallet bin. Pallets of product in baskets will be placed on the floor alongside the hoppers feeding the lines, while product in pallet bins will be placed into a bin tipper. The operator at the feed end of the line will either operate the bin tipper to transfer the load to the hopper as needed, or will commence tipping baskets of product into the hopper as needed to keep the line properly fed.

Processing

The plant will have three processing lines in Phase III, described below.

Line One: Tender fruits and vegetables packing and/or packaging: The product is moved to the line by an electric pallet jack and set beside the feed hopper. If the product is in baskets, the line operator will empty the baskets into the feed hopper to feed the line at a steady aggressive speed. If in a pallet bin, a Big Joe forklift in the area will be used to place the bin in the bin tipper and the line operator will use the control to tip the bin at a rate needed to keep the hopper full. At the bottom of the hopper belt with cleats moves the product from the hopper to the line as needed to keep the crew working at an efficient pace. Sufficient personnel will be assigned to the first conveyor to handle the necessary tasks which vary according to the quality of the produce. From one to six people can work on this line but the standard crew is four.

The produce will be split into two streams by a divider on the conveyor, one stream on each side. The personnel will remove culls and any other undesirable material from the flow of product and drop it into a slot on the side of the conveyor, which guides it onto a belt conveyor below the primary conveyor and moves it into a bin located to the side of the line. This crew can sort product into an isolated lane at the center of the main conveyor or onto a narrow conveyor mounted about a foot above the main conveyor. That way, they can sort by grade, color, defect or size depending on the raw material or the specifications for the finished product.

The main flow of product on the first conveyor will be directed onto the second conveyor which can also have up to six people working along the two sides. These people can be doing one of a number of chores, from placing fruit such as peaches in bags, and packing product such as tomatoes in trays, to packing product in cartons by hand. The line is very flexible and can be used to grade and pack almost any kind of produce item in a variety of ways. It can also be used to package produce items in a variety of packages (clam shells, trays, bags, etc.), to fresh cut and bag products such lettuce, apples and the like and even to prepare produce for freezing in the blast freeze tunnel when line three is down or more capacity is needed. Finished product can be packed in cartons or can be packaged directly from the second conveyor or from one or both of the rotary accumulation tables.

Line Two: Firm fruit and vegetable packing and/or packaging: In much the same manner as Line One, fruits or vegetables will be fed to this line from either pallet bins or baskets at a rate needed to keep the line working efficiently. Upon the product's arrival in baskets, the person feeding the line will pick up a basket of product and tip the contents into the receiving hopper. The conveyor in the bottom of this hopper will transfer the product to the trash (and pee-wees) eliminator. In addition to any trash and very small sized product, one or two workers will pull unacceptable product from the conveyor and drop it to the belt below the roller conveyor via slides. The trash and eliminated product will be conveyed to the side into a pallet bin.

The produce, as fed from the hopper by a belt with cleats, will feed a powered roller conveyor that will allow the very small produce items (pee-wees) to fall between the rollers. This conveyor at the feed end of the line will also provide the opportunity to get rid of trash and culls before the produce is washed at the next station.

The clean produce is then conveyed via a transfer conveyor to a size grader where it is separated into four sizes. The predominant size (small, medium or large) will be conveyed to the packaging line. The other three sizes (including jumbo over the end) will be dropped into pallet bins via a special articulated conveyor known as a "lowerater" to minimize damage to the produce. At a later time (usually near the end of the shift), the other sizes will be run over the line for packaging and/or packing.

Following size grading, a special piece of equipment can be inserted into the line for removing the peel from the produce items. This can range from peeling carrots and potatoes with an abrasive peeler to the peeling of onions with air pressure. Once the product is bagged, tray packed, wrapped, or placed in a clam shell, it will be packed from a rotary accumulation table into cartons. The packed cartons will be unitized on a pallet and moved to the finished goods storage room by an electric pallet jack where it will be staged until it is placed into a rack by a forklift. Early on the day it is scheduled for shipping, it will be moved to the dock and staged waiting for the arrival of a truck to pick it up.

Line Three: Preparation line for adding value to product destined to be frozen: In the same manner as described for Line One, product will be fed to this line. However, this is special product that is destined to be reduced in size by slicing and/or dicing and the individual pieces frozen on trays in a blast freeze tunnel. In some cases, the product will be peeled prior to being cut into smaller pieces. Although the end product is not what is commonly known as individually quick frozen (IQF) product since it is accomplished on trays rather than on a fluidized bed, it actually is individual pieces of product which are quickly frozen (quick but not quite as quick as on a fluidized bed). Peel and other trimmings will be dropped through slots on the side of the conveyor onto a collection conveyor mounted below the principal conveyor and will be conveyed to the feed end of the conveyor where it will be transferred into a pallet bin.

The vegetables which will be processed on this line will include spinach, broccoli and cauliflower while the fruits would include peaches, nectarines, strawberries and other varieties of berries. It will be important to select products for this venture that can be marketed either fresh or frozen. This flexibility is important because when the fresh market is slow or there is a glut of a product, it can be frozen to extend the shelf life. It is also important to note that, as the business grows and future phases of growth are implemented, this line can also feed a dehydrator. At that time, the blast freeze tunnel may be replaced by an IQF tunnel with a fluidized bed conveyor. In that case, the tunnel can be used as a dehydrator and the trays and racks can be used for the dehydration operation.

There are two conveyors which are used to grade the produce and prepare it for freezing. The product will fall from the last of these conveyors onto a surge belt conveyor from which the trays will be filled. A plastic liner will be placed in each tray prior to filling it with about five pounds of product. Filled trays will be placed in mobile racks, 30 trays per rack. The loaded racks will be pushed into the blast freeze tunnel which has the capacity to hold 14 racks. The doors will be closed and the freezing cycle will start and last for about half an hour, more or less, depending on the product.

The racks of product, once the product is frozen, will then be moved to a stripping line where the plastic liner will be pulled from the tray allowing the frozen product on it to fall onto the conveyor. The product will be conveyed to the other end of the line where it will be packed into cartons in much the same manner as the filling of the trays with product prior to freezing.

Regarding the options for Year 7 expansion, since the marketing of the IQF product will be restricted due to the fact that freezing on trays in the rack in the blast freeze tunnel will not meet the specifications by many companies for IQF product, there will be a strong incentive to purchase and install a modern IQF tunnel. When that occurs, the earlier investment in the trays, racks, and blast freeze tunnel can be utilized for drying fruits and vegetables since it is just a matter of replacing the refrigeration coils with dehydration coils in the blast freeze tunnel to make it a drying tunnel. The trays and racks are used in a similar manner for both operations.

Storing and Shipping

Each package of the finished product will be sealed and labeled, and then, product will be unitized on pallets at the end of each line. When a pallet is full, it will be moved to one of the storage rooms via an electric pallet jack, frozen product to the freezer and fresh finished product to the finished goods warehouse. The pallet of product will be set on the floor of the room and when available, a forklift will move the pallet of product into a rack or will double stack it.

When scheduled for shipping, the product will be moved to the pre-staging area of the dock early in the day by a forklift to await the arrival of the truck picking it up. Normally, forklifts will only be used for raising and lowering things and electric pallet jacks for moving product from place to place horizontally. However, since the freezer and the finished goods store are so close to the dock, the forklift used to remove the product from the rack will generally also move it to the dock.

Material Handling Equipment

Overall, there will most likely be two fork lift trucks involved in the operation (perhaps only one initially), two electric pallet jacks, one Big Joe forklift and about four manual pallet jacks. Most likely, it will be necessary to add an extension to the dock for battery charging and to provide a place for the refrigeration equipment. The Big Joe will primarily be used to load pallet bins into the bin dumpers and remove them when they are empty. Electric pallet jacks are the most effective handling since they are quicker than forklifts and cost much less to procure and maintain.

The next section provides the investment detail for the facility budget.

V. HUB INVESTMENT BUDGET DETAIL

Table 5 which begins on the following page provides the budget detail for each cost center category of the food hub facility for the investment required from project start up (Phase I) to the establishment and operations of Phase III and expansion in Phase IV. This information includes overall quantity, number of units needed and per unit cost (or price per square foot), and total investment costs for each line item. Detail is provided for construction, equipment and installation, as well as associated expenses, such as auxiliary systems, including utilities, permits, design services, and contingency.

The items which have a unit cost provided but no quantity (and therefore no cost) shown are included as a cost category because they may be a possible cost, depending on the location of the facility and the status of utilities and infrastructure to and on the site. For example, if the facility was built in an area served by municipal utilities, a storm water pond would not be needed, but one would need to be developed if the facility was located in a rural area that was not serviced. If there is not city or county water, then it is recommended to drill a well. If there is no service for waste water, a septic tank with leach lines for the “black” waste is recommended and a parcel for the disposal of process water (either more land or a neighboring grove/parcel for irrigation).

In terms of other utilities requirements, there should be a gas line relatively close to the facility and 2,000 amps of electrical service available in the area.

It should be noted that there may be slight changes in the final cost estimates used in the hub facility pro forma analysis, based on updated market information and refinement of the project concept and budget items.

TABLE 5. SACRAMENTO VALLEY FOOD HUB FACILITY
CONSTRUCTION BUDGET ESTIMATE, BY YEAR, YEARS 2-7

Job-Cost-Center Category	Unit-Cost	YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		Total Cost
		Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	
BUILDING* (160 x 140 SF)	**$64**		**$ -**	**22,144SF**	**$1,425,521**		**$ -**		**$ -**		**$392,000**		**$ -**	**$1,817,521**
Production space, fresh pack	$50			6,200 SF	$310,000									
Pre-cooler space	$50			814 SF	$40,700									
Cooler, raw produce (total two temperature zones)	$50			7,900 SF	$395,000									
Cooler, finished produce	$50			1,810 SF	$90,480									
Freezer, finished produce	$75			1,000 SF	$75,000									
Shipping dock & prestaging area	$50			2,800 SF	$140,000									
Cold Store Doors, Horizontal Slide, 8x10, installed	$9,456			6 EA	$56,736									
Freezer Store Doors, Horizontal Slide, 8x10,installed	$10,590			1 EA	$10,590									
Blast Freezer Tunnel Doors, 5x8, installed	$3,743			2 EA	$7,487									
Rapid Rollup Door, Staging Area, 8X10	$12,000			1 EA	$12,000									
Rollup Door, Dry Storage, 8x8	$4,562			1 EA	$4,562									
Sectional Door, Vertical lift, 12x12, insulated	$6,020			1 EA	$6,020									
Man doors, 3x8, cold store, installed	$1,605			4 EA	$6,422									
Man doors, 3x8, freezer, installed	$2,045			1 EA	$2,045									
Dock equipment (doors, seals, levelers)	$12,000			3 EA	$36,000									
Offices & Employee facilities w/MEP	$50			1,600 SF	$80,000									
Blast Freezer Tunnel enclosure (no equipment)	$35			288 SF	$10,080									
Mezzanine	$40			1,600 SF	$64,000									
Depressed truck dock approach	$35			1,440 SF	$50,400									
Slab on grade w/canopy for outdoor pre-grading	$35			800 SF	$28,000									
Addl. construction years later	$70									5600 SF	$392,000			

*Includes structures & general MEP.

Job-Cost-Center Category	Unit-Cost	YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		Total Cost
		Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	
REFRIGERATION*	**$8,500**		**$ -**	**65.30**	**$555,012**		**$ -**		**$ -**		**$ -**		**$ -**	**555,012**
Pre-cooler, 300 SF/TR				2.71 TR										
Raw produce storage, 385 SF/TR				20.52 TR										
Finished produce storage, 385 SF/TR				4.70 TR										
- freezer storage, 435 SF/TR				2.30 TR										
Staging area & dock, 200 SF/TR				14.00 TR										
Freezing process				6.97 TR										
Process area at 50 dF, 440 SF/TR				14.09 TR										
BASIC PRODUCTION EQUIPMENT (FRESH & FROZEN FRUITS/ VEGETABLES/GREENS)			**$498,482**	**$ -**			**$144,966**		**$245,15**		**$48,000**	**$ -**		**$936,602**
OUTDOOR PRE-GRADING			*$113,580*											*$113,580*
Destoner	$20,000	1 EA	$20,000											
Washer for field dirt removal	$34,020	1 EA	$34,020											
Sanitation system for washer	$7,560	1 EA	$7,560											
Dewatering	$27,000	1 EA	$27,000											
Grading conveyor	$ 25,000	1 EA	$25,000											
PACKING LINE #1, SOFT FRUITS/VEGETABLES	*1 TON/HR*		*$ -*		*$ -*		*$66,815*		*$ -*		*$ -*		*$ -*	*$66,815*
Receiving hopper w/cleated take-away conveyor	$5,500					1	$5,500							
Grading/sorting conveyor	$1,200					25	$30,000							
Transfer conveyors & chutes	$500					20	$10,000							
Rotary accumulation table, 4 ft dia.	$4,000					2	$8,000							
Closer applicator	$3,500					1	$3,500							
Manual scales	$350					8	$2,800							
Inkjet coder, industrial	$1,615					1	$1,615							
Trash conveyor	$600					9	$5,400							
PACKING LINE #2, FIRM FRUITS/VEGETABLES	*1 TON/HR*		*$157,920*		*$ -*		*$ -*		*$ -*		*$48,000*		*$ -*	*$205,920*
Receiving hopper w/cleated take-away conveyor	$7,500	1 EA	$7,500											

*Includes materials and installation

Job-Cost-Center Category	Unit-Cost	YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		Total Cost
		Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	
Peewees/trash/cull take-away conveyor	$350	10 LF	$3,500											
Brush washer	$24,000									1 EA	$24,000			
Peeler	$24,000									1 EA	$24,000			
Combo washer/peeler (Magnuson), 1 Ton/Hr	$36,000	1 EA	$36,000											
Transfer conveyor (vibratory)	$10,000	1 Ton/Hr	$10,000											
Size-grading conveyor (e.g. Kerian)	$27,346	1 Ton/Hr	$27,346											
Take-away conveyors, variable speed, 6 ft, 30" w	$3,000	3 EA	$9,000											
Bin fill lowerator	$10,000	2 EA	$20,000											
Borting conveyor	$1,000	20 LF	$20,000											
Rotary accumulation table, 4 ft dia.	$4,000	1 EA	$4,000											
Roller conveyor, caster stand, 12 ft, 30" wide	$9,000	1 EA	$9,000											
Roller conveyor, caster stand, 24 ft, 24"-30" wide	$15,000	0 EA	$ -											
Metal detector & check weigher combo	$6,000	1 EA	$6,000											
Inkjet coder, industrial	$1,615	1 EA	$1,615											
Inkjet coder, handheld	$350	0 EA	$ -											
Carton closer/sealer, mech'l	$2,160	1 EA	$2,160											
Carton sealer, handheld	$200	2 EA	$400											
Manual scales	$350	4 EA	$1,400											
PACKING LINE #3, REPACK OR FOR FREEZING	*1 TON/HR*		*$ -*		*$ -*		*$ -*		*$57,800*		*$ -*		*$ -*	*$57,800*
Receiving hopper w/cleated take-away conveyor	$5,500							1 EA	$5,500					
Grading conveyor	$1,600							10 LF	$16,000					
Sorting conveyor	$1,600							10 LF	$16,000					
Surge conveyor	$1,000							6 LF	$6,000					
Tray filling skate wheel conveyor, 30" wide	$3,500							1 EA	$3,500					
Tray fill scale	$1,300							1 EA	$1,300					
Frozen repack conveyor	$1,000							6 LF	$ 6,000					

Job-Cost-Center Category	Unit-Cost	YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		Total Cost
		Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	
Tray filling for finished, scate wheel conveyor, 30" wide	$3,500							1 EA	$3,500					
PRODUCTION RELATED SYSTEMS & EQUIPMENT			*$15,900*		*$ -*		*$34,560*		*$ -*		*$ -*		*$ -*	*$50,460*
Drip pans	$80	80 LF	$6,400											
QC check weighing cart	$1,500	1 EA	$1,500											
Metal detectors	$4,000	2 EA	$8,000											
Box making machine	$34,560					1 EA	$34,560							
CONTRACTOR SERVICES			*$202,460*		*$ -*		*$40,550*		*$185,620*		*$ -*		*$ -*	*$428,630*
Mechanical Installation, Process Equipment		40%	$114,960			40%	$40,550	40%	$23,120					
Electrical Installation	$250	350 Amps	$87,500					650	$162,500					
FREIGHT		*3%*	*$8,622*		*$ -*	*3%*	*$3,041*	*3%*	*$1,734*		*$ -*		*$ -*	
PRODUCE HANDLING/STORAGE			**$ -**		**$ -**		**$ -**		**$175,480**		**$ -**		**$ -**	**$175,480**
Racks, Cooler, raw produce	$200							650 postn	$130,000					
Racks, Cooler, finished produce	$200							156 postn	$31,200					
Racks on wheels for IQF, 14 per freezing batch	$150							28 EA	$4,200					
Trays for freezing racks, 30 ea. per rack	$12							840 EA	$10,080					
FIRE PROTECTION			**$ -**		**$193,602**		**$ -**		**$ -**		**$ -**		**$ -**	**$193,602**
Sprinkler system	$3			22,144	$62,002									
Fire extinguishers - allowance	$300			8	$2,400									
Fire hydrant system	$170			760	$129,200									
AUXILIARY SYSTEMS & EQUIPMENT			**$59,200**		**$586,730**		**$325,730**		**$2,000**		**$ -**		**$78,000**	**$1,051,660**
Power service (PG&E), 3/480, 1000 Amps	$50,000			1 cnnct	$50,000									
NG service (PG&E), 2000 MBTUH, allowance	$50,000			1 cnnct	$50,000									
Crate Washer	$40,000			1 EA	$40,000									
Crates	$15			2000 EA	$30,000	2000 EA	$30,000					2000	$30,000	
Pallets	$65			898 EA	$58,370	898 EA	$58,370							
Pallets Bins	$120			78 EA	$9,360	78 EA	$9,360							
Jet Precooler (Blast Fan, no	$12,200	1 EA	$12,200											
Hot water pressure washer, electric, portable	$12,000	1 EA	$12,000											

Job-Cost-Center Category	Unit-Cost	YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		Total Cost
Forklift trucks, electric, w/misc. attachments	$36,000					2 EA	$72,000					1 EA	$36,000	
Pallet jacks, electric	$12,000			1 EA	$12,000	1 EA	$12,000					1 EA	$12,000	
Pallet jack, manual	$2,000			1 EA	$2,000	1 EA	$2,000	1 EA	$2,000					
"Big Joe" lift truck	$15,000	1 EA	$15,000											
Forklift battery charging stn	$10,000	1 EA	$10,000											
Floor scale, for pallets	$12,000					1 EA	$12,000							
Truck scale	$75,000													
Air compressor, packaged unit	$1,000					30 HP	$30,000							
Compressed air piping system, installed	$500					100 CFM	$50,000							
Water well	$50,000													
Water treatment allowance	$40,000													
Wastewater treatment allowance	$25,000			1 LOT	$25,000									
Septic system (for black sewer)	$40,000			1 LOT	$40,000									
Site grading incl. for retent. ponds & bldg pad prep.	$120,000			1 LOT	$120,000									
Industrial water retention pond	$120,000													
Storm water retention pond	$220,000													
Site fencing	$15			2000 LF	$30,000									
Pavement (roads & parking)	$3			40000 SF	$120,000									
OFFICE & EMPLOYEE SPACE														
Furniture (allowance)	$4,000	1 LOT	$4,000			1 LOT	$4,000							
Computers & other hardware (allowance)	$6,000	1 LOT	$6,000			1 LOT	$6,000							
Lunch room equipment, counters & cabinets	$40,000					1 LOT	$40,000							
Commissary kitchen	$ -													
POTENTIAL PROCESSING LINES & AUXILIARIES			**$ -**		**$ -**		**$ -**		**$ -**		**$240,000**		**$675,000**	**$915,000**
Remote Receiving Stations	$120,000									2 EA	$240,000			
Opt. 1. IQF Freezer Tunnel (mechanical), 1 Ton/Hr	$250,000											1 EA	$250,000	
Opt. 2. Convert Blast Freezer enclosure to Dryer	$100,000											1 EA	$100,000	

Job-Cost-Center Category	Unit-Cost	YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		Total Cost
Opt. 3. Add jams & sauces line (*)	$200,000											1 EA	$200,000	
Opt. 4. Add aseptic line for fruit & vegetable purees (*)	$360,000											1 EA	$360,000	
CIP skid (For Opts. 3 & 4)	$75,000											1 EA	$75,000	
Steam or Hot Water Boiler system supply, 2 MMBTUH	$110,000											1 EA	$110,000	
Boiler system & distribution piping installation	$130,000											1 EA	$130,000	
PROJECT SUB-TOTAL			**$557,682**		**$2,760,865**		**$470,696**		**$422,634**		**$680,000**		**$753,000**	**$5,644,877**
MOBILIZATION			**$ -**		**$48,593**		**$2,353**		**$2,113**		**$3,400**		**$3,765**	**$60,224**
Permits, 0.5% OF VALUATION				0.5%	$16,593		$2,353		$2,113		$3,400		$3,765	
Testings	$7,000			1 Prjct	$7,000									
Surveys, stacking, temp. facilities, etc.	$25,000			1 Prjct	$25,000									
ENGINEERING & MANAGEMENT			**$265,484**		**$165,927**		**$61,191**		**$54,943**		**$88,400**		**$97,890**	**$733,835**
Design svcs, 8% of project		8%	$265,484		$ -	8%	$37,656	8%	$33,811	8%	$54,400	8%	$60,240	
Construction Management, 5% of project			$ -	5%	$165,927	5%	$23,535	5%	$21,132	5%	$34,000	5%	$37,650	
PROJECT TOTAL			**$823,166**		**$2,975,385**		**$534,240**		**$479,690**		**$771,800**		**$854,655**	**$6,438,936**
CONTINGENCY		**7.5%**	**$61,737**	**7.5%**	**$223,154**	**7.5%**	**$40,068**	**7.5%**	**$35,977**	**7.5%**	**$57,885**	**7.5%**	**$64,099**	**$482,920**
GRAND TOTAL PROJECT VALUE (CAPITAL TO BUILD & INSTALL)**			**$884,903**		**$3,198,539**		**$574,308**		**$515,667**		**$829,685**		**$918,754**	**$6,921,856**

(*) requires boiler system upgrade

(**) Does not include traceability & inventory software

Sales Tax Rate (Sacramento County) 8%

VI. HUB OPERATING EXPENSES

This section presents an initial estimate of the hub facility's operating expenses as of Phase III, Years 4 and 5 of operations. It also describes the assumptions for labor and other expenses. The general assumptions regarding the level of production at the facility, estimated revenues, costs of raw material (cost of goods sold - COGS), packaging and goods sold, and earnings before interest, taxes, depreciation and amortization (EBITDA) – an indicator of potential profitability, are set forth below. Additional market analysis and assessment of the supply of raw material (input) conducted by the Project Team, as described in the *Research Analysis of Food Hub Trends and Characteristics* and in the *Business Plan*, provides a more refined estimation of the costs and margins for these items. Tables 6 summarizes the overall assumptions for the hub's operations in Year 5.

TABLE 6. GENERAL PROJECT/FACILITY ASSUMPTIONS, PHASE III

Production of two tons of produce (input) per hour = 4,160 tons per year = 8,320,000 pounds per year
Revenue is $2,000 per ton, based on two tons per hour = $8,320,000 revenue per year
Cost of goods sold (COGS) averages 53.5% of revenue
EBITDA of between 15% & 30% of revenue (Earnings before interest, taxes, depreciation and amortization)

Table 7 below provides a summary of total estimated labor costs at Phase III, with 35 employee having varying levels of skills. While the wage rates may be a bit low, the allowance for payroll costs and fringe benefits is not. On average, a food hub that has food processing functions can provide opportunities for higher annual wages than for other occupations along the agricultural value chain, such as distribution functions.[1] It will be important to have professional staff who are able to develop and nurture a personal relationship with the growers as well as potential customers, including institutions which may have customized needs.

TABLE 7. ESTIMATED LABOR EXPENSES FOR PHASE III

POSITION	NUMBER	SALARY/HR.	SALARY/YEAR
Manager	one	$27	$ 57,000
Supervisor	one	20	41,600
Sales and Marketing	two	20	83,200
Unskilled	twenty	10	416,000
Skilled	five	15	156,000
Bookkeeper	one	20	41,600
Clerical	two	12	49,920
Operator, Receiving Station	one	15	31,200
Agricultural Advisor	one	20	41,600
Truck Driver	one	15	31,200
TOTAL			949,320
Payroll costs including fringe benefits (@ 40%)	Thirty-five		379,728
Total estimated labor cost			**$ 1,329,048 = 16% of revenue**

[1] Marquez, Michelle. Environmental Scan, Agriculture Value Chain, California. Center of Excellence, California Community Colleges, June 2011, pp. 15-16.

In terms of staffing related to transportation, the potential to lease trucks or hire a trucking service should be explored, along with the opportunity to partner with the food banks using their logistics capacity, routes and expertise. Table 8 below is a summary of other expense items in addition to labor.

TABLE 8. ASSUMPTIONS - OTHER ESTIMATED PROJECT EXPENSE ITEMS

ASSUMPTIONS	
EXPENSE ITEMS	**ANNUAL COST/$**
Utility cost @ 1.5% of revenue	$120,000
Maintenance supplies @ 2% of equipment cost	17,760
Transportation cost @ 1.75% of revenue (one truck with driver and three automobiles)	145,600
Advertising and promotion costs @ 1.5% of revenue	124,800
Insurance and legal costs @ 0.5% of revenue	41,600
Costs of permits and licenses @ 0.2% of revenue	16,640
Miscellaneous annual supplies (pallets, bins, baskets, hair nets, paper towels, etc.) @ 0.75 of revenue	58,240
Other Expense Items = 6.3% of revenue	$524,640
Total Operating Expenses, with Labor expenses = 22.2% of revenue	**$1,843,688**

Combining labor and other expenses, total estimated annual operating expenses would be **$1,853,688.** The numbers for these estimated operating expenses should function as a means for stimulating discussions. While the estimates are based on solid theory, determining the actual amounts to be assigned to each expense item for a particular company is almost an art and requires a great deal of reckoning. The purpose of this narrative is to explain the rationale for each line item.

In order to determine other costs as a percent of revenue (or equipment cost), in most cases the actual amount was calculated and then converted to a percent. To facilitate this, Phase III revenue was assumed to be $8,320,000 (two tons per hour @ $2,000/ton as noted above in Table 6). The utility cost is estimated to be $10,000 per month or 1.5% of revenue. Maintenance, on the other hand, is for expendables only and figured at 2% of equipment cost. The other operating expense items also are estimated as a percent of the assumed revenue for Phase III. The equivalent annual dollars are also shown for each line item.

The amount of acreage required to support the volume of input (produce) for Phase III is small enough that all the raw material can be aggregated within a 30 mile radius of the plant (see the *Business Plan* for an estimate of acreage based on a target crop mix identified in the pro forma analysis). Therefore, only one receiving station (at the plant) will be needed for this phase. Nevertheless, it is important to include an estimate of the cost to pick up some raw material from the field and to deliver most of the finished goods to customers. It has been determined that one truck with a driver will be more than sufficient to handle this work. However, it will be necessary to include three automobiles, one for each sales person and one for the agricultural advisor. It is estimated that these vehicles can be leased and maintained at an annual cost of $145,600 which, for purposes of this analysis, is 1.75% of revenue.

It is important to the success of the proposed operation to invest in promotion. Therefore, two people are included in the staffing for the development of new business; they will need a healthy budget for advertising and promoting. It is proposed that this will require 1.5% of the assumed revenue, or $124,600. Assumptions for other expenses are explained in Table 8.

OTHER ASSUMPTIONS

For the purposes of discussion, some additional general assumptions are provided related to other items which will help determine the feasibility of this venture. These include the cost of goods sold (COGS), which in turn includes the cost of raw materials (produce) and the cost of packaging.

Cost of Raw Materials

Foodpro prepared a review of information provided by SACOG and other data on the cost of the raw material which, along with the cost of packaging, makes up the cost of goods sold (COGS). This information includes the costs for sourcing many different types of fruits and vegetables, with an estimate of the cost of each item at the farm gate and at wholesale, as well as the price that the retailer is willing to pay for each item, and the retail price for each product.

While it may not always be possible to buy at the farm gate price, it should not be necessary to pay the wholesale price, which is much higher. Even so, either one provides for rather large margins. It is Foodpro's experience that the cost of the raw material, although variable (from about 40 to 70% of revenue), should average about 50% of the revenue. Together with the packaging material, the cost should average about 53.5% for the COGS at the volume assumed for Phase III. In addition, the plant will be adding value which will increase the margin even more. The purpose of mentioning this is to caution that the analysis leading to the revenue for each product, and especially the COGS, needs to be done with great care so as to determine the most accurate costs and margins. The more refined analysis is included in the Business Plan.

Packaging Materials

Packaging material is not considered to be an operating expense but is part of the cost of goods sold (COGS). It needs to be estimated along with the operating expenses. Considering that a carton will be needed for every 40 pounds of product, 208,000 cartons will be needed annually. These will be medium strength cartons and should be two piece telescoping cartons. The cost of one dollar per carton has been verified by carton manufacturers. Additionally, some of the produce will be bagged, tray packed, wrapped, etc. (although some will be packed bulk with no "secondary" packaging), and the average cost per carton for such packaging is estimated at $0.40. The annual cost for packaging is estimated to be $291,200 for Phase III, which would be 3.5% of the assumed project revenue.

EBITDA

The EBITDA (earnings before interest, depreciation, and amortization) should run between 15 and 30% depending on the state of development of the venture. However, there is every reason to believe that the EBITDA for Phase III will be towards the upper end of that range. The mix of crops, cost of goods sold, cost to process the crops and other factors affect the EBITDA. The *Business Plan* pro forma contains a detailed analysis of a potential crop mix for each production line and the potential economic viability of each.

VII. SUMMARY

The cost estimate for a Sacramento Valley Food Hub facility is based on assumptions for construction of and equipment for a new facility. Costs might be reduced if an appropriate facility were found and could be leased, or an existing facility could be purchased and used as is or retrofitted. Indications are that there are not that many appropriate facilities available but this merits further exploration. Costs also could be reduced based on the potential to receive sales tax exemptions such as for purchase of manufacturing (processing) equipment, incentives and rebates for resource-efficient building and system design, waste utilization, and renewable energy for transportation such as Renewable Natural Gas.

Based on the location of the facility and ability to meet eligibility criteria, it is possible that some grant funding or a low interest business loan would be available through a federal, state, local or other program to assist with development costs. The *Business Plan* addresses the potential to prototype a sustainable facility and operation, including the possibility of utilizing technology innovations for food processing building design and operations working with UC Davis.

The *Business Plan* explores a range of services that could be provided through the hub, some of which could provide an additional revenue stream, such as providing assistance with Good Agricultural Practices (GAP) certification and liability insurance. It also describes the need to partner with organizations such as non-profits that are already providing valuable technical support, training and services to growers, new farmers, and others in the food system value chain.

The Appendix contains background information on IQF refrigeration capacity sizing requirements for the facility model which would be added in Phase IV.

APPENDIX A: REFRIGERATION REQUIREMENTS

IQF (INDIVIDUALLY QUICK FROZEN) REFRIGERATION CAPACITY SIZING

	DESIGNATION	Q-TY	UNITS
FINISHED STORAGE NEEDS	Racks per freezing batch	14	EA.
	Trays per rack	30	EA.
	Produce weight per tray	5.0	LBS
	Freezing batch, product input	2,100	LBS
	Freezing time	1	HR
	Freezing, throughput	2,100	LBS/HR
	Initial produce temperature	60.0	dF
	Produce freezing point temperature, average	30.5	dF
	Final produce temperature	15.0	dF
	Heat of respiration (above freezing), average	20,000	BTU/(day-ton)
	Specific heat above freezing, average	0.95	BTU/(lb-dF)
	Specific heat below freezing, average	0.45	BTU/(lb-dF)
	Refrigeration load, respiration	875	BTU/HR
	Refrigeration load, cooling to freezing point	58,853	BTU/HR
	Refrigeration load, cooling below freezing point	14,648	BTU/HR
	Total refrigeration load	74,375	BTU/HR
	Allowance for cooling of racks & trays	12.5%	
	Total refrigeration load to freeze a batch	**6.97**	TR

S A C O G

A project of the
Rural-Urban Connections Strategy
(RUCS)

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT

Impediments to Supplying Locally Grown Specialty Crops

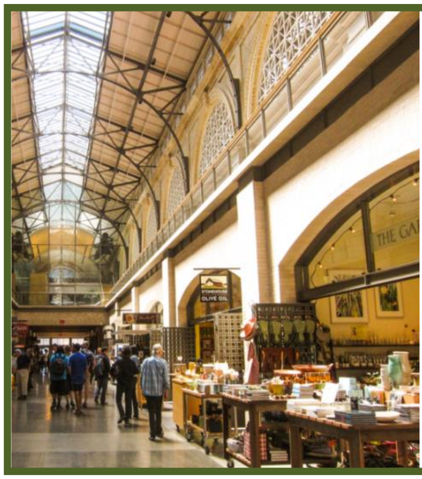
July, 2014

Prepared by:

Sacramento Area Council of Governments

In partnership with:

Applied Development Economics, Inc.
Foodpro International, Inc.
The Hatamiya Group
DH Consulting



Impediments to Supplying Locally Grown Specialty Crops

Most of the food grown today moves from the farm gate to the consumer through a concentrated and specialized system that takes advantage of economies of scale to provide a cheap and consistent product. This system maximizes efficiency and specialization yet also tends to distance production location and farmer identify from the final consumer. While large-scale commodity production continues to be the most prevalent model in the agricultural sector, the last few years have witnessed an ever growing trend towards farm-identified local food products. There are several reasons for the new interest in local food. Customers are increasingly seeking opportunities to reconnect with producers and ensure they are purchasing a healthy, fresh, quality product. And producers can manage risk and expand into a growing market segment by diversifying production.

Several recent surveys document the emerging demand for locally grown food: a 2012 National Grocers Association survey for example found that over 85 percent of U.S. consumers partly base their grocery store selection on whether it carries local products. In addition, a 2009 National Restaurant Association survey found that 89 percent of fine dining restaurants and nearly 30 percent of quick service restaurants in the U.S. serve locally sourced foods and the group projects that locally sourced food will be the industry's 'top trend' in 2014. Moreover, according to a Produce Marketing Association survey by the Hartman Group in 2011, U.S. consumers increased their tendency to buy locally grown fresh fruits and vegetables by 30 percent over the previous year.[1]

The Sacramento region is particularly well situated to capitalize on this noticeable shift in demand for increased local food. Agriculture has long been a cornerstone of the regional economy, with nearly $2 billion worth of crops grown in the SACOG region in 2012.[2] In addition to its economic benefits, agriculture is a way of connecting the region's rural and urban communities: SACOG estimates 41 certified farmers markets, 31 CSA operations, and numerous farm stands in the region.[3] And recently the region has embraced its agricultural roots with numerous

---

[1] Farm Futures, "Local Food Projected to be Hot Trend in 2014," Dec 9, 2013, http://farmfutures.com/story-local-food-projected-hot-trend-2014-0-105820; PMA, "Consumer Survey Reveal Growing Importance of Fresh, Local and Safe Produce," January 2011, http://www.pma.com/resources/research-center/consumer-trends/consumer-survey-article.

[2] SACOG analysis of Yuba, Yolo, Sutter, Sacramento, El Dorado, and Placer County 2012 Crop Reports.

[3] SACOG RUCS database for year 2013.

communities holding local food events, perhaps best highlighted by the inaugural Sacramento Farm-to-Fork festival in 2013.

Despite this noticeable shift in demand there remain serious challenges in supplying food grown for the local market. Overall the region's 2.3 million people consume about 2 million tons of food per year, yet only a sliver of this comes from local production. For specialty crops in particular there seems to be an imbalance between the region's status as a major agricultural producer and its emphasis on increasing local food consumption: the region has at least 526,000 acres of specialty crop production yet currently only about 1.25 percent of this land is in production for local markets.[4]

One central question for this region's agriculture cluster is how to overcome impediments in supplying locally grown food through scaled up production and distribution that better meets growing demand for regionally produced specialty crops at a consistency, quantity and price point attractive to both producers and consumers. This paper begins to address that question by documenting the existing barriers in growing and distributing specialty crop for the local market and then providing analysis on possible strategies that could incent an increase in local supply. The paper is divided into three parts, with the first section drawing on existing research and extensive grower interviews to delve into specific impediments farmers currently face growing specialty crops for the local market. The second portion of the paper describes how these barriers affect different market avenues for locally grown specialty crops, mainly farmers markets, community supported agriculture (CSA), farmstands, and wholesale. Finally, the paper concludes with an economic analysis for a series of possible economic development incentives aimed at overcoming barriers to supplying locally grown specialty crops.

[4] SACOG RUCS database.

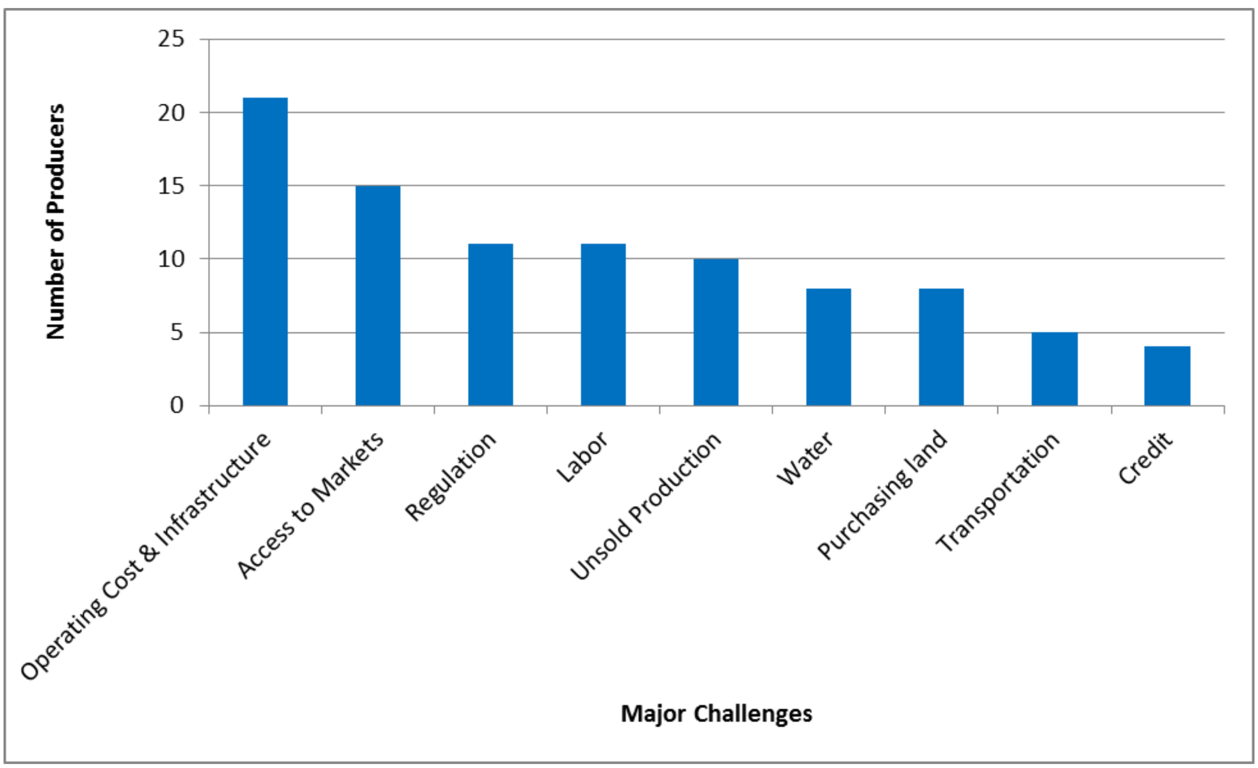
PART I: BARRIERS

The path to get locally grown food from production to market contrasts sharply with the commodity system that moves most product through our current food system, thus producing challenges unique to the local market segment. To better understand these unique challenges SACOG and Soil Born Farms conducted a survey of 70 local specialty crop farmers regarding production, marketing, and barriers in expanding market channels. These farmers accounted for over 50,000 acres in production, with the majority—approximately 48,000 acres—devoted to fresh fruit and vegetable production.

The survey asked farmers to identify the top three challenges they face as a producer and where they need help overcoming these barriers. Figure 1 below reports the grower responses to this question. Of all the challenges raised in the survey, operating costs had the highest incidence. Through interviews growers expanded on this cost challenge, relating higher costs to the lack of operating infrastructure dedicated to a local production system. Other challenges in this first theme include transportation infrastructure.

The second major theme identified in the grower survey and corroborated through interviews is the barrier of market access, which also includes the challenge of unsold production. Next, regulation and labor also emerged as major challenges. Finally, financial challenges such as credit or purchasing land round out the list of the top challenges local farmers face providing fresh fruit and vegetables to the local market.

Figure 1. Challenges Faced by Local Specialty Crop Farmers



Source: SACOG and Soil Born Farms Local Farmer Survey

In addition to the survey, SACOG conducted extensive outreach to growers and participated in grower workshops such as New Farmers Discussion Group and California Small Farm Conference over the course of 2012 to 2014. During this time SACOG also has reached out to economic development practitioners and other agriculture stakeholders to further inform the barriers to local market discussion.

Both the survey and interviews discuss new markets for local products and what barriers limit more widespread participation. Through this process SACOG identified and compiled the most prominent challenges producers face in growing specialty crop for the local market: operating cost and infrastructure, market access, labor availability and intensity, and regulation. Additionally, the strength of the existing national and international commodity system creates a disincentive for many producers to expand into local production, exacerbating the challenges of meeting ever growing demand for locally supplied food. Each of these challenges is explored in turn.

CHALLENGE #1: OPERATING COST AND INFRASTRUCTURE

Large-scale commodity production still dominates the agriculture sector and the region's current agriculture infrastructure reflects this orientation toward exports. The structure of this infrastructure is generally not conducive to local markets, thus requiring a local food system to have its own aggregation and distribution networks. The lack of specialized local-serving infrastructure in the region adds costs both on and off the farm, which can dissuade many growers from participating in local production. For example, a producer growing a wide variety of specialty fruit and vegetable crops for local production may find it prohibitively expensive to acquire the crop-specific equipment and machinery that improves efficiency and reduces labor cost; in contrast, a farmer producing a single commodity crop for export markets would be able to focus on-farm capital investments towards specialized inputs.

In addition to on-farm challenges, the lack of infrastructure oriented to local production presents challenges along the entire food supply chain. Through interviews, growers have identified the shortage of off-farm agriculture and food infrastructure tailored to regional aggregation, handling, processing and distribution as perhaps the primary constraint in meeting demand for more locally grown food. In particular, growers note the lack of mid-scale produce handling and processing capacity as a major constraint— growers will not produce for the local market if they can't see a viable supply chain infrastructure that enables their product to efficiently reach consumers. (Incidentally, it is such a supply chain that is also drives contractual arrangements between farmers and distributors, an important assurance to farmers that they will sell their product. The market access section below discusses further effects of contractual arrangements in production decisions.)

The lack of off-farm aggregation infrastructure makes it more difficult to efficiently aggregate, process and transport different types of produce grown in various parts of the region to local customers. Furthermore, consumers tend to value locally-grown specialty crop for its perceived freshness, yet the region needs locally-serving agriculture infrastructure to remove crop field heat and thus optimize freshness, reduce food waste and extend shelf life.[5]

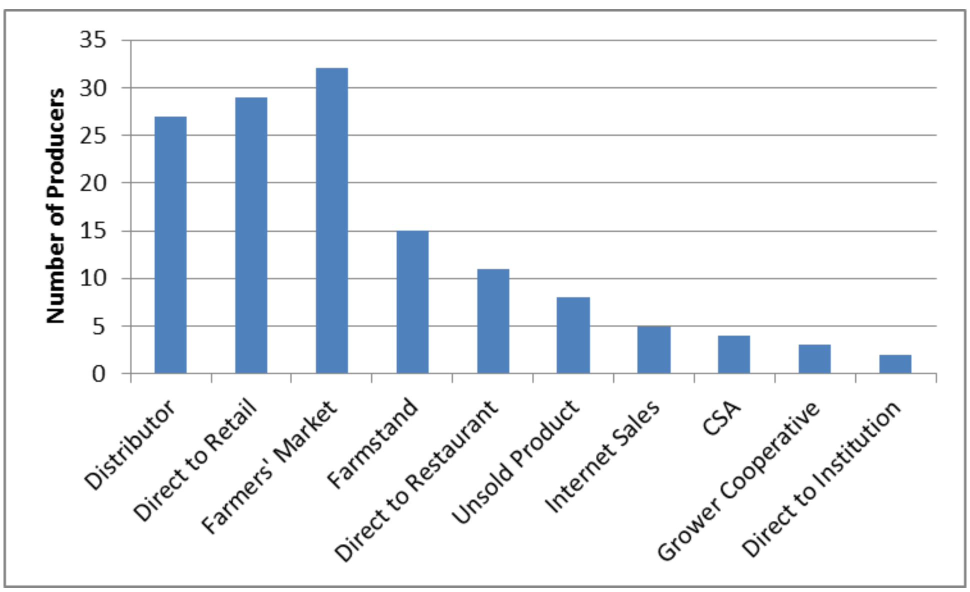
[5] Regional Agricultural Infrastructure Project, "Cost Estimate Analysis: Sacramento Valley Food Hub." Prepared by Applied Development Economics, Foodpro International, DH Consulting and the Hatamiya Group, June 2014.

CHALLENGE #2: MARKET ACCESS

Even when producers develop efficient ways to grow and a means to distribute product to the local market, they may be deterred from dedicating acreage for local production given a lack of market access. Unlike in contract agriculture, growers focused on local markets seldom are provided the security of a guaranteed outlet for their product. Exacerbating the challenge, many growers voiced concern that the common ways of getting product to local consumers—chiefly farmers markets and CSAs—may already be saturated. Furthermore, growers expressed skepticism that consumers at the end of the day would in fact buy local products given higher costs. This lack of understanding in the sector of emerging local demand means growers and others may fail to see a clear market signal and adjust production accordingly. And while growers recognized the opportunity provided by the region's perennial consumption at institutions such as schools, hospitals and prisons, they also lamented that existing procurement practices and price points make local institutional demand difficult to access.

SACOG's local growers' survey asked farmers to identify the channels they use to sell their products. Farmers were able to list multiple market outlets and 54 farmers responded to the question. The results, represented below in Figure 2, provide a wide range of responses; many farmers specialized in either wholesale or direct marketing. Though not a true random sample of the region's specialty crop farmers, the responses also illustrate the difficulty in developing a dedicated market outlet by tapping into the region's institutional demand. Only two farmers sold directly to institutions and these sales account for less than five percent of their total sales.

Figure 2. Market Outlet for Local Farmers



Source: SACOG and Soil Born Farms Local Farmer Survey

CHALLENGE #3: LABOR

The specialty fruit and vegetable crops most likely to be grown for local consumption have a much higher labor component compared to other types of crops. For example, data from University of California Cooperative Extension cost of production studies suggest that a single acre of alfalfa needs only six hours of machine labor and an addition hour of non-mechanized labor for production. Similarly, growing corn would require about ten hours of labor per acre. In contrast, the cost of production studies report significantly higher labor commitments per acre for specialty crops: over 200 hours for conventional stonefruit production, 550 for leafy greens, and 1,000 hours for strawberries.[6]

A look at the same cost of production database shows that not only are specialty crops more labor intensive than other crops, but specialty crops grown for local consumption currently tend to require a greater labor contribution than conventional specialty crop production. The reason behind this labor difference partly stems from production methods commonly used in local production, as many of the growers producing for the local market are smaller in scale and relatively new to farming, and thus may lack the specialized machinery and economies of scale that reduce labor costs. And unlike commodity production, farmers growing for the local market generally require a further labor contribution even after harvest, from staffing farmers markets to transporting direct product to multiple locations across the region. While varying by crop, the labor difference may be one and a half times higher to grow specialty crops for the local market than for conventional markets.[7]

Like other parts of the state, the Sacramento region's agriculture industry faces acute farmworker labor shortages; this shortage compounds the challenges of growing for the local market. Indeed, the California Farm Bureau reported a statewide farm labor shortage between 10 and 30 percent in 2012,[8] and recent work by SACOG suggests a regional farm labor shortage of as much as 19 percent in the six-county Sacramento region based on estimates of demand.

Table 1. Estimated Farm Labor Shortage in Sacramento Region

County	Estimated Supply	Estimated Demand	% Difference
El Dorado	302	577	48%
Placer	265	661	60%
Sacramento	2,190	2,352	7%
Sutter	2,472	2,356	-5%
Yolo	2,430	3,213	24%
Yuba	761	1,231	38%
Source: American Community Survey 2007-2011 for supply, SACOG 2008 crop map for demand			

[6] SACOG analysis of Cost and Return Studies, University of California Davis Agricultural & Resource Economics. http://coststudies.ucdavis.edu/.

[7] SACOG analysis of Cost and Return Studies.

[8] California Farm Bureau Federation, "Walking the Tightrope: California Farmers Struggle with Employee Shortages," 2012. http://www.cfbf.com/employmentsurvey/pdf/CFBF_Farm_Employment_Survey2012.pdf.

CHALLENGE #4: REGULATION

While not an issue solely for regional food system production, farmers wishing to sell to the local market must navigate a complex regulatory system that adds costs and time to the production process. As Table 2 below illustrates, this system touches almost every aspect of production, from fertilizers and pesticides to water and labor.

Table 2. Examples of Regulations in Specialty Crop Production

Theme	Under Regulation
Air	Diesel Trucks
	Tractors
	Stationary Diesel Engines
	Agriculture Burning
Transportation	Load Security
	Placarding
Pesticides	Restricted Materials
	Pesticide Use
	Reporting
	Worker Safety
Water	Surface Water
	Ground Water
	Water Diversion
Safety	Traceability
	Pesticide Residue
Marketing	Certified Organic
Labor	Heat Illness
	Equipment Use Requirements
	Timekeeping and Overtime
Land Use	Endangered Species

What is unique about farmers growing for the local market is that since many are smaller in scale and relatively new to farming, they lack both the experience, wherewithal, and ability to steer such a complex system. In interviews, producers who had been growing primarily for personal consumption, but wishing to expand to the local market, expressed distress that the transition to small scale commercial production and processing also brings a corresponding and unanticipated level of regulatory burden. Indeed, many growing for the local market operate at a scale large enough to trigger regulations, but too small to have resources dedicated to working through the regulatory system.

Recent work by the Ag Innovations Network demonstrates how the existing regulatory system can be a barrier impeding the supply of more locally grown specialty crop. During interviews with growers, Ag Innovations Network documented that farmers "understand regulation to be a necessary part of running a farming operation and often agree with the underlying intent of regulations." Navigating the regulatory process however "is confusing to most farmers, leaving them feeling uncertain about cost and timelines and fearful of additional scrutiny." This fear of uncertainty and additional scrutiny may deter producers from expanding into the local market, especially for small-scale farmers that “are disproportionately affected by these challenges.”[9]

Certifications Further Burden for Small and Mid-Sized Specialty Crop Producers

While not mandated, voluntary certification programs are increasingly becoming necessary as a cost of doing business for local growers, especially as customers such as grocery stores, restaurants, or farmers markets require safe practice documentation from upstream producers. The Good Agricultural Practices (GAP) certification program represents one of the most common of these certifications, where a grower institutes and documents a food safety plan and then invites an auditor to the farm to review the on-site food safety system.

In addition to the time needed, the GAP certification can demand monetary expenditures to reach compliance. The cost of the audit—while varying greatly based on farm size—can reach more than $1,000, yet the real burden for farmers comes from changes on the farm needed to pass a successful audit.[10] A case study of a 130-acre farm in Vermont for example found that the capital investment to comply with GAP requirements could reach $130,000. When annualized over a decade, the report’s author estimates GAP compliance costs between $10,000 and $30,000, or one to three percent of the farm’s total sales.[11]

Further challenges include confusion about which GAP audit to pursue. The USDA’s GAP certification has been one of the most prevalent, but individual customers may require their own unique certification. Indeed, the surfeit of audit standards and schemes has led to an effort to centralize GAP certification through the Produce GAP’s Harmonization Initiative. The initiative, led by a committee of produce industry representatives, aims to harmonize standards into a single audit accepted by all buyers. USDA incorporated the initiative in its own certification and released harmonized checklists in fall of 2013.[12]

In addition to the GAP certification, different paths to market for locally-grown production come with their own level of certification. For example, most of the farmers markets in the SACOG region are California Certified Farmers Markets (CFM). To sell at a CFM a producer needs to apply as a Certified Producer, which requires an on-site inspection of the growing grounds to verify the producer grows all products presented for sale. And in order for a grower to use the term organic, she must comply with all the regulations contained in the California Organic Food Act of 2003 which requires operations in excess of $5,000 per year to be certified by a third party organization.

---

[9] Ag Innovations Network, “Regulating for Agricultural and Public Outcomes: Perspectives and Recommendations.” January 2014.

[10] A Farmer’s Guide to Understanding Food Safety and GAP Audits, “The Cost: What You Might Spend to Become GAP Certified.” http://gapcertification.com/the-costs-what-you-might-spend-to-become-gap-certified.

[11] Hans, Estrin, “Here Comes GAP Certification: The inside story of a Vermont farmer going for USDA GAP certification.” UVM Extension, December 9, 2010. http://www.uvm.edu/vtvegandberry/GAPS/HarlowFarmGAPSCaseStudy.pdf.

[12] David E. Gombas, Ph.D, “Produce GAPS Harmonization Initiative,” United Fresh; USDA Agricultural Marketing Service, Grading, Certification and Verification.

CHALLENGE #5: CONVENIENCE OF EXISTING PRODUCTION SYSTEM

The prevalence and strength of the existing commodity agricultural system greatly compound the above four challenges of increasing the supply of specialty crop grown for the local market. For example, instead of trying to piece together a local supply and distribution chain, farmers growing commodity crops can take advantage of established infrastructure and mechanized production to reduce labor and realize economies of scale. Through time, farmers have also developed strategies to deal with the known regulatory system; switching to new crops and production patterns would entail a significant outlay of both money and time. And perhaps most importantly, commodity agriculture offers farmers more certainty and stability through the form of guaranteed contracts, and recently, high margins of return: with a crop value of $1.96 billion, the region's agricultural output is at an all-time high.[13] In other words, farmers need to see a strong market case of why to grow for the local market compared to the familiarity, accessibility, and profitability of export-oriented agriculture.

[13] SACOG analysis of County Crop Reports for year 2012 (the most recent data available).

PART II: BARRIERS BY MARKET OUTLET

The previous section lays out the key issues regional growers and stakeholders identified as barriers limiting the supply of locally grown specialty crop in the SACOG region. This section builds off the above by delving into the extent of these barriers by the major market segments for locally grown food, comparing the challenges and opportunities of direct marketing to conventional production measures.

FARMERS MARKETS

Farmers markets across the nation have taken off in popularity and now serve as a major way for local growers to reach consumers. Indeed, more producers in SACOG's local grower survey listed farmers markets as an outlet than any other response. By directly marketing to consumers through a farmers market, growers can provide detailed information about their product (production practices, varieties, source), and receive consumer feedback. Additionally, farmers markets are well suited for small, new, or transitioning farmers given the low barriers to entry, generally just a truck and a stand. And by removing the middleman, farmers at a direct market can expect higher prices and are paid at the time of sale.

Despite these advantages, local growers targeting farmers markets must still overcome the four main barriers of operating costs, access, labor and regulation. First, by directly marketing to consumers, farmers must rely on their own infrastructure to get to market instead of selling to a distributor with specialized facilities. This requires significant grower labor and time to get to and staff the various markets. For access, growers have expressed concern that the direct market in the region already is saturated—the proliferation of markets potentially has drawn the customer base too thin—and difficulty in getting spots in the more popular and established markets. Finally, farmers markets in the region tend to require certifications which, as mentioned above, add another level of regulatory complexity to production.

COMMUNITY SUPPORTED AGRICULTURE

Along with farmers markets, community supported agriculture represents a second major way farms targeting local consumption get their product to market. While the earliest growth in CSAs in the state centered in the Bay Area, recently the Sacramento region has seen an expansion of providers and also products. The advantages of farmers growing for a CSA include up-front payment often above retail prices and a guaranteed market as the crop is pre-sold. However, member turnover and the challenges advertising the CSA service vitiate the ability to secure an established market long-term. Further challenges center on the acute logistical needs of the CSA, forcing the farmer to employ not only farming skills but also database and supply chain management and devote resources to developing an appropriate CSA infrastructure. Recently signed Assembly Bill 224 requires CSAs to register with the California Department of Food and Agriculture as a direct marketing producer and to specify whether the producer is part of a single or multi-farm CSA. The new law also covers safe handling of farm products and includes trace-back requirements.

FARMSTANDS AND AGRI-TOURISM

The final major direct marketing channel for local growers' product comes from sales at or near the point of production. There's certainly nothing new about farmstands—California farmers have been selling their product from the field at road-side stands since they started farming—and the recent growth of agri-tourism complements this market outlet. While farmstands reduce farmers' reliance on external operating infrastructure, the tradeoff often is that the infrastructure to bring consumers to the farm –such as signage on agri-tourism routes—often is underdeveloped and outside of the farmer's control. Farmstands also experience fluctuating and somewhat unpredictable levels of customers, limiting the opportunity for guaranteed market access.

Of the four main barriers to supply locally grown food, regulatory challenges may be the most pronounced in the farmstand market outlet. In addition to possible parking limitations or conversely, minimum parking requirements, farmers looking to increase local market access through farmstands often face zoning and planning restrictions that preclude direct sales on agricultural lands. Recently some progress has been made on this issue. Assembly Bill 2168, effective January 1, 2009, exempts field retail stands selling only produce on-site from the California Health and Safety Code. Local regulations and codes can also prohibit the sale of processed farm products. AB 2168 creates a new category of farm stands that can sell some processed agricultural products. Yet under the bill these processed farm products must be prepared and packaged in an approved facility and not require refrigeration. Assembly Bill 1616, effective January 1, 2013 allows small-scale farmers to market certain processed foods made in private-home kitchens, subject to several conditions.

WHOLESALE MARKETING

Despite rapidly increasing interest in locally grown food, regionally direct-sourced products only account for a small percentage of total food sales—SACOG estimates that less than 2 percent of the food produced in the region is also consumed in the region. Wholesaling presents one option to increase the efficiency of the local production system. Through wholesale marketing, farmers can sell larger quantities of product with less effort and institutional buyers, retails, universities and distributors can access this larger quantity of affordable, safe, regionally grown products at a central location. Farmers in the region have expressed interest in participating but have identified the same barriers to entering this market: access to proper storage and handling, transportation, business planning and management, increased labor and time to learn a new system, keeping production up with demand, and adapting to wholesale pricing and food safety and liability requirements.

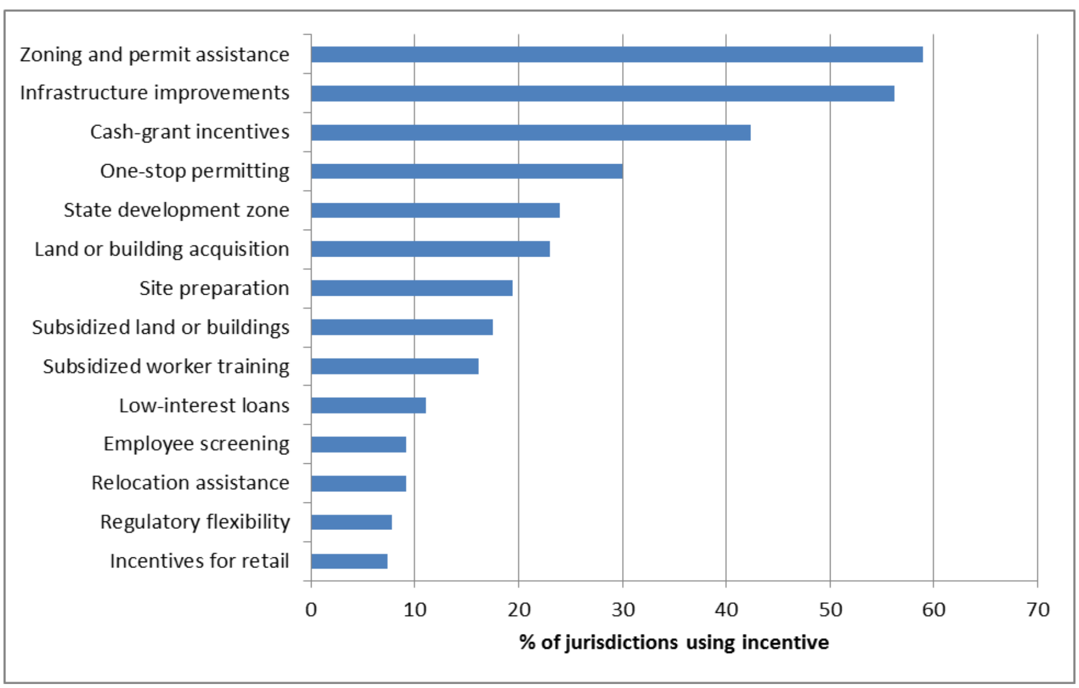
PART III: INCENTIVE ANALYSIS

Growing for the local market presents many challenges, especially when compared to the opportunity cost of growing under the commodity production system. To overcome these market barriers, local and state policymakers can develop incentives and economic development programs tailored to increasing the supply of specialty crops grown for local markets. The Sacramento region has at least 526,000 acres, or $1.1 billion annually of specialty crop production, that could be affected by incentive programs. The final section of this report gauges the feasibility of a menu of possible solutions to increase supply of locally grown specialty crop through an economic analysis of four incentive programs.

POSSIBLE INCENTIVE TOOLS

Local governments can employ a variety of tools and strategies to incent certain forms of economic activity. In a 2006 study, Jonathan Morgan of the University of North Carolina documented the utilization of local economic development strategies in over 200 jurisdictions. The results, reproduced below in Figure 3, report the most common of these strategies. As the figure illustrates, these general tools range in purpose and scope, yet target many of the same key barriers local growers face. In other words, jurisdictions across the country already are using existing economic development strategies to address infrastructure, labor, access and regulatory challenges to support economic growth in a variety of industry sectors; these same tools and programs can be applied to the local agriculture sector. Below, the paper explores four possible incentive programs, each tailored to overcome one of the four barriers of infrastructure, access, labor and regulation that limit the supply of more locally grown specialty crop. In each of the four incentives the analysis highlights strategies local decision makers can take to support growth in the local food system.

Figure 3. Local Economic Development Incentives



Source: Jonathan Morgan, "2006 Survey of Local Governemtn Economic Development Activities." School of Government, University of North Carolina at Chapel Hill.

INCENTIVE #1: SALES TAX EXEMPTION OF LOCAL FOOD PROCESSING EQUIPMENT

BARRIER ADDRESSED- OPERATING COSTS AND INFRASTRUCTURE

Table 3. Overview of Incentive Cost and Economic Impact

Regional Economic Impact			Public Sector Costs	
Jobs Created	Purchasing Power of New Jobs	Direct Increase in Gross Regional Product	One-time loss of sales tax revenue (state)	One-time loss of sales tax revenue (local)
35	$1.32 million	$4.2 million	$37,321	$38,209

EXPLANATION

A regional food hub can provide aggregation, distribution and marketing for source-identified food products, thus providing scalability to the local food system and helping overcome the infrastructure constraints of supplying local demand. Yet the construction of a food hub facility demands significant upfront infrastructure costs. Work conducted for SACOG by a project team of Applied Development Economics, Inc., Foodpro International, Inc., The Hatamiya Group and DH Consulting has provided a set of financial tools on the costs of starting and scaling up a financially viable regional food hub.[14] This work itemizes the capital and operating costs of the facility compared to net cash flows and the internal rate of return on investment. A public contribution to the food hub through an incentive program can improve the facility's return on investment, thus making it more attractive to private investors that would contribute the bulk of the facility's financing.

One possible public incentive that both incorporates recent changes in the state's economic development program and can be applied to a potential food hub is the manufacturing sales and use tax exemption of the Governor's Economic Development Initiative. This initiative, codified in the recently passed AB 93 and SB90, redirects existing economic development funds into three new incentive programs: the sales tax exemption, a hiring credit, and an income tax credit. Of these three incentives the sales tax exemption has the most applicability for a regional food hub, in that beginning in July 2014 the initiative eliminates the state's share of sales tax (4.2 percent) on eligible purchases of manufacturing equipment, including food processing equipment.[15]

The proposed food hub model developed by the above consultant team estimates a cost of $888,602 in processing equipment by the fifth year of a 22,144 square foot food hub of three packing lines.[16] Under the new

---

[14] Applied Development Economics, Foodpro, The Hatamiya Group and DH Consulting, "Regional Agricultural Infrastructure Project Cost Estimate Analysis: Sacramento Valley Food Hub," June 2014.

[15] Governor's Economic Development Initiative, http://www.business.ca.gov/Portals/0/AdditionalResources/Reports/GEDIv2.2013.pdf.

[16] Regional Agricultural Infrastructure Project Cost Estimate.

state development program the purchase of this processing equipment would be eligible for sales tax exemption, translating to cost saving to the hub operator.

Incentive #1: Sales Tax Exemption of Local Processing Equipment analyzes the effect of the manufacturing equipment rebate if applied to the construction of a locally-serving food hub. In addition to the state portion, the proposed incentive also models a local government match so that the acquired processing equipment is exempt from all sales tax.[17]

ANALYSIS

The combined state-local sales tax exemption would reduce the cost of the processing equipment for the model food hub facility by $75,531 in the first five years of operations. Of this, the state would lose $37,321 in sales tax revenue and the local jurisdiction hosting the facility would forfeit $38,209. Based on existing food hub models, the facility would create 35 jobs providing $1.33 million in annual wages and benefits by year five of operation.[18] By this time the facility would process 4,076 tons per year for annual revenue of $8,828,000. The cost of raw material would account for about half of this revenue, resulting in approximately $4.2 million in new value-adding activity in the regional economy.[19]

The regional food hub would provide aggregation, handling and distribution infrastructure for local farmers targeting the local market, helping to overcome the operating infrastructure barrier to production. The public incentive program would subsidize part of the cost of the catalytic machinery that transforms raw agricultural output into value-added products ready for the local market. The incentive package requires an initial public investment in the facility that doesn't become net cash flow positive until it reaches an expanded scale of throughput at year five of operation. As such, the public contribution doesn't fully pay off—both in terms of added jobs as well as additional economic activity—at the time of the initial investment. Once at capacity, however, the facility generates substantial economic activity relative to the initial public investment, with the returns increasing as time progresses. A pro forma financial tool constructed by the project team estimates the facility to provide an internal rate of return on investment of nearly 20 percent by year 15 of operations, with annual revenues of over $18 million.[20] The pro forma analysis shows the facility to be financially feasible without any public support; however, the public incentive program improves the overall financial attractiveness of the facility to investors by lessening the up-front equity contribution of the food hub operator during the vital startup years when the facility brings in little revenue while requiring an influx of capital expenditures.

While this first incentive is based on the Governor's new Economic Development Initiative, local decision makers can augment the state's program to make investment more attractive in their jurisdictions. As the incentive models, local governments can match the state's exemption to help realize the economic gains and new jobs of a locally-serving food hub. Additionally, local economic development departments can serve as a resource to help the food hub operator navigate the new state program.

---

[17] The analysis assumes a sales tax rate of 8.5 percent, of which 4.2 percent goes to the state.

[18] Regional Agricultural Infrastructure Project Initial Cost Estimates.

[19] Ibid

[20] Sacramento Regional Agriculture Infrastructure Project, "Comprehensive Food Hub Pro Forma." July 8, 2014.

INCENTIVE #2: LOCAL PURCHASING REQUIREMENTS

BARRIER ADDRESSED: MARKET ACCESS

Table 4. Overview of Incentive Cost and Economic Impact

Regional Economic Impact			Public Sector Costs
Jobs Created	Purchasing Power of New Jobs	Direct Increase in Gross Regional Product	Single School District
17	$437,142	$1.275 million	$191,250

EXPLANATION

The capacity to tap into regional institutional demand as a guaranteed market for local specialty crop production could greatly mitigate the market access barriers curbing supply of more locally grown food. For example, the region has five food banks serving 90,000 clients and 17 hospitals whose cafeterias provide for patients, staff and visitors. Just one of these hospitals—UC Davis Medical Center—serves an average of 1,800 patient meals a day.[21] Another notable institutional opportunity comes from schools. Currently there are only a handful of farm-to-school initiatives in the region,[22] suggesting growth potential in expanding local products to more of the region's nearly 400,000 elementary and high school students.

UC Davis Dining Service's sustainability report showcases how increased local sourcing can translate into economic opportunity for regional growers. Currently the university spends $6.8 million a year on food for residential dining services alone (not including the additional $2.5 million annual retail dining program).[23] About 15 percent of the food consumed in campus dining halls is grown or handled within 250 miles, leading to nearly $1 million of expenditures for local food just from dormitory demand at a single institution.[24] In the future the university plans to emphasize purchases of food grown within 50 miles. Furthermore, in May of 2014 the CSUS Board of Trustees approved a statewide Sustainable Food Policy to have 20 percent of food spending across the entire California State University system go to local farms. Likewise, in July of 2014 the UC President announced the UC Global Food Initiative, a plan that includes new policies whereby local growers can become campus suppliers.

---

[21] Soil Born Farms and Community Alliance with Family Farmers, "Establishing a Food Hub for the Sacramento Valley." August 2012, https://www.soilborn.org/images/stories/PDFs/foodhub_final_report.pdf.

[22] Ibid

[23] UC Davis Dining Services, "Sustainable Foodservice Progress Report 2013," http://dining.ucdavis.edu/documents/UCDavisSustainableFoodserviceProgressReport-2013.pdf .

[24] Ibid

The second of the four local specialty crop incentives in this paper analyzes a shift in local procurement policy to mandate a minimum threshold of 15 percent of food purchases at institutions come from growers within the Sacramento region.[25] Many different institutions—from hospitals to jails to private business campuses—could implement such a policy. The analysis uses the Sacramento City Unified School District (SCUSD), one of many districts in the region voicing interest in increasing local sourcing, as a case study of the effects of such policy. The district serves 47,900 students across 81 campuses, providing about 10,000 breakfast meals and 30,000 lunches a day during the school year.[26]

ANALYSIS

The implementation of a local purchasing requirement for SCUSD Nutrition Services would result in a dedicated annual demand of $1.27 million for specialty crop that could only be met by local suppliers within the Sacramento region.[27] With this guaranteed market outlet the analysis estimates growers would need to dedicate around 100 acres in local production and would create 17 new jobs in the local food system.[28] To meet the mandates of the policy, however, the school district would likely accrue additional costs relative to its operating budget without the above local purchasing requirement. First, the analysis is constructed to reflect current conditions in the region, notably the lack of a food hub to aggregate and distribute local specialty crop to regional institutions. Without this infrastructure, the incentive analysis assumes the school procurement officer needs to pay above wholesale price for local fresh fruit and vegetables. And perhaps more importantly, the incentive analysis includes the overhead cost of switching from the existing procurement system to a direct, flexible purchasing strategy to capitalize on locally-produced specialty crops. Combined, these costs would add an estimated additional $191,250 the first year to the school district to provide the same amount of food.[29]

Looking at the food hub and local purchasing incentives together, however, showcases some possible synergies that could reduce the public costs of the programs. SACOG's Agriculture Infrastructure project team analyzed the financial feasibility of both growers and the operator of a food hub with a business model targeting the institutional market. The review found the while initially incurring a loss, the food hub would become profitable at scale-up providing product to institutions at wholesale prices. And with access to the new infrastructure, farmers growing for the hub in aggregate would also turn a profit supplying specialty crop below wholesale prices. As such, the review suggests a food hub could help provide the supply of fresh fruits and vegetables to regional institutions at wholesale prices, thus eliminating part of the additional costs of the incentive program.

[25] USDA's Farm to School Census shows that many school districts in the state report local food purchases well above the 15 percent threshold. However, this number is self-reported and doesn't provide a boundary to what constitutes local production. Instead, the analyzed incentive applies only to crop production within the SACOG region. http://www.fns.usda.gov/farmtoschool/census.

[26] Soil Born Farms and Community Alliance with Family Farmers, 2012.

[27] Given SCUSD's annual food costs of $8.5 million in 2011-2012. http://www.fns.usda.gov/farmtoschool/census#/district/ca/633840.

[28] Based on the average revenue per acre of specialty crop ($17,500), annual hours of labor per acre (500) and hours of full-time equivalency (2,080) consistent throughout the four incentives.

[29] SACOG analysis of SCUSD annual food budget and Greenwise Farm to School findings.

INCENTIVE #3: NEW EMPLOYMENT CREDIT

BARRIER ADDRESSED: LABOR INTENSITY

Table 5. Overview of Incentive Cost and Economic Impact

Regional Economic Impact			Public Sector Costs	
Jobs Created	Purchasing Power of New Jobs	Direct Increase in Gross Regional Product	State	Local
74	$1,847,040	$5,408,130	$648,975	$185,421

EXPLANATION

The labor intensity of specialty crops grown and processed for the local market presents a key economic barrier restricting the supply of more locally grown food. One way to encourage more local production is through policies targeting the labor difference between production systems. One such potential policy comes from the recently passed California Economic Development Initiative. This initiative reshapes economic development in the state, phasing out Enterprise Zones and redirecting their $750 million annual expenditures into three new incentive programs, including the sales tax exemption discussed above and an investment incentive. A hiring credit for job creation is the third of these incentive programs and represents an opportunity to address labor challenges in local agriculture production.

Compared to other industry sectors, agriculture enterprises in the region wanting to grow for local markets are competitive potential candidates to collect the new hiring credit. First, the credit pertains just to census tracts with higher shares of both unemployment and poverty, so have applicability in the region's rural areas. The credit also only affects wages up to $28 an hour, thus precluding many other sectors from participation. In addition, to establish eligibility for the State's new hiring credit a firm must register a net increase in jobs. As established in the labor section, not only are specialty crops generally more labor intensive than others, but those specialty crops grown for the local market tend to rely more on labor and less on mechanization. Thus an expansion in local production would require a corresponding expansion in labor, making specialty crops producers well positioned to meet the credit's job creation prerequisite.

Incentive #3: New Employment Credit analyzes the potential effect of the state's new hiring credit on the local production system. The credit provides 35 percent of wages for each applicable new job meeting the above restrictions. This 35 percent wage subsidy provided by the credit allows local specialty crop labor to receive a higher wage without burdening the producer. This premium on the top of prevailing wages in the agriculture sector could provide a competitive advantage for local production. Importantly, however, stakeholders expressed concern that unlike in other industry sectors, higher wages may not be as efficacious a strategy attracting labor to agriculture. As such, the incentive—especially its estimated job creation component—represents an initial attempt to address labor challenges in local production. A reassessment after several years of operation would provide a fuller valuation of the actual costs and public returns of the incentive.

Given this qualifier, overall the incentive may draw new participants to the sector and make local production positions more attractive in a system already marked by constrained labor supply. Additionally, producers can apply the credit to positions off the farm—such as the aggregation and processing functions of the food hub mentioned in the first incentive—that produce added synergy between the various incentive programs. And to further incent the increase of crop supplied to the local market, local jurisdictions can subsidize worker training, a common local economic development tool that unlike ongoing wage subsidies, only requires a targeted outlay of public resources.

As the hiring credit incentive only applies to firms who register a net increase in jobs the below analysis of this incentive looks at regional specialty crop producers currently experiencing a labor shortage, assuming these firms would be more likely to increase employment in the short term if labor costs were subsidized.[30] To estimate the number of regional growers currently experiencing a labor shortage who would utilize the hiring credit to add jobs in local production, the analysis measures labor shortage rates in specialty crops established by the California Farm Bureau Federation as well as Soil Born Farms' survey and SACOG interviews with local growers.

ANALYSIS

Based on the above assumptions SACOG estimates that initially about 50 specialty crop farms in the region facing labor constraints would utilize the public incentive package to add labor and increase local crop production. The extent of the labor added by farms stems from the degree of labor shortage. The California Farm Bureau Federation survey found that 71 percent of growers in labor-intensive crops expressed a labor shortage in 2012, ranging from less than 10 percent to over 50 percent.[31] In the incentive analysis, those farms experiencing smaller labor shortages add fewer labor hours per year. In total, the incentive would add an estimated 154,000 hours of farm labor.[32] Assuming 2,080 hours a year per full time employee, the incentive would create 74 on-farm jobs in the local food system. This uptick in local production would add $5.4 million to the regional economy just from the direct value of the crop.[33]

Compared to the other potential incentives the labor subsidy carries a substantially higher public cost. This derives from the structure of the incentive, which in essence supports the substitution of labor over capital. However, when gauged via the other plausible incentives such as the equipment sales tax exemption, the new employment hiring credit—instead of leveraging further private investment—provides a direct relationship between public support and increase in the local production system, as well as new jobs.

---

[30] Labor shortage rates come from California Farm Bureau Federation, "Walking the Tightrope: California Farmers Struggle with Employee Shortages." 2012.

[31] California Farm Bureau Federation, 2012.

[32] Based on the CFBF data the analysis applies the following labor shortage per acres rates: 25 hours per acre for a labor shortage of less than 10 percent, 75 for 10 to 20 percent, 125 for 20 to 30 percent, 200 for 30 to 50 percent, and 250 for fifty percent and above. The analysis also assumes an average farm size of 20 acres.

[33] Given an average of $17,500 in revenue per acre of local specialty crop.

INCENTIVE #4: PERMIT STREAMLINING FOR LOCAL FARMERS

BARRIER ADDRESSED: REGULATORY BURDEN

Table 6. Overview of Incentive Cost and Economic Impact

Regional Economic Impact			Public Sector Costs
Jobs Created	Purchasing Power of New Jobs	Direct Increase in Gross Regional Product	Farmbudsman Office
30	$782,000	$2,500,000	$119,000

EXPLANATION

The total cost of regulations on California agriculture is estimated at $2.2 billion, with producers devoting between five and nine percent of income towards regulatory compliance.[34] More than the cost of individual programs, specialty crops farmers have expressed concern about the cumulative impact of the regulatory system.[35] Indeed, producers recently have significantly increased hours devoted to compliance, which now accounts for perhaps ten percent of management time.[36] Farmers growing for the local market are particularly impacted by these time constraints, often lacking the resources and expertise to navigate such a complex system.

Recent work by the Ag Innovation Network lays out strategies to help reduce the regulatory burden placed on growers such as interagency coordination and increased communication.[37] Of all the recommendations, providing ways to reduce growers' time commitment in complying with regulations would perhaps best serve farmers wishing to grow for the local market. One recommendation from the report focuses on improving the technical support capacity of public sector agencies specializing in permit assistance and streamlining.

Work by Jonathan Morgan of the University of North Carolina mentioned above shows how permit assistance is one of the most common economic development tools employed by local governments. In particular, local economic development agencies develop information on the cumulative regulatory requirements by business type for major industry sectors and can provide assistance with permit streamlining for local and also state and federal sources.

---

[34] Sean Hurley, Richard Thompson, Christopher Dicus, Lori Berger and Jay Noel, "Analysis of the Regulatory Effects on California Specialty Crops," January 31, 2006.

[35] Ag Innovations Network, "Regulating for Agricultural and Public Outcomes: Perspectives and Recommendations," January, 2014.

[36] Hurley et al, 2006.

[37] Ag Innovations Network, 2014.

This local permit assistance does not come without a public cost, measured in the time and operating budget of local economic development agencies. The incentive in this regulatory section analyzes the economic impact of local permit streamlining service targeted to farmers wishing to grow for the local market but challenged to overcome regulatory barriers. While opening opportunities for local growers, this policy would also result in higher ongoing costs for local governments. The economic impact of this possible incentive program is discussed below.

ANALYSIS

Incentive #4: Permit Streamlining for Local Farmers expands economic development staff time in the local jurisdiction hosting the incentive to provide dedicated permit assistance service for small growers. The analysis assumes that growers in the local jurisdiction would have access to a permit team consisting of the equivalent of one full time employee (FTE) per year. The public cost of this team would be $119,000 per year based on local data. This cost includes salary, overhead, supplies and equipment.[38]

Given estimates of regulatory streamlining from the state's economic development division, the incentive would allow farm operations to reduce regulatory compliance hours to a third of current levels.[39] Estimates suggest that as growers currently spend around 10 percent of management time on regulation, this permit streamlining would free up 150 hours of management per year per farm benefiting from the assistance.[40] Growers could use this time for a variety of purposes. This incentive analysis models how many new acres farm operators could manage to meet regulatory compliance as a result of the new additional management time.[41] A project team analysis of University of California Cooperative Extension Cost of Production studies finds managers on average spend 15 hours of regulatory compliance per acre of specialty crop production. As such, the additional 150 hours saved from permit streamlining assistance could result in 10 new specialty crop acres meeting full regulatory compliance that could be opened to production. The new production would result in 2.5 new jobs and $175,000 in economic activity per farm using the permit streamlining assistance.[42] In aggregate the economic impact of the incentive would derive from the number of farmers the single permitting team could assist per year. In the first year of operation the analysis applies a conservative estimate of participation as the local economic development team conducts outreach and increases specialization in the local food system.[43] Overall the analysis predicts the

[38] Based on the cost of a single farmbudsman position in the region. SACOG interview with Michelle Stevens, Yolo-Solano Farmbudsman.

[39] Analysis based on posted CalGold material and assumptions about efficiencies from specialized service. http://www.business.ca.gov/Programs.aspx.

[40] Based on a 42.5 hour workweek for farm managers.

[41] An alternative incentive method would be to simply calculate how much the added time is worth based on farm manager earnings. This incentive takes the analysis further by showing how time can translate into production in the agriculture sector but assumes unutilized capacity.

[42] Given $17,500 of revenue per acre of specialty crop production.

[43] In the first year of operation the analysis models a savings of 2,250 hours of management time, spread evenly across fifteen farm operations. The program would likely build greater efficiencies moving forward as it develops further expertise.

regulatory streamlining program would result in 30 farm sector jobs and a $2.5 million increase in gross regional agricultural product for the Sacramento region in the first year of the program's operation. As with all the other incentives, these modeled impacts represent an initial attempt to quantify costs and opportunities in the sector given the lack of existing analyses and economic development programs focused on local specialty crop production. As new data and programs become available these estimates can be further refined and reassessed.

CONCLUSION

This project has identified the key barriers constraining an increase in the supply of further specialty crop production targeted to meet local demand in the Sacramento region. The analysis shows how when compared to the established commodity system, challenges in operating costs, infrastructure, market access, labor intensity and regulatory hurdles vitiate the emerging market opportunity of a local food cluster.

To overcome these entrenched challenges and make local growing a more competitive option relative to conventional production, policymakers and stakeholders can turn to economic development strategies incentivizing local production. The four analyzed incentives in this paper represent economically feasible solutions in constructing a local food system; while emphasizing different components of the local value chain, all leverage substantial private dollars for every dollar of public investment. The four economic incentives also provide opportunity to both respond to a new state economic development framework as well as give local governments tools to bolster the local food system. In addition to helping navigate new state programs, the incentives showcase commonly-used local economic development strategies from permitting assistance and regulatory streamlining, to worker training and changes in purchasing policies. Additionally, the incentives vary in implementing agency, including local economic development departments, schools, and other institutions.

Table 7. Summary of Incentive Programs

Incentive Program	Barrier	Public Costs	Direct Local Economic Expansion	Leverage per Public Dollar Expenditure
Sales Tax Exemption	Operating Costs/ Infrastructure	$75,530	$4.16 million	$50
Local Purchasing Requirement	Market Access	$191,250	$1.27 million	$7
New Hiring Credit	Labor	$834,396	$5.47 million	$6.5
Permit Streamlining	Regulatory	$119,000	$2.5 million	$21

In addition to the increase in gross regional economic activity, the four analyzed incentives provide a possible path forward to support the Regional Agricultural Infrastructure project's strategy of increasing the supply of locally grown specialty crops, and improving access to fresh, healthy food in the region's underserved communities. The initial implementation of these four incentives together could possibly add nearly 1,000 acres of specialty crop production in the region and $13 million in agricultural value within the first years of adoption. As such, the incentives represent initial steps local governments can take so that farmers need not shoulder the full burden of scaling up the local specialty crop system. And through time the four incentive programs are structured to sustain growth in local production—the market access program, for example, initially only applies to a single institution in the region. And adopting the incentives together could lead to further synergies in the local food system. As such, a regional incentive program coupling recent trends in the state's economic development landscape with local government buy-in can help position the SACOG region to capitalize on growing demand with increased specialty crop production.

A project of the
Rural-Urban Connections Strategy
(RUCS)

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT

RESEARCH ANALYSIS OF FOOD HUB TRENDS AND CHARACTERISTICS

August, 2014

Prepared by:

Applied Development Economics, Inc.

In partnership with:

Foodpro International, Inc.
The Hatamiya Group
DH Consulting

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT TEAM

APPLIED DEVELOPMENT ECONOMICS, INC.:

TRISH KELLY
Principal

DOUG SVENSSON
President

THE HATAMIYA GROUP:

LON HATAMIYA
President & CEO

FOODPRO INTERNATIONAL, INC.:

BILL WASHBURN
President

OLGA OSIPOVA
Vice President of Technical Services

JOEL SVENDSEN
Project Engineer

DH CONSULTING:

DAVE HARZOFF
Principal

SACRAMENTO AREA COUNCIL OF GOVERNMENTS (SACOG):

DAVID SHABAZIAN
RUCS Program Manager
dshabazian@sacog.org

GARETT BALLARD-ROSA
Planner 1
gballard-rosa@sacog.org

AMY LEE
Planner 1
amylee@sacog.org

www.sacog.org

The Rural-Urban Connections Strategy (RUCS) is the region's rural economic and sustainable strategy complementary to the Blueprint, the region's overall growth strategy (http://www.sacog.org/rucs/)

EXECUTIVE SUMMARY

The *Research Analysis of Food Hub Trends and Characteristics* is a component of the Sacramento Regional Agricultural Infrastructure Project which is developing new business tools and assessing models to facilitate increased sales and consumption of locally grown foods in the six-county Sacramento region. Currently, it is estimated that only two percent of regional food consumption is from local sources. The analysis focuses on food hubs, agricultural infrastructure facilities which help connect locally grown and source-identified fresh produce – specialty crops – to local markets and customers, especially by creating new market channels between smaller and medium-sized growers and larger institutional and business buyers.

This analysis provides market context for development of a Sacramento Valley Food Hub and information on existing fresh produce distribution assets, food system trends and innovations, and profiles of successful and emerging food hub models that might be of value for the region. Research shows that the food hub movement is growing rapidly across the county, with more than 300 hubs identified by the U.S. Department of Agriculture in 2014. Growth is driven by the increasing consumer demand for fresh, locally sourced and sustainably produced foods and the desire to strengthen local and regional food systems and economies. This trend is considered to be a permanent shift, as reflected in numerous studies and consumer surveys, and policy and procurement commitments by major institutions such as hospitals and schools. Some of the most recent are major policy directives by the California State University system and the University of California system.

The Sacramento region has strong, although unevenly distributed, direct market assets for fresh produce, including many farmers' markets, Community Supported Agriculture (CSA subscription food box programs), farm stands and agri-tourism destinations. There are also significant fresh produce aggregation and distribution facilities in the region, but a significant amount of this infrastructure is for large external-based markets, for crops such as nuts, rice and tomatoes. There is a major gap in getting more locally grown specialty crops into market channels across the region at the scale needed to supply schools, hospitals, the hospitality industry, grocery stores, government and other institutions on a reliable, consistent and cost-effective basis.

The current system for distributing and procuring fresh produce in the region is complicated, with many different types of vendors, distributors and purchasing agreements. The development of a marketing channel for locally grown produce must take into consideration the breadth of existing contracts and relationships, in order to find the right structures and best fill marketing niches and opportunities. One clearly emerging pathway is to focus on the development of a hub providing a market channel for locally sourced and identified foods that fits into existing supply networks and provides more streamlined access to the resource – fresh produce – that many distribution, wholesaler and food service companies are striving to provide to their customers. This is a trend that is beginning to emerge in California and across the country, and can involve partnerships beyond traditional market relationships.

This report summarizes the findings of major food hub studies including operating characteristics, financial performance, and impacts, and provides profiles of selected innovative for-profit and nonprofit hub models. They include food banks that are serving as major catalysts in transforming their regional food systems.

TABLE OF CONTENTS

I. INTRODUCTION **1**

PROJECT BACKGROUND 3

THE SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT 3

II. KEY FOOD HUB RESEARCH FINDINGS **6**

THE TREND FOR LOCAL AND SUSTAINABLY PRODUCED FOODS 7

RECENT FOOD HUB STUDIES: SOME KEY FINDINGS 11

III. SACRAMENTO REGION FOOD SYSTEM CAPACITY **20**

OVERVIEW OF FRESH PRODUCE DISTRIBUTORS 21

ILLUSTRATIVE MAJOR CUSTOMERS AND SUPPLIERS 26

PROPOSED PROJECTS 31

IV. PROFILES OF FOOD HUB MODELS **33**

FOOD HUBS/LOCAL FOOD SYSTEM PROGRAMS TO WATCH 52

APPENDIX A: LIST OF PROJECT INTERVIEWEES **54**

APPENDIX A: FOOD HUB RESEARCH REFERENCES AND RESOURCES **57**

RESEARCH ANALYSIS OF FOOD HUB TRENDS AND CHARACTERISTICS

I. INTRODUCTION

This research analysis on food hub trends and characteristics is a component of the **Sacramento Regional Agricultural Infrastructure Project** sponsored by the Sacramento Area Council of Governments (SACOG) through its Rural-Urban Connections Strategy (RUCS). SACOG is an association of local governments in the six county Sacramento region providing transportation planning and funding serving as a forum for regional issues, including linking land use, transportation and air quality (see map on the following page). The Blueprint, a signature SACOG project, is the region's long-term growth strategy. RUCS is the region's rural economic and environmental sustainability strategy complementary to the Blueprint.

Over the past several years, RUCS has identified the need for expanded regional "agricultural infrastructure" to strengthen the local and regional food system and the region's many rural communities. **Agricultural infrastructure commonly is defined to encompass aggregation, packing, processing, marketing and distribution capacity and facilities, including "food hubs."** Overall, agricultural infrastructure:

- Improves the efficiency and sustainability of the local food system;
- Increases access to healthy foods in underserved communities;
- Supports the viability of agriculture;
- Creates new jobs and economic opportunities; and,
- Helps preserve valuable farmlands.

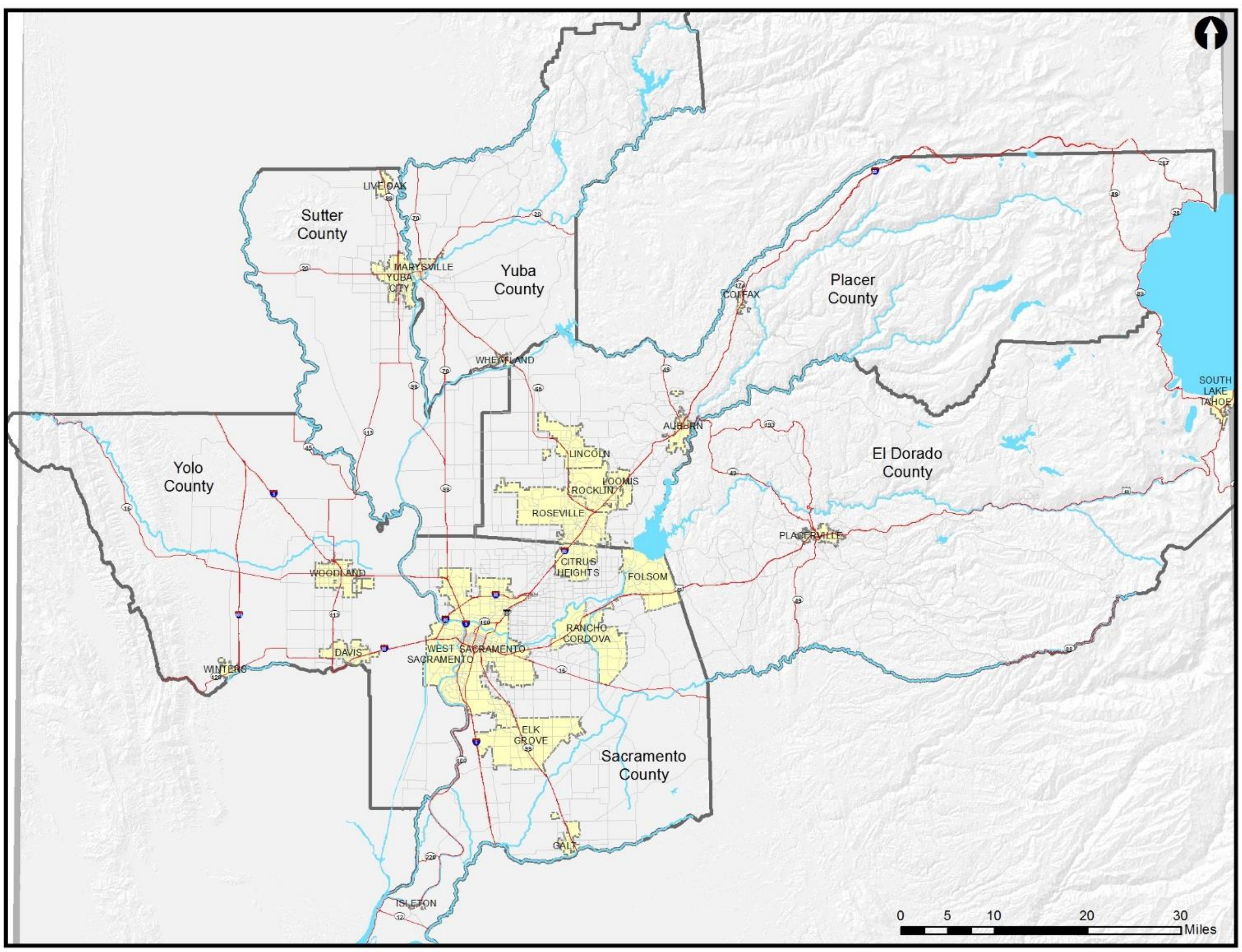
SACOG obtained funding from the California Department of Food and Agriculture, the California Strategic Growth Council and the U.S. Department of Housing and Urban Development to assess the feasibility and costs of models for development of new agricultural infrastructure, focusing primarily on food hubs. Food hubs help connect locally produced and source-identified foods to local markets and customers, especially by creating new market channels between smaller and medium-sized growers and larger institutional and business buyers.

SACOG contracted with a consulting team (Project Team) led by Applied Development Economics, Inc., in partnership with Foodpro International, Inc., the Hatamiya Group, and DH Consulting, to assess the market and financial feasibility of development regional agricultural infrastructure. As part of the project, the Project Team conducted research on trends in local and sustainably grown foods, trends in food hub operating characteristics and financial performance, and innovations in local and regional food systems that are rapidly gaining attention across the country and in California, including successful and promising examples of food hub business models. The findings contained in this report - *Research Analysis of Food Hub Trends and Characteristics* - provide market context for the development of financial feasibility analytic tools and a business plan for a Sacramento Valley Food Hub model. The analysis focuses on hub operations for specialty crops, defined by the U. S. Department of Agriculture (USDA) as fruits, tree nuts and vegetables.

The *Business Plan* and *User Manual* (for the financial feasibility tool kit) also draws upon other analyses prepared by the Project Team and SACOG: *Sacramento Valley Food Hub Cost Estimate Analysis* with capital and equipment costs for a hub facility*; Impediments to Supplying Locally Grown Food* which identifies barriers for both growers and food hubs in building the local food system; and *Food Banks and Food Hub Development* which discusses the potential role of food banks to incubate and/or support a regional food hub.

The map below shows the SACOG six county planning region.

MAP OF THE SACRAMENTO REGION



PROJECT BACKGROUND

Agriculture has deep roots in the Sacramento region. Named America's Farm to Fork Capital due to the wealth and diversity of its agricultural bounty and legacy, the region has more than 1.49 million acres of farmland and more than 7,200 farms and ranches of all sizes.[1] Production of more than 150 crops totaled 3.4 million tons in 2010.[2] The farmgate value of these products reached almost $1.98 billion in 2012.[3]

However, through RUCS analysis and outreach with stakeholders throughout the region, SACOG identified a major gap in the regional food system. Despite being a major population center, most of the region's, tremendous agricultural output leaves the area, including crops destined for national and overseas markets and high value produce going to Bay Area restaurants, stores and other customers. While Sacramento region residents consumed almost 1.9 million tons of food in 2012, SACOG estimated that only about two percent of this food came from local sources.[4]

This project focuses primarily on food hubs as a key missing element in the region's local market infrastructure, which includes assessing the potential for food banks to support food hub operations and opportunities to increase access to fresh produce in underserved communities. It builds upon the findings of the initial food hub feasibility study – *Establishing a Food Hub for the Sacramento Valley* – that was completed in 2012 by Soil Born Farms, the Community Alliance with Family Farmers (CAFF) and Foodways Consulting. This study identified many risks and challenges in developing such a hub, but strongly supported "the need for and advantages of a regional market-serving mechanism to provide core fresh produce procurement and aggregation functions while maintaining and accentuating source identity."[5] The authors determined that further development of financial analytic and business planning tools was needed, along with other recommendations.

In addition, the project builds upon several other Sacramento region agricultural infrastructure studies, including those conducted by the Agricultural Sustainability Institute at UC Davis, and many local initiatives to expand access to locally grown fresh produce. A common theme is that the growing demand for locally-sourced food from businesses and institutions such as schools and hospitals, restaurants, food banks, retailers, food service operators, distributors, wholesalers and niche processors requires the development of expanded food aggregation and distribution capacity with dedicated market channels to meet the scale of demand and facilitate connections between growers and customers.

THE SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT

The purpose of the Sacramento Regional Agricultural Infrastructure Project (Ag Infrastructure Project) is to provide a business model, financial feasibility analytic tools and strategic plan for a self-sustaining mid-scale aggregation and distribution operation – a food hub with aspects of processing functions – to serve regional specialty crop producers, including small to medium-sized growers, especially those who lack the capacity to

---

[1] Farm and land estimates, 2012 USDA Census of Agriculture.
[2] SACOG Crop Map, www.sacog.org/rucs.
[3] County Agricultural Commissioner Reports, 6 counties, 2012.
[4] Food consumption estimates – SACOG Food Calculator, USDA data bases, 2012. SACOG estimate of share of local produce, 2007 USDA Census of Agriculture and SACOG Crop Map.
[5] Harrison, Shawn, Dave Runsten and Libby O'Sullivan. "Establishing a Food Hub for the Sacramento Valley," August 2012, p. v.

access business and institutional markets. The tools and plan are being developed as a resource for entrepreneurs, jurisdictions, investors and other interested stakeholders to advance the development of this infrastructure.

The Ag Infrastructure Project's hub feasibility analysis, contained in the *Business Plan*, assesses regional market demand for fresh produce (specialty crops); identifies levels of production, illustrative target crops, and operating costs for a viable hub operation model; and summarizes policy and other barriers that will need to be addressed. A key focus is to provide market channels and support for small to medium-sized growers – including new farmers, economically disadvantaged farmers, veterans entering agriculture and others – but the hub can be a market resource for growers of any scale. Participation of larger growers, especially in the initial phase of the hub, could help provide the product volumes necessary to achieve economies of scale that would in turn create the capacity to serve larger customers with cost-competitive pricing and reliability of supply, and establish a solid market base.

In the long-term, a financially sustainable business, whether for-profit or non-profit, will be the best way to provide market opportunities for small and medium-sized growers, working with a wide range of partners to address additional community and social benefit goals. A core aspect of the approach is to leverage existing resources within the region, including the food banks which are leaders in the local food system movement and have transportation, logistics and other capacity to help incubate a regional food hub. Other options include partnerships with existing fresh produce distribution companies and wholesalers which have a strong presence in the region, to provide them with a new market channel for locally sourced and identified produce and value-added products.

The Project's feasibility analysis shows that over the time needed to scale up market relationships with growers and customers and develop operational capacity, there appears to be enough demand in the region to support more than one hub, and more than one type of hub. This presents a valuable economic development opportunity that can benefit communities throughout the region, through creation of new jobs and potential capital investment. Information is presented in this document on different types of hub models and lessons from hub operations, to help expand the knowledge base and information resources about complementary approaches to the proposed hub model. The models show how food hubs are evolving in terms of value-added activities and systems approaches, including the changing role of food banks in catalyzing regional food systems.

Expanding agricultural infrastructure will help the region capitalize on emerging opportunities related to the burgeoning food economy and address important community objectives such as retaining more food dollars in the local economy; improving food security; reducing food waste; providing alternative opportunities for young and new farmers; and keeping valuable farmland in production. It will begin to rebuild the mid-scale agricultural infrastructure that had previously existed throughout the region but has been lost over time due to changing markets, industry consolidation, economies of scale, regulatory issues, urbanization and other factors.

The following sections of this report provide research findings and analysis intended to inform regional discussions and decision-making about the development of agricultural infrastructure. They include:

- Key Hub Research Findings - Summary of key findings regarding food hub trends and characteristics nationally, as overall context for understanding market and other dynamics of this emerging business model

- Sacramento Region Food System Capacity - Overview of existing fresh produce aggregation and distribution capacity in the region, illustrative institutional customers for fresh produce, and potential new projects which will shape the market environment and provide context for the development of a regional food hub; and,

- Profiles of Food Hub Models - Description of a variety of existing and emerging food hub business models that demonstrate a range of approaches to meeting varying market conditions, capacities and needs, including hubs with a market specialization, which are selected for their potential relevance to the Sacramento region, and of interest to for-profit and nonprofit food hub developers.

Research findings are based on interviews and meetings with stakeholders and key informants and the local, regional, state and national levels (see Appendix A for a list of interviewees); consultation with policy researchers nationally including USDA Agricultural Marketing Service and the National Good Food Network; input and guidance from SACOG Board members and Project Advisory Team; data collection and analysis; and a thorough literature review (see Appendix B for a list of references and resources). Project Advisory Team members include the Sacramento Food Bank and Family Services, Soil Born Farms, Yolo Food Bank and Yolo County Agricultural Commissioner's Office.

II. KEY FOOD HUB RESEARCH FINDINGS

The food hub movement is growing rapidly across the nation as a strategy to support and strengthen local and regional food systems. While the term "food hub" has a diversity of meanings, a common current usage describes an enterprise that provides aggregation, distribution, and marketing services and sometimes processing services to small and medium regional growers. It connects growers to larger markets they could not otherwise serve, and provides a source of fresh, sustainably grown locally produced food for regional institutional, wholesale and retail customers at a scale required to meet their needs. Below is a working definition for a regional food hub developed by the U.S. Department of Agriculture (USDA):

> *A food hub is "…a business or organization that actively manages the aggregation, distribution and marketing of source-identified food products, primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail and institutional demand."*
>
> *James Barham et al, Regional Food Hub Resource Guide, U.S. Department of Agriculture, Agricultural Marketing Services, April 2012, p. 4.*

Food hubs are often described in contrast with the more conventional commodity-scale aggregation and distribution food system that provides most of the food consumed in the United States today. In some cases there is a blend of the two, where many hubs work in concert with the existing distribution network, and many conventional distributors, wholesalers and retailers are carrying more and more locally-sourced food to satisfy a growing customer demand. Regional food systems experts at UC Davis refer to regionally-focused market channels for local fresh produce as "values-based supply chains (VBSC)."[6]

As of April 2014, the U.S. Department of Agriculture (USDA) Agricultural Marketing Services (AMS) estimates there are more than 300 food hubs currently in operation in the United States.[7] Its July 2013 inventory found approximately 230 hubs. The increase reflects the expanded identification of existing hubs and creation of new hubs between 2013 and 2014. The number of hubs identified in California increased from 12 to 18 over the past year. Two are listed in the Sacramento region – Capay Valley Farm Shop and the Tahoe Food Hub.

The growth in the number of food hubs nationally illustrates the importance of this movement. As in the Sacramento region, growth is being driven by the increasing consumer demand for fresh, locally sourced foods and the desire to rebuild local food systems. There is a commitment to support local growers and economies; preserve local agricultural lands; increase food security and access to fresh and healthy foods, especially in underserved communities; and provide new business opportunities for small and medium scale producers. Consumer motivations include food taste, nutrition, freshness, quality and safety, and knowing the source and manner in which the food was produced.

---

[6] Lerman, Tracy, Gail Feenstra and David Visher. "A Practitioner's Guide to Resources and Publications on Food Hubs and Values-Based Supply Chains: a Literature Review," Sustainable Agricultural Research and Education Program, Agricultural Sustainability Institute, University of California, Davis, p. 1. April 15, 2012

[7] Agricultural Marketing Services, U.S. Department of Agriculture, "Working List of Food Hubs," updated 04/28/2014; http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5091437

Paralleling the growth in the number of food hubs nationally, since 2012 there has been a major increase in research about food hubs and their missions, legal structures, functions, operating characteristics and impacts. These efforts are part of policy attention on strategies and resources to develop viable local and regional systems. This focus is occurring because food hubs are showing promising potential as an emerging and viable business model, and require better understanding as experience is gained to guide design and investment decisions, and ensure success on the ground.

THE TREND FOR LOCAL AND SUSTAINABLY PRODUCED FOODS

Three questions come up often in discussions about local food system development and operating standards and criteria of food hubs regarding locally sourced products, and responsive infrastructure investments:

1. How is “local” defined?
2. Will the current trend for local be a lasting phenomenon?
3. What are the criteria for locally sourced foods in terms of sustainability and organically grown?

Local Definition

Definitions for “local” vary widely, including those used by the Federal Government. Some definitions span between 100 miles and 400 miles. USDA notes that it may not be possible to have one definition that fits all circumstances, due to varying conditions such as climate, geography, cropping patterns, proximity to population centers, infrastructure and other factors. The Agency suggests that “local food should have a ‘flexible’ definition that relies not only on the distance from which products are sourced, but also where the product itself was produced and how extensive a system is required to get it to the consumer.”[8]

The Sacramento region, as noted, is blessed with a great diversity of crops, favorable climate and others assets that many regions lack. In theory, defining local for most regionally produced agricultural products is feasible coming from within 100 miles. Some large institutions in the Sacramento region with local sourcing goals have definitions that extend beyond 200 miles in some cases, but still request that fresh produce suppliers try to source within 100 miles. For some consumers such as multi-site hospital systems that have centralized purchasing and food preparation, such as Kaiser Permanente which has 21 hospitals in Northern California and contracts out for its food service operations, buying local is not always easy to define. Kaiser Permanente (KP) defines local as within 250 miles from the South San Francisco facilities where meals are prepared, with the goal that providers purchase as much produce as possible from Northern California growers.[9] KP’s focus is to increase the transparency of the food chain so that the source of the produce/the grower is known.

For purposes of the SACOG Ag Infrastructure Project, the economic analysis is assessing how much produce could be sourced from within the six-county SACOG region, while understanding that its regional “food shed” extends to contiguous counties and neighboring regions such as the San Joaquin Valley, the Bay Area, and the North Sacramento Valley.

---

[8] Matson, James, Martha Sullins and Chris Cook, “The Role of Food Hubs in Local Food Marketing,” USDA Rural Development, Service Report 73, p. 7. January 2013

[9] Reed, Kathleen. Sustainable Food Program Manager and National Farmers Market Coordinator, National Nutrition Services – Procurement and Supply, Kaiser Permanente. Interview conducted June 19, 2014.

Local Sourcing: Trend vs. Fad?

As the nation's farm to fork capital, it goes without saying that the Sacramento region is a national leader in the local food system movement and leaders, stakeholders and residents across all sectors are deeply committed to the development of a locally driven, sustainable, healthy food economy as a foundation of the region's future. Research by the National Restaurant Association and other industry organizations which are responding to consumer demand documents the strength of the trend towards locally grown foods. For example, the National Restaurant Association's 2014 Culinary Forecast, based on a national survey of nearly 1,300 professional chefs, identified the hottest menu trends for 2014. Locally sourced and healthy foods and environmental sustainability dominate the list. As noted by Hudson Riehle, Senior Vice President of the National Restaurant Association's Research and Knowledge Group:

> *"Today's consumers are more interested than ever in what they eat and where their food comes from, and that is reflected in in our menu research trends. True trends – as opposed to temporary fads - show the evolution of the wider shifts of our modern society over time, and focus on the provenance of various food and beverage items, unique aspects of how they are prepared and presented, as well as the dietary profiles of those meals."*
>
> **Hudson Riehle**, Senior Vice President, National Restaurant Association

Source: National Restaurant Association, http://www.restaurant.org/News-Research/Research/What-s-Hot

The strong consumer support for local foods also is illustrated in the findings of the "2014 Ripe for Grocers: The Local Food Movement Survey" conducted by A.T. Kearney, which reported that seventy percent of survey respondents are willing to a pay a premium for locally grown produce, and prefer retailers that carry more locally produced items. The research found a strong correlation between fresh and local, with smaller retailers having an advantage regarding perceptions of "fresh."[10] Many other reports and surveys have documented similar findings, which also have been echoed in this project's interviews and meetings with the California Restaurant Association and the members of its Sacramento Chapter, the California Grocers Association, and fresh produce distribution companies located in the region, among other businesses, who report that "local is the new organic" in the eyes of the customer.

Institutions such as schools and hospitals are major drivers in the trend for local produce. For example, in May 2014 the California State University (CSU) Board of Trustees approved a state-wide Sustainable Food Policy that "will govern the more than $100 million spent on food across the 23-campus system." Under the policy, each campus will have until 2020 to ensure that at least 20% of all food spending goes to farms and local businesses that met Real Food Challenge guidelines.[12] In July 2014 University of California (UC) President announced the UC Global Food Initiative which includes campuses exploring purchasing partnerships with K-12 school districts and new policies whereby local growers can become campus suppliers.[13] UC Davis Food Services has an existing local/sustainable sourcing program and Yolo County has a farm to school program being managed by the Yolo County Agricultural Commissioner's Office. Many K-12 school districts throughout the region are working to increase sourcing of local produce, either directly with growers or through their existing produce distributors.

One hundred and twenty-seven hospitals participate in the California Healthy Food in Health Care program, which "guides health care facilities to make food a fundamental part of prevention-based health care" through sustainable food purchasing. According to a 2013 survey, 91% of the participants purchase local and/or sustainable foods and beverages and 62% of facilities purchase organic food. Twenty-two facilities spent a combined total of almost $3.6 million on local and/or sustainable food and beverages in 2012.[14] Seventy percent of facilities report purchasing local and/or sustainable foods and beverages through their broadline distributors (p. 11).

Bay Area Hospitals Driving Demand for Local and Sustainable Food

In Northern California, a team of six hospitals in the Bay Area are participating in a Farm Fresh Healthcare Project to increase sourcing of local and organic produce from family farmers. As a result of the program, ten family famers including a few in the Sacramento region have sold nearly 67,000 pounds of local and organic produce to the hospitals.[11] Growers ranged in size from 10 acres to 1,500 acres, with half between 200 and 500 acres. Two produce distribution companies also participate. The institutions are collaborating to combine hospitals' purchasing power to help create economies and scale and market certainty for growers. As noted in the report, "finding alternative aggregation points can allow more sourcing from small-scale farmers." One of the mid-range participating farms acted as an aggregator with available refrigeration capacity for approximately twenty smaller organic farms in the region (p. 5). One farm reported it was able to increase its organic strawberry acreage by 30%, and plans another increase of 30% as a result of the project (p. 12).

---

[10] Riemenschneider, Pamela. "Survey: Consumers want local, willing to pay premium," The Packer, May 6, 2014.
[11] Klein, Kendra. Farm Fresh Healthy Project How-To Guide, Health Care Without Harm, p. 5, Spring 2014.
[12] CSU Chancellor's Office. "CSU Board of Trustees Approves State-wide Sustainable Food Policy," May 21, 2014.
[13] Dillard, Helene, Dean. "UC Global Food Initiative Initiated by UC President Napolitano," College of Agricultural and Environmental Sciences, UC Davis. July 14, 2014.
[14] Klein, Kendra and Sayre, Lucia. *California Healthy Food in Health Care,* Health Care Without Harm and Physicians for Social Responsibility, pp. 5, 10, 11, 2014.

Kaiser Permanente, which has three hospitals in the Sacramento region, asks their food service providers and distributors to meet certain criteria for procuring sustainably and regionally grown fresh produce in Northern California. The hospital system is large enough that it can drive demand back through the supply chain. Other hospital systems in the region such as Sutter Health work directly with a local fresh produce distribution company. See Section III for additional detail.

Sustainable, Organic Food Production?

During the course of this study, several people asked whether or not a Sacramento food hub would be focused on organic produce or conventional produce, or a mix. A focus of the local food system movement early on nationally was organically grown produce. Over time, trends have evolved to include an emphasis on environmentally sustainable production methods without necessarily being certified as organic. National research on food hubs conducted in 2013, described in the following section, explored the approach of food hubs related to procurement of locally produced foods and their use of specific criteria (requirement for) versus preferences for certified and non-certified organic, sustainably produced and other categories of food products. Requirements account for current production realities and cost structures. Findings are cited in the next section of the document.

Generally, organically grown foods are sold for a higher cost than conventionally grown produce, especially in mainstream grocery stores. As these stores and food companies enter the organic market on a larger scale, industry analysts foresee organic products being sold at or near the price of conventional products, reducing consumer barriers related to cost.[15] According to Tom Johnson of PricewaterhouseCoopers in Minnesota, "Supermarkets are enhancing their organic selections because, in addition to being more profitable, shoppers are paying more attention to health in their food and household choices. It will grow exponentially in coming years. Organic is now becoming part of retailers' commitment to wellness."[16] Consumer demand is being driven in part by consumers wanting to ensure healthy food for their children.

A recent Minneapolis Star Tribune newspaper article cited the following statistics[17]:

- According to the Organic Trade Association, sales of products labeled natural and organic grew 7.5 percent in 2012, twice the overall growth rate of conventional food products.
- According to USDA, while organic food sales were $35 billion in 2013, they accounted for less than 5 percent of total at-home food sales.
- According to a TechSci Research Report, organic sales are expected to grow 14 percent annually through 2018.

The determination of the focus of a Sacramento Valley food hub would depend on the operator of the hub. However, commitment to a "values-based" approach for local food procurement includes an emphasis on environmental sustainability. Many growers in the Sacramento region already use sustainable production methods as well as organic. As noted in the surveys above, for many consumers, "local" equates with more

[15] Ewoldt, John. "As organic foods go mainstream, prices likely to fall," Minneapolis Star Tribune, as cited in the Sacramento Bee. May 25, 2014
[16] Ibid.
[17] Ibid.

sustainable production methods, given that the transparency of where their food is coming from and how it is produced is increased, and there is a potential connection with local growers. Research on many food hub models indicates that this approach can be feasible cost-wise, in part because the hub can help increase efficiencies, and in part because there is a market value for sustainably produced local foods. This is an important market driver in developing viable local food systems.

RECENT FOOD HUB STUDIES: SOME KEY FINDINGS

The local food system landscape is evolving so quickly that it is impossible to capture an exhaustive portrayal of all food hubs and other food system innovations. However, thanks to several recent and ongoing research studies on food hubs across the nation, the body of knowledge on this fast growing movement is building. This section summarizes some key findings from this research, including food hub business models, functions, operational characteristics, impacts and best practices across a wide spectrum of types and locales. Some of the referenced studies aggregate the findings of other studies and are helpful in gaining a broad perspective on recent research findings and efforts to advance understanding of this emerging business model.

The field of study is dynamic. This analysis identifies studies and organizations that can be ongoing resources, including for new information about diverse operating models. In particular, important resources are USDA's Agricultural Marketing Service (AMS) and the Wallace Center at Winrock International. AMS both conducts and supports research on food hubs, with many valuable publications and information on funding and capacity building sources. (http://www.ams.usda.gov/AMSv1.0/) The Wallace Center is dedicated to market-based solutions for a 21st century food system, and serves civic, business and philanthropic organizations by helping to "advance regional, collaborative efforts to move good food – healthy, green, fair, affordable food – beyond the direct-marketing realm into larger scale markets." To carry out this mission, the Center established the National Good Food Network as a networking, communications and information hub, documenting and reporting on new and emerging research on food hubs and food system innovations through webinars, electronic newsletters, research and conferences. The Network also supports the growing community of practice across the country, especially by "investing in groups and collaborative efforts engaged in scaling up aggregation and sales of good foods to more substantial wholesale channels." (http://nationalgoodfoodnetwork.com/about/history)

Findings of the National Food Hub Survey September 2013

This report is the largest food hub survey to date and provides a comprehensive overview of the state of food hubs. It was conducted by the Michigan State University Center for Regional Food Systems in association with The Wallace Center at Winrock International to address the lack of information on characteristics and overall performance of food hubs. USDA assisted with the development of the survey. One hundred and twenty-five hubs responded to the survey, with 107 usable responses, representing hubs from across the country and across metropolitan and non-metropolitan counties at all levels of scale. The universe of businesses surveyed excludes conventional commodity-scale produce distributors and other food hub-like businesses. Most of the hubs tend to be smaller and focused on locally sourced food. Thus, a local food hub-like operation associated with a conventional distributor or other business or organization is likely not represented in the survey results. Nonetheless the data provides an important profile of this quickly evolving food sector.

SUMMARY OF KEY SURVEY FINDINGS:[18]

Operating Characteristics and Sales:

- Sixty-two percent of the food hubs started operations within the last five years.
- Forty-seven percent are for-profit, 34% nonprofit, 13% cooperative and four percent publicly owned.
- Hubs with varying years of service and operational structures (including non-profits) were observed generating a positive cash flow.
- Average sales in 2012 exceeded $3.7 million per hub.
- Over 95% of hubs are experiencing an increasing demand for their products and services.
- The average food hub supports 19 paid positions (full-time, part-time and seasonal).
- Sixty-six percent operate without grant funding. Those with grant funding tend to support food access and community initiatives such as food banks, mobile markets, food literacy, & youth employment opportunities; about half can accept SNAP benefits.
- Nearly half have stated commitments to social equity, increased food access and community and economic development.

Markets, Suppliers and Services:

- Seventy-six percent of the hubs reported that all or most of their producers (suppliers) were either small or mid-sized.
- Sixty-one percent are working with 40 producers or less.
- The hubs' most common customer base was restaurants, small grocers and K-12 food service operations. The hubs' own storefront retail, online stores and CSAs provide a significant percent of total gross sales.
- Seventy-four percent reported the majority of their customers are located within 100 miles.
- Many food hubs offer a number of additional services to their producers, customers and communities. More than 50% of food hubs indicated that they provided product storage and marketing services for producers and facilitated food donations to local food banks.
- The focus is on fresh produce and herbs; the average hub carries 5 different product lines, including meat and poultry, eggs, other processed or value-added foods, milk/dairy.

Very few of the hubs are engaged in value-added processing activities although many sell value-added products. This is an area of future interest as hubs see the potential to increase revenues from these types of activities. In general, many questions arise about producer practices around raising and handling crops and livestock, certification and safety aspects, and what hubs require of them. The survey found a relatively small percentage of hubs required produce that is certified organic (11%) but a high percentage that prefer it (60%); similarly, for non-certified but practicing organic – 17% required it but 73% preferred it. It should be noted that food safety certification practices and requirements will change with the implementation of the Food Safety Modernization Act (FMSA) for which rules are currently being developed by the FDA.

Many food hubs with varying years of service and operational structures, including non-profits, were observed to be generating a positive cash flow over time as operations scale up and experience is gained. (See the

[18] Fischer, M., Hamm, M., Pirog. , Fisk, J., Farbman, J., and Kiraly, S. "Findings of the 2013 National Food Hub Survey," Michigan State University Center for Regional Food Systems and the Wallace Center at Winrock International. September, 2013. Also the fact sheet: "Key Findings from the 2013 National Food Hub Survey" and webinar presentation September 19, 2013 http://www.ngfn.org/resources/ngfn-cluster-calls

Sacramento Valley Food Hub Business Plan for an example of the Food Hub Pro Forma which illustrates this finding). Researchers concluded that food hubs can be financially viable businesses. Findings also show that hubs help build the capacity and economic viability of producers. Noting that 76% of survey respondents said that all or almost all of the suppliers were either small or mid-sized, about half of the respondents reported that:

- All or most of their producers diversified their product offerings.
- Forty-five percent reported that all/most growers extended their growing season.
- Forty percent reported that all/most producers adopted more sustainable business methods.
- Thirty-five percent reported that all/most producers increased their financial literacy and/or business acumen.

Findings also indicate that it is easier financially to start a hub as a nonprofit that relies on grants the first few years, then transitions to a for-profit as the operation scales up. Marketing programs and capacity are critical to help hubs prepare for the needs of institutional markets. Many challenges exist such as accessibility to capital and other resources, including to increase trucking and warehousing capacity. As new businesses, many hubs indicated they are looking for guidance in managing growth and balancing supply and demand. A need for effective management skills was underscored.

Food Hub Benchmarking Study

This study was conducted by the Wallace Center, the Farm Credit Council, Farm Council East and Morse Marketing Connections LLC in 2013 to better understand how food hubs work as a market sector, with different business models, from a financial and operational standpoint rather than in terms of the kinds of foods delivered. The study addresses a major gap in information about the financial performance of food hubs. This information is important so lenders can understand the risks and values of investing in food hubs, especially as their numbers continue to grow to meet consumer-driven demand.

A cross-section of 15 hubs was analyzed using financial documents for 2011 and 2012. Given the limited sample size, the information is for the peer group and not the entire food hub sector. The study results showed losses, which may be a function of the small sample size. According to the report, "there is an inherently high amount of overhead cost in order to keep a food hub operating such as investment in the principal plant, warehouse, and transportation/delivery fleet…It is typical of a high volume, low margin business that overhead costs need to be spread over a large amount of sales."[19] The range of profit was up to 22%, demonstrating the potential for the food hub model.

Research conducted for the *2013 National Food Hub Survey* cited above indicates that older food hubs are profitable. An overall conclusion of the *Benchmarking Study* is that hubs are a growing part of the local food system and an emerging market and business model that is here to stay. It is important to understand hubs

[19] National Good Food Network Collaboration Study. "Food Hub Benchmarking Study, Report on Findings 2013," Wallace Center at Winrock International, Farm Credit East, The Farm Credit Council, and Morse Marketing Connections LLC, p. 10. 2013

better, including the financials aspects, the impacts they are having, and what is needed to help them work. Key findings are summarized below.

SUMMARY OF KEY SURVEY FINDINGS:[20]

Operating Characteristics and Sales:

- Average age of hub: 11 years
- Average revenue: $1.65 million, for average 301 days of operation
- Facilities: 9,000 s.f., 2 loading docks, delivery fleet with average 54,000 miles driven annually
- Status/operations: Nonprofit – 53%; take ownership of product as opposed to being a broker – 73%; sales from value-added products – 4%;
- Sources of revenues: sales (84%), grants & contributions (9%), other enterprises (6%)
- Average full time equivalent employees: 5
- Average equity: 57% (% of asset based owned by the company
- Average Cost of Goods Sold (cost of procuring the product that is re-sold): 68%; Cost of Sales (expenses incurred to see products): 11%
- Gross Margin (overhead): 21.3%; Net Margin: -2.99%

Customers and Vendors:

- Sourcing distance 521 miles
- Strictly organic – 20%; grow some of own product – 27%; buy from own incubator farms – 33%
- Customers: grocery/food stores (43%), restaurants & caterers (22%), other distributors (19%), direct retail (6%), institutions (schools, hospitals, government) (5%), food processors (4%)
- Average number of customers: 326
- Product sales to largest customers: 19%, to largest 10 customers (64%)
- Average number of vendors: 79 (farmer vendors, 57%); purchases with 10 largest vendors – 50%
- Food safety certification required: 33%
- Membership fees charged: to vendors 13%, to customers – 20%

The Role of Food Hubs in Local Food Marketing

This study, completed in early 2013 by USDA, looks at recent research and studies to define what a food hub is and various distinguishing characteristics. These include the services that hubs provide, typical organizational and business structures, operational issues and constraints, reasons for establishment and their economic role in the food system value chain. Findings focus on what food hubs need to do to serve as a viable solution for local food marketing. Several funding sources and case study models are provided. The list below shows the range of functions that food hub can provide: [21]

---

[20] Presentation by Chad Gerencer, Morse Marketing Connections, Gary Matteson, Farm Credit Council, and Erin Pirro, Farm Credit East. National Good Food Network Webinar, http://www.ngfn.org/resources/ngfn-cluster-calls/financial-benchmarks-for-food-hubs. August 15, 2013

[21] Matson, James, Martha Sullins and Chris Cook, "The Role of Food Hubs in Local Food Marketing," USDA Rural Development, Service Report 73, pp. 24-33. January 2013

FOOD HUB FUNCTIONS:

- **Market access** for local small and medium size growers and local food availability for customers, including larger customers such as institutions and retail chains
- **Access to capital,** including private equity and private and public loans and grants to support local food system infrastructure that individual growers might have trouble accessing
- **Transportation and distribution,** one of the costliest and most complicated aspects of a hub
- **Food product brokerage services**, connecting growers with the correct market outlet
- **Increasing market share** by bundling different products and from different producers, including for CSAs
- **Season extension** by providing cold and dry storage, sourcing from different producers with different harvest schedules and greenhouses
- **Facilitating consumer-producer relationships,** especially important for transitioning farmers
- **Technical assistance and producer development,** building production and/or marketing capacity among their producers
- **Cooperative purchasing**
- **Insurance coverage and certifications** (such as GAP and HACCP)
- Minimal or more advanced **processing services**
- Support for local **economic development or other social objectives**
- **Information flow and sharing** to support production, product differentiation, respond to consumer demand, and provide education
- **Professional and dedicated management** for food hub operations

Using the **USDA Regional Food Hub Resource Guide's** categorization of different types of food hubs, which notes that regional food hubs are generally classified by either their structure or their function, the study describes several possible legal (business) structures. A food hub's legal structure and form of governance reflects its mission and business model. They are summarized below:

TYPE OF HUB LEGAL STRUCTURE	DESCRIPTION OF ENTITY
Privately Held Business Corporation – C, S, LLC; Benefit, partnership – joint venture, limited; sole proprietorship, or subsidiary of other entity	Can be various corporate or partnership ownership structures, or other. Primary objectives are to return profits to their owners while providing food aggregation and distribution services to producers and customers. Some companies also include social objectives to respond to consumers or to reflect the values of their ownership.
Non-Profit (benefit corporation, many producer-owned - some operating as cooperatives, charity, subsidiary of other entity)	Many non-profits are established for social reasons, which may include specialized services and technical assistance to its suppliers and customers. As they become more engaged in commercial activities many evolve to convert to, or create, for-profit affiliated enterprises.
For-Profit Cooperatives (producer-owned, retailer-owned, consumer-owned or possibly a combination of types)	Commonly, cooperatives are democratically led by the membership for the direct benefit of the members. They are governed by an elected board and day-to-day operations are managed by professional staff. Member fees provide some of the working capital and excess revenues are typically returned to members either through direct payments or other goods or services.

TYPE OF HUB LEGAL STRUCTURE	DESCRIPTION OF ENTITY
Publicly held (government run, concession, non-profit operated)	The number of publicly held food hubs is limited, although many food hubs have been launched with the assistance of public resources. Over time, it can be difficult for commercial activities to be publicly-owned. Even if a public entity was involved early on, most hubs gravitate towards a different ownership structure as they grow.
Informal	Informal food hubs are not common, but some are supported by an internet platform that allows information sharing between buyers and sellers through online postings but provide little other services.

Although the regional food hub movement continues to grow, there are many challenges that will need to be addressed; some are similar to what other small businesses experience. They are summarized as follows:

FOOD HUB CHALLENGES:

- **Initial capitalization and ongoing access to capital,** including unconventional and unique government sources (some sources may require certain governance structures or organizational objectives)
- **Liability, risk management, adequate insurance coverage, contracting expertise**
- **Management and operational expertise,** matching facilities and staff to a growing enterprise
- **Regulatory compliance and food safety protocols,** including as they change over time
- **Adequate information systems** for financial control, business management and decision making, customer education and marketing
- **Understanding evolving food trends and customer demands**
- **Gaining access to or developing adequate infrastructure capacity** (aggregation, processing, packaging, storage, distribution, marketing and management) necessary to address market demands for quality, production methods, consistent supply
- **Understanding and meeting owners, members, producer or customer needs**, requirements, goals, and business objectives
- **Operating profitably and still delivering products at competitive or acceptable prices,** particularly in early stages
- **Producer knowledge**
- **Good strategic planning** for start-up and growth
- **Ongoing advisory and technical assistance services**

The study draws on examples from around the country and previous research to identify some common keys to success. The “Roadmap” is as follows:

<table>
<tr><th colspan="2">LESSONS FOR FOOD HUB DEVELOPMENT: THE “ROADMAP”</th></tr>
<tr><td>1</td><td>Develop a strategic plan with clear goals and vision</td></tr>
<tr><td>2</td><td>Engage all stakeholders early and identify their interests and capabilities to achieve:
Management and leadership that addresses producers, investors and business partner (vendors, service providers, etc.) needs and requirements.
Skilled personnel with the knowledge and experience to achieve management and operational success for financial systems and controls, regulatory requirements, marketing, packaging, food handling/quality control/inventory management, producer advising and business and customer relations
Well-matched producers and business partners in size, levels of expertise, and common business objectives
Previous experience producing and distributing food to local markets</td></tr>
<tr><td>3</td><td>Understand the logistics of dealing with the locations and levels of expertise of producers, markets to be accessed, backhauling potential, and the services and pricing implications to address those.</td></tr>
<tr><td>4</td><td>Provide producer education and advisor services to inform and coordinate production, address food handling and safety requirements, and develop common expectations as to the services available and requirements of the hub. This can include partnership with an outreach entity.</td></tr>
<tr><td>5</td><td>Develop protocols to reduce risk and address food safety and quality requirements of customers. These can include practices to achieve required certifications, mandated post-harvest handling practices, and providing affordable liability insurance coverage.</td></tr>
<tr><td>6</td><td>Secure adequate capital for the type of operation envisioned, including investments in accounting and management software and equipment, receiving and food handling, sorting, processing and packaging equipment, delivery and distribution vehicles, warehousing and real estate costs and marketing and communication initiatives. Include an online capability and adequate working capital to cover regular expenses. Some of these functions may best be outsourced but still require capital.</td></tr>
<tr><td>7</td><td>Explore a variety of business structures to determine the most appropriate form to support the mission and business goals. Remain flexible and self-evaluate periodically to determine if changes are necessary to better accomplish goals as the enterprise evolves.</td></tr>
<tr><td>8</td><td>Identify and understand available sources of financial and technical support. Many unconventional capital sources beyond commercial loans, which are difficult for new businesses to acquire without a track record, are now available. Technical assistance can come from small business assistance organizations, non-profits, academic institutions, government programs and advisors, business partners or outsource service providers. Donated, shared, or second-hand equipment can help with cost control. All owners must be financially invested to share in the risk for the success of the organization.</td></tr>
<tr><td>9</td><td>Acquire, analyze, present and manage information efficiently for informed management decisions and a free flow of timely information to producers and customers. This is critical for reducing risk, maintaining quality control, providing high levels of customer responsiveness and education, maximizing sales, and regulatory compliance. Trained staff and good technology systems are vital.</td></tr>
</table>

Food Hubs: Solving Local, Small Farm Aggregators Scale Up with Larger Buyers

This study was prepared in March 2014, by the Wallace Center at Winrock International. Its focus is to inform food industry representatives on the growth and readiness of regional food hubs as needed intermediaries to help get local foods into grocery and food service supply chains. Serving as the nexus between smaller producers and larger suppliers, regional food hubs are “the scaling up strategy for local food.”[22] Teaming up with food hubs allows retailers and food service companies to differentiate themselves with local food programs and satisfy strong consumer demand. Together they can develop supply chain solutions to increase local food access at the scale needed for safe and reliable distribution of local foods through large-volume wholesale channels. The case studies describe strategies for addressing issues of: packaging and quality control; food safety; seasonality; consistency; and transportation. Five case studies are presented on five established food hubs, including Common Market in Philadelphia which is profiled in this document.

Innovations in Local Food Enterprise: Fresh Ideas for a Just and Profitable Food System

This report was prepared in 2013 by the Wallace Center at Winrock International. It is based upon learnings from the Center’s Healthy Urban Food Enterprise Development Center and the work of others focused on creating market-based and non-market based-food access solutions to fresh food access and community development. Findings identify areas of innovation that link solutions across areas such as affordability and profitability, infrastructure and logistics, community engagement, and marketing. The enterprises featured in the report “aim squarely at healthy food access in low-income communities and income generation for their own operations and/or new income streams for local and farm enterprises.” [23] The report presents several case studies, two of which are provided as models later in this report: DC Central Kitchen and the Agricultural and Land-Based Association (ALBA).

Hudson Valley Food Hub Initiative: Research Findings and Recommendations

The Hudson Valley Food Hub study was completed in 2013, with research conducted by the Hudson Valley Pattern for Progress and the Urban Design Lab at the Earth Institute at Columbia University. The study examined the potential to develop additional aggregation, processing and distribution infrastructure as a viable means to support small to medium growers and surrounding communities in the Hudson River Valley of New York. Concluding that a hub would support the local economy, it provides recommendations on which food hub features would be most beneficial to strengthen sustainable agriculture and the regional food value chain. Some of the recommendations are tailored to the unique needs of the Hudson Valley, while some are more widely applicable:

- Focus food hub development on distribution and logistics and marketing services. Marketing is not just about branding; it is about pursuing market opportunities and cultivating buyers for local food products.

[22] Cantrell, Patty and Heuer, Bob. “Food Hubs: Solving Local,” The Wallace Center at Winrock International, p. 1. 2014
[23] Muldoon, M.F., Taylor, A.K., Richman, N., Fisk, J. “Innovations in Local Food Enterprise: Fresh Ideas for Practitioners, Investors, and Policymakers,” p.5. 2013

- Target a variety of products (meat, dairy, value-added) in addition to produce to maintain a year-round supply of products.
- Provide traceability and information about product sources and production methods, which are being demanded by buyers.
- Target anchor buyers in the retail and institutional food sectors.
- Identify, train, and recruit staff knowledgeable in the food industry and logistics.
- Invest in food hub development by complementing the existing distribution network and infrastructure.
- Provide farmers business and production services to improve efficiency, increase production and get them wholesale-ready.
- Enhance production, processing and distribution infrastructure to strengthen the local food value chain and to complement food hub development.
- Partner with existing organizations to deliver services and to coordinate local food system information and other resources.

OTHER RESOURCES

There are numerous other studies with useful information about food hubs and the many dimensions of food system infrastructure. Several are listed in Appendix B. As noted, many reports and resources are available through the websites of USDA, Agricultural Market Service and the National Good Food Network. This is a rapidly evolving field of study and new reports and valuable information are being made available on a frequent basis. Additional specific food hub feasibility reports and guides are referenced in the project's hub feasibility analysis and *Business Plan.*

III. SACRAMENTO REGION FOOD SYSTEM CAPACITY

As noted earlier in this document, it is estimated that most of the fresh produce consumed in the region is brought in from many different outside sources. A priority goal for the region, as articulated by the RUCS project, the Farm to Fork initiative, the Sacramento Food System Collaborative, Greenwise and the Next Economy Ag and Food Cluster, among other efforts, is to increase the amount of locally grown food consumed locally from the current estimate of two percent of total food consumption.

To achieve this goal it is important to understand the market context for developing appropriately scaled and focused food system infrastructure, including food hubs, for the region. This section provides an overview of existing food system infrastructure for the aggregation and distribution of fresh produce for different types of customers. It identifies the primary food service operators and fresh produce distributors serving the region, located in or near the region, and presents information on major institutional and business consumers of fresh produce and their suppliers as illustrative of current market arrangements. It also identifies some proposed local projects which have some aspect of hub-types functions. Thus, this review helps situate how a potential Sacramento Valley Food Hub would fit into existing market relationships, capitalize on potential partnerships, and respond to possible gaps in the current local food system.

In many regions of the country where food hubs have been started, the impetus has been to provide fresh, sustainably locally grown produce to local consumers primarily through aggregation and distribution of this produce from many smaller growers for direct market channels such as farmers' markets, retail operations, and Community Supported Agriculture (CSAs). These hubs meet a critical market gap, especially in regions with limited growing capacity and/or existing market infrastructure, and are often mission-driven.

Comparatively, given the breadth of the Sacramento region's agricultural economy, capacity of its growers, climate, soils and long growing season, the region has strong – although somewhat unevenly distributed – direct market assets for fresh produce. There are almost 50 farmers' markets – both California Certified Farmers' Markets and several sponsored by food banks, community-based organizations and hospitals; more than 30 CSA programs; and numerous farm stands and agri-tourism destinations such as Apple Hill, operating throughout the region, serving households, restaurants and other consumers directly with locally grown fresh produce and prepared products.

There are several farms in the region, mostly based in Yolo County, which are relatively large and have experience and capacity to deal with several types of market outlets. They are selling directly to consumers at farmers' markets and farm stands and through their own and others' CSA programs; to food banks, restaurants, schools and retailers – including in a few cases their own retail outlets; and to wholesale fresh produce distribution companies.

In addition to direct-to-consumer market assets, there are significant aggregation and distribution facilities in the Sacramento region. A great deal of this infrastructure is for large external-based markets, such as for rice, nuts, and tomatoes. Several aggregation and distribution companies in the region are large-scale wholesale grocers and distributors and they are not geared to sourcing locally grown produce for local markets. Multi-store grocery store chains which are local owned, including Raley's and Nugget, have major distribution centers in the region and source from local growers in season as well as from growers outside the region, primarily through their fresh produce distributors, especially for year round supplies of fresh produce. The Sacramento Natural Foods Co-op and the Davis Food Co-op are pioneers in sourcing fresh produce from local growers.

There are a variety of companies supplying the region with food management services and fresh produce that are a cross-section of local, California-based, national or international firms. While their facilities are located in the region or in Northern California, most of the produce they supply for the region is sourced from outside of the region, including from national and international markets. This enables companies to supply customers with consistent sources and levels of produce on a year-round basis.

There is a major gap in getting more locally grown produce into market channels across the region at the scale needed to supply schools, hospitals, the hospitality industry, grocery stores, government, and other institutions on a reliable, consistent and cost-effective basis. While it is difficult to quantify a precise target for expanded local market connections and consumption, efforts are moving the dial in the right direction. However, there are many practical challenges that must be addressed to make this goal a reality. It is important to understand existing market relationships, assets and gaps so that grower and customer needs can be met through development of appropriate agricultural infrastructure.

OVERVIEW OF FRESH PRODUCE DISTRIBUTORS SERVING THE SACRAMENTO REGION

This section provides information regarding twelve fresh produce distribution companies that are based in or near the Sacramento region which are primary fresh produce suppliers to and food service managers for major business and institutional customers within the region. Table 1 presents a listing of these companies with an overview of the company, their facilities, sales, and operations, and their primary clients and service areas. Information was obtained by interviews with some of the companies and source materials they provided, company websites, newspaper articles and research reports including "*Establishing a Food Hub for the Sacramento Valley."* There is a new food hub in Placer County – the Tahoe Food Hub – which is beginning to provide fresh produce to restaurants, schools, casinos, hospitals and other institutional and business customers in the North Lake Tahoe area. A profile of the Hub in included in the next section of the report.

Table 2 following provides additional information about a cross-section of institutional customers and their overall food service and fresh produce providers. While these are not exhaustive lists of customers and suppliers, they do illustrate that this marketplace is complex, dynamic, and ever-evolving. A Sacramento Valley Food Hub operator would need to explore these market relationships further, especially to assess the potential for partnerships beyond a customer-supplier relationship. One of the major opportunities identified by the national research on food hubs and development of effective market channels for local grown produce is to develop partnerships with existing providers as the expanded source for locally grown produce, assisting them to access these products more easily.

Also, Table 1 notes that beyond fresh produce, several companies provide customers with a range of value-added products such as dairy, oils, meat, grains, and so forth; redi-cut products for which they contract with other companies; customized products such as salads and meals; and products such as frozen purees. These represent additional opportunities for services and products to be provided by a local hub. These potential services are described more fully in the Food Hub Business Plan.

Table 1. SACRAMENTO REGION FRESH PRODUCE DISTRIBUTORS SACRAMENTO REGION, 2014		
Company/Location	**Company Overview**	**Clients/Service Area**
Capay Valley Farm Shop, Esparto	Community-owned S-Corp founded in 2007. Aggregates, markets and distributes for 45+ farms located within a 35-mile radius of its hub in Esparto, CA. Offers multi-farm CSA program and wholesale service of fruits, vegetables, pastured meats, eggs, olive oil, nuts and honey. About one-third of business is CSAs.	Sacramento and the greater San Francisco Bay Area. Serves CSA customers at dozens of businesses, hospitals, state agencies, specialty retail locations as well as residential home delivery. Serves customers including restaurants, corporate food service, caterers, and specialty retailers to meet their wholesale needs. Five percent of total sales is in Sacramento region; will be expanding sales in the region.
Farm Fresh to You, West Sacramento and Capay Organic (the farm), Capay	Family owned and operated. Farm Fresh to You since 1992, the farm since the 1970s. Bundled CSA service with produce from Capay Organic and other contracted growers. $20 million in revenues in 2013. Offers flexible agreements, customized boxes. An farmer/aggregator model, where Capay Organic acts as an aggregator for local farms for other customers; has 100 vendors. Has aggregation and distribution facility and call center in West Sacramento, which handles ordering and customer service. Has proprietary data base and software system. Customized line set ups for putting the CSA boxes together. Has more than 100 employees in Yolo County and about 500 employees statewide. Owns 140 vans for door to door delivery and trucks for distribution to their hubs, and uses a few leased semis for North to South transport. Runs the CSAs year round; wants to keep customers throughout the winter, so they can move to local as seasonal produce comes in. Farms 450 acres in Yolo with nearly 60 types of crops, and 150 acres in Imperial Valley to address seasonality issue. Also purchases from about 60 small farms in the region and larger ag producers. Key to success is logistics; there are plenty of small growers who want an outlet. Contracts with Bay Fresh Produce, Tracy, for redi-cut. Provides services to small growers, with food safety requirements and certification, insurance umbrella.	Customers: 70% is CSAs; 29% is grocery stores, brokers, restaurants; 1% is schools. Has 40,000 CSA clients, door to door. Sacramento facility distributes to the region and out to their 3 Northern California hubs – San Francisco, San Jose and San Leandro. Southern California facility distributes to Los Angeles, Orange and Ventura counties. Participates in several programs to increase access. Coordinates distribution of produce to Harvest of the Month program for Yolo County Farm to School program for 36 schools, and fresh produce for West Sacramento schools. Working with UC Davis Food Service. Will grow specific produce at request of customer. Could expand to grow for/sell to schools although not easy financially, but willing. Sells at 13 farmers' markets in Bay Area and Sacramento. Looking to increase corporate sales for company-sponsored CSA or corporate cafeterias. Partners with food banks for produce donations and low-cost buying options. 7000 people annually tour the farm, including students; there are many hosted events.

Company/Location	Company Overview	Clients/Service Area
FreshPoint, San Francisco and FreshPoint Central California (Turlock)	North America's leading fresh produce distributor, owned by Sysco, among North America's largest foodservice distributor. S.F. facility features more than 1,900 items such as fresh fruits and vegetables, including specialty organic produce, frozen products, bread, dairy and cheese, pasta, fresh cuts, fresh juices. Has a 50,000 s.f. state-of-the-art green facility. Entire warehouse is refrigerated. Purchases from Northern and Central California growers, including several in the Sacramento region. 125 employees. Central California has state of the art distribution facility and new fleet. Offers full product line of fruits, vegetables, herbs, fresh juices, organics, exotic and baby vegetables, and full line value-added vegetables and salads.	S.F. supplies Northern California, including premier restaurants, hotels, cruise lines, schools and other institutions. Also distributes to Asia, Hawaii and the East Coast. Central California serves Northern California and Western Nevada. Additional clients include contract feeders, healthcare, retail. Fresh-Cut Division produces hundreds of customer-specific redi-cut fruit and vegetables, proprietary or custom mixes, custom salads, etc. on made to order basis.
General Produce, Sacramento	Family-owned, in business 80 years. $100 million in sales, 250 employees. Owns sizable fleet and warehousing (over 110,000 s.f. of refrigerated space), has large investment in tracking technology. Has a Mt. Shasta warehouse/division with 30 people. They buy as much local produce as possible for schools and other customers, and prefer to do so when the price point is possible – when local is in season. Schools do specify local preference. Buys from all over as well, and provides custom packaged products, pre-cut, organic, ethnic foods, floral products, eggs, dairy, juices and produce supplies. Service area is Northern California, Western Nevada and Southern Oregon.	Food service about 30% - schools, restaurants, convalescent homes; retail about 50% including independent and chain grocery stores, hotels, caterers; export and wholesalers about 10% each. Major client is Revolution Foods in Oakland – supplies healthy prepared meals for the San Francisco Unified School District (and Charter School in Yuba County). Contracted supplier for Elk Grove Unified School District. Handles specific requests by districts to manage purchases from individual growers when they have supplies.
Next Generation Foods, Olivehurst	Founded in 2006 by 5th generation farmer, to create and maintain a market for value-added agricultural products from family farms in the area. Items are grown using organic and sustainable farming practices and include various rice medleys, balsamic vinegars, bulk walnuts and other products.	The company primarily distributes bulk quantities of products to restaurants and retail accounts in Northern California; also available for households. Costco sometimes carries the rice products.
Nor-Cal Produce, West Sacramento	40 year+ family-owned company, full service wholesale produce distribution company. Purchases from local growers.	Nugget Market is major long-term customer.

Company/Location	Company Overview	Clients/Service Area
Produce Express, Sacramento	Thirty year old company, Wholesale distributor of fresh produce, for-profit privately owned. Purchases from about 35 growers in the Sacramento region, working to expand purchases; sources local strawberries from Southeast Asian farmers. Also buys from the San Francisco Wholesale Produce Market. Estimated $23 million in sales in 2010, maintains a fleet of 30 trucks. Also sells specialty products like dairy, cheese, oils, vinegars, honey, pasta, juices, frozen purees, heirloom grains including rice, beans; provides redi-cut products for customers, from Sunsen and Tam's. Has 50 employees. Could source more local growers if demand were greater.	Serves primarily food service operations including restaurants in the greater Sacramento Valley region, both high end and chains; also sells to some schools, state agencies with cafeterias, others including UC Davis Medical Center. All commercial, no retail customers. K-12 school customers are primarily private schools but engaged in trying to sell to schools. Is major source for specialty locally grown produce for the restaurants, focus on seasonal. Can provide very small scale to very large scale.
ProPacific, Durham, with offices and warehouse in Sacramento	Founded in 1983. Also has distribution facilities in Durham, Redding, and Eureka. Specializes in fresh produce but also supplies eggs, dairy, cheese, deli products, frozen items, and other prepared foods.	Serves foodservices, retail, healthcare, schools, institutions and distributors in Central and Northern California, the Bay Area, and Western Nevada. Can provide third party logistics.
Rohrer Brothers, Sacramento, Milpitas, Santa Rosa, Salinas	Nearly 100 years old. Buys from farms all over the country.	Clients include small markets to supermarkets, fast food, fine restaurants, institutions located in California, Nevada, Asia and the Pacific Rim.
Sodexo	International food services company.	Has several major customers in the region, including Beale Air Force Base, UC Davis and other schools.
Sysco Foods, Sacramento	Global company with food distribution services for restaurants, healthcare and educational facilities, lodging establishments, others, and equipment and supplies for the food service and hospitality industries.	Has several customers in the region, including several large schools districts, and Rideout Memorial Hospital.
Trinity Fresh, Sacramento	Established in 2007. Wholesale distributor. Manages all produce procurement on behalf of customers from field to distribution. Has one-stop ordering and tracking for customers for range of products offered with proprietary online presence and software platform (Trinity Technology). Provides full line of produce,	Serves multi-unit restaurants and institutions, including schools, hospitals and casinos. Includes Cattlemens Steakhouse, Thunder Valley Casino Resort, Jackson Rancheria and Sutter Hospitals. Operates distribution centers in Northern and Southern California and the

Company/Location	Company Overview	Clients/Service Area
	organics, dairy, eggs, dried fruits, nuts, flowers, fresh pre-cut items, high-end Asian food products. Works with growers throughout California, Western US, Mexico, Canada, some organic fruit from overseas; not that many in the region, but they branding current products Farm to Fork and working with new growers. They contract directly with some growers to grow specific produce. Suppliers of prepared, minimally processed food include Tams Fresh-Pac and Renaissance Food Group. More than 75% of dairy comes from within 100 miles. Has 23,000 s.f facility with 9,000 s.f. dry space, 2 large coolers and 1 smaller cooler; call center for customer service for 3 locations. Serves as advisor for Arden Garden Market project.	Southwest and Texas. Offers seasonal locally produced (within 100 miles) fresh produce. Will supply what customers need. Has a fleet of about 20 trucks with 18 distribution points. Currently offer only a small share of organic produce due to customer type. They partner with Capay Organic in Southern California. Donates to Sacramento Food Bank & Family Services and Senior Gleaners. Is bidding on school contracts, especially for higher ed institutions.

Sources: Project team interviews with suppliers; Greenwise Joint Venture Interviews; SACOG records; “Establishing a Food Hub for the Sacramento Valley” report; websites; marketing materials

ILLUSTRATIVE MAJOR CUSTOMERS AND SUPPLIERS

This section provides an overview of current Sacramento regional food system dynamics in terms of selected major suppliers and institutional consumers. Table 2 is an illustrative summary of some major institutional and business customers of fresh produce in the region and who their suppliers are. It is a complicated system with many different types of vendors and purchasing arrangements.

Information was generated from interviews with both customers and suppliers, jurisdictions, economic development professionals, associations, county farm bureaus, and agricultural commissioner offices; SACOG records; research reports; websites; and marketing materials. Information for the five largest school districts in Sacramento County was provided by Greenwise, which has been attempting to identify purchasing and procurement practices and origin of fresh local produce and food miles. Data is incomplete in that most of the food distributors that service the school districts are only able to give geographic information for their supplier, generally an aggregator, and not the grower. However, the school districts are committed to sourcing more locally grown produce, and have some measures in place to maximize local food procurement.

The development of a marketing channel for locally grown produce in the Sacramento region must take into consideration the breadth of existing contracts and relationships in place in order to find the right structures and best fill marketing niches and opportunities. The Ag Infrastructure Project's business plan recommendations address operational, policy and partnership issues to be considered given the existing marketplace and capacity.

As noted above, based on the overall research the Project Team conducted on hub models and food system research findings around the country, and extensive consultation with many food system stakeholders in the Sacramento region, one clearly emerging pathway is to focus on development of a hub providing a market channel for locally sourced and identified foods that fits into existing supply networks and provides more streamlined access to the resource that many distributors and food services companies are working to provide to their customers. These findings will be addressed in the analysis of the financial feasibility tools and business plan.

Table 2. MATRIX OF SELECTED INSTITUTIONAL PURCHASERS OF LOCAL PRODUCE AND PRIMARY DISTRIBUTORS SACRAMENTO REGION, 2014

Institution/Purchasers	Distributor/Supplier/ Food Management	Other Fresh Produce Suppliers	Notes
Beale Air Force Base, Yuba County	Sodexo		Contract food service overseeing many food operations.
Bon Appetit – Intel Folsom Campus (part of Compass Group Company – non-commercial food services/on-site restaurant company)	Have list of qualified vendors for various products – produce is San Francisco Specialty Produce (sources from some local growers); Has some flexibility for local purchases;	Two primary local organic farm sources: Watanabe and Azolla Farms; supplements with a few others; can buy specialty items from Produce Express	Serves 6,500 meals per day; buys some ready-cut produce – Produce Express does this well. Other Bon Appetit accounts in the region: Oracle (Rocklin), William Jessup University (Rocklin), Vision Services Plan (Rancho Cordova), McGeorge Law School (Sacramento); also Genetech (Vacaville) and University of the Pacific (Stockton).
CSU Sacramento	20 contracted retail locations including national franchises, 5 self-operated locations		11% of produce in 2010-2011 was locally/regionally grown; furthering commitment to purchase local foods by partnering with farms like Capay Organic.
Davis Joint Unified School District	Capay Organic a major supplier, direct sales purchases from several local growers		Capay Organic is central distributor for Yolo County's Harvest of the Month. 3,000 meals per day, one kitchen can handle it. Has a salad bar at every school, garden-based education and field trips to farms.
Elk Grove Unified School District; 66 schools, more than 62,000 students	General Produce		Serves about 60,600 meals per day. Has big central kitchen, warehouse, cooks many meals from scratch, distributes to theirs dozens of school sites; jointly bids on produce with San Juan Unified School District. Has less storage than Sacramento.
Esparto Unified School District	Produce Express	Produce Express buys from Capay Valley farmers	District has a new central kitchen; much produce is organic. Provides approximately 575 meals a day.
Folsom Cordova Unified School District, 33 schools, 18,893 students	Pro Pacific		Serves about 9,200 meals per day
Kaiser Permanente (KP) – 3 hospitals in the region, North and South Sacramento and Roseville	KP contracts with FoodService Partners which operates a Central Commissary in South San Francisco to provide patient meals, and with Morrison Health Care Food Services (part of Compass Group) to operate cafeterias in hospitals	FoodService Partners contracts with US Foods which in turn contracts with Daylight Foods, Inc. (Milpitas) for fresh produce including organic, and other products, mostly from Central and Northern California farms	Part of 21 hospital system in Northern California region. 7,000 patient meals per day prepared mostly from scratch in Central Commissary and sent to hospitals. Fresh produce is pooled; it is difficult to provide locally grown produce to specific hospitals. Morrison is working with KP on healthier food choices and purchasing sustainably/locally grown fresh produce, with KP goal to purchase 20% of fresh produce from within Northern California by 2015. KP has programs which supports farmers' markets on hospital grounds; sponsors "Healthy Eating, Active Living" collaborations that include local food initiatives.

Institution/Purchasers	Distributor/Supplier/ Food Management	Other Fresh Produce Suppliers	Notes
Placer Food Bank, Roseville	Purchases from a variety of growers		Weighs, sorts, packs and distributes 6 million pounds of food annually through more than 60 regional hunger-relief organizations; includes about 2 million pounds of fresh produce. Serves Placer, El Dorado and Nevada counties.
Rideout Memorial Hospital, Yuba County	Sysco	Has several fresh produce vendors	
Sacramento Charter High School	Sodexo		Has Edible Sac high Program with student run-garden. Sodexo works with the program to offer food fresh and from scratch.
Sacramento City Unified School District, 75 schools, 47,897 students	Sysco, FreshPoint	Has a farm to school program and purchases from local growers for certain crops such as strawberries and apples	Serves about 41,250 meals per day Passed bond to build a central kitchen; has Farm to School Coordinator building relationships with local growers. Bids for produce. Produce budget is $1.3 million. Has salad bars in every school. Has large storage facility. Has a full-time grant writer who seeks funding to subsidize local purchasing.
Sacramento County			County jails serve 15,000 meals per day; no purchase local requirements. Have discussed possibility of regional institutional purchasing cooperative agreement (9 school districts in the county).
Sacramento Food Bank and Family Services	Capay Organic, Capay Family Farm Shop, Durst Farms, Soil Born Farms, Farm to Family Program (Delta), others including donations from Farm Fresh to You, General Produce, Trinity Produce		Produce is 40% donations and 60% purchases, at wholesale market prices, at a mutually agreed upon price, mainly due to farmer having excess of crop, or wanting to offer lower price due to mission. Distributed 1.5 million pounds of fresh produce in 2013.
San Juan Unified School District, 70 schools, 47,116 students, about 24,400 meals per day	General Produce		No central kitchen, staff cook fewer meals from scratch; jointly bids on produce with San Juan Unified School District. General Produce buys local when in season; buys when price point is possible for the district. They handle purchasing and handling if school district wants to buy from local grower.
Sutter County School District	Sysco		

Institution/Purchasers	Distributor/Supplier/ Food Management	Other Fresh Produce Suppliers	Notes
Sutter Health, Sacramento Sierra Region, 9 hospitals	Trinity Fresh - Sources much of their produce locally from their growing Farm to Fork program, when seasonally available, also buys from California, Western US, and elsewhere		Provides all fresh produce and dairy (5% of (purchases); almost all other food products are purchased from U.S. Foods through Novation non-profit healthcare provider group. Monthly purchase list is stable throughout the year – about 40 items have guaranteed contract prices that do not fluctuate over the year; the rest fluctuate by season and market price. Some purchases are value added (washed, prepped, etc.); need to get actual prices paid from distributors. Buyer cannot recommend paying premium for local produce.
Thunder Valley Casino	Trinity Fresh, General Produce. Trinity buys from local growers like Capay Organic, Durst, Timco		Buys from both suppliers, based on costs
Truckee/Tahoe School District	Produce Plus		Wrap around farm to school program. Has a local preference in bidding. Note: working with new Tahoe Food Hub
Twin Rivers Unified School District, 59 schools, 31,632 students	Pro Pacific		Brings weekly farmers' market a flyer for Pro Pacific and asks farmers to work with them to integrate crops. Bids for produce; produce budget is $1.5million
UC Davis Dining Services	Sodexo is food service manager. Fresh Produce supplier is FreshPoint. Manager got some local growers including Capay Organic and Next Generation Rice accepted in FreshPoint Primus network. Capay bills FreshPoint, FreshPoint bills Sodexo, but Capay delivers directly to the school.	Capay Organic also does some limited aggregation and provides insurance for some smaller growers. Some campus-grown food is purchased from UC Davis Farms - olive oil, sun-dried tomatoes, meat. Also white and brown rice from Yuba and Butte counties	Has student, faculty and staff population of over 53,000. Three dining commons on campus serve 50,000 meals each week. Sustainability Manager is charged with maximizing the amount of local products served. Procurement handled through a national contract; FreshPoint SF provides fresh produce. Sodexo spent more than $1.5 million in 2011/2012 on products from local and sustainable growers (19% of all food purchases). Local defined as within 250 miles but focuses on 50 to 150 miles. UCD has a central kitchen. UDC budgeting more (a premium) to get local grown food. FreshPoint might be interested in working with a new distribution intermediary that provides local, sustainably grown seasonal produce if it can be permitted by national contracts. Sodexo might also be interested. All food suppliers must be covered by $5 million liability policy, be GAP certified, sign a hold harmless agreement.

Institution/Purchasers	Distributor/Supplier/ Food Management	Other Fresh Produce Suppliers	Notes
UC Davis Medical Center	US Foods is main food vendor. Produce Express is main fresh produce distributor	Produce Express purchases from many local growers	The Center has more than 6,500 employees, provides care to more than 200,000 patients per year. Per the report “Establishing a Food Hub for the Sacramento Valley,” the Center’s Dept. of Food and Nutrition Services is responsible for patient meal services, 4 retail food outlets, and catering. It is self-operating and provides an average of 1,800 meals per day. The retail outlets process 5,000 transactions daily, with annual sales of $3.6 million In 2009, the Center sent $455,070 on purchase of fruits and vegetables, 14% of total food purchases. They have really not ventured into organic produce yet; have some concerns they would be able to get the quantity they need for the price they can pay, They purchase local yogurt and milk. Alchemist CDC is facilitating a Veggie RX program, a new program where patients receive vouchers to use at farmers’ markets; a dietician gives nutrition education. Has a weekly seasonal farmers’ market on Medical Center property.
West Sacramento School District	Direct sales from Capay Organic		No central kitchen. Need to deliver to each school. Capay provides specific produce items.
Winters Unified School District	Buys directly from local growers		Prepares meals from scratch
Woodland School District	Buys directly from a few local growers and Rohrer Brothers		Rohrer Brothers – local produce wholesaler and distributor
Yolo Food Bank	Yolo County growers sell and also donate produce.		Fresh produce donations (39%) and purchases (61%); Key farms are local organic farms, large and small, and conventional producers, all produce is local.
Yuba County Charter School	Revolution Foods	General Produce supplies produce to Revolution Foods	Company is based in Oakland, provides prepared organic meals.
Yuba County School District	Sysco		

Sources: *Project team interviews with institutions, suppliers and other key informants; Greenwise Joint Venture research and interviews; “Establishing a Food Hub for the Sacramento Valley;” UC Davis “Sustainable Foodservice Progress Report 20112;” SACOG data; websites; newspaper articles*

PROPOSED PROJECTS

Demonstrating the great interest in the Sacramento region to capitalize on emerging market opportunities in the local and regional food system, there are several proposed commercial and community-centered projects at various stages of planning and implementation for retail, wholesale and processing facilities. They are geared to providing opportunities for local growers and food entrepreneurs to reach expanded local markets, including direct to consumer, farm to school, and farm to business/institution. The Sacramento Food Bank and Family Services and the Yolo Food Bank also have facilities expansions and retrofits in the planning phases that will increase their capacity to aggregate, pack and distribute fresh produce from local growers to clients and community-based partners and, possibly, incubate value-added fresh produce packaging and processing activities and enterprises. The following is a list of the some of the region's proposed projects.

Table 3. Proposed Food Projects, Sacramento Region, 2014

Project Developer	Proposed Project
Arden Garden Market, North Sacramento	A 501 (c)(3) planned as an independent marketplace, 45,000 s.f., for locally-sourced and prepared foods, open daily, year-round, with outdoor fresh produce market 3 days a week, an Ethnic Foods building, food literacy programs, community events, food-related business entrepreneurship. Hub planned with rental stalls for growers. Target is 200 vendors (food and other products). Currently fundraising, planning to begin operations summer 2014. North Sacramento is a USDA-designated food desert.
Capital Commerce Center, Sacramento County	Former Campbell Soup property, 130 acres with existing facilities including warehousing/distribution, production/food processing, cold storage and freezer, and several land/build to suit sites for new facilities. Has excellent utilities and transportation access. Major redevelopment project that is focused on food processing, distribution and related industries as well as other uses. Surrounding area on Franklin Boulevard is undergoing revitalization activities.
North Yuba Grown, North Yuba County	Local producer organization with growers from North Yuba County and Butte County, seeking space for a food hub packing, storage and distribution facility. Members include olive oil producers, grass fed beef ranchers and poultry, vegetable and produce growers, bakery, wineries/vineyards, grocery store. Has North Yuba Grown agri-tourism project funded by CDFA Specialty Block Grant to develop a farm trails map, working with UCD Small Farm Center. Sourcing to local school, has direct and retail sales. Developing hoop houses and other ways to extend seasonal products. With expansion can connect with regional markets.
Northwest Land Park LLC, Sacramento	Infill residential project in Northwest Land Park, redevelopment of industrial site. Will eventually include relocation of existing food distribution companies. Future project will include a 10,000 s.f. year round market for local produce vendors in the structure currently occupied by Produce Express; a 2.5 acre farm planned, to supply neighboring schools with produce.
Sacramento Certified Farmers' Market	Farm to Fork Chef's Market to provide a farmers' market for restaurants - in planning stage, for one day a week, near site of current Sunday farmers' market.
Sacramento Food Bank and Family Services, Sacramento	The Food Bank is renovating its main distribution center to create over 15,000 S.F. of dry storage space and more than 2,500 S.F. of cold storage space and upgrade all facilities for increasing its capacity to handle, process and store fresh produce. The warehouse and cold storage spaces will be professionally racked for high storage of bins and pallets. Processing will include repacking/bagging. The renovation will allow

Project Developer	Proposed Project
	the Food Bank's capacity increase its fresh produce from 1.5 million pounds in 2013 to 2 million by the end of 2014. Food Bank also plans to upgrade and add equipment like forklifts.
Sacramento Public Market, Downtown Sacramento	In planning stages to identify site; will be modeled after markets like the San Francisco Ferry Terminal Building, Napa's Oxbow Market, and Seattle's Pile Market, to provide a permanent market place for regional farmers and complement existing farmers' markets. Would include restaurants and prepared foods; could entail some hub functions. Seeks to raise profile of the region related to Farm to Fork.
West Sacramento Urban Farm Project	Urban agriculture infill project sponsored by the City of West Sacramento as part of its effort to address blight and support its overall Global Food Hub strategy. Project is on 2/3 acre - farmers and farm operation will be provided by the Center for Land Based Learning. Markets for the produce include contracts with local restaurants, grocery stores and sales at the West Sacramento Farmers' Market. The City is looking at several other infill sites as well.
World Food Center, UC Davis	UC Davis is developing a proposal for a long-range plan for a third University campus, focused on agriculture, food and nutrition. The plan is in the early stage of formation, but possible locations could be downtown Sacramento or West Sacramento. The campus could contain research facilities including in the area of food processing which would be relevant for the hub.
Yolo Food Bank, Woodland	The Food Bank purchased a 36,500 S.F. industrial building in 2013 adjacent to existing Food Bank operations, to expand capacity to access, co-pack, store and potentially process fresh produce, and to develop financial self-sufficiency by owning instead of leasing facilities and potentially generating some revenues streams. The building has been gutted and will be reconfigured for the following uses: half of the building will be for food bank operations (office, warehouse, distribution); other parts will be for commercial kitchen for culinary training for low income residents and/or for leasing space to potential entrepreneurs, and a processing line for co-packing, jams, sauces, freezing and other activities to extend the season, reduce waste and provide nutritious food in the winter. The Food Bank is preparing engineering cost estimates for a capital campaign to raise funding for the retrofit and expansion. Also looking to expand with 3-4 refrigerated trucks.

Sources: Interviews with Dan Friedlander, Arden Garden Market, Kevin Smith, Northwest Land Park LLC, Joe Rodota, Sacramento Public Market, Ernesto Lucero, City of West Sacramento, Mary Kimball, Center for Land Based Learning, Nate Ellis, Hackman Capital, Gary Hawthorne, North Yuba Grown; Discussions with UC Davis World Food Center; Meeting with North Yuba Grown growers; Meetings/interviews with Blake Young, Jeremiah Rhine, and Erik Kintzel of Sacramento Food Bank and Family Services, and Kevin Sanchez, Yolo Food Bank; West Sacramento Urban Farm groundbreaking; websites, newspaper articles

There is also an on-line hub/marketplace in the planning stage, the North Sacramento Valley Food Hub, to be launched sometime in 2014 to facilitate increased sales between local growers and local grocery retailers, restaurants, distributors, schools, hospitals, hotels and other institutional buyers.

IV. PROFILES OF FOOD HUB MODELS

This chapter presents profiles of diverse food hub business models from across the country and in California that have potential applicability for the Sacramento region. These models helped inform the development of the project's *Business Plan*. While the *Business Plan* analysis is based on a for-profit hub model, the profiles demonstrate the possibilities of alternative approaches in developing regional food system infrastructure over the next several years. This project's analyses show that there is potential for more than one hub in the region and more than one type of hub. It is up to the individual entrepreneur/investor to determine the preferred model(s); these profiles are intended as a resource to show different operational aspects that could go into a hub.

The Project Team identified these models through a literature review of the reports summarized in this document as well as other research reports and food hub feasibility studies; interviews with food hub experts at USDA AMS, USDA Rural Development California, the Wallace Center and others; and research on individual hubs identified in USDA's inventory of regional food hubs and via consultation with the Wallace Center. The Project Team used the following criteria to help select the hubs that are profiled:

- At a level of scale geographically and financially that would be relevant for the Sacramento region;
- A viable for-profit model, especially with a value-added/processing component;
- A robust nonprofit model with a focus on regional food-system building;
- An evolving model of a food bank to fresh produce focus;
- Partnership with a distribution company; and,
- Focus on particular niches and customers, especially schools, for which customized approaches are needed given the specific requirements and constraints to be addressed in serving these types of institutional customers.

As described earlier in this report, USDA identified three general types of market models: farm to business and institution, farm to consumer (households and individuals), and a hybrid – a combination of both.[24] Food hubs also have several different business (legal status) models: privately held (for-profit), nonprofit, cooperative, publicly held, and informal. Some are mission-driven, serving various social objectives; some have primarily a business mission; and some are oriented to accomplish a combination of both. Some hubs are specialized, serving only a select group of growers or commercial markets. Many hubs provide additional supportive services to growers – including new farmers – and/or customers, which provides for an additional revenue stream. The models included in the profiles below incorporate as many aspects as possible of these approaches, to provide a range of perspective and possibility.

Most food hubs across the country do not have processing functions, although many do include processed foods as part of their product offerings in order to respond to customer needs, diversify their supplies, and extend seasonality. Many hubs are developing social enterprise programs that have facilities like community kitchens or food incubators that provide training and business services for food businesses and prospective employees and operators, rather than as part of the function of the food hub itself. According to national food hub research, there

[24] Matson, James, Martha Sullins and Chris Cook, "The Role of Food Hubs in Local Food Marketing," USDA Rural Development, Service Report 73, January 2013, pp. 11.

is a strong interest in looking at these types of value-added activities as a way to strengthen the financial viability of hub operations, extend the season, provide jobs, and fill gaps in mid-scale agricultural infrastructure.

The profiles generally describe each hub's level of sales, business model, strategic objectives, area served, customers served, services offered, and additional information. They cover a range of models, operating characteristics, approaches and activities, including those blending business and social enterprise goals, and food banks that are transitioning to more comprehensive approaches to address hunger and poverty and foster the development of sustainable food systems in their regions. They illustrate the variety of options that are available.

The list of food hub research references and resources in Appendix B includes reports that have additional information on many different types of food hubs and models. The Project's *Business Plan* contains information on the recommended business model, services and revenues sources for the Sacramento Valley hub operation, incorporating information from this and other research and analysis. The following organizational/business models are profiled in the following section by type:

FOR-PROFIT

1. Blue Ridge Produce
2. ECO – Eastern Carolina Organics (Grower and Owner, LLC, Wholesale Organic Produce Distributor)
3. Farm to Table Co-Packers
4. Gourmet Gorilla (specialized – schools)
5. Revolution Foods (specialized – schools)
6. Veritable Vegetable – Wholesale organic produce distributor (privately-held)

NONPROFIT

1. ALBA Organics
2. Common Market
3. DC Central Kitchen
4. Farm Fresh Rhode Island
5. Iowa Food Hub
6. Tahoe Food Hub

FOOD BANKS

1. North East Georgia
2. Rochester

The food banks are nonprofits but are included as a separate category to highlight the transformational role they are playing in regional food system infrastructure development.

FOR-PROFIT

Food Hub Name:	**Blue Ridge Produce**
Year Established:	2011
Annual Sales:	N.A.
Location:	Elkwood, Virginia
Website:	www.blueridgeproduce.net

Business Model:	Private for-profit LLC, owned by two co-founders. Formed to create efficient, high-value market channel to support the local farming community, increase production and increase access to healthy, locally-grown produce
Area Served:	Virginia, Washington, D.C. metro area and the East Coast
Strategic Objectives:	Increase the capacity and accessibility for small to mid-size diversified fresh produce growers to connect with high-value wholesale markets, build the identity of the Blue Ridge brand – "a new model for local produce distribution"; also builds a value-based relationship with growers
Customers Served:	Primarily large grocery store outlets and wholesalers

Services Offered:

- Purchases and aggregates fresh fruits and vegetables grown locally, regionally and statewide from farms and markets them to wholesalers; produce can be conventionally and organically grown
- Working with more than 40 growers, totaling 10,000 acres of tillable land; ranges from small artisan growers to those with larger tracts; key services are: post-harvest handling, farm pick up, packing, cooling, marketing and distribution
- Also provides training and technical assistance to growers, enabling them to enter larger markets and increase farm income; assists with planning to increase production of most profitable crops; will assist growers with GAP certification
- Strives to build a values-based relationship with growers of all sizes which will help to scale up agriculture in the region to take advantage of growing market demand for locally grown foods, and to source from organic, local and low spray producers

Additional Description:

- Two primary lines of business: production and aggregation. Buys directly from farmers and aggregates and packs the produce to distribute to the wholesale market. Owns a 33 acre industrial site; 35,000 s.f. warehouse with cooler space; the site has 2 acres of greenhouses where tomatoes and lettuce are grown hydroponically in the off-season
- Purchased 420 acre farm, with agricultural easement; hopes to lease land to growers for production
- Will seek B-Lab certification (B Corp certification as a for-profit benefit corporation)
- Aiming to encourage new generation of entrepreneurial farming; there are emerging opportunities for Asian vegetable growers with consumer interest in their products
- Building a brand identity consistent with the image of the Blue Ridge Foothills, with attributes of clean air and water, beautiful farms, sense of community. Will brand produce with Blue Ridge identity along with the grower's farm brand.

Sources: website

FOR-PROFIT

Food Hub Name:	**ECO – Eastern Carolina Organics**
Year Established:	2004
Annual Sales:	N.A.
Location:	Durham, North Carolina
Website:	http://easterncarolinaorganics.com/about.php

Business Model:	Started as a pilot project of the Carolina Farm Stewardship Association, to support emerging organic farmers and organic tobacco farmers while improving the supply of local organic produce. In 2005, became a private, grower- and manager-owned LLC with 13 growers and 2 staff owners. Today, ECO works with over 40 growers and 100 customers as a fresh produce wholesale distribution center. ECO pools diverse harvests from several regions, to meet the demand for a steady stream of high-quality, seasonal food choices throughout the year. Committed to development of a sustainable food system.
Area Served:	Eastern North Carolina, ships to customers in the South and beyond; works with growers in North and South Carolina
Customers Served:	Markets and distributes wholesale Carolina organic farm produce to retailers, restaurants (chains and independents), buying clubs, Whole Foods, corporate cafes

Services Offered:

- Marketing and distribution
- Post-harvest handling, packaging
- Business/production planning - Production Coordinator works with core growers to set crop plans for each year
- Certifications
- Provides ways for conventional growers to enter the expanding organic market, including assistance with transition to organic farming
- Educates the public about the benefits of buying local, organic produce
- Enables participating growers to profitably sell products
- Growers "pick to order" for customers, managed through ECO
- Advocacy

Additional Description:

- Eighty percent of sales go back to growers.
- Each winter coordinator collects updated demand data from customers and tailors production to local market demand. Customer collaboration has resulted in increasing certain crops and initiating new ones based on suggestions from chefs
- Has very experienced staff on growing and distribution networks
- Seeks partner growers with crop appropriate infrastructure, including Internet access, irrigation, post- harvest washing, packing and refrigeration, transportation, greenhouse
- Region extends from coast to mountains, providing year round growing season
- Retrofitting a 26,000 s.f. warehouse as an "ECO-Hub" for all produce grown by their farm collective in the East Carolina region. Plans to surround the ECO-Hub with like-minded businesses and organizations, will host environmentally sustainable demonstration projects

Sources: http://easterncarolinaorganics.com; National Good Food Network Webinar, Starting a Food Hub, May 16, 2013, www.ngfn.org

FOR-PROFIT

Food Hub Name:	**Farm to Table Co-Packers**
Year Established:	**2010**
Annual Sales:	N.A.
Location:	Kingston, New York (Hudson Valley)
Website:	www.farm2tablecopackers.com

Business Model:	Full-service for-profit contract packaging company that manufactures and packages foods and other products for its clients, owned by two partners. Provides bottling, canning, IQF, dry pack services.
Area Served:	Primarily works with Hudson Valley growers, sells in the Albany and New York areas and the Northeast
Strategic Objectives:	Founded to meet gap in getting local products into markets. Partners with nonprofits and state entities which promote Hudson Valley products and support growers with funding and capacity
Customers Served:	Largely distributes goods to retail outlets, farm stands and colleges between New York City and Albany

Services Offered:

- Works with local farms to create new products and find more ways to get them into the marketplace, along with their own products. Processes food such as jams and sauces both for the farms and for small food producers, often connecting food producers with local farmers. Company is part of the Hudson Valley Food Hub, along with Hudson Valley Harvest, which was founded in 2011 by a farmer, that sources meat and produce from local farmers, freezes the items and sells them to stores and restaurants throughout the Northeast, including Whole Foods in New York City. The two companies work with more than 75 regional farms, from small to very large commercial operations. Handles vegetables, fruit, eggs, meat, honey and grain; has over 60 private labels.
- Farm to Table Co-Packers helps farmers lower costs for packaging and distribution; provides a process that connects farmers with business resources such as Northeast Center for Food Entrepreneurship at Cornell University, the SBDC, and the Hudson Valley Agri-Business Development Corp (HVADC; assesses co-packing needs; tests recipes; and provides full production and packaging.

Additional Description:

- Prices paid to farmers are often above standard wholesales market prices, focus on fair & sustainable
- Company was founded to address gaps in distribution access. Founders had two firms: Winter Sun Farms which works with local farms to produce local quick frozen vegetables and fruit that is distributed to more than 1,000 CSA customers during winter months and colleges, and Pika's Farm Table which produces a line of frozen soups, quiches and appetizers using local produce sold at farmers' markets and retail operations. Processed over 800,000 pounds of fresh produce in 2012.
- Employment ranges from 20 people during off-season to 60 people during harvest. 30,000 s.f. with a full processing line, a full bakery, and an incubator/test kitchen in a former IBM building. The facility has 3 loading docks and more than 10,000 s.f. of storage for refrigerated, frozen or dry goods.
- The State of New York funded 5 distribution hubs across the state, focusing largely on processing raw foods into frozen food or canned goods, to create new entry points for farmers into markets. HVADC along with Farm to Table Co-Packers and Hudson Valley Harvest received a $775,000 state grant to expand more processing equipment, cold/freezer storage, and trucks and distribution depots. Will increase production capacity by 25%. Farm to Table Co-Packers has had multiple funding sources.

Sources: websites; "Farms' food hubs mean business," by Kristen Brown, February 19, 2013; "Mid-Hudson Success Story, Farm to Table Co-Packers: a fresh take on farm fresh food," Empire State Development; "Cutting Edge State Level Initiatives for Food Hub Development," National Good Food Network Conference, March 2014

FOR-PROFIT

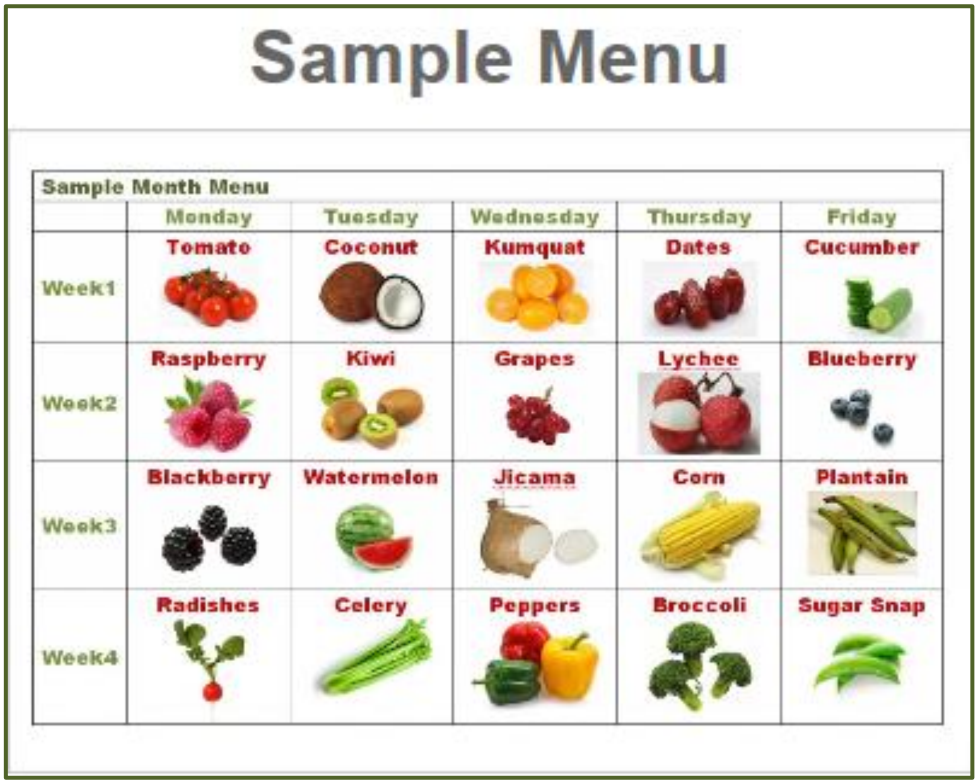
Food Hub Name:	**Gourmet Guerilla**
Year Established:	2009
Annual Sales:	$4.5 million in 2013
Location:	Chicago, IL
Website:	http://www.gourmetgorilla.com/

GourmetGorilla™
local & organic food for kids

Business Model:	Mission-driven for-profit, privately held business, founded by 2 parents. Created to bring healthier meals to Chicago-area schools by providing local sustainably and organically produced meals and snacks to K-12 schools and early childhood programs. Meals are produced at own commercial kitchen and delivered daily.
Area Served:	Greater Chicago Area and Wisconsin; works with a network of rural and urban growers, food hubs, dietitians, nutritionists, chefs and organic food product producers.
Strategic Objectives:	Provide higher quality ingredients from more local sustainable sources (stimulate local food economy), efficient labor and processes (bring better ingredients to schools at lower cost), and products children like and are nutritionally balanced; exceed USDA, Illinois Board of Education and other requirements for nutrition; serve the underserved community
Customers Served:	90 K-12 schools, early childhood programs (public, charter, and private)
Services Offered:	▪ Prepared meals from scratch (breakfasts, lunches and snacks) for schools and early childhood programs, delivered daily; deliver meals hot and cold ▪ Prepares 10,000 meals every weekday from industrial kitchen ▪ One stop online ordering monthly or daily for schools and parents; multiple healthy, flavorful menu choices daily; all meals made with local, sustainably grown and organic produce; emphasis on foods that are familiar to children ▪ All meats are free range, grass fed and all natural, not subjected to artificial growth hormones & antibiotics, or artificial preservatives; peanut and tree nut free facility
Additional Description:	▪ Working towards zero waste facility; has “environmentally responsible” delivery vehicles ▪ Sources mostly from Mid-West vendors in Illinois (organic vegetables and fruit from urban and nearby farms), Indiana (meat), Michigan (meat), Missouri (meat), Wisconsin (organic dairy and pasta) ▪ Designed initial website themselves and had $28,000 in start-up capital from investors and a micro-loan ▪ Business has double in size nearly every year. Employs 45 people working out of 4,000 s.f. kitchen space; plans to hire 80 more with an in-town move to a 15,000 s.f. space that will increase refrigeration to 11,000 s.f. and provide loading docks

Sources: http://easterncarolinaorganics.com; National Good Food Network Webinar, Starting a Food Hub, May 16, 2013, www.ngfn.org

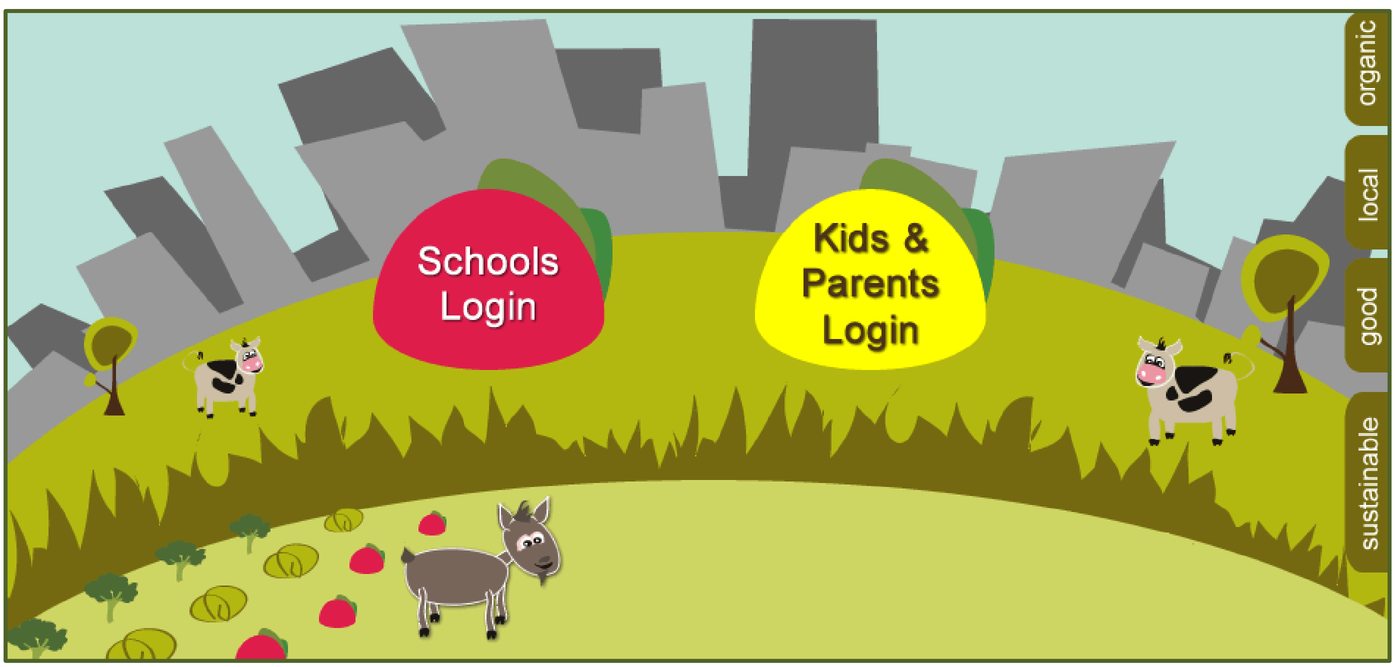
The following is a sample menu from Gourmet Gorilla, and the view of the web page designed to make it easy for parents and schools to order online. Ordering is available daily or monthly.



Sample Menu

Sample Month Menu

	Monday	Tuesday	Wednesday	Thursday	Friday
Week1	Tomato	Coconut	Kumquat	Dates	Cucumber
Week2	Raspberry	Kiwi	Grapes	Lychee	Blueberry
Week3	Blackberry	Watermelon	Jicama	Corn	Plantain
Week4	Radishes	Celery	Peppers	Broccoli	Sugar Snap



FOR-PROFIT

Food Hub Name:	**Revolution Foods**
Year Established:	2006
Annual Sales:	Almost $70 million in 2013
Location:	Oakland, California
Website:	www.revolutionfoods.com

Business Model: For-profit enterprise, B Corp. Started to bring healthy meals into school cafeterias. Mission is "to build lifelong healthy eaters by making kid-inspired, chef-crafted™ food accessible to all." Goal is to produce and distribute unprocessed, balanced meals to students across the U.S. Company is dedicated to improving children's health, reducing obesity, and improving academic, social and emotional success.

Area Served: Schools in ten states and Washington, D.C., mostly in low-income urban areas in Colorado, New Jersey-New York metro area, New Orleans area, Northern California/Sacramento, Texas, Southern California

Strategic Objectives: Operates in areas with high population density so that costs can be spread over a larger volume of product, to provide healthy foods to children who would otherwise not have access to it. Committed to creating a sustainable and profitable financial model.

Customers Served: K-12 schools – 200,000 prepared meals a day or a million meals a week, in nearly 1,000 schools in 25 cities; 2/3rds of children are in low-income households. Includes a Yuba County Charter School.

Services Offered:

- Provides support to schools and food service directors by providing fresh, hand-prepared breakfast, lunch, snack and supper meals and products. Meals include only natural, whole ingredients free of fructose corn syrup, artificial colors, flavors and preservatives. More than 100 entrée options.
- Fresh meals are prepared daily and delivered from 7 centralized culinary centers, since many schools do not have the equipment to handle fresh foods. When they set up a new regional location they have to find a facility to prepare the meals. Preference is to renovate an existing facility, including empty warehouses. Has $9 million contract with S.F. Unified School District.
- Now offering retail meal kits in grocery stores; partners with schools to offer nutrition education programs. Products also in school vending machines.
- Model includes a supply chain of fresh food providers daily; uses scale to achieve affordability; all meals are reimbursable and compliant with the National School Lunch Program.

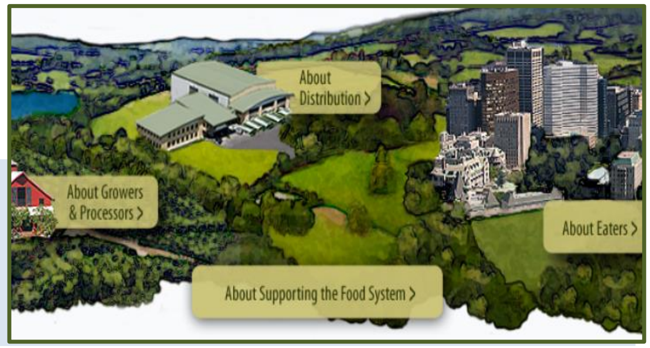
Additional Description:

- Has more than 1,000 employees in ten states; able to employ workers who might not otherwise have a job. Also hires workers who have disabilities. 21% of employees are from underserved communities. Workers earn above minimum wage and full-time workers have health care benefits.
- Owners have business backgrounds; started company with venture capital. Secured economic development loans and grants for workforce development and other activities, from City of Oakland. They have not yet reached profitability but are positioned to do so.
- Partners with food providers who share values, including Food in the Road, a community of family farmers, chefs and food business workers. 50% of suppliers are local and independent.
- Selected in 2012, ranking #5, on The World's 50 Most Innovative Companies; for past 2 years, received #2 spot in Inner City 100 awards from the Initiative for a Competitive Inner City.
- 50% growth rate in 2012, same rate expected in 2013.

Sources: websites; "North American Food Sector, Part One; Program Scan and Literature Review Report," Urban Sustainability Directors Network, 2013

FOR-PROFIT

Food Hub Name:	**Veritable Vegetable**
Year Established:	1974
Annual Sales:	$44 million in 2013
Location:	San Francisco, CA
Website:	http://www.veritablevegetable.com/



Business Model:	For-profit mission-driven, wholesale primarily organic produce distributor, places high value on relationships with growers, customers and employees and on a sustainable food system; a women owned business. Seeks to maximize profit for small-and mid-sized farmers by paying the highest return possible for their products. Company was originally formed as a collective. Designated a Certified B Corp in 2014.
Area Served:	California, portions of the Southwest with 24 distinct truck routes; also ships to New York and Hawaii
Customers Served:	700+ wholesale buyers and other customers, including retail stores, restaurants, institutions, schools, corporate campuses, hospitals and other organizations

Services Offered:

- Offers organic and sustainably produced produce
- Purchases from more than 300 producers (2013)
- Online, fax or phone ordering
- Source tracking and production method documentation
- Order by 3 pm for next day delivery
- Operates 24/7; trucks operate along set routes picking up produce directly from farms, and delivering it to customers; provides quality control and connections
- Daily fruit and vegetable availability lists with specific farm source and production method for each lot; can order by farm
- Serves wholesale customers of all sizes
- Publishes bi-weekly food trends, supply issues newsletter for customers
- Works with growers to forecast crop needs and market opportunities

Additional Description:

- Operates in environmentally sensitive manner: trucks, warehouses and waste; has its own fleet of zero-emission, hybrid trucks. Company diverts 99% of its waste; routes unsellable product to local food banks
- Operates 38,000 s.f. of warehouse space, another 6,000 s.f. in development (2013); 15,500 s.f. of warehouse space are walk-in coolers; another 3,000 s.f. of walk-in coolers are in development
- Supports food system education through website and media availability of principals
- Is the oldest organic produce distribution company in the country, with 120 employees
- Sole distributor of fresh produce to Sacramento Natural Foods Co-Op – farmers who sell directly to the Co-Op also sell to Veritable Vegetable
- Working with small and mid-sized growers is more expensive but this is part of the company's mission and what customers want
- Has participatory management systems

Source: website; "Innovations in Local Food Enterprises"

NONPROFIT

Food Hub Name: **ALBA Organics**
Year Established: 2002
Annual Sales: More than $5 million in 2013
Location: Salinas and Watsonville, CA
Website: http://www.albafarmers.org/

Business Model: Licensed organic produce aggregator and distributor owned by the non-profit Agriculture and Land-Based Training Association (ALBA), a 501(c)3. Supports approximately 50 growers, primarily Latino, low-income growers who receive access to land, storage and cooler space, delivery infrastructure, sales support and sales training. ALBA seeks to create business opportunities for farm workers and other aspiring farmers of limited means by offering farmer education and small farm incubator programs that provide graduates with subsidized access to equipment and land leases. Producers have ongoing training and market access opportunities.

Area Served: Monterey Bay Area and San Francisco Bay Area and other northern California locations

Customers Served: Approximately 80, including wholesale distributors, corporate food services, hospitals, universities (i.e., Stanford Dining Services), schools, grocery stores, restaurants, retail stores, Asilomar Conference Center; also sells at farmers markets

Services Offered:

- Locally grown, source-identified certified organically grown produce; purchases from variety of farmers through ALBA Organics and within the region
- Customer delivery service
- Can arrange custom growing relationships to meet customers special needs
- Opportunity to support small scale organic farmers, many of whom are immigrants
- Fifty percent of funding is public
- Partners with schools and university customers to offer agricultural education and onsite farm field trips
- Initiated a food enterprise incubator, leasing 30,000 s.f. facility to expand warehouse space and create a commercial kitchen incubator, in partnership with El Pajaro Community Development Corporation

Additional Description:

- Crops are grown at 2 organic farms – 110 acres and 195 acres; facilities include office, resource center for training (ALBA Rural Development Center), maintenance workshop, produce cooler, distribution facilities, delivery trucks near Salinas. With growth, has moved main office to warehouse and cooler facility in Watsonville, providing more support to growers in the surrounding area
- More than 50 crops are grown
- There are 10 ALBA employees; 100 part-time or full time jobs generated by incubator businesses per year
- 350 farmers have entered into its Small Farm Education program over the last 12 years; 170 graduates. Offers marketing education on packing and sales for wholesale and retail distribution, and food safety and quality control.
- First year farmer apprenticeships – growers have access to land, irrigation equipment, from one half up to eight acres at the farm incubator

Sources: website; North American Food Sector, Part One; Program Scan and Literature Review; Innovations in Local Food Enterprise report

NONPROFIT

Food Hub Name:	**Common Market**
Year Established:	2008
Annual Sales:	More than $4 million
Location:	Philadelphia, PA
Website:	http://commonmarketphila.org/

Business Model: Mission-driven wholesale produce distributor of locally produced foods to approximately 200 wholesale customers; works with more than 75 growers and processors; a 501(c)3.

Strategic Objectives: Does not aim to be customers' sole grocery provider, but rather, to be the solution for locally sourced food. Goal is to strengthen small to medium-sized regional growers while providing access to locally produced foods, especially to underserved communities, through wholesale customers; to encourage sustainable growing practices; to pay a fair price to farmers; to help preserve farmland in region and keep food dollars local

Area Served: Greater Philadelphia/Mid-Atlantic Region for customers; growers are located in Pennsylvania, New Jersey and Delaware within 200 miles (farms average 125 acres in size)

Customers Served: Schools, colleges, hospitals, workplaces, grocers, non-profits, faith-based institutions

Services Offered:

- Aggregation and distribution of fresh produce and other value-added products from sustainable producers; has a farmer outreach team
- Source and production information for customers on each case and invoice
- Self-certification of each grower according to GAP protocols; implemented a HACCP plan and passed third party safety audit
- Shared facilities to help serve underserved populations

Additional Description:

- New facility (2013) with 52,000 s.f. warehouse space, 10,000 s.f. office space and 10,000 s.f. cold storage; delivery fleet of 3 trucks; stocks more than 750 products
- Originally financed through personal savings and credit cards and a planning grant from the State of Pennsylvania via a bond measure
- Continued with small grant and loan guarantee from the state and revolving line of credit to borrow against receivables; additional foundation grants and after 3 years, new PRI* financing for new facility ($1.2 million) and to refinance earlier debt, through impact investment fund RSF Social Finance. *PRI=program-related financing, typically financing for charitable or social purposes
- Combined single ordering (consolidated availability) list for all caseload products
- Sells seasonal fruits and vegetables, grocery items, grain, dairy, eggs, & meat
- Offers frozen and canned products plus protein, grain, dairy and other minimally processed value-added local products manufactured by others during winter
- Operates six days per week, year-round
- Does no processing, but carries local products from those that do
- Developing co-located/co-packer/local processor Philly Good Food Lab to provide dedicated food preparation space and dry and cold storage for like-minded food enterprises and local entrepreneurs that can benefit from Common Market supply and distribution services, thus collaboratively growing the local food economy; generates revenue by leasing space to co-packers, micro-growers, processors, partners
- Maintains a relationship with secondary providers (Sysco, US Foods, etc.) to have items when locally produced food is not available

Sources: website; Interview notes of Cutting Edge Capital with Haile Johnson, Founder; Case studies in National Good Food Network reports

COMMON MARKET

The graphic below illustrates the role of Common Market as the intermediary between the wide range of food products from local farms and the variety of customers which it serves. Products are marketed as “Delaware Valley Grown – Good – Fresh – Local.”

Common Market works with a wide variety of customers, including public and independent schools, universities, hospitals, retail food co-ops, supermarkets, nonprofit organizations, elder care facilities, value added producers, food trucks and more. Our goal is always the same: to make your local food program successful!

We understand that you rely on us to deliver the freshest local food grown in the Delaware Valley. Our friendly staff will work with you to select the right seasonal products for your store or cafeteria, arrange a convenient delivery time and provide you with marketing and other support for your local program.

NONPROFIT

Food Hub Name:	**DC Central Kitchen (DCCK)**
Year Established:	1989
Annual Sales:	$13 million (2012)
Location:	Washington, D.C.
Website:	www.dccentralkitchen.org

Business Model:	Non-profit 501(c)3 Integrated model with commercial kitchen, centralized processing, culinary training, business Incubation, meal preparation and foodservices, food waste recovery; has a nonprofit and for-profit approach to revenue generation.
Strategic Objectives:	Created to reduce waste, high costs and redundancy for Capitol region non-profits dedicated to fighting hunger. Uses food as a tool for individual and community empowerment
Area Served:	Washington, D.C. area
Customers Served:	Partnership with nearly 100 partner agencies and 10 public schools, local nonprofits, city agencies, and other organizations in. Serves 10,000 meals per day (half go to schools)

Services Offered:

- Prepares healthy, made-from-scratch meals for schools and partner agencies
- In-house catering business providing jobs
- Partnership with corner stores in underserved communities to provide fresh produce – generates 60% of income
- Culinary training program
- Provided a pilot healthy meals program for 7 DC elementary schools
- Provides jobs for graduates of programs
- Food literacy education programs

Additional Description:

- Has 145 full- and part-time staff, 68 of whom are DCCK graduates
- Non-profits who receive meals send their clients to enroll in DCCK's job training programs; many are ex-offenders. Averages 80-90 graduates a year; most are employed by institutions, schools and other non-profits; DCCK also hires program alumni to support its own programs and revenue-generating social enterprises
- Buys food at auction. Partners with local farmers to buy seconds of fruits and vegetables. Total poundage of locally sourced meals in 2011 was 22%
- Freezes fresh produce at harvest time in-house at their two production facilities using blast chillers, then shipped off-site to contracted freezer storage space until needed for use in menu items later in the year
- Sales are 64% of revenues, charitable donations are 36%
- Invested $$156,000 in local farms; prevented $1.2 million in food waste

Sources: website; North American Food Sector, Part One; Program Scan and Literature Review; Innovations in Local Food Enterprise

NONPROFIT

Food Hub Name:	**Farm Fresh Rhode Island (FFRI)**
Year Established:	2004
Annual Sales:	$1. 11 million in 2012
Location:	Pawtucket, Rhode Island
Website:	http://www.farmfreshri.org/

Business Model: Hybrid model: farm fresh to consumer and farm fresh to business/institution; 501(3)c, with holistic approach to rebuilding a year round food system – has many programs to promote market access, culinary training, food entrepreneurship, ag land preservation, health and nutrition, farm to school, community education; does not do direct distribution.

Strategic Objectives: Expand local food production; increase efficiency of processing, distribution and sales; foster and support new class of business built around local foods; increase number of outlets to buy/eat local foods. Increase consumption of locally produced foods from 1% inn 2009 to 3% in 2015 – the 99% Opportunity to buy more local.

Area Served: Rhode Island, Boston Metro Area for customers; growers and producers are from Rhode Island, Connecticut, Eastern Massachusetts

Customers Served: Restaurants, stores, farmers markets, hospitals, worksites, schools

Services Offered:

- Runs 9 farmers' markets, operates Wintertime Market – year round indoor market with produce in winter from hoop houses, greenhouses, etc.
- Market Mobile – farm to chef/institution delivery, through on-line ordering system direct from 50 family farms, farmer sets prices, food origin preserved; orders are by farm, not commodity.
- Harvest Kitchen – trains at-risk youth in culinary programs, provides internships, youth make local food products sold at farmers' markets, stores, etc.
- Open Kitchen – FFRI provides commercial kitchen space for lease with co-packing, cold storage, some freezer and provides network of commercial kitchens and facilities to incubate food entrepreneurs, provide access to counseling, loans
- Veggie Box – delivery of produce boxes to work sites and community centers
- Farm to School – 39 school districts buy some local produce; also, education programs
- Provides information to vendors, customers; hold events; provide nutrition education and programs for seniors, families, SNAP/EBT, Farm to Food Pantry donation program
- Community events

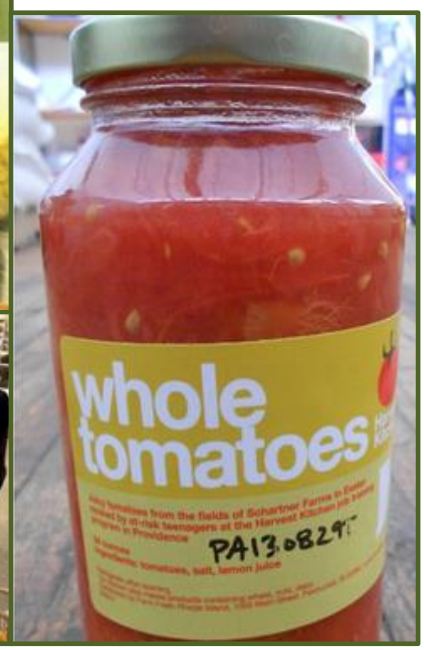
Additional Description:

- $220,000 in sales in 2009, $1.5 million in sales for growers in 2012
- Works with network of partners and expanding to regional New England food system; partners include state agencies working with at-risk youth
- Has 20 staff
- Revenue sources include several foundations (29%), state/federal grants (14%), Market Mobile (25%), individual donations and Local Food Fest (11%), market fees (9%), Veggie Box (7%), Harvest Kitchen sales (3%)
- Working on expansion of aggregation/distribution capacity next to Wintertime Market
- Provides on-line resource for local farms and markets

Source: website

FARM FRESH RHODE ISLAND HARVEST KITCHEN

Source: Farm Fresh Rhode Island



NONPROFIT

Food Hub Name: **Iowa Food Hub**
Year Established: Pilot Project, hub started in 2013
Annual Sales: N/A
Location: Cedar Rapids, Iowa
Website: www.iowafoodhub.com

Business Model: Hybrid – Farm to Consumer and Farm to Business/Institution; 501(c)3; manages the aggregation, distribution and marketing of source-identified food products from local and regional producers to strengthen ability to satisfy wholesale, retail, institutional demand.

Strategic Objectives: Created for research, education, and demonstration to develop ways to connect farmers and families with food grown close to home. Goals: to increase sales and consumption of locally grown food; operate a more efficient food distribution system; support local small-to-mid-sized farms that can supply schools, hospitals, grocers, restaurants

Area Served: Northeast Iowa, works with growers and processors, some beginning, some established

Customers Served: Schools, institutions, consumers at business sites

Services Offered:

- Worksite Food Box Program – provides year-round, weekly local food deliveries to mid- to large-sized worksites, including university sites, other schools; targets customers who do not belong to CSAs; has a variety of options including food boxes with meat, veggies, meatless, with fresh bread, eggs only, and weekly staples. Ordering is done on line; farmers set price. Has 13 locations, moved from pilot project to anchor enterprise in 2013
- Working on system for EBT/SNAP benefits for underserved communities
- Information dissemination about what works
- Farm to School program and institutional sales; does custom hauling for its producers
- Local food procurement and sales
- New market development and research with focus on schools, institutions, grocery stores; transfer information to growers

Additional Description:

- Partners include Northeast Iowa Food and Farm Coalition, Northeast Iowa Food and Fitness Initiative, Coop Extension, University of Iowa, Luther College, Northeast Iowa Community College, John Deere Dubuque Works and Community Foundation of Greater Dubuque
- Obtained private and public grant funds to develop model and offer specialized technical assistance to farmers and food producers
- Food boxes include fresh produce and wide variety of products from Iowa food processors

Source: website; "Iowa Food Hub Worksite Food Box Program Connecting Local Growers, Consumers," Jean Caspers-Simmet, May 5, 2014, agrinews.com

NONPROFIT

Food Hub Name:	**Tahoe Food Hub**
Year Established:	2013
Annual Sales:	N/A
Location:	Truckee, CA
Website:	http://www.tahoefoodhub.org/

Business Model:	Nonprofit wholesale aggregator and distributor of sustainably-produced produce, eggs and meat to restaurants and institutions in the Tahoe/Truckee area, taking advantage of it close proximity to year-round production.
Strategic Objectives:	Mission-driven to support regional sustainable agriculture, small farmers, local economies and to provide a healthier range of food products to the community. Goals: Increase access to local fresh foods by connecting wholesale and institutional buyers to regional food program. Create new markets for small-scale farmers, ranchers and specialty food businesses. Also experimenting with local year-round production capacity in dome greenhouses to improve food security. Plans to work with agencies supplying healthy food to at-risk populations.
Area Served:	Tahoe area/Truckee distribution; is sourcing within 100 miles, primarily from the Sierra foothills and eastern Sacramento Valley (Placer, Nevada, Yuba, Butte counties)
Customers Served:	Restaurants, schools, hospitals, resorts and casinos, small grocers, food providers who serve those in need

Services Offered:

- Farm to Market Program (F2M) - Wholesale aggregation and distribution of regionally and sustainably produced produce, eggs and meat. Includes Farm to School Program (F2S) – partnering with Harvest of the Month; developing Farm to School Fund so local businesses/individuals can contribute to buying local food
- Customer deliveries
- Helping customers with the source and production methods of food served
- Developing a recognized regional brand that customers can use
- Healthy Food Access Program - Serving underserved populations with high quality food in partnership with social service providers
- Sierra Agroecology Center – education about agriculture in an alpine ecosystem and sustainable farming practices. Partnering with Truckee Community Farm on an experimental 850 s.f. geodesic greenhouse

Additional Description:

- Organized with start-up staff and board and in fundraising mode currently
- Raised $28,000 in funding through crowdsourcing to purchase truck, assisted by the Sierra Business Council

Source: website

FOOD BANK

Food Hub Name:	**Food Bank of North East Georgia**
Year Established:	1992 (Food Bank)
Annual Sales:	N/A
Location:	Athens, Georgia
Website:	www.foodbankng.org

Business Model:	Nonprofit, developing a Whole Community Food Network model that brings together a food bank, farms, communities, educational institutions, nonprofits and businesses to build the local food system.
Strategic Objectives:	Food Bank mission is to end hunger as part of overall effort to alleviate poverty; provide fresh and nutritious food to the needy; and to develop sustainable local food system. Developed new strategy to improve outcomes in 5 mountain counties of 14 county service area. Assessment identified need for more fresh produce distribution, storage, processing capacity to serve farmers and clients. Launched a $3.2 million capital campaign in 2013 to build a permanent facility with warehouse, fresh prep, quick freezing, commercial kitchen, and community education space, leveraging Food Bank expertise/assets.
Area Served:	5 Northeast Georgia mountain counties served by the Food Banks's Rabun County branch facility
Customers Served:	In 2013, the Food Bank provided 3.5 million pounds in the Rabun County branch area for 30,000 people through 44 agencies - 25% of total Food Bank service area. Goal is to expand to 5 million pounds of food

Services Offered:

- Food Hub will provide marketing, aggregation services for growers; Rabun Phase 1 facility will offer fresh prep and processing capacity, storage, and transportation infrastructure and equipment. Staff will provide one-on-one assistance to farms, and market development, sales, distribution. Key opportunities: Farm to School and higher education; winter farmers' market with frozen produce; sales to restaurants and grocery chains; 80% of food hub revenues will go to farmers
- Facility plan: 15,000 s.f. warehouse, 5,000 s.f. freezer and cooler storage, office, community education rooms. Quick freezing operation will process 15,000-20,000 pounds per week, for later distribution to local agencies, Athens warehouse, etc.
- Community kitchen to provide licensed space for farmers to develop value-added and frozen products through a kitchen use fee and/or co-packing with the hub's quick freezing (IQF) services; will provide job training opportunities and incubate businesses
- Food Hub benefits from availability of other pieces of the network, such as warehouse, processing, and transportation capacity
- Farm to School Georgia Organics – offers hands-on learning
- Education on diet and nutrition; growing, cooking and preserving fresh foods – classes for food service professionals, social services and institutions
- Obtains food from many sources, processes it and stores the product in dry, refrigerated and frozen storage, for distribution for emergency food services
- Has mobile pantry programs with farmers' market style delivery

Additional Description:

- Partners: Northeast Georgia Locally Grown, local farms, University of Georgia, Georgia Organics, Small Business Development Center, USDA, schools, Sustainable Mountain Living Communities, Pittulloch Foundation, residents
- Food Bank as a partner reduces capital needs
- Majority of farms are small, mostly selling through farmers' markets and on-line cooperative marketing site, Northeast Georgia Locally Grown. Farmers want assistance to help them expand their farms

Source: website; National Good Food Network – "Food Banks as Regional Food Hub Partners," 2013

FOOD BANK

Food Hub Name: **Foodlink**

Year Established: 1978

Annual Sales: $28.9 million in revenues, 2013

Location: Rochester, New York

Website: www.foodlinkny.org

Business Model: Nonprofit regional food bank; evolving to a food hub with innovative programs. Hunger prevention requires increasing food access via market-based solutions. Raises revenues from donated food, fees for service, sales of wholesale food, public support, government/other grants, events

Area Served: 10 counties in Central/Western New York

Strategic Objectives: Increase in hunger caused by Recession, along with decreases in donated resources, spurred change - committed to use assets and resources to impact on the cause (poverty) rather than the symptom (hunger) and change food system. Belief that food banks should be involved in economic development

Customers Served: More than 500 community partners, including food pantries, soup kitchens and shelters, and non-emergency organizations such as day care centers, group homes, senior homes, etc.

Services Offered:

- Provides 16.7 million pounds of food per year – 30+ food-related programs, 65 full time staff
- Proactive purchasing of healthy foods; does menu planning for agencies; has 5 unique nutrition education programs aimed at building food literacy
- Food Access Programs: farm stands – 12 sites with community partners; curbside market, a social enterprise – 30 sites, mostly public housing; healthy corner stores – pilot, working with 3 stores; 10 garden project sites; 3 million pounds of produce distributed
- Freshwise Kitchen prepared and provided more than 885,000 meals for children; growing thousands of pounds of food at community gardens and Foodlink's urban farm

Additional Description:

- Moving from passive model (receive donated food, redistribute) to proactive (purchasing, growing processing food), from charity to social enterprise; also embracing market-based solutions, focus on health. Diversifying customer base of non-emergency nonprofit organizations that can't afford to shop retail; working directly with individuals and select for-profits (e.g. corner stores)
- Investing in local economy – over $250,000 spent on local farms, offers storage capacity at below market value; pilot commercial kitchen program; expansion of locally produced purchased products
- Has job training programs for Freshwise Kitchen and food bank
- Infrastructure includes 80,000 s.f. warehouse, 3,700 s.f. cooler, 5,200 s.f freezer, 10,000 s.f. commercial kitchen; fleet of 13 trucks, including refrigerated; also has inventory system, skilled workforce, critical relationships
- Starting value added-processing of apples for distribution as a Food Bank product, and for small and mid-sized farmers that lack infrastructure, who will brand and sell the products; will expand Farm to School and Farm to Institution programs

Sources: website, National Good Food Network webinar, "Food Banks as Good Food Partners," December 13, 2013; Foodlink 2013 Annual Report

FOOD HUBS/LOCAL FOOD SYSTEM PROGRAMS TO WATCH

As this report has shown, local food system/food hub innovations are rapidly unfolding throughout California and the country. There are several new models and programs that bear watching – a few are summarized below. Some of them highlight the evolving role of nonprofits and food banks in their local food system, as they craft new strategies to address hunger, poverty and unemployment.

Project/Location	Description
Baltimore Food Hub, Baltimore	A $1.4 million EDA investment in the work of the Historic East Baltimore Community Action Coalition Inc. will help revitalize the abandoned historic buildings of the city's Eastern Pumping Station to catalyze Baltimore's food economy. The project will address a shortage of commercial kitchens and food processing facilities for specialty food products by creating a center of entrepreneurship and jobs. The Hub will offer comprehensive services and resources, including an incubator with commercial kitchen space, food storage facilities, farm stand and garden center. The $16.3 million project is projected to open in 2015. A prominent local chef will have a production kitchen, and Big City Farms will build an urban farm on the site. With job training, the project could create 100s of jobs. Bon Appetit, a food service provider for nearby Johns Hopkins University, will be one of the partners along with the University.
Bellingham Food Bank – Food Bank Fresh, Washington State	The Food Bank contracts with seven partner farms to grow fresh produce for food bank clients, working off season with local farms to develop a crop list for the upcoming harvest year, establishing prices that allow for a reasonable return and paying them up front for their contract. In so doing the Food Bank increases the amount of fresh produce in the community, and creates a new market outlet for farmers who can grow their wholesale and CSA program at the same time.[25]
Food Bank of North Alabama	Serves 11 Northern Alabama counties. Has added programs that address food system issues. In 2012, launched the pilot program the Farm Food Collaborative, which helps Alabama farmers sell local food to schools, hospitals, workplace cafeterias, and grocery stores. Created a revolving loan fund offering financing to growers and/or locally-owned food-based enterprises to create jobs for low-to-moderate income persons or provide services in under-resourced communities. Working with partners on a grass-roots effort to form the North Alabama Food Policy Council, to foster a more-locally based food system where no one goes hungry and where local dollars stay in the community.
Snohomish County Food Hub, City of Everett, Washington State	Construction of a 60,000 s.f. farmers' market and food hub is underway, scheduled to open in 2014, offering high-quality local fruit, vegetables, meat and dairy products as well as value-added foods produced on-site with local ingredients. Will include a large commercial kitchen and processing facility where farmers can make products to sell at the market or across the nation. The marketplace will offer 90 retail spaces of varying sizes to farm producers in the Puget Sound area. The project was developed through working with farmers to keep agriculture in the County economically viable and meet consumer demand for fresh and local foods. It will anchor a housing project and hotel with space for restaurants. The entire project is estimated at $50 million, financed through the EB-5 investment program. The project is being privately developed but the Snohomish County Growers Alliance will manage the project.[26]

Sources: websites; newspaper articles, EDA e-newsletter, "Success Story – Expanding Baltimore's Food Economy and Job Market," November 2013.

[25] Morange, Max. "Food Bank Fresh Aids Whatcom County farmers, ensures produce for clients," The Bellingham Herald, June 17, 2013.

[26] Washington State Dept. of Health, http://depts.washington.edu/waaction/action/n1/a18.html.

Artist's rendering of the Baltimore Food Hub

Source: http://www.eda.gov/news/blogs/2013/11/01/success-story.htm

APPENDIX A: LIST OF PROJECT INTERVIEWEES/RESOURCES

ORGANIZATION	CONTACTS
Agricultural Advisors, Inc.	John Post, President, Yuba and Sutter Counties
Arden Garden Market	Dan Friedlander, Developer
Bon Appetit	Andrew Tescher, General Manager, Intel Campus
California Air Resources Board	Judy Nottoli, Air Resources Engineer, Office of the Small Business Ombudsman
California Department of Food and Ag	Karen Ross, Secretary Elysia Fong, Farm to Fork Coordinator Sarah Hanson, Farm to Fork
California Department of General Services	Robert Ullrey, Food Procurement Unit
California Grocers Association	Ron Fong, CEO Keri Askew Bailey, Policy Director
California Health and Human Services Agency	Diana Dooley, Secretary Jim Suennen, Associate Secretary, Office of External Affairs Janne Olson-Morgan, Assistant Secretary, Program & Fiscal Affairs
California Restaurant Association	Jot Condie, CEO Bobby Coyote, Owner, Dos Coyotes, Chapter President Allison Zander, Program Manager
Capay Valley Farm Shop	Thomas Nelson, Co-Founder and President Ronit Ridberg, Director of Business Development
Capay Valley Vision	Nancy Pennebaker, Chair
Capay Organic, Farm Fresh to You	Thaddeus Barsotti, Co-CEO Barbara Archer, Communications Director Victoria Berends, Branding Director
Center for Land-Based Learning	Mary Kimball, Executive Director
Corti Brothers Grocery	Darrell Corti, President
City of Davis	Joe Krovoza, Mayor Rob White, Innovation Officer Sarah Worley, Economic Development Director
Davisville Farms	Jim Donovan, Managing Partner
El Dorado County	Norma Santiago, Supervisor, District 5 Brian Veerkamp, Supervisor, District 3 Charlene Corvath, Agricultural Commissioner
El Dorado County Farm Bureau	Valerie Zentner, Executive Director
Evans and Brennan (School Food Service Consultants)	Georgeanne Brennan
Foodlink, Rochester, N. Y.	Mitch Gruber, Community Access Manager
Foodways Consulting	Libby O'Sullivan
Full Belly Farm	Paul Muller, Co-Owner Judith Redmond, Co-Owner
Gnos Farms and Farm Credit West	Craig Gnos, Owner and Board Member
Governor's Office of Business and Economic Development (GO-Biz)	Andrew Strumfels, Office of Permit Assistance

ORGANIZATION	CONTACTS
Greenwise	Sarah Leddy, Project Manager, Foodwise Colin Mickle, Foodwise Coordinator Katherine Mitchell, Foodwise Fellow Amarachi Okemiri, Foodwise Fellow
Hackman Capital	Nate Ellis, Capital Commerce Center Lead
Kaiser Permanente	Kathleen Reed, Sustainable Food Program Manager and National Farmers Market Coordinator, National Nutrition Services – Procurement and Supply Jake Rosenberg, Assistant Administrator for Support Services, Sacramento Medical Center
Manas Ranch	Fred Manas, Owner
Mariani Nut Company	John Aguiar, Sales
North Yuba Grown	Gary Hawthorne, President
Northwest Land Park development	Kevin Smith, Project Manager
Placer Community Foundation	Veronica Blake, CEO
Placer County	Joshua Huntsinger, County Agricultural Commissioner Dave Synder, Economic Development Director
Placer Food Bank	Dave Martinez, Executive Director Alan Osterstock, Programs Director
Produce Express	Jim Mills, Sales Representative
Placer Real Food	Joanne Neft, Author and Marketing Specialist
Public Health Institute	Ronit Ridberg, Food Procurement Project Consultant, California Health in all Policies Task Force
Rideout Memorial Hospital, Yuba County	John Weiler, Former Board Chairman; Business Manager, Oji Bros. Farms, Inc.
City of Sacramento	Dean Peckham, Manager, Economic Development Leslie Fritzsche, Downtown Development Manager
Sacramento County	Don Nottoli, Supervisor, District 5 Phil Serna, Supervisor District 1 Lisa Nava, Chief of Staff, Sup. Serna Troy Givans, Director, Economic Development Juli Jensen, Agricultural Commissioner
Sacramento Food Bank and Family Services	Blake Young, President & CEO Jeremiah Rhine, Chief Operating Officer Erik Kintzel, Food and Operations Director
Sacramento Public Market Project	Joe Rodota, President & CEO, Forward Observer
SODEXO, UC Davis Food Service	Linda Adams, Director
Soil Born Farms	Shawn Harrison, Executive Director
Solano-Yolo Farmbudsperson Program	Michelle Stephens, Farmbudsperson
Sutter County	Stanley Cleveland, Supervisor, District 2 Mark Quisenbery, Agricultural Commissioner Danelle Stylos, Development Director
Sutter Health, Sacramento Sierra Region	Jack Breezee, Regional Director Food and Nutrition Services
Trinity Fresh	Paul Abess, President Danee Brady, Marketing Manager

U.S. Department of Agriculture (USDA), D.C.	Jim Barham, Economist, Agricultural Marketing Service Errol Bragg, Director, Agricultural Marketing Service Terry Long, Director, Market News, Fruit and Vegetable Programs, Agricultural Marketing Service
USDA California	Val Dolcini, State Director, Farm Service Agency Glenda Humiston, California State Director, Rural Development Robert Tse, Special Projects, Rural Development
University of California Cooperative Extension	Cindy Fake, Horticulture and Small Farms Advisor, Placer-Nevada Counties Chris Greer, County Director, Rice Farming Systems Advisor, Sutter-Yuba and Colusa Counties
University of California, Davis	Bob Adams, Executive Director, Sustainable Ag Tech Innovation Center, Child Family Institute for Innovation & Entrepreneurship Edward Silva, Program Coordinator, Sustainable Ag Tech Innovation Center, Child Family Institute for Innovation & Entrepreneurship
Valley Vision	Bill Mueller, CEO Robyn Krock, Project Manager, Food System Collaborative
Wallace Center at Winrock International	Jeff Farbman, Senior Program Associate
City of West Sacramento	Christopher Cabaldon, Mayor Chris Ledesma, COuncilmember Mark Johannessen, Mayor Pro Tem Diane Richards, Manager, Economic Development Ernesto Lucero, Economic Development Specialist
Williams-Paddon	Jim Williams, Owner, Advisor, Next Economy Project
City of Winters	Cecilia Aguiar-Curry, Mayor John Donlevy, City Manager
City of Woodland	Tom Stallard, Councilmember
Yocha Dehe Wintun Nation	Betsy Marchand, Advisor
Yolo Ag and Food Alliance	Kristy Lyn Levings, Chair Co-Owner, Chowdown Farm
Yolo County	Don Saylor, Supervisor, District 1, Yolo Food Connect Mike McGowan, Supervisor (former) Diane Parro, Deputy to Supervisor Saylor John Young, Agricultural Commissioner Dennis Chambers, Chief Deputy Ag Commissioner Nicole Sturzenberger, Farm to School Outreach Coordinator
Yolo Food Bank	Kevin Sanchez, Executive Director
Yuba City	Darin Gale, Economic Development Director
Yuba County	Roger Abe, Supervisor, District 4 Mary Jane Griego, Supervisor, District 3 John Nicoletti, Supervisor, District 2 John Fleming, Economic Development Coordinator Kevin Mallen, Director, Community Development and Service Agency Louie Mendoza, Agricultural Commissioner
Yuba-Sutter Chamber of Commerce	Steve Dambeck, Director of Visitor Services
Yuba-Sutter EDC	Brynda Stranix, President/COO
Yuba-Sutter Farm Bureau	Megan Foster, CEO A.J. Anderson, Chair, Young Farmers and Ranchers Group

APPENDIX A: FOOD HUB RESEARCH REFERENCES AND RESOURCES

- Barham, James and Adam Diamond. *Moving Food Along the Value Chain: Innovations in Regional Food Distribution*, US Department of Agriculture, Agriculture Marketing Service. March, 2010.
- Barham, James, Debra Tropp, Kathleen Enterline, Jeff Farbman, John Fisk, and Stacia Kiraly. *Regional Food Hub Resource Guide*, U.S. Dept. of Agriculture, Agricultural Marketing Service. Washington, DC. April, 2012. <http://dx.doi.org/10.9752/MS046.04-2012>
- Brannen, Sarah; Upstream Advisors. *Hudson Valley Food Hubs Initiative: Research Findings and Recommendations,* Local Economies Project, The New World Foundation, April, 2013. Research conducted by Hudson Valley Pattern for Progress and the Urban Design Lab at the Earth Institute, Columbia University
- Cantrell, Patty and Heuer, Bob. *Food Hubs: Solving Local,* The Wallace Center at Winrock International. March 2014
- FarmsReach. *Building Regional Produce Supply Chains – Helping Farms Access & Sell to Multiple Channels, Helping Large-Volume Buyers Access Regional Foods*. August 2011
- Feenstra, Gail, Tracy Lerman and David Visher. *Food Hubs and Values Based Aggregation and Distribution: a Toolkit for California Farmers and Ranchers,* University of California, Davis. 2012
- Feenstra, Gail, Sharmain Hardesty and David Visher. *Developing Values-Based Distribution Networks to Enhance the Prosperity of Small and Medium Sized Producers, California Case Studies*, UC Davis. January, 2012
- Fischer, M., Hamm, M., Pirog, R., Fisk, J., Farbman, J., & Kiraly, S. *Findings of the 2013 National Food Hub Survey.* Michigan State University Center for Regional Food Systems & The Wallace Center at Winrock International. September, 2013, http://foodsystems.msu.edu/activities/food-hub-survey
- Harrison, Shawn, Dave Runsten and Libby O'Sullivan. *Establishing a Food Hub for the Sacramento Valley,* a project of Soil Born Farms and Community Alliance with Family Farmers. August, 2012
- Hughes, Al. "East Baltimore Plans for Urban Revitalization with New Food Hub," Seedstock. February 29, 2014
- Intervale Food Hub. *Intervale Food Hub Manual for Farmers, Processors and Vendors*, Intervale Center. 2012
- Klein, Kendra. *Farm Fresh Healthcare Project How-To Guide,* Health Care Without Harm. Spring 2014
- Klein, Kendra, Lucia Sayre. California Healthy Food in Health Care, Health Care Without Harm and San Francisco Bay Area Physicians for Social Responsibility. 2013
- Lerman, Tracy, Gail Feenstra and David Visher. *An Annotated Bibliography of Publications and Resources on Food Hubs and Values-Based Supply Chains,* University of California, Davis. April 2012
- Matson, James, Martha Sullins and Chris Cook. *The Role of Food Hubs in Local Food Marketing*, USDA Rural Development Service Report 73, US Dept. of Agriculture, Agricultural Marketing. January, 2013
- Muldoon, M.F., Taylor, A.K., Richman, N. Fish, J. *Innovations in Local Food Enterprise: Fresh Ideas for Practitioners, Investors, and Policymakers for a Just and Profitable Food System,* Wallace Center at Winrock International. 2013.

- National Good Food Network. *Food Hub Benchmarking Study, Report of Findings, 2013,* Wallace Center at Winrock International, Farm Credit East, The Farm Credit Council, and Morse Marketing Connections, LLC. 2013
- National Good Food Network webinar archives, hosted by the Wallace Center at Winrock International, at http://ngfn.org/resources/ngfn-cluster-calls
- Pansing, Cynthia, John Fisk, Michelle Muldoon, Arlin Wasserman, Stacia Kiraly and Tavia Benjamin. *North American Food Sector, Part One: Program Scan and Literature Review,* Wallace Center at Winrock International. 2013
- Pansing, Cynthia, John Fisk, Michelle Muldoon, Arlin Wasserman, Stacia Kiraly and Tavia Benjamin. *North American Food Sector, Part Two: A Roadmap for City Sector Innovation and Investment,* Wallace Center at Winrock International. 2013
- Pressman, Andy and Chris Lent. *Food Hubs: a Producer Guide,* National Sustainable Agriculture Information Service, National Center for Appropriate Technology. July, 2013
- Riemenschneider, Pamela. "Survey: Consumers want local, willing to pay premium," The Packer. May 6, 2014
- Sachs, Elizabeth, and Gail Feenstra. *Emerging Local Food Purchasing Initiatives in Northern California Hospitals,* UC Sustainable Agriculture Research and Education Program, Agricultural Sustainability Institute, UC Davis. 2008
- US Department of Agriculture, Agricultural Marketing Service, Local Food Marketing Portal. http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateA&navID=FoodHubsLinkWFMHome&rightNav1=FoodHubsLinkWFMHome&topNav=&leftNav=WholesaleandFarmersMarkets&page=FoodHubsandOtherMarketAccessStrategies&resultType=&acct=frmrdirmkt
- Vanderburgh-Dertz, Darrow and Malini Ram Moraghan. *Food Hub Business Assessment Tool Kit, Wholesome Wave*. March 2014

A project of the
Rural-Urban Connections Strategy
(RUCS)

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT

SACRAMENTO VALLEY FOOD HUB BUSINESS PLAN

August, 2014

Prepared by:

Applied Development Economics, Inc.

In partnership with:

Foodpro International, Inc.
The Hatamiya Group
DH Consulting

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT TEAM

APPLIED DEVELOPMENT ECONOMICS, INC.:

TRISH KELLY
Principal

DOUG SVENSSON
President

THE HATAMIYA GROUP:

LON HATAMIYA
President & CEO

FOODPRO INTERNATIONAL, INC.:

BILL WASHBURN
President

OLGA OSIPOVA
Vice President of Technical Services

JOEL SVENDSEN
Project Engineer

DH CONSULTING:

DAVE HARZOFF
Principal

SACRAMENTO AREA COUNCIL OF GOVERNMENTS (SACOG):

DAVID SHABAZIAN
RUCS Program Manager
dshabazian@sacog.org

GARETT BALLARD-ROSA
Planner 1
gballard-rosa@sacog.org

AMY LEE
Planner 1
amylee@sacog.org

www.sacog.org

The Rural-Urban Connections Strategy (RUCS) is the region's rural economic and sustainable strategy complementary to the Blueprint, the region's overall growth strategy (http://www.sacog.org/rucs/)

EXECUTIVE SUMMARY

The Sacramento Valley Food Hub Business Plan is a component of the Sacramento Regional Agricultural Infrastructure Project which is developing new business tools and assessing models to facilitate increased sales and consumption of locally grown foods in the six-county Sacramento region. Currently, it is estimated that only two percent of regional food consumption is from local sources. The analysis focuses on food hubs, agricultural infrastructure facilities which help connect locally grown and source-identified fresh produce – specialty crops – to local markets and customers, especially by creating new market channels between smaller and medium-sized growers and larger institutional and business buyers.

The Sacramento Valley Food Hub Business Plan presents the results of research, market analyses and extensive stakeholder consultation to recommend a conceptual business model for a Sacramento regional food hub and test the feasibility of the model with a financial feasibility analysis. The following are the results of the analyses:

- The demand for locally and sustainably grown food is strong and growing; major drivers include new initiatives from the California's higher education systems, hospitals, and K-12 schools to procure local produce.
- Sacramento region residents consumed almost 1.9 million tons of food in 2012. More than one million tons was fruits and vegetables – specialty crops (56%).
- There is existing fresh produce aggregation and distribution capacity in the region, but a great deal is oriented to exporting food outside the region; it is difficult for many smaller growers to connect with larger institutional and business markets and for buyers to source produce locally at the scale they need.
- The analysis identified 23 target specialty crops that would be good candidates for a hub. For almost all crops there is an imbalance between acres needed to produce what is consumed in the region and what is actually grown, constituting a strong market opportunity for development of one or more hubs in the Sacramento Valley.
- Scaling up to reach levels of throughput for the food hub model is very manageable – only 27 acres of supporting agriculture production would be needed in Year 1, expanding to 171 acres in Year 4 and 743 acres in Year 7.

Based on the market analyses and assessment of the level of operations needed to get to viable scale of hub operations, the recommended hub model is a for-profit enterprise, to create a supply channel for large-scale buyers primarily, including existing fresh produce distributors and wholesalers, institutions such as schools and hospitals, restaurants, food banks, governments, and other commercial and non-profit customers which are seeking locally grown, source-identified food. Based on the hub model, the initial focus is on wholesale rather than retail pricing structures. The financial analysis tested both the feasibility of the pro forma analytic toolkit and the feasibility of the proposed hub model, based on the operating assumptions about the hub's processing lines, cost of goods (produce), production volumes, facilities and operating costs, scaling up process, and customers and suppliers. The following are some key findings from the feasibility analysis:

- The cumulative capital cost of developing the 22,150 s.f. building and purchasing equipment is approximately $6.4 million in Year 6. The facility would be ready for use in Year 4. There is a possibility that state and local economic development and utility incentives and rebates could partially offset costs.

- The hub will have four processing lines by Year 7 which will give it flexibility to handle many different crops with different levels and types of production and processing. Lines will accommodate fresh cut tender produce, fresh cut firm produce, frozen, dehydrated, jams, sauces, purees and aseptic packaging, with packing, storage and custom packaging capabilities.
- While the hub carries an operating loss in the early years, by Year 5, with 2+ processing lines operating and a projected revenue of $8.8 million, the hub attains a positive cash flow. It attains a positive Internal Rate of Return (IRR) by Year 8 (6%), reaching 15% by Year 10, when annual revenues are over $18 million.
- The financial analysis is based on a wholesale pricing structure and estimates for more basic levels of processing. The actual level and types of value-added processing functions will vary greatly on the needs of the hub's customers, the marketplace and the pricing structure that can be obtained by the hub operator. The hub is financially feasible at this level of operations. While higher value-added activities will cost the operator more in terms of labor and other costs, the margin will be greater and thus the level of profitability.
- The hub's success will be enhanced with partnerships and collaboration with a wide range of entities involved in various aspects of the regional food system. The food banks in particular can assist the hub's start up with logistics, transportation, and networks, and possibly serving as mini-aggregation sites and transfer stations. The food hub will have a farm advisor who will assist farmers with business and crop planning, marketing and developing trusted relationships which will be vital, especially to assist smaller growers in getting in to larger customer markets.

There are barriers that need to be addressed to realize the opportunities for developing food hub infrastructure throughout the region. They include the need for: serviced and zones sites and facilities; streamlined local permitting processes; more supportive institutional purchasing policies and procurement infrastructure which currently are a disincentive for purchasing locally grown produce; food safety and traceability and liability insurance for growers and the hub; assistance with overall regulatory compliance; and better information on institutional fresh produce purchasing patterns and requirements.

The report also identifies a number of potential financing resources for development of hub facilities, equipment and operations.

TABLE OF CONTENTS

I. INTRODUCTION 1

II. REGIONAL MARKET ANALYSIS FINDINGS 5

III. BUSINESS PLAN MODEL.. 13

IV. FINANCIAL FEASIBILITY ANALYSIS.. 19

V. BARRIERS…………………. 26

VI. FINANCING RESOURCES 29

APPENDIX A. Regional Specialty Crop Consumption and Demand 34

APPENDIX B. Hub Crop Mix Volumes Years 4-7 and Acreage Needed.. 37

APPENDIX C. Pro Forma Financial Analysis 41

APPENDIX D. Bibliography of Business Model and Financial Analytic Tools –
Reports and Resources Guides.. 44

SACRAMENTO VALLEY FOOD HUB BUSINESS PLAN

I. INTRODUCTION

This *Business Plan* is a component of the **Sacramento Regional Agricultural Infrastructure Project** sponsored by the Sacramento Area Council of Governments (SACOG) through its Rural-Urban Connections Strategy (RUCS). SACOG is an association of local governments in the six county Sacramento region providing transportation planning and funding and serving as a forum for regional issues, including linking land use, transportation and air quality (see map on page 2). The Blueprint, a signature SACOG project, is the region's long-term growth strategy. RUCS is the region's rural economic and environmental sustainability strategy complementary to the Blueprint.

Over the past several years, RUCS has identified the need for expanded regional "agricultural infrastructure" to strengthen the local and regional food system and the region's many rural communities. **Agricultural infrastructure commonly is defined to encompass aggregation, packing, processing, storage, marketing and distribution capacity and facilities, including "food hubs."** Overall, agricultural infrastructure:

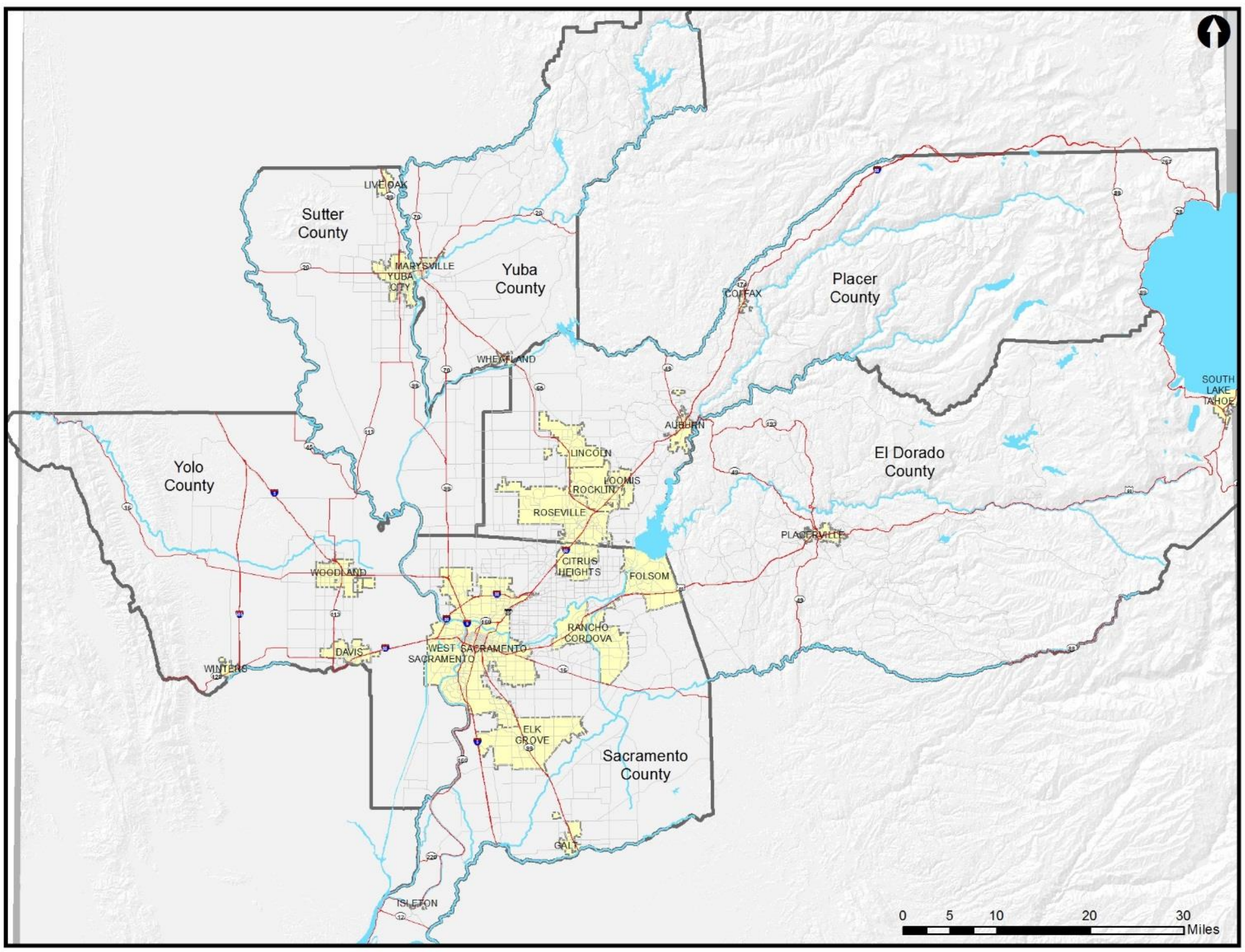
- Improves the efficiency and sustainability of the local food system;
- Increases access to healthy foods, especially fresh produce (fruits and vegetables), in underserved communities;
- Supports the viability of agriculture;
- Creates new jobs and economic opportunities; and,
- Helps preserve valuable farmlands.

SACOG obtained funding from the California Department of Food and Agriculture, the California Strategic Growth Council and the U. S. Department of Housing and Urban Development to assess the feasibility and costs of models for development of new agricultural infrastructure, focusing primarily on food hubs. Food hubs help connect locally produced and source-identified foods to local markets and customers, especially by creating new market channels between smaller and medium-sized growers and larger institutional and business buyers. This document presents the findings of market analyses and testing of financial feasibility analytic tools, including pro formas, for a Sacramento Valley Food Hub model, with a recommended business plan. It focuses on specialty crops, defined by the U.S. Department of Food and Agriculture (USDA) as fruits, tree nuts and vegetables.

SACOG contracted with a consulting team (Project Team) led by Applied Development Economics, Inc., in partnership with Foodpro International, Inc., the Hatamiya Group, and DH Consulting, to prepare this business plan. The plan draws on the findings of the other analyses prepared by the Project Team and SACOG: the *Research Analysis of Food Hub Trends and Characteristics* which provides market context and examples of successful and promising types of hub business models; the *Cost Estimate Analysis* which details capital improvement costs for and operating characteristics of a 22,150 square foot hub enterprise; *Impediments to Supplying Locally Grown Food* which identifies barriers for both growers and food hubs in building the local food system; and *Food Banks and Food Hub Development* which assess the role of food banks to incubate and/or support a regional food hub. It is supplemented by the *Financial Feasibility Toolkit.*

The map below shows the SACOG six county planning region.

MAP OF THE SACRAMENTO REGION



BUSINESS OBJECTIVES

The purpose of the Sacramento Regional Agricultural Infrastructure Project (Ag Infrastructure Project) is to:

> ***Provide a business model, financial feasibility analytic tools and business plan for a self-sustaining mid-scale aggregation and distribution operation – a food hub with aspects of processing functions – to serve regional specialty crop producers, including small to medium-sized growers, especially those who lack the capacity to access business and institutional markets. The tools and plans have been developed by SACOG as a resource for entrepreneurs, jurisdictions, investors and other interested stakeholders to advance the development of this infrastructure.***

The objectives of the project are to create new market channels and support for small to medium-sized growers, including new farmers, economically disadvantaged farmers, veterans entering agriculture and others. The hub also is intended to be a market resource for growers of any scale. Participation of larger growers, especially in the initial phase of the hub, could help provide the product volumes necessary to achieve economies of scale. In turn, this would help create the capacity to serve larger customers with cost-competitive pricing and reliability of supply, and establish a solid market base for locally grown specialty crops and value-added produce. Another focus is to assess the potential for the region's food banks to incubate and/or provide hub-related services.

A business plan for a Sacramento Valley Food Hub was developed by:

- Assessing regional market demand for fresh fruits and vegetables (specialty crops);
- Identifying illustrative target specialty crops, levels of production, and capital and operating costs for a viable hub operation model;
- Estimating the financial feasibility of the proposed hub model;
- Summarizing policy and other barriers that will need to be addressed; and,
- Identifying potential funding resources.

In the long-term, a financially sustainable business, whether for-profit or nonprofit, will be the best way to provide market opportunities for small and medium-sized growers, working with a wide range of partners to address additional community and social benefit goals. A recommendation will be to leverage existing resources within the region, including the food banks which are leaders in the local food system movement and have transportation, logistics and other capacity to help incubate a regional food hub network. Other options include partnerships with existing fresh produce distribution companies and wholesalers which have a strong presence in the region, to provide them with a new market channel for locally sourced and identified produce and value-added products.

The feasibility analysis shows that over the time needed to scale up market relationships with growers and customers and develop operational capacity, there appears to be enough demand in the region to support more than one hub, and more than one type of hub. This presents a valuable economic development opportunity that can benefit communities throughout the region through creation of new jobs and capital investment. Information is presented in *Research Analysis of Food Hub Trends and Characteristics* on different types of hub models and lessons from hub operations to help identify complementary approaches to the hub model proposed in this *Business Plan*. These models show how food hubs are evolving in terms of value-added activities and systems approaches, including the changing role of food banks in catalyzing regional food systems.

Expanding diverse types of agricultural infrastructure will help the region capitalize on emerging opportunities related to the burgeoning food economy and address important community objectives such as retaining more food dollars in the local economy; improving food security; reducing food waste; providing alternative opportunities for young and new farmers; and keeping valuable farmland in production. It will begin to rebuild the mid-scale agricultural infrastructure that had previously existed throughout the region but has been lost over time due to changing markets, industry consolidation, economies of scale, regulatory issues, urbanization and other factors.

The following sections of this report provide key research and analysis findings as the foundation for the Sacramento Valley Food Hub Business Plan:

- Market Demand Analysis Findings and Target Crop Analysis;
- Proposed Business Model, Cost Estimate Summary and Hub Services;
- Financial Feasibility Analysis;
- Barriers; and,
- Financing Resources.

II. REGIONAL MARKET ANALYSIS FINDINGS

This section of the Business Plan presents the market case for a food hub including information on trends and market drivers for locally grown produce; existing produce aggregation and distribution capacity within the region – primary suppliers and customers, and market gaps; regional consumption of produce that will drive demand for locally grown and processed produce and thus for the food hub; estimated levels of current crop production for potential target specialty crops; levels of acreage needed to meet regional demand; and target crops to be analyzed to test the financial feasibility of the hub.

THE TREND FOR LOCAL GROWN

The *Research Analysis on Food Hub Trends and Characteristics* describes major trends and market drivers generating demand for local and sustainably produced foods, including specialty crops. These are some key findings:

TRENDS AND MARKET DRIVERS FOR LOCALLY GROWN FOOD

- Demand for locally grown food is strong nationally and growing, driven by diverse consumers including households, businesses, institutions, nonprofits and others. As the nation's Farm to Fork capital, the Sacramento region is a national leader in this movement.
- The National Restaurant Association's 2014 Culinary Forecast of the hottest menu trends is dominated by locally sourced and healthy foods and environmental sustainability. Strong consumer support for local foods in grocery stores was documented by a 2014 national industry survey.
- Organic food sales are also on a strong growth path, reflecting retailers' commitment to wellness and consumers' desire to ensure healthy food for their children. As more mainstream grocery stores carry organically grown food, consumer barriers related to cost will be reduced.
- Project research and interviews with a wide range of stakeholders, including industry associations, hospitals, restaurants, schools, food banks, produce distribution companies, growers, and jurisdictions all validated these trends.
- As examples of demand drivers, in May 2014 the California State University Board of Trustees approved a statewide Sustainable Food Policy wherein each campus will have until 2020 to ensure that at least 20% of all food spending goes to farms and local businesses. In July 2014 the University of California President announced the UC Global Food Initiative wherein campuses will explore purchasing partnerships with K-12 school districts and new policies whereby local growers can become campus suppliers. In Northern California, Kaiser Permanente is asking food service providers to meet certain criteria for procuring sustainably and regionally grown fresh produce, impacting future supply chains. There are many local initiatives such as Yolo Farm to School that are generating demand.
- Food hubs are an emerging and viable business model nationally, enabling local growers to connect to a broader marketplace, improve their bottom line, and better meet consumer and supplier demand for locally grown produce and value-added products. The number of hubs identified by USDA has increased from approximately 230 in July 2013 to more than 300 in April 2014.

EXISTING FRESH PRODUCE AGGREGATION AND DISTRIBUTION CAPACITY

The Sacramento region's agricultural economy is exceptionally diverse, with beneficial climate and soils; water; long growing season; skilled growers; and supportive public policy. Unlike many other areas in the country, the region has strong – although somewhat unevenly distributed – direct farm to consumer market assets, with a large number of farmers' markets, Community Supported Agriculture (CSAs) and farm stands, and direct sales to food banks, restaurants, and some grocery stores and schools. However, most business and institutional customers purchase from a variety of distributors and wholesalers, and there are many gaps in connecting local growers with these local customers. The *Research Analysis on Food Hub Trends and Characteristics* provides information on fresh produce distributors serving the Sacramento region and selected institutional customers. This overview highlights opportunities and gaps for developing agricultural infrastructure:

EXISTING SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE
▪ There is existing fresh produce aggregation and distribution capacity in the region, a great deal of which is geared for large production volume crops such as almonds, walnuts, rice and processing tomatoes which are mostly exported from the region. ▪ The regional "food shed" is large, extending to neighboring counties and regions, such as the San Joaquin Valley, the Bay Area, and the North Sacramento Valley. A significant portion of the region's specialty crops goes to customers in the Bay Area, where growers obtain a good market price. ▪ There are several fresh produce distributors and wholesalers serving the region's larger business and institutional customers but they purchase large amounts of produce from outside the region. They also work with some local but mostly out of region suppliers to provide redi-cut produce and value-added food products to customers. ▪ There is fragmentation of purchasing power across types of customers. Existing procurement policies make it difficult for many institutions to purchase locally grown specialty crops. ▪ Many stakeholders and key informants identified the need for a dedicated fresh produce market channel to aggregate demand, coordinate with and assist smaller growers, and more efficiently reach business and institutional customers. ▪ In this region, agricultural infrastructure needs to reach a certain level of operating scale (crop throughput) to be feasible over the long term. ▪ There is strong interest from jurisdictions in the development of regional food system infrastructure. ▪ There is enough demand and production to support infrastructure at locations throughout the region. ▪ Development of this infrastructure needs to be integrated with existing capacity and target its market niche, which is to provide source-identified locally grown and value-added foods to existing distributors and wholesalers, as well as directly to a variety of business, government and institutional customers.

REGIONAL DEMAND FOR FRESH PRODUCE

Regional demand for fresh produce is expressed as the estimated level of consumption of specialty crops by residents of the Sacramento region. To determine this demand, SACOG first calculated the overall consumption of food by major food type for each of the region's six counties and the region overall, using USDA databases to estimate per capita consumption by food type for the region's population of 2,360,844 in 2012. As shown in Table 1, total overall food consumption in 2012 was almost 1.9 million tons, in primary weight tons per year. The Project Team used primary weight as opposed to retail or consumer weight as the unit of measure because it reflects the actual level of crop production needed to supply the final level of consumer weight consumption. Almost 1,055,000 tons of the region's total food consumption (56%) was in fruits and vegetables.

TABLE 1. ANNUAL TOTAL FOOD CONSUMPTION BY COUNTY AND REGION, 2012 (IN PRIMARY WEIGHT TONS PER YEAR)

Food Group	SACOG Region	Sacramento	El Dorado	Placer	Sutter	Yolo	Yuba
Fruits	385,393	236,356	29,432	58,956	15,489	33,272	11,887
Vegetables	669,185	410,403	51,105	102,369	26,895	57,773	20,641
Meat	226,009	138,608	17,260	34,574	9,083	19,512	6,971
Nuts	5,968	3,660	456	913	240	515	184
Eggs	48,249	29,590	3,685	7,381	1,939	4,165	1,488
Grains	115,046	70,556	8,786	17,599	4,624	9,932	3,549
Fats/Oils	33,406	20,488	2,551	5,110	1,343	2,884	1,030
Dairy	312,290	191,524	23,849	47,773	12,551	26,961	9,632
Sugars	102,128	62,634	7,799	15,623	4,105	8,817	3,150
TOTAL tons per year:	**1,897,673**	**1,163,818**	**144,924**	**290,298**	**76,268**	**163,832**	**58,533**

Source: SACOG Regional Food Consumption Calculator analysis of USDA's FICRCD (Food Intakes Converted to Retail Commodities Database) and LAFA (Loss-Adjusted Food Availability) datasets, 2012. FICRCD provides national commodity-level data for food consumption per capita. The LAFA data set serves as a proxy for food consumption for certain more detailed levels of foods.

Existing consumption of fruits and vegetables in the region constitutes the basic demand for locally grown specialty crops and is a strong market driver for the hub, especially as SACOG estimates that most of the produce consumed in the region is not grown in the region. As the region's population continues to grow, so too will the demand (in volume) for fresh produce. Additional growth opportunities to meet fresh produce demand will become available when certain crops that are grown in the region – or that could be grown – become more popular, especially as consumption patterns change with increased awareness of health benefits and availability of certain crops. Kale is a good example of this trend. Demand for fresh produce by visitors has yet to be calculated for the hospitality industry, another important customer base given Sacramento's role as state capital and the region being a thriving business and tourism destination. An additional market would be for the production of specialty crops as a supply input for value-added food processing as this sector evolves locally.

HUB TARGET SPECIALTY CROPS, AND CROP CONSUMPTION AND PRODUCTION LEVELS

With the overall level of regional consumption calculated, the Project Team estimated levels of consumption by major specialty crop type and levels of production in the region for specific crops, to identify potential demand/supply imbalances which might present a market opportunity for the hub in terms of target crops. The documentation of both was a data challenge. SACOG worked across two USDA data sets to arrive at the estimated levels of consumption for specific types of produce. In terms of production, many specialty crops are aggregated into group categories in county reports because their production is relatively small. Thus, the County Agricultural Commissioner Reports and the Pesticide Use Reports – two common data resources used in production estimates – do not always provide crop-specific levels of production. There were many data gaps.

In the late spring of 2014 the USDA released the 2012 Census of Agriculture. SACOG used this database to estimate specialty crop production for each county and the overall region. While it is the most comprehensive and up-to-date dataset comparing agricultural production, it does not necessarily provide a full picture of potential supply and demand imbalances in specialty crop consumption and production. For example, for certain specialty crops such as walnuts or tomatoes, the region grows an abundance that exceeds the amount needed to provide for local consumption levels, yet the Census of Agriculture does not determine how much is retained in the region and how much is sent outside the region. Given this limitation, the Census of Agriculture analysis did provide a good filter for identifying and screening potential target crops for the hub.

Every major crop categorized by crop type was reviewed to identify initial areas of supply and demand imbalance. This information fed into the next level of analysis, to identify potential target crops to supply the food hub, looking across all fresh produce crop type and cultivation categories for seasonal balance and diversity. The Project Team used the criteria listed at right to select potential crops for aggregation, handling, packaging, processing, and distribution at the hub facility. Table A-1 in Appendix A shows a list of 23 potential target crops meeting these criteria initially.

TARGET CROP LIST SCREENING CRITERIA

- Consumption patterns, growing consumer demand
- Availability as locally grown or potential to be grown locally
- High ratio between wholesale/retail price vs. farm price - high margins
- High potential for value-added (including customized packing, redi-cut, processing)
- Seasonal availability
- Ability to extend season (through processing, etc.)
- Innovations in food trends

With the potential target specialty crops identified, SACOG calculated the annual food consumption by county and in the region in primary weight tons per year, which represents the potential demand for these crops. The Project Team identified the average yield per acre in tons referencing a variety of data sources, including consultation with County Agricultural Commissioners and review of UC Davis Cost of Production studies, and calculated the number of acres that would be needed to meet regional consumption if all demand were to be met locally for the target crops. All told, more than 32,000 acres of production would be needed to meet regional consumption levels of these target crops. Detail is shown in Table A-2 in Appendix A.

SACOG then calculated the actual estimated acres in production in 2012 by county and the region for the potential target specialty crops, which totaled almost 140,000 acres. Levels of production include both conventionally and organically grown produce. Table A-3 in the Appendix which shows areas of crop specialization and concentration by county, which could be a factor in determining a location for the hub, given needs for access to crop supply, consumer markets and transportation networks.

Table 2 presents a summary of the acres of current production in the region for the target specialty crops (the supply), compared to the potential acres of production represented by regional consumption (the demand). In almost all cases, the amount of acres needed to meet consumption levels is far larger than the actual number of acres in production. Crops where production is larger than consumption – lima beans, peaches, tomatoes and walnuts – are ones which primarily are exported from the region.

Excluding these four crops, there are currently 3,520 acres in production for the remaining crops, with a demand for consumption totaling almost 21,000 acres. Project analysis suggests that a significant level of these remaining specialty crops also is exported outside of the region, including through CSAs and sales to restaurants and institutions in the Bay Area.

TABLE 2. SACRAMENTO REGION PRODUCTION (SUPPLY) VS. CONSUMPTION (DEMAND) OF TARGET SPECIALTY CROPS, 2012

Target Crop	Acres in Production	Acres Needed to Meet Regional Consumption
Apples	1,723	8,129
Apricots	118	225
Asparagus	63	1,721
Bell Peppers	32	323
Blackberries	102	10
Blueberries	92	570
Broccoli	56	1,497
Carrots	17	940
Celery	7	167
Chili peppers	144	258
Eggplant	84	79
Kale	10	307
Lettuce (all)	83	2,755
Lima Bean	2,189	940
Onions	222	1,028
Peaches	9,668	747
Raspberries	14	47
Spinach	23	522
Squash	606	729
Strawberries	123	781
Sweet potatoes/yams	2	770
Tomatoes (both fresh and processing)	54,491	9,475
Walnuts	69,175	219
TOTAL	**139,041**	**32,239**
TOTAL - Less Lima Beans, Peaches, Tomatoes and Walnuts	**3,519**	**20,858**

Sources: For production- 2012 USDA Census of Agriculture
For consumption- SACOG food calculator and USDA National Agricultural Statistics Service NASS 8 year CA average yields per ton

Production would be needed from more than 32,000 acres to meet the needs of regional consumption year round for all the target specialty crops shown in Table 2. The region's target crop supply-demand imbalance presents a strong market opportunity for development of one or more hubs throughout the Sacramento Valley.

RECOMMENDED TARGET SPECIALTY CROP LIST AND ACREAGE NEEDED FOR HUB OPERATIONS

The Project Team review of the target specialty crop list found that for the hub to be successful in returning its investment on the equipment acquired for the operations, the hub's handling and value-added processing equipment as well as the facility as a whole should be utilized through most of the year, with the goal of year-round operations. There should be more than a single crop available during any certain season, to secure the customer base and to average the returns, as they vary by crop between lows and highs. Especially at the initiation of the hub's operations, it may prove to be challenging to secure a sufficient source of a single crop for processing (e.g., cutting, chopping) on the line through the crop's season, for the length of time and volumes required to make the line profitable.

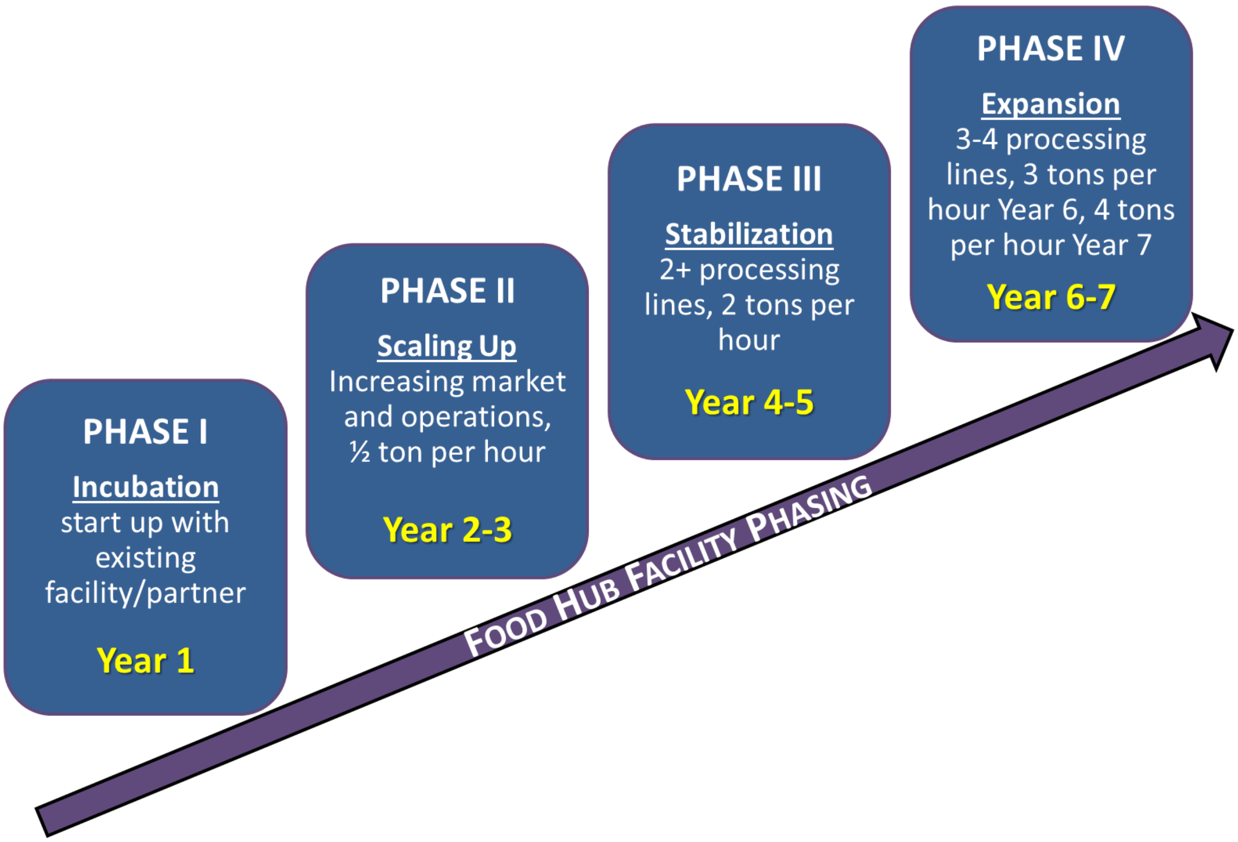
It is strongly recommended that the hub secures the sourcing of not less than 2 and as high as 5 individual crops to be processed, for each of the hub's three proposed lines – tender fresh produce, firm fresh produce and frozen produce, for every month of the year. See the *Cost Estimate Analysis* for detailed description of the hub's processing lines and operations. As operations progress and the hub's market niche is established, transitioning to a larger number of crops is encouraged. Due to seasonal fluctuations of the availability of the crops, the late spring/early summer period may prove to be most challenging for successful competition in the market as the farmers take advantage of the "first fruits of the season" so to speak, when winter is over and the consumers are longing for fresh fruits and vegetables, which increases the purchase price of the produce (Cost of Goods Sold) for the hub.

With all this in mind, and with regard to recent market trend surveys and analysis, the Project Team narrowed down the variety of crops for a target specialty crop mix that would be viable candidates for the hub's three processing lines as described in the *Cost Estimate Analysis*.

ILLUSTRATIVE TARGET CROP LIST		
Line 1 (tender produce)	**Line 2 (firm produce)**	**Line 3 (frozen produce)**
bell (sweet) peppers broccoli kale lettuces spinach tomatoes blueberries peaches raspberries strawberries	carrots celery eggplant onions squash sweet potatoes/yams	bell (sweet) peppers broccoli spinach blueberries strawberries peaches raspberries *(includes some surplus from lines 1 and 2)*

The Project Team used the above crop list as the basis for conducting a financial analysis of the proposed food hub operations, using pro forma analytic tools to determine the hub's potential feasibility. To arrive at estimated levels of produce needed for each processing line by project phasing, Foodpro developed assumptions for times of operation and levels of volume by month for the three processing lines, for reaching target levels of stabilized operations in Year 5. At this time, the hub is trading off processing on the three lines to achieve the requisite volume of production and scaling up of markets and production capacity. Full utilization of all three lines occurs in Year 6. A fourth processing line for higher level freezing is added as part of an expansion phase (year 7), providing the ability to shift one of the other lines to dehydration functions.

See the graphic below for a depiction of the phases of the hub from incubation to scaling up, stabilization and expansion, with the numbers of processing lines and levels of throughout (tons per hour) of fresh produce. The *Cost Estimate Analysis* provides a detailed description of this process and the specific operations of each line.



The assumptions described above were integrated into the pro forma analysis, based on the purchase, processing and sales prices for selected crops. Analyses using alternative mixes of crops is possible (See the *Financial Feasibility Tool Kit*). For example, while apples, apricots and chili peppers (which were in the initial target crop list) were not included in the pro forma analysis, they and other crops could certainly be added in a different product mix scenario.

Appendix B contains detailed information on the recommended target crops, listing crops by processing line by volume (in total pounds and converted to tons), average crop yields per acre, and acres of crop production needed to supply produce for the hub. The information covers Years 4 through 7 which represent phases 3 and 4 of the project. Year 4 is the first year the hub would be located in a larger facility after start-up and scaling up of operations from Years 1 through 3.

This information was generated to provide a realistic estimate of the acreage and levels of crop production required for a feasible hub operation. As seen in Table 3, the total acreage that would be needed to supply produce during the start-up year is less than 30 acres. Given the particular mix of crops analyzed in the pro forma analysis, approximately 171 acres would be needed in Year 4, with 2 lines in operation. In Year 5, three lines will be operational but functioning as 2+ lines, trading off functions. Full operation of all three lines would occur in Year 6. In Year 7, when the facility expands its capacity by adding a fourth processing line, the projected volume of processing would require approximately 740 acres of production.

TABLE 3. ESTIMATED LEVELS OF PRODUCTION AND ACREAGE NEEDED FOR HUB OPERATIONS, YEARS 4-7

	Year 1	Year 4	Year 5	Year 6	Year 7
Number of processing lines	2 limited	2	2+	3	4
Tons of production per hour	-	1	2	3	4
Total tons	312	2,059	4,076	5,830	7,787
Acreage Needed	**27**	**171**	**351**	**539**	**743**

Source: Project Team Analysis

This comes out to an average of about 11 acres per ton of production over the seven years. Using this average, the required acreage for Years 2 and 3 would be approximately 52 and 76 acres respectively. While different crop mixes would result in different acreage requirements, the amounts of acreage at each phase are very achievable levels, especially since the hub managers will have several years to develop relationships with growers so as to reach the targeted level of volume needed over time. There are many existing and new farmers that have indicated an interest to supply a hub.

In summary, the consumption and production analysis conducted for this *Business Plan* has resulted in a target hub specialty crop mix able to be grown and processed in the region that not only meets a verified market demand but would also extend seasonality, add value through processing, respond to innovation in food trends, and provide the hub with branded and source-identified produce that has market value. See Chapter IV for results of the financial feasibility analysis of this crop mix. The proposed crop mix provides an achievable level of acreage – about 350 – in Year 5 to produce a needed level of specialty crops for a single food hub operating at fully stabilized capacity, given the region's existing agricultural production, capacity and market trends.

III. BUSINESS PLAN MODEL

HUB MODEL RATIONALE

Based upon the analyses conducted over the past year, the recommended business model for the Sacramento Valley Food Hub is for a for-profit food hub. The *Findings of the 2013 National Food Hub Survey* reported that 47% of food hubs were classified as for-profit.[1] The following are the types of legal (business) structures for a for-profit hub as defined in USDA's *Regional Food Hub Resource Guide:*

TYPE OF HUB LEGAL STRUCTURE	DESCRIPTION OF ENTITY
Privately Held Business Corporation – C, S, LLC; Benefit, partnership – joint venture, limited; sole proprietorship, or subsidiary of other entity	Can be various corporate or partnership ownership structures, or other. Primary objectives are to return profits to their owners while providing food aggregation and distribution services to producers and customers. Some companies also include social objectives to respond to consumers or to reflect the values of their ownership.

The Project Team considered a number of important factors in reaching this conclusion, including the following:

- Diversity of current regional crop production as well as the potential for future production;
- Scalability of crop production mix and market distribution opportunities;
- Flexibility of the proposed food hub processing lines to meet market demand;
- Strong potential for short-term profitability and ongoing viability;
- Reasonable initial capital investment; and,
- Lack of need for public subsidy.

As discussed in Chapter II, the regional production and consumption analysis indicates an achievable potential for a target crop mix able to be grown and processed that meets a verified market demand. For the hub to be feasible it has to reach a scale large enough to achieve profitability and continued viability over the long-term, and to serve the region's identified needs. The pro forma analysis summarized in Chapter IV projects revenues of more than $8.8 million in Year 5 (the year the hub operation shows a net cash flow); $12.9 million in Year 6; and $18.3 million in Year 7 as capacity is expanded. Many nonprofit hubs nationally do not operate at this projected level of scale. At the community level, it would be difficult for a nonprofit enterprise to achieve the level of private capital investment needed without some form of public subsidy.

The project's food hub research analysis looked at several for-profit and nonprofit models and determined that given the regional context and the characteristics of the various models, the for-profit model also offered the flexibility needed to respond to market conditions and opportunities well into the future and not be constrained by size and limited funding issues. The hub is designed with the capacity for processing lines to be adapted quickly for different crop mixes depending on market opportunities, including most promising high-

[1] Fischer, M., Hamm, M., Pirog, R., Fisk, J., Farbman, J., and Kiraly, S. (September 2013). Findings of the 2013 National Food Hub Survey. Michigan State University Center for Regional Food Systems and The Wallace Center at Winrock International. P. 11.

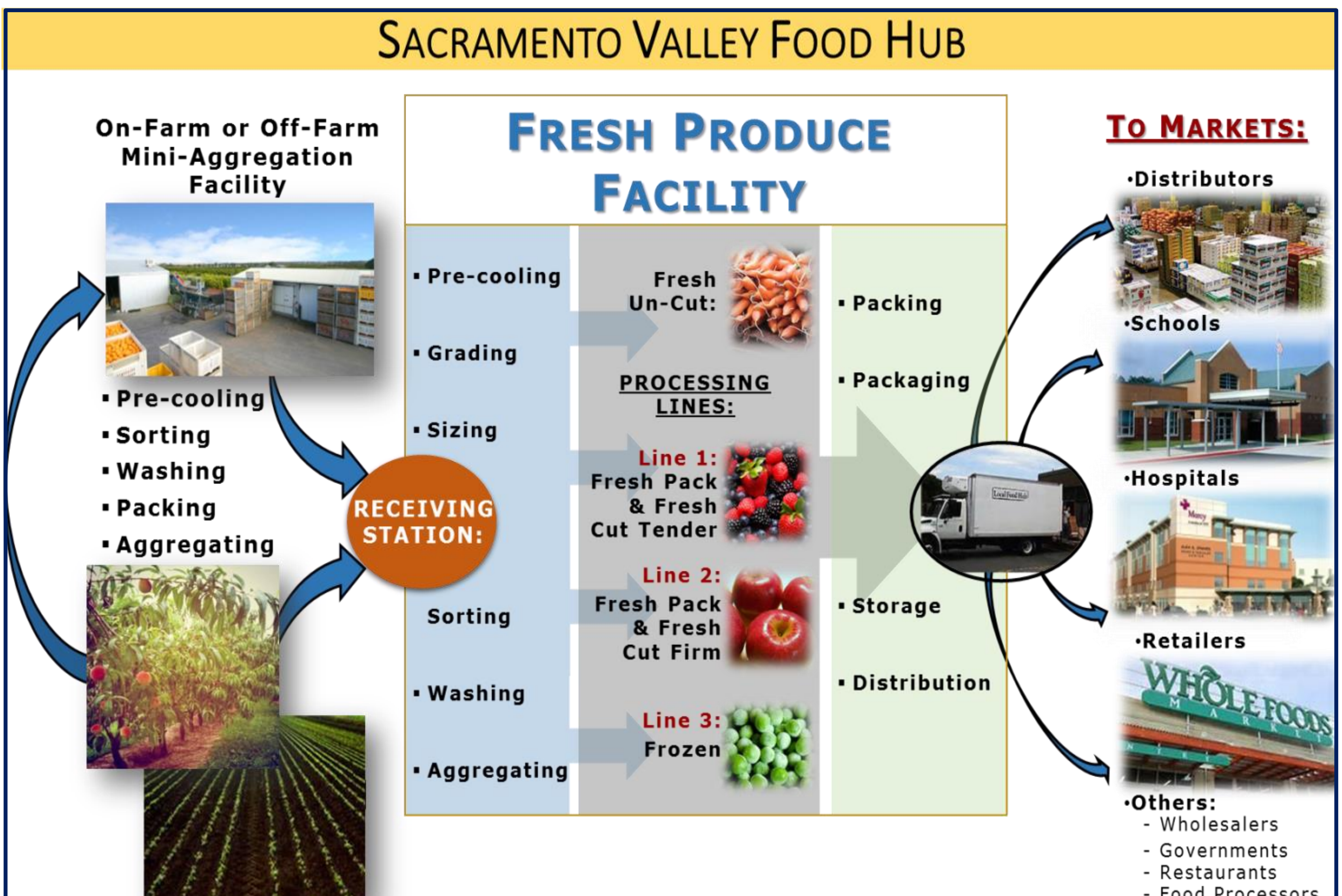
return segments and processing such as flash freezing which is growing in demand across the country. The lines can also be adapted to capture emerging trends such as new protein and food sources.

HUB TARGET MARKET

Over the course of the project, the concept including the target market (customers) was refined based on the regional market analysis, interviews with key stakeholders across the regional food system, and national research on innovations with this rapidly evolving business model. Based on the depth of existing aggregation and distribution capacity in the region – including the diversity of direct to market outlets, identified market gaps and barriers (which are further discussed in Chapter V of this report), and alignment with national "field of practice" trends—it is recommended that the Sacramento Valley Food Hub's initial focus be to:

> ***Create a supply channel for large-scale buyers primarily, including existing fresh produce distributors and wholesalers, institutions such as schools and hospitals, restaurants, food banks, governments, and other commercial and nonprofit customers which are seeking locally grown, source-identified food.***

Serving to facilitate "farm to institution" procurement is a strong and growing food hub trend.[2] The graphic below illustrates the hub's proposed functions, described in greater detail in the *Cost Estimate Analysis*.



[2] Jalonick, M.J., "Locally-Grown Foods Look to Bigger Business," The Wall Street Journal, July 16, 2014.

The proposed hub can come in the form of more intentional partnerships with distribution and wholesalers, as is beginning to occur in other regions of the country, rather than just sales relationships.[3] This approach will help connect local growers to businesses such as restaurants and grocery stores and institutions such as schools and hospitals that already have contracting relationships with existing produce distributors and wholesalers and/or food service contractors, which are looking for a specific market channel for high quality locally sourced and branded fresh produce.

Many hubs focus on developing diverse types of clients. The opportunity to identify and cultivate a range of customers over the longer-term is something that will be part of the hub's business plan, driven by mission and values of the hub owners. Some hub feasibility studies suggest building a business base with the highest end customers possible, because this base is less price sensitive. Institutions and businesses such as schools and foodservice distributors purchase very large quantities of produce but they are more price sensitive. As with any business, having a diversity of customers helps provide stability for the business.

The hub also could focus on a specific market niche such as schools at a larger scale across the region, which would require some specialized expertise and commitment of the part of a distributor, building on the experience of the Farm to School Yolo Initiative locally, and other efforts nationally, to get to scale and food system impact. Two of the hub models profiled in the *Research Findings* – Gourmet Gorilla and Revolution Foods – focus exclusively on schools and early childhood education programs.

In summary, it is difficult for smaller growers to tap into the institutional system and this model would provide them with the market channel to do so.

HUB SUPPLIERS

As shown by the analysis of the level of acres needed to produce the requisite supply of crops for the hub – 27 acres in Year 1, increasing to 171 acres in Year 4 – the hub should be able to engage an adequate number of growers initially and during the scaling up process if the prices are right. This is due to several factors: the small amount of land required to provide produce for the start-up phase; the large number of growers in the region; the region's strong consumer-driven demand for locally grown and branded produce and value-added products; and the large gap in the supply of locally grown produce compared to consumption which creates a strong market opportunity. With the hub serving as a market intermediary to connect growers of all scales to local customers, including distributors and wholesalers as well as a variety of business, institutional and other customer types, the efficiency of the market place should be improved, drawing more suppliers to participate as the hub scales up operations.

According to the *Findings of the 2013 National Food Hub Survey,* food hubs had an average of 80 producers/suppliers of all sizes, but overall, the majority (61%) work with 40 producers or fewer.[4] The number of producers/suppliers depends on the volume of produce they could provide to the hub, as well as the diversity of crops. Interest in serving the local market is rising. As examples, several growers in the Sacramento region have shifted to growing a more diverse range of specialty crops than in the past, including transitioning some aspects of their operations from commodity-type crop production, to meet increasing levels of local

[3] *Food Hubs: Solving Local, Small Farm Aggregators Scale Up with Larger Buyers,* March, 2014.
[4] Jalonik et al, p. 14.

market demand and to have better connections with their customers. New growers coming out of local farm incubation and training programs are focused on meeting this local demand as well.

Potential suppliers for the hub include:

- Existing larger farmers who have expressed willingness to use a portion of their acreage for specialty crops and would sell to the hub if prices are competitive.
- Existing small scale farmers, including minority and economically disadvantaged growers, organic growers and others seeking to expand and reach broader markets including institutional customers; most of these currently sell directly to consumers at farm stands, farmers' markets, some CSAs and some schools and restaurants. They need assistance and a market outlet to get to the next level of scale and market price.
- New farmers of all ages and backgrounds, increasingly women, who are graduating from training programs such as from the Center for Land-Based Learning Farm Academy, Soil Born Farms, UC Davis and Ubuntu Green. These programs are creating a pipeline of future farmers who primarily are interested in growing sustainably produced foods for local markets. Programs have been developed to assist veterans.
- The hub itself, which could supply produce if it had its own farm operations, or contract with or buy from specific growers for certain crops and volumes. Farm Fresh to You and Capay Valley Farm Shop use this approach as aggregator/growers.

HUB SERVICES

The *Research Analysis of Food Hub Trends and Characteristics* described the types of services and activities that are provided by food hubs and affiliated partners, including functions identified by USDA Rural Development in their documentation of hubs nationally. The foundation for a successful hub is experienced and knowledgeable staff. In addition to management skills and expertise in the food "business," two core functions are essential – marketing and creating a clear and compelling brand for the hub and its products, and providing technical assistance and capacity building to farmers. The hub staffing plan includes positions to provide these services, with the goal of developing the relationships and connections necessary for long-term success.

As noted in a food hub feasibility study prepared for Southern Wisconsin which echoes a common theme across studies nationally, emphasizing a strong relationship with growers will help ensure a consistent quality supply of produce, especially during the first few years of the hub. Two other key recommendations were to "make it easy for customers to do business with the food hub," and "collaborate with other intermediaries and partners to strengthen the market," given the highly interdependent nature of the industry.[5]

The following is a list of recommended food hub services and activities that could be provided by the Sacramento Valley Food Hub. They are based upon the list of potential activities developed by USDA, informed by the hub research and market analyses and input from regional stakeholders. Some of these services such as providing GAP training and certification, liability insurance and technical assistance also will generate a revenue

[5] Dane County Planning and Development Department. *Southern Wisconsin Food Hub Feasibility Study*, pp. 7-8. September, 2011.

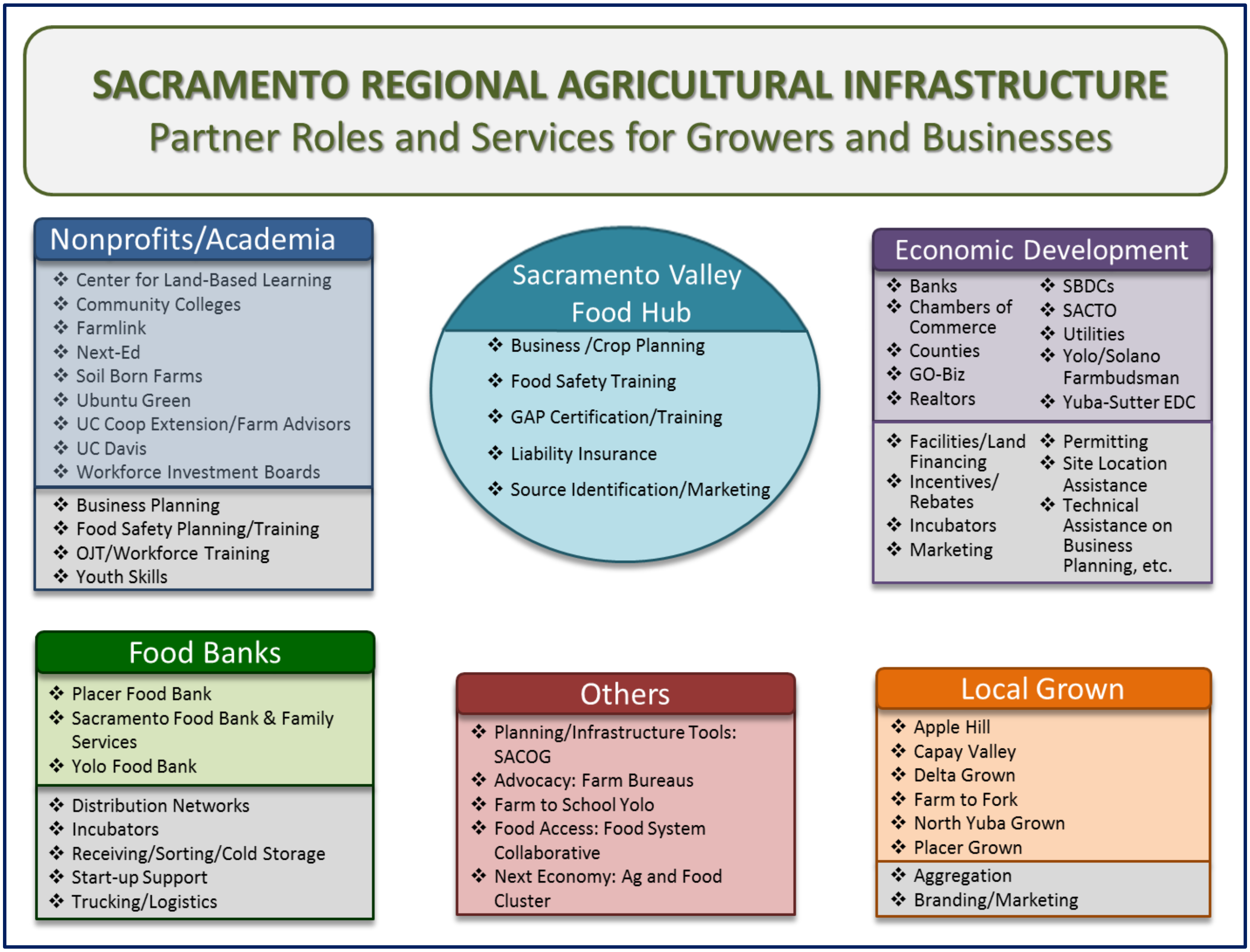
stream for the hub. Research shows that growers working with food hubs improve their business and crop planning, often resulting in better financial outcomes for them.

RECOMMENDED FOOD HUB SERVICES/ACTIVITIES		
Operations Services	**Producer Services**	**Community/Environmental Services**
Pre-cooling, sorting, grading, culling, washing, cooling	Actively linking producers and buyers, contracting for product	Increasing community awareness of "buy local" benefits
Producer aggregation	On-farm pick up, crate system, delivery	Distributing to nearby "food deserts"
Packaging and re-packaging	Production and post-harvest handling training	Food bank donations
Light processing (trimming, cutting, freezing, drying)	Management services, business and crop planning	Youth and community employment opportunities
Brokering	Value-added product development	Recycling and composting programs and renewable energies
Branding and market promotion	Food safety and Good Agricultural Practices (GAP) training and certification	Contract with growers & distributors with existing receiving & cleaning stations as mini-aggregation sites
Cold and dry storage, extending seasonality	Liability insurance	Partnering with food banks on logistics and transportation
Distribution	Facilitating access to capital	Education on policy barriers, including local procurement issues

Sources: *The Role of Food Hubs in Local Food Marketing, The USDA Regional Food Hub Resource Guide*, Project Team

As a for-profit enterprise, the hub's success will be enhanced by partnerships and collaboration with a wide range of entities involved in varied aspects of the regional food system. Formalized partnerships with nonprofits and other entities would enable the region to leverage features of nonprofit hub models – including the ability to generate funding support from government and philanthropic sources. As an example, complementary hub-related services such as workforce training and social enterprise activities could be provided by a nonprofit partner such as a food bank, a training organization, or an economic development entity. Additional community and environmental services could be provided by partner organizations to improve access to healthy foods in underserved neighborhoods and strengthen the overall sustainability of the regional food system.

The graphic on the following page illustrates the types of partner organizations in the region and the roles they could play in providing services and support for growers of and customers for locally grown and source identified foods. They include nonprofits and academia, food banks, economic development organizations, Local Grown programs, and regional planning, economic, food access and agricultural stakeholder groups. This network is a strong regional asset that can help address the constraints to development of the Sacramento region's agricultural infrastructure, including those described in SACOG's 2014 analysis of *Impediments to Supplying Locally-Grown Food.*


SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE
Partner Roles and Services for Growers and Businesses
Nonprofits/Academia
Center for Land-Based Learning
Community Colleges
Farmlink
Next-Ed
Soil Born Farms
Ubuntu Green
UC Coop Extension/Farm Advisors
UC Davis
Workforce Investment Boards
Business Planning
Food Safety Planning/Training
OJT/Workforce Training
Youth Skills
Sacramento Valley Food Hub
Business /Crop Planning
Food Safety Training
GAP Certification/Training
Liability Insurance
Source Identification/Marketing
Economic Development
Banks
Chambers of Commerce
Counties
GO-Biz
Realtors
SBDCs
SACTO
Utilities
Yolo/Solano Farmbudsman
Yuba-Sutter EDC
Facilities/Land
Financing
Incentives/ Rebates
Incubators
Marketing
Permitting
Site Location Assistance
Technical Assistance on Business Planning, etc.
Food Banks
Placer Food Bank
Sacramento Food Bank & Family Services
Yolo Food Bank
Distribution Networks
Incubators
Receiving/Sorting/Cold Storage
Start-up Support
Trucking/Logistics
Others
Planning/Infrastructure Tools: SACOG
Advocacy: Farm Bureaus
Farm to School Yolo
Food Access: Food System Collaborative
Next Economy: Ag and Food Cluster
Local Grown
Apple Hill
Capay Valley
Delta Grown
Farm to Fork
North Yuba Grown
Placer Grown
Aggregation
Branding/Marketing

IV. FINANCIAL FEASIBILITY ANALYSIS

Utilizing the results of the analyses described in this document and other research conducted for this study, the Project Team conducted a detailed financial feasibility analysis for the Sacramento Valley Food Hub, developing a set of pro forma analytic business tools for each year of operations, from start-up to scaling up of operations to a profitable level of operation. The analysis tested various alternatives of crop volumes, types and mixes across the hub's processing lines to formulate a realistic operating and capital investment scenario. The analysis determined that the hub could be a feasible operation over time. This chapter presents a summary of the analysis, methodologies used, and findings.

The pro forma tools were developed based on Foodpro's long experience and expertise in food engineering design and analyses; a thorough review of food hub feasibility studies, including newly provided tool kits sponsored by federal agency and foundation partners; and the experience of the project team members in preparing and analyzing development project models. Detailed spread sheets containing input information for the variables are contained in the pro formas which are provided separately and described in the *Food Hub Financial Feasibility Toolkit*. The Toolkit is a user's guide for the materials, and explains how to conduct a sensitivity analysis to assess additional alternatives with different crop mixes and use of the processing lines. The feasibility analysis was developed and tested with actual 2013 commodity price data, described below.

PRO FORMA COMMODITY PRICING METHODOLOGY

In order to most accurately and consistently reflect commodity prices within the market place, the Project Team relied upon available monthly averages of reported data to the United States Department of Agriculture as related to the recommended hub target crops. The Project Team examined prices for point of production (*Shipping Point*) and prices paid at wholesale markets (*Terminal Market*). *Shipping Point* and *Terminal Market prices* are derived from the Monthly Averages as reported by the United States Department of Agriculture, Agricultural Market Service's (AMS) Market News.

For more than 90 years, AMS has provided current, unbiased price and sales information to assist in the orderly marketing and distribution of farm commodities. Reports include information on prices, volume, quality, condition, and other market data on farm products in specific markets and marketing areas. The data is disseminated within hours of collection via the Internet and made available through electronic means, in printed reports, by telephone recordings, and through the news media. Using direct contacts with sales persons, suppliers, brokers and buyers, AMS Market News Reporters collect, validate, analyze, and organize unbiased data on price, volume, quality and condition, making it publicly available within hours of collection at no cost.

Shipping Point prices are f.o.b. (free on board) prices that represent open market (spot) sales by first handlers at point of production or port of entry on product of generally good quality and condition. For purposes of this analysis, the Project Team examined only *Shipping Point prices* from California. *Terminal Market prices* represent sales at first receivers to retailers or other large users of wholesale lots generally of good quality and condition. For the feasibility analysis, the Project Team examined only *Terminal Market prices* reported at San Francisco, as it was the closest reported proximity to Sacramento Region and the region has close market ties with the Bay Area. Prices are a monthly average for both conventionally and organically grown specialty crops.

Wholesale prices are used given the proposed hub business model's focus on institutional, wholesaler and distribution company customers, at least initially. This is a conservative approach regarding the hub's price structure; other hub models targeting different markets would expect different price structures.

PRO FORMA ANALYSIS FINDINGS

The commodity pricing data formed the basis for the pro forma analyses along with target crop types, levels of production by month and product mix, types of hub activities/functions, staffing and other operating costs. The *Cost Estimate Analysis* provides a detailed description of proposed hub operations and facility cost categories which is the foundation for identifying capital investment costs for the hub's facility and equipment. This section provides a summary of the key findings of the feasibility analysis, accompanied by a series of tables with referenced data.

PRO FORMA ANALYSIS SUMMARY- HUB 20 YEAR OPERATIONS

Table 4 summarizes the pro forma analysis from initial investment through Year 20. The top part of the table shows the gross revenue estimates for each year. In this analysis, projected revenues are only from food aggregation, processing, storage, and distribution functions. However, it is recommended that the hub also offers services to other food distributors in terms of brokering product transactions, and/or offering other expertise and services to growers, including activities like providing liability insurance and certification and training to growers.

The expenditures cover the Cost of Goods Sold (COGS – the price the hub operators pay to purchase the produce), including packaging materials, non-personnel operating costs as detailed in Appendix C-1, and labor staffing and costs as detailed in Appendix C-3. The operating characteristics of the hub, in terms of tons of produce processed, revenues, COGS (Cost of Goods Sold) per lbs., and the gross margin (the difference between revenue and COGS), are shown in the lower portion of Table 4.

The pro forma analysis assumes that the hub operators would need to front half of the first year's operating expenses, including the cost of produce (COGS) to be processed in the facility, as an equity investment in Year 0. Revenues from the sale of goods offsets the additional operating costs in Year 1. The facility runs an operating loss of nearly $250,000 in the first year. This amount, and subsequent operating losses during the first three years, is added to the required equity investment in the pro forma. If the facility were able to secure an operating capital line of credit, these costs could be financed, but we have not assumed that would be possible in this analysis.

Table 4 also indicates the annual debt service required for the construction of the building and the purchase of the major operating equipment. Combined with the Net Operating Income (Earnings Before Income Taxes, Depreciation, and Amortization - EBITDA), the debt service and the annual equity investments result in the Net Cash Flow for the operation. Assuming financing can be obtained for 80 percent of the capital cost (not including the land), the cash requirement to construct and equip the facility would be about $1.3 million including land acquisition, with some relatively small capital cost outlay in Year 7 to add a fourth operating line. In addition, about $2.3 million in operating capital would be needed to sustain the facility until it begins to show positive net cash flow in Year 5. Thus, the total cash investment requirement is estimated to be nearly $3.6 million to get the hub up to stabilized profitable operation.

TABLE 4. PRO FORMA ANALYSIS - HUB 20 YEAR ANNUAL OPERATIONS											
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 10	Year 15	Year 20
Revenue		**$459,030**	**$858,000**	**$1,248,000**	**$4,609,774**	**$8,828,863**	**$12,980,958**	**$18,257,245**	**$18,257,245**	**$18,257,245**	**$18,257,245**
Processing Lines		$459,030	$858,000	$1,248,000	$4,609,774	$8,828,863	$12,980,958	$18,257,245	$18,257,245	$18,257,245	$18,257,245
Add'l Services Revenue											
Expenditures		**$707,462**	**$1,113,213**	**$1,500,862**	**$4,211,981**	**$7,530,961**	**$10,989,236**	**$16,004,295**	**$16,004,295**	**$16,004,295**	**$16,004,295**
COGS (w/pkging)		$383,609	$734,448	$1,068,288	$2,644,131	$5,018,658	$7,625,788	$11,642,894	$11,642,894	$11,642,894	$11,642,894
Labor		$271,863	$324,643	$368,368	$894,823	$1,305,793	$1,678,306	$2,094,198	$2,094,198	$2,094,198	$2,094,198
Operating Costs		$51,989	$54,122	$64,206	$673,027	$1,206,511	$1,685,141	$2,267,204	$2,267,204	$2,267,204	$2,267,204
Net Op. Inc. (EBITDA)		**($248,432)**	**($255,213)**	**($252,862)**	**$397,794**	**$1,297,902**	**$1,991,722**	**$2,252,950**	**$2,252,950**	**$2,252,950**	**$2,252,950**
Percent of Sales		-54%	-30%	-20%	9%	15%	15%	12%	12%	12%	12%
Debt Serv. On Cap			($103,578)	($484,660)	($541,354)	($601,457)	($698,523)	($744,935)	($744,466)	($143,611)	$0
Annual Equity Investments	($353,731)	($255,213)	($695,434)	($664,297)	($105,140)	($105,531)	($169,796)	($82,369)	$0	$0	$0
Net Cash Flow	**($353,731)**	($503,645)	($1,054,225)	($1,401,820)	($248,700)	$590,915	$1,123,403	$1,425,646	$1,508,484	$2,109,339	$2,252,950
Internal Rate of Return							-20%	-3%	15%	22%	24%
Operating Characteristics											
Total Tons Processed		312	572	832	2,059	4,076	5,830	7,787	7,787	7,787	7,787
Revenue per lbs		$0.74	$0.75	$0.75	$1.13	$1.07	$1.11	$1.17	$1.17	$1.17	$1.17
COGS per lbs		$0.61	$0.50	$0.50	$0.65	$0.61	$0.65	$0.75	$0.75	$0.75	$0.75
Gross Margin		$0.12	$0.25	$0.25	$0.48	$0.46	$0.46	$0.42	$0.42	$0.42	$0.42
Percent of Sales		16%	33%	33%	43%	43%	41%	36%	36%	36%	36%

When the hub operation occupies the permanent facility in Year 4, there would be three operating lines: 1) tender fresh produce, 2) firm fresh produce, and 3) frozen processing. In this analysis, all of these operating lines would provide a level of processing and packaging suitable for the wholesale market. That is, there would be washing, sorting, and some cutting or chopping on selected products. Packaging is assumed to be of more generic wholesale quality rather than a retail level. As the hub gains operating experience and more diverse customers, it could likely achieve a level of retail processing and gain a price premium on certain products.

Each of the operating lines is designed to operate at a maximum of one ton per hour. None of these lines is projected to achieve full operating capacity in Year 4, however, since the hub will be scaling up as it continues to develop a buyer/supplier network and to realize full operating efficiencies. This results in a net operating income of about $400,000 and an EBITDA of 9 percent, but it does not cover the debt service or the continuing cash investments to expand the production capacity of the facility.

In Year 5, it is expected that most of the crop throughput will be on Lines 1 and 2 while Line 3 provides a more deep processing option as operations scale up. The equipment for Line 3 (the freezing tunnel) is flexible and designed to run on either Line 1 or Line 2. In this scenario, Line 3 functions as a "safety valve" for the hub operator, allowing diversion of crops from Lines 1 and 2 and purchase of surplus crops during months when prices are low. Operating adjustments would be made on Lines 1 and 2 to keep to two tons per hour total processing volume for the hub as a whole during this year. The labor and operating costs are tied to this total volume assumption. The *Financial Feasibility Toolkit* version of the pro forma model allows the operator to vary assumptions on product mix by operating line on a month to month basis.

Line 3 provides a higher level of value to the produce by freezing excess product for use in the off season and as inputs for other higher level food processing. To some extent, the freezing allows culls from Lines 1 and 2 to be "rescued" for use in other food processing. For other fresh produce, Line 3 adds value for the hub operations by allowing it to stockpile excess produce from Lines 1 and 2 for sale during off-peak periods when prices are higher. It is important to note, however, that the extra handling on this line and the freezing process itself further reduces the product weight for many crops. Therefore, it is important for the hub operator to coordinate the timing of production and sales on Line 3 to ensure a favorable gross margin from the frozen products.

For example, there are months in which the finished frozen prices for certain crops are lower than the fresh farmgate price, particularly when factoring in the reduced product weight from the freezing. However, the COGS for the diverted fresh crops are accounted for under Line 1 and 2, so they are assumed to be free in calculating the gross margin for Line 3. Therefore, the farmgate price for Line 3 would be a weighted average of diverted produce (at $0/lbs.) and fresh produce (at the normal farmgate price). The market prices for products from Line 3 would reflect the difference in retail frozen and fresh prices by crop. We have assumed that the finished product from Line 3 would be sold during non-harvesting months for each crop, and therefore would command a premium price (but discounted for the fact that it is frozen and not fresh).

As a result, the revenues produced from Line 3 occur during different months than the costs of production for each crop. This results in uneven operating income for Line 3 on a month to month basis, but the annual contribution of Line 3 is very positive. The EBITDA is 11 percent for the year with only Lines 1 and 2 running but increases to 15 percent by adding Line 3. This is a little lower than anticipated in the *Cost Estimate Analysis*, but it is a function of the price spread on the selection of target crops in the model. For example, we could increase the percentage above 15% by assuming a much greater volume of raspberries, which is a very high value crop. However, the limited supply data we have suggests the crop mix shown in the model for each line is more realistic at this time. The development of the hub provides an opportunity for growers to make crop pattern shifts over the next several years to meet future demand.

By Year 6, Line 3 would be operated at a full one ton per hour and Lines 1 and 2 are not reduced while Line 3 is operating. This results in a throughput of three tons per hour and a total annual production of 5,830 tons. The hub generates nearly $2 million in EBITDA (15.3% of sales). Table 5 below shows how the hub performance varies with different combinations of the Lines in operation.

TABLE 5. FINANCIAL PERFORMANCE VARIATION BY OPERATING LINE, YEAR 6

	All Three Lines	Line 1	Lines 1 and 2	Lines 1 and 3	Lines 2 and 3
Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA)	$1,991,722	$408,022	$902,741	$1,497,003	$919,205
Percent of Sales	**15.3%**	**8.0%**	**11.8%**	**14.3%**	**11.7%**

Year 7 in Table 4 shows the result of adding an Individual Quick Frozen (IQF) Line as Line 4. The additional capital cost for this line is provided in Appendix C-2, Capital Cost and Financing Estimates. With this additional Line, the hub would operate at 4 tons per hour and process 7,787 tons of produce per year. We have assumed this Line would use all newly purchased raw product and any diversion of product from Lines 1 and 2 would go only to Line 3, which is also a freezing line.

The price structure and operating model for Line 4 is similar to Line 3. Raw produce would be purchased for Line 4 during months when the crops are plentiful and farmgate prices are relatively low. The finished product would be warehoused and sold during non-peak months at the highest price available for each individual crop. Even so, since Line 4 does not benefit from "free" diversions of produce off the other Lines, the gross margin is lower than for Line 3. Further research is needed to determine if prices for IQF products might be higher than for standard frozen products, such as those from Line 3. However, Line 4 does contribute in a positive way to the overall bottom Line of the Hub, and the EBITDA at full operation in Year 7 is more than $2.25 million.

As described in detail in the *Cost Estimate Analysis,* when Line 4 is introduced, Line 3 can be converted relatively easily for dehydrating produce. The hub facility budget provides options and costs for other types of processing such as a jams and sauces line, and one for aseptic packaging.

Overall, the hub achieves a 15 percent Internal Rate of Return (IRR) by Year 10 and by Year 20 has generated an IRR of 24 percent. Under the financing assumptions in this analysis, all debt service would be retired by Year 17, so the EBITDA after that point contributes fully to the bottom line, although increased maintenance costs and capital replacement expenditures can be expected beyond twenty years. Clearly, to achieve these results, a skilled staff and strong marketing and advertising strategies are very important.

It should be noted that there will be various levels of value-added activities on the various processing lines. Functions vary from basic sorting and packing, to customized packaging, cutting, chopping, trimming, freezing, drying and other processing options. The actual level of activity will vary greatly depending on the needs of the customers and the pricing structure that can be obtained by the hub operator. While higher level value-added activities will cost the operator more in terms of labor and other costs, the margin will be greater. The financial feasibility analysis is based on estimates for the more basic levels of processing, so it can be assumed that if the hub is financially viable at this level of operations, it will have the opportunity to generate higher levels of revenue and return with higher levels of value-added processing activities.

HUB NON-PERSONNEL OPERATING COSTS

In Year 1, the hub is envisioned to start in an existing building with minimal expenditures initially for equipment and supplies. The hub would lease space and pay only for labor and direct operating expenses, such as a forklift, pallets and pallet bins. These costs are detailed for the first few years in the upper portion of Appendix C-1, Non-Personnel Operating Costs. During the initial year, the hub is projected to process 312 tons of produce, operating essentially 26 weeks per year on a reduced daily schedule of 6 hours per day. This would increase to about 572 tons for the second year. During the second year, the hub would add more processing equipment, allowing production to increase to 832 tons in Year 3, before the operation moves to a new permanent facility in Year 4.

HUB CAPITAL COST AND FINANCING ESTIMATE

In Year 6, the cumulative cost of developing the facility and purchasing equipment is estimated at approximately $6.4 million. The costs for land, building and major equipment are shown in Appendix C-2, Capital Costs and Financing Estimates. They are phased by the year in which the expenditures are needed. A more detailed discussion regarding the facility is contained in the *Cost Estimate Analysis*.

The feasibility analysis assumes the hub operators could obtain financing for 80 percent of the building and equipment costs but would need to fund the remaining hard costs plus the land acquisition from cash (or investor equity). Assuming financing can be obtained for 80 percent of the capital cost (not including the land), the cash requirement to construct and equip the facility would be about $1.3 million through year 6, including land acquisition, with some relatively small capital cost outlay in Year 7. In addition, about $2.3 million in operating capital would be needed to sustain the facility until it begins to show net cash flow in Year 5. Thus, the total cash investment requirement is estimated to be nearly $3.6 million through Year 6. The hub shows a positive rate of return by Year 8.

Based on the assumptions outlined the *Cost Estimate Analysis,* beginning in Year 2 the hub owners would purchase a site and begin design of a permanent facility, which would be built in Year 3 and be ready for use in Year 4. It should be noted that the Project Team and SACOG gathered information on many possible food hub sites and facilities throughout the region and a decision was made to prepare the cost estimate for a new facility in case a suitable site/facility was not available, and to provide an opportunity for the hub to incorporate and possibly help prototype sustainable technologies in building design and operations, especially for food processing, waste and resource recovery and energy and water efficiencies.

The lower portion of Appendix C-2 shows the projected phasing of investor equity and debt service costs. Chapter VI, Financing Resources, provides information on potential facility funding sources, incentives and rebates. There is a good possibility that state and local economic development incentives such as manufacturing equipment sales tax exemptions and other incentives and rebates such as those available through various utility programs and services, available for both food processing-related facilities and equipment from design through construction and operations, would reduce the overall capital investment required.

STAFFING

In terms of staffing, the hub would begin with three full time employees devoted to buying and sales, with one of these employees also managing the production facility when it is in operation. It is essential that the hub operators develop a buying and marketing network and strategy early on in order to develop a steady supply of raw products and suppliers, and ready customers as the hub's volume increases each year. The production personnel, including a part time supervisor, would begin as hourly employees during the first few years as the production volume scales up. This staff would be supplemented by a part time book keeper, a truck driver and the services of a professional accountant. At the permanent facility, the staff would increase to 35 Full Time Equivalent (FTE) employees by Year 5. See Appendix C-3 for detail.

An important element of the staffing plan is the Agricultural Advisor. The Advisor will be working closely with growers to develop market connections; secure trust; assist with business and crop planning and contracts; and marketing. These functions will increase the opportunity for small growers to participate in the hub and have the opportunity to gain access to new markets, improve skills, and increase their financial prospects.

HUB LOCATION

The hub facility is location neutral, meaning it could be based in a variety of locations throughout the region. Some key location criteria are that the hub should be centrally located to suppliers and customers, have access to major transportation routes, be on a site that is fully serviced with infrastructure if possible, and has expansion potential. As hub operations expand and regional demand for locally grown produce increases, the analysis indicates that there is enough demand to support more than one hub, so there is opportunity for several communities to benefit from serving as a hub location. The concept for the hub also envisions that there would be fresh produce receiving stations at various locations, approximately 30 miles from the hub, that would serve as transfer stations to get fresh produce to a central location where it would then be aggregated and distributed to larger customers throughout the region (or beyond). In this way, the receiving stations also could tap into sub-regional crop specialties and get them into the broader regional marketplace. See the *Cost Estimate Analysis* for additional detail.

SUMMARY

The financial feasibility analysis demonstrates that the proposed food hub model can be a viable business enterprise. Based on the assumptions for target crop mix and volumes by month, using actual 2013 wholesale pricing data, the analysis serves as a proof of concept for the testing of a for-profit food hub model geared to providing a market channel for existing distributors and wholesalers serving institutions and businesses, and directly to the institutions and businesses. The *Financial Feasibility Toolkit* provides the ability to perform sensitivity analysis on alternative operating scenarios. Given that the financial feasibility analysis is based on a wholesale pricing approach, and the hub is viable with this pricing and operating structure, it is expected that the hub would show a higher rate of return with pricing for higher-value added products and processes, including niches products and retail sales.

V. BARRIERS

The food hub market and financial feasibility analyses show that the hub can be a financial viable operation. However, opportunity for success is affected by challenges facing agriculture in general and in the development of local and regional food system infrastructure specifically, an issue that is being addressed across the country, in California and in the Sacramento region. As this project's research findings document, there are many market drivers including increasing consumer demand and new institutional policies that are creating many new opportunities for agriculture and value-added activities. This chapter identifies some of the key barriers and potential solution-oriented actions that will allow the Sacramento region to capitalize on new economic development opportunities related to expansion of local and regional food systems.

Obviously, the farming/production of the region's specialty crops is the foundation for sourcing locally grown fresh produce. While deeply interrelated, the focus for this discussion is on the specialized agricultural infrastructure needs for a local aggregation, processing and distribution system – rather than on the production side, which has been addressed in other analyses. It summarizes issues identified in the SACOG report *Impediments to Supplying Locally Grown Food* (July 2014) based on a survey of 70 growers in getting their produce into local markets. One of the fundamental challenges is the lack of off-farm aggregation, processing and distribution infrastructure, for which this Agricultural Infrastructure Project is intended as a resource, and the lack of a clear market signal to growers on this emerging market opportunity.[6] Others are described below.

This summary also includes additional issues raised by stakeholders during the course of this project; project research on issues faced by food hubs nationally; and research conducted on behalf of USDA Rural Development California on the regulatory challenges facing small agricultural producers and businesses.[7] Key policy issues, barriers and actions are summarized as follows:

Policy Issue	Barriers and Actions
Serviced and Zoned Sites and Facilities, Local Permitting Processes	Interest is high on the part of jurisdictions throughout the region to site/develop agricultural infrastructure facilities; not every community has appropriately zoned and serviced sites and facilities. There is inconsistency across jurisdictions on land use and regulatory approaches. Information is needed on status of existing facilities. **Actions:** Further identify capacity of potential sites and facilities; assess infrastructure and zoning status and policy ordinances, and permitting requirements; and assess project readiness. Local governments should streamline ordinances and permits, building upon ordinances and policies that are working across the region. Consider less restrictive zoning for ag land that would allow for processing and distribution of value-added processing on site. Local public agencies should provide dedicated permit and other technical assistance to small growers and processors. The Yolo Solano Farmbudsman program is an example of cross-jurisdiction approach.

[6] SACOG. *Impediments to Supplying Locally Grown Food*, p. 4. July, 2014.
[7] Zhang, Tara, "A Seamless Online Information Service for Business Regulations," UC Berkeley, Goldman School of Public, Policy, eforthcoming, 2014.

Policy Issue	Barriers and Actions
Institutional Purchasing Policy and Procurement Infrastructure	Large scale purchasers of fresh produce such as schools, hospitals and prisons have the potential to have a major impact on the demand for local food, but many are locked into low cost contracts through subsidized government programs or have long-standing contracts with food service and distribution companies that do not focus on local purchasing. Most local governments in the region do not have "local purchase" targets for fresh produce purchasing - bid requirements are usually focused on lowest cost, rather than supporting local businesses. State agencies face similar challenges. Even when institutions have set targets for local, sustainable fresh produce purchases, the local distribution "system" cannot yet deliver at the volumes and levels of consistency needed. **Actions**: Partners should conduct education and advocacy around "local purchase" targets. Identify model policies and successful practices to help build capacity. Work with existing aggregators/distributors who can partner to facilitate market channel for local supply to meet institutional demand. Entities such as cities, counties, hospitals, schools, hospitality industry and other public institutions should adopt procurement policies to encourage more purchases of locally grown food. To that end, convene institutional representatives within systems (i.e., schools, hospitals) across the region which are facing specific challenges, building on initiatives such as the Farm to School Yolo program of the Yolo County Agricultural Commissioner's Office, and the Bay Area's Farm Fresh Healthcare Project for hospital procurement of locally grown produce (Northern California).
Food Safety and Traceability	Regional institutional consumers and distributors underscore the critical importance of ensuring food safety and traceability on the part of suppliers. The Food Safety Modernization Act (FSMA) was signed into law in 2011 to enact comprehensive food safety prevention practices for growers and food facilities. The FDA is in the rulemaking and guidance development process, with planning underway for the next phase of implementation. Stakeholder groups have raised concerns about the complexity of proposed rules, the costs of transitioning to higher food safety standards, and potential negative impacts on smaller and organic operations, food hub and processing facilities, and other partners in local food systems. Final rulings will have implications for the hub in terms of how it is able to work with smaller growers. See the following FDA link for updates: http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm395105.htm The USDA Agricultural Marketing Services, in partnership with The Wallace Center, is developing a Group GAP (Good Agricultural Practices) certification option. This cooperative approach offers a more cost effective means of addressing supply chain requirements for small-and mid-sized farms that the current farm-by-farm GAP certification paradigm. The pilot shows that individual producer costs are reduced significantly. This could result in a USDA-offered program in 2015, with resources identified to assist those participating. **Actions:** Monitor the implementation process for FSMA and assist local growers and food facilities with the process for compliance. Collaborate with the California League of Food Processors. The hub could assist growers with this transition, GAP certification and other food safety, sourcing and traceability requirements. The region should monitor the availability of the Group GAP certification option.

Policy Issue	Barriers and Actions
Liability Insurance	Smaller growers cannot afford to meet costly liability requirements of food merchandising and food service purchasers, including for schools and hospitals. **Action**: The hub should provide liability insurance as a fee for service to farmers.
Overall Regulatory Compliance	Regulations affecting agriculture are complex. According to a forthcoming report, there are at least 6 regulatory agencies at the Federal level, 11 agencies at the State level, two agencies at the regional level, and up to 9 agencies at the local level that administer and enforce agricultural regulations for farming which also affect on-farm value-added activities including processing. Hub facilities with cold storage, freezer and processing functions must address additional regulatory requirements. Both produce and processing activities are subject to the requirements of the still evolving Food Safety Modernization Act. There is no one-stop source that can present smaller farmers with clear and comprehensive regulatory compliance, which also affects development of value-added agricultural processing activities.8 The SACOG report Impediments to Supplying Locally Grown Foods has a detailed list of regulatory challenges facing growers wishing to supply to the local market, which are also a challenge for larger growers (but who have better capacity to address them). Action: The report recommends the development of a one-stop online business regulation information service for small growers/businesses. There are some models which could be the basis of a pilot in the region.
Data Needs	It is very difficult to obtain timely and adequate information on institutional fresh produce purchasing patterns – types of crops purchased, pricing, levels of volume, calendar, etc., and specific supplier gaps, so as to target market niches and develop effective market channels. **Action**: SACOG and partners could conduct targeted market assessments and convene institutions and suppliers to develop system solutions.

Financing challenges and resources for development and operations of food hub facilities are discussed in Chapter VI.

[8] Zhang, Tara. *A Seamless Online Information Service for Business Regulations*, p. 6, prepared for USDA Rural Development, California. Draft May, 2014, forthcoming.

VI. FINANCING RESOURCES

In order for the Sacramento Valley Food Hub to operate as a for-profit entity, it will require careful consideration of various financing options and opportunities. This chapter presents information on the most accessible financing options as well as some new programs that could prove to be beneficial.

First and foremost, the food hub will have an immediate need for private equity investment. This could come wholly from the initial owner/operator of the food hub and/or a combination of owner/operator investment with individual private investors. Second and no less important, this *Business Plan* assumes an initial 20% private investment with 80% of remaining start-up costs obtained through debt financing.

Debt financing could come in many forms and from various sources, including but not limited to: 1) Direct bank or other lender loans; 2) the Industrial Development Bond ("IDB") Financing Program; 3) the Rural Economic Development Loan and Grant Programs through the United States Department of Agriculture; and 4) the Small Business Administration's ("SBA") Certified Development Corporation ("504") Loan Program. There are also various business tax credits and utility rebate programs that might be utilized.

More specifically, debt financing could include both secured and unsecured loans, private and/or public debt, syndicated and/or bilateral debt, and any other types of debt. Debt financing for the food hub could be a combination of the programs previously mentioned.

In addition to conventional bank lending, the IDB Program in California provides manufacturing and processing companies low-cost, low-interest financing for capital expenditures. Eligible capital expenditures include the acquisition of land, building construction, building renovation, and the purchase of machinery and equipment. IDB's require the involvement of local governments as the issuing entity. The local government can be a city, county, economic development authority, or a joint powers authority. However, where local government does not wish to participate in the issuance process, the California Infrastructure and Economic Development Bank can issue IDB's. The borrower in the IDB process must be a manufacturing company requesting from $1 million to $10 million.[9]

USDA's Business and Industry Guaranteed Loan Programs are another possible option.[10] The Business and Industry Guaranteed Loan Program (B&I) aims to increase opportunities for new and existing businesses in rural areas to borrow money from private lenders. Through the B&I program, the USDA will issue a guarantee to the private lender, giving the borrower more favorable interest rates. The USDA will also cover part of the loss if the borrower becomes unable to make regular loan payments. The 2014 Farm Bill requires USDA to set aside 5 percent of the total B&I guarantee funds to support local and regional food enterprises. Loans can support enterprises that process, distribute, aggregate, store, or market foods produced either in-state or transported less than 400 miles from the origin of the product. To be eligible under the reserved funds, the borrower must be a cooperative, nonprofit organization, federally recognized Native American Indian Tribe, public entity, corporation, or an individual.

[9] http://www.treasurer.ca.gov/cidfac/idb.asp
[10] http://www.rurdev.usda.gov/BCP_gar.html

The B&I program has the authority to fund local food infrastructure in rural areas as long as the project supports farm and ranch income. Priority is given to underserved communities with limited supply of affordable, healthy food and retail grocery stores, as well as a high rate of poverty. The maximum loan guarantee USDA will issue is 80 percent for loans of $5 million or less, 70 percent for loans between $5 million and $10 million, and 60 percent for loans of more than $10 million. Loan funds can be used for business expansion and development, purchase of land, buildings, equipment and supplies, or to provide working capital.

Additionally, SBA's CDC/504 Loan Program is also available. To be considered for a SBA 504 loan, applicants must[11]:

- Operate as a for-profit company.
- Do business (or propose to) in the United States or its possessions.
- Have a tangible net worth less than $15 million and an average net income less than $5.0 million after taxes for the preceding two years.
- Loans cannot be made to businesses engaged in speculation or investment in rental real estate.
- Be an eligible type of business. While the vast majority of businesses are eligible for financial assistance from the SBA, some are not. Check the program list of eligible and ineligible types of businesses to see if the company qualifies.
- Under the 504 Program, plan to use proceeds for an approved purpose. CDC/504 loan proceeds may be used for the financing of fixed assets like real estate or equipment. The program list explains Eligible and Ineligible Use of Proceeds.
- Not have funds available from other sources. SBA does not extend financial assistance to businesses when the financial strength of the individual owners or the company itself is sufficient to provide all or part of the financing. Both business and personal financial resources are reviewed as part of the eligibility criteria. If these resources are found to be excessive, the business will be required to use those resources in lieu of part or all of the requested loan proceeds.
- Have the ability to repay the loan on time from the projected operating cash flow of the business.
- Good character. SBA obtains a "Statement of Personal History" from the principals of each applicant firm to determine if they have historically shown the willingness and ability to pay their debts and whether they have abided by the laws of their community
- Have relevant management expertise.
- Prepare a feasible business plan

[11] http://www.sba.gov/content/cdc504-loan-program-eligibility

SBA 504 loan proceeds can be used for the purchase of land, including existing buildings; the purchase of improvements, including grading, street improvements, utilities, parking lots and landscaping; the construction of new facilities or modernizing, renovating or converting existing facilities; and the purchase of long-term machinery and equipment. A 504 loan cannot be used for working capital or inventory; consolidating, repaying or refinancing debt; and/or speculation or investment in rental real estate. Importantly, SBA recently provided the following clarification to its Certified Development Companies (CDCs) regarding the SBA's position on the use of SBA 504 loans and IDBs to finance a single manufacturing project:

> SBA may participate in projects financed by federal tax-exempt obligations, such as IDB's. When the 504 loan project includes an IDB, and the IDB requires a lien on the project property, the IDB lien must be junior to the SBA loan. When the IDB portion of the 504 loan project is not secured by a lien on the project property, SBA's debt may be subordinate to the IDB. If a letter of credit serves as collateral on both the SBA and IDB transaction, SBA's right to payment under the letter of credit may be subordinate to that of the IDB. This requirement for IDBs holds true for other forms of federal tax-exempt obligations.[12]

As a result, IDB's secured by a bank-issued letter of credit can used in combination with SBA 504 loans to finance up to 90 percent of a manufacturing project's capital costs. The proceeds of SBA 504 loans can be used to finance: building purchases and renovations; land purchases; and furniture and equipment purchases. The maximum SBA 504 loan is $5 million. The following is an example of a possible financing structure for a $5 million manufacturing project similar to the financing needs of the proposed food hub:

- $2.5 million (50%) IDB supported by a bank-issued letter of credit (first lien on the collateral);
- $2 million (40%) SBA 504 loan through a CDC (second lien on the collateral); and,
- $500,000 (10%) borrower contribution.

As stated above, ultimate financing for the food hub could come in many forms including private equity investment along with multiple options of debt financing.

The following are some additional financing and incentive resources for both investors and jurisdictions, related to infrastructure/site requirements, development of food-related facilities, and business operations. They can help jurisdictions get ready for proposed projects with infrastructure improvements and site preparation, and assist businesses with site specific infrastructure, capital and operating cost financing needs. Some jurisdictions also offer local incentives such as: below market sales and lease costs, site financing, business loan programs, and fast track permitting. They are not described here as they vary by community, but local and regional economic development organizations can provide information and assistance for prospective projects.

[12] http://www.treasurer.ca.gov/cidfac/news/sba.pdf

Funding/Incentives Source	Program Description
California Enterprise Development Authority (CEDA) www.ceda.caled.org	A Joint Powers Authority to address gaps in economic development financing. CEDA issues industrial development bonds for small to medium-sized California manufacturers and 501 (c)3 bonds to nonprofit organizations. Both IDB's and bonds help provide low cost financing for acquisition, construction and expansion.
California Freshworks Fund http://cafreshworks.com/about/	This is a public-private partnership loan fund that has raised $272 million. The fund provides loans and grants to healthy food retailers and distributors willing to locate in Food Opportunity Areas (food deserts). Partners include banks and other investors, foundations, industry associations, hospitals, USDA Rural Development, the California State Treasurer's Office, nonprofits.
Cap and Trade Funding, California Air Resources Board http://www.arb.ca.gov/	The 2013 Scoping Plan Update can link the Cap and Trade Auction Proceeds of the Investment Plan to climate strategies in agriculture that can be supported through incentives, including with farm and food processor renewable energy development. Funding will be set aside for disadvantaged communities which might be a resource.
EB-5 Regional Center	A federal Immigrant Investor program - http://www.uscis.gov/node/42086
Manufacturing Equipment+ Sales and Use Tax Exemption, GO-Biz, State of California www.business.ca.gov	Part of the Governor's Economic Development Initiative, this exemption eliminates the state's share of sales tax (4.2%) on eligible purchases of manufacturing equipment, including food processing equipment. The purchase of the hub's processing equipment would be eligible. The savings would be increased if there was a local government match. See SACOG's analysis of benefits in *Impediments to Supplying Locally Grown Food.*
Pacific Gas and Electric (PG&E) www.pge.com	Savings by Design Program offers services and incentives to help owners and designers of commercial buildings raise energy performance, in conjunction with the California Department of Public Utilities, with participation of PG&E and SMUD. Owners are eligible for incentives on buildings. Food processors can earn rebates for the installation of solar, wind, fuel cell and other generation systems. Other energy efficiency rebates/incentives are available.
RSF Social Finance http://rsfsocialfinance.org/	Serves nonprofit and for-profit enterprises that meet financial, operational and impact criteria, in food and agriculture. Core lending programs offer mortgage loans, construction loans and working capital lines of credit, ranging from $200,000 to $5 million.
Sacramento Metropolitan Utility District (SMUD) www.smud.org	In addition to Savings by Design Program, the Systems Approach program evaluates individual efficiency improvements and provides incentives. Utility representatives meet with building designers early in the process for energy solutions in areas of food processing equipment, lighting, heating, cooling, refrigeration, etc. There are custom incentives for manufacturing process improvements and controls, up to $450,000.
Slow Money http://slowmoneynorcal.org/	Non-profit that facilitates investment in local food systems, with office in San Francisco serving Northern California.
U.S. Department of Commerce, Public Works and Economic Adjustment Program http://www.eda.gov/	Investments help support construction or rehabilitation of essential public infrastructure and facilities to generate or retain private sector jobs and investments, attract private capital and promote regional competitiveness
U.S. Department of Agriculture, Rural Development www.rurdev.usda.gov	Has several programs for which local jurisdictions are eligible that can provide assistance on development of infrastructure, including the Community Facilities Direct Loan and Grant Program, including for transportation infrastructure and industrial parks, and for business and economic development programs.

SACOG's analysis on impediments to supplying locally grown food describes how incentives could help reduce costs for the food hub. As an example, with the combined state-local sales tax exemption for manufacturing food processing equipment under the new Governor's Economic Development Initiative, it is estimated that the hub could save approximately $75,000 over its first five years of operation.[13] Incentives and rebates provided through the region's utilities can provide significant savings for operating processing facilities; an additional resource is the Savings by Design program provided by both PG&E and SMUD wherein utility representatives meet early in the design process with facility engineers and architects to build energy solutions into both buildings and processing operations.

In July 2014 USDA announced the creation of a new U.S. Rural Infrastructure Opportunity Fund that will allow private entities to invest in rural infrastructure projects including water and wastewater systems and regional food systems. CoBank, a national cooperative bank, is the Fund's anchor investor. It has committed $10 billion in hopes of spurring private investment in rural infrastructure projects, as well as open investment opportunities for endowments, pension funds, foundations and others. These types of resources should be monitored proactively to ensure that the region can participate in forthcoming opportunities.

A valuable information resource is the *Access to Capital* guide developed by the California Financial Opportunities Roundtable. It contains a wealth of information about capital resources and support organizations for agricultural value chain businesses and infrastructure needs, as well as rural community and economic development efforts, including information on alternative investment strategies and sources of funding. (http://www.rurdev.usda.gov/Reports/CA-CalFOR.pdf).

[13] SACOG. *Impediments to Supplying Locally Grown Food*, pp.14-15. July, 2014.

APPENDIX A. Regional Specialty Crop Consumption and Demand

Appendix A provides background information on the analysis used to estimate regional specialty crop consumption and demand for the Sacramento Valley Food Hub.

Data sets used to calculate regional consumption on food by crop, per capita: the FICRCD (Food Intakes Converted to Retail Commodities Database) and LAFA (Loss-Adjusted Food Availability) datasets, 2012. FICRCD provides national commodity-level data for food consumption per capita. The LAFA data set serves as a proxy for food consumption for certain more detailed levels of foods.

The following tables show the initial list of illustrative specialty crops to identify potential target crops to supply the food hub, based on application of target crop list screening criteria by the Project Team, across major crop types and cultivation categories (Table A-1); annual target specialty crop food consumption by county and acres needed to meet regional consumption levels (Table A-2); and acres in production (Table A-3).

TABLE A-1. ILLUSTRATIVE TARGET HUB CROPS	
SPECIALTY CROP TYPE, CULTIVATION CATEGORY	**CROP**
Apiaceae (salad crop)	Celery
Berries	Blackberries Blueberries Raspberries Strawberries
Brassica Vegetables	Broccoli Kale (also are Greens)
Bulb	Onions
Cucurbit	Squash (winter and summer, variety)
Leafy Greens (Salad Greens)	Leafy Greens (lettuces) Spinach
Legumes (Beans/Peas)	Edible Pea Pods/Chinese Snow Peas Garbanzo Beans (chick peas) Lima Beans
Liliaceae (Lily)	Asparagus
Nightshade Vegetables (Solanaceae)	Chili Peppers Eggplant Sweet Peppers Tomatoes (2 products, fresh pack & heirloom)
Nuts	Walnuts
Pomaceous	Apples
Root Vegetables	Carrots
Stone Fruit	Apricots Peaches
Tuber Vegetables	Yams/Sweet Potatoes

TABLE A-2. ANNUAL TARGETED CROP FOOD CONSUMPTION BY COUNTY/ ACRES NEEDED TO MEET REGIONAL CONSUMPTION LEVELS (2012) IN PRIMARY WEIGHT TONS PER YEAR									
Specialty Crop	**SACOG Region**	**Sacramento**	**El Dorado**	**Placer**	**Sutter**	**Yolo**	**Yuba**	**Annual Yield per acre (tons)**	**Acres Needed to meet Regional Consumption**
Apples	65,031	39,883	4,966	9,948	2,614	5,614	2,006	8.0	8,129
Apricots	1,285	788	98	197	52	111	40	5.7	225
Asparagus	2,696	1,654	206	412	108	233	83	1.6	1,721
Bell Peppers	6,218	3,813	475	951	250	537	192	19.3	323
Blackberries	81	50	6	12	3	7	2	8.0	10
Blueberries	2,001	1,227	153	306	80	173	62	3.5	570
Broccoli	11,507	7,057	879	1,760	462	993	355	7.7	1,497
Carrots	14,716	9,025	1,124	2,251	591	1,270	454	15.7	940
Celery	5,938	3,642	453	908	239	513	183	35.6	167
Chili peppers	4,059	2,489	310	621	163	350	125	15.8	258
Eggplant	1,186	727	91	181	48	102	37	15.0	79
Kale	2,571	1,577	196	393	103	222	79	8.4	307
Lettuce (all)	25,487	15,631	1,946	3,899	1,024	2,200	786	9.3	2,755
Lima Bean	1,086	665	83	166	44	94	33	1.2	940
Onions	22,153	13,586	1,692	3,389	890	1,913	683	21.6	1,028
Peaches	11,945	7,326	912	1,827	480	1,031	368	16.0	747
Raspberries	428	262	33	65	17	37	13	9.1	47
Spinach	4,694	2,879	358	718	189	405	145	9.0	522
Squash	7,390	4,532	564	1,130	297	638	228	10.1	729
Strawberries	11,718	7,187	895	1,793	471	1,012	361	15.0	781
Sweet potatoes/ Yams	11,548	7,082	882	1,767	464	997	356	15.0	770
Tomatoes (both fresh & processing)	144,232	88,455	11,015	22,064	5,797	12,452	4,449	15.2	9,475
Walnuts	590	362	45	90	24	51	18	2.7	219
TOTAL	**358,560 (tons)**								**32,239 (acres)**

Source: Yield, tons per acre - USDA National Agricultural Statistical Service, CA. 8 year average yields, (2004-2012), with strawberry and lettuce yields per acre adjusted based on county crop reports

TABLE A-3. ACRES IN PRODUCTION FOR TARGET SPECIALTY CROPS BY COUNTY AND REGION, 2012							
	El Dorado	Placer	Sacramento	Sutter	Yolo	Yuba	Region
Apples	839	73	629	ND	163	19	1,723
Apricots	3	5	7	1	77	25	118
Asparagus	0	0	1	0	62	0	63
Bell Peppers	2	5	19	4.8	ND	1	31.8
Blackberries	38	29	9	13	2	11	102
Blueberries	61	3	5	1.5	19	2	91.5
Broccoli	0	1	9	4.5	38	3	55.5
Carrots	1	1	2	0	13	0	17
Celery	0	0	6	0	1	0	7
Chili Peppers	4	3	1	2	131	3	144
Eggplant	3	1	23	1	53	3	84
Kale	4	0	1	0.4	4	1	10.4
Lettuce (all)	15	9	48	4	ND	7	83
Lima Beans	0	0	0	1,790	399	0	2,189
Onions	1	3	54	105	55	4	222
Peaches	137	141	26	6,135	210	3,019	9,668
Raspberries	8	2	0	3	0	1	14
Spinach	1.5	1	1	0	19	0	22.5
Squash	12	16	42	1.5	531	3	605.5
Strawberries	16	16	34	3	35	19	123
Sweet potatoes/Yams	0	0	0	0	1	1	2
Tomatoes (fresh & processing)	49	47	2,056	13,051	39,269	19	54,491
Walnuts	281	314	413	37,305	16,640	14,222	69,175
TOTAL	**1,475**	**670**	**3,386**	**58,425**	**57,822**	**17,363**	**139,042**

Source: 2012 USDA Census of Agriculture; ND denotes data not disclosed

APPENDIX B. Hub Crop Mix Volumes Years 4-7 and Acreage Needed

SACRAMENTO REGIONAL AGRICULTURE INFRASTRUCTURE PROJECT ILLUSTRATIVE HUB CROP MIX VOLUMES – ACREAGE NEEDED, AT YEAR 4 OF OPERATIONS 1 TON PER HOUR, 2 LINES REDUCED CAPACITY (PHASE III)				
Crop	**Lbs.**	**Tons**	**Yield – tons per acre**	**Acres**
Line 1 – Tender Fresh Produce				
Iceberg lettuce	27,000	13.5	9.3	1.5
Green leaf lettuce	26,750	13.4	9.3	1.4
Red leaf lettuce	26,750	13.4	9.3	1.4
Romaine lettuce	27,000	13.5	9.3	1.5
Spinach	300,000	150.0	9.0	16.7
Broccoli	442,500	221.2	7.7	28.7
Kale	247,500	123.8	8.4	14.7
Tomatoes	605,000	302.5	15.2	19.9
Bell peppers	72,500	36.3	19.3	1.9
Blueberries	62,500	31.2	3.5	8.9
Strawberries	463,000	231.5	15.0	15.4
Raspberries	37,000	18.5	9.1	2.0
Peaches	25,000	12.5	16.0	0.8
Total	**2,362,500**	**1,181.4**		**114.8**
Line 2 – Firm Fresh Produce				
Eggplant	442,500	221.3	15.0	14.7
Celery	75,000	37.5	35.6	1.1
Carrots	495,000	247.5	15.7	15.8
Sweet potatoes	77,500	38.7	15.0	2.6
Onions	435,000	217.5	21.6	10.1
Squash	230,188	115.0	10.1	11.4
Total	**1,755,188**	**877.5**		**55.7**
OVERALL TOTAL	**4,117,688**	**2,058.9**		**170.5**

Sources for Yields per acre data: National Agricultural Statistical Services, USDA, 2003-2011, 8 year average; Sacramento Region County Agricultural Commissioner Reports, 2012; selected UC Davis Cost of Production Studies, 2008-2013.
Note: Average yields per acre might be less for organic crops

SACRAMENTO REGIONAL AGRICULTURE INFRASTRUCTURE PROJECT ILLUSTRATIVE HUB CROP MIX VOLUMES – ACREAGE NEEDED, AT YEAR 5 OF OPERATIONS (2 TONS PER HOUR, 2+ LINES - PHASE III)				
Crop	**Lbs.**	**Tons**	**Yield – tons per acre**	**Acres**
Line 1 – Tender Fresh Produce				
Iceberg lettuce	54,000	27.0	9.3	2.9
Green leaf lettuce	53,500	26.75	9.3	2.9
Red leaf lettuce	53,500	26.75	9.3	2.9
Romaine lettuce	54,000	27.0	9.3	2.9
Spinach	600,000	300.0	9.0	33.3
Broccoli	885,000	442.5	7.7	57.5
Kale	495,000	247.5	8.4	29.5
Tomatoes	845,000	422.5	15.2	27.8
Bell peppers	145,000	72.5	19.3	3.8
Blueberries	62,500	31.25	3.5	8.9
Strawberries	580,500	290.25	15.0	19.4
Raspberries	37,000	18.5	9.1	2.0
Peaches	50,000	25.0	16.0	1.6
Total	**3,915,000**	**1,957.5**		**195.4**
Line 2 – Firm Fresh Produce				
Eggplant	664,750	332.4	15.0	22.2
Celery	150,000	75.0	35.6	2.1
Carrots	836,550	418,3	15.7	22.6
Sweet potatoes	155,000	77.5	15.0	5.2
Onions	740,550	370.3	21.6	17.1
Squash	620,750	310.4	10.1	30.7
Total	**3,167,600**	**1,583.9**		**99.9**
Line 3 – Frozen (new volume, not diverted from lines 1 and 2)				
Spinach	50,000	25.0	9.0	2.8
Broccoli	300,000	150.0	7.7	19.5
Bell peppers	200,000	100.0	19.3	5.2
Squash	111,500	55.8	10.1	5.5
Blueberries	80,000	40.0	3.5	11.4
Strawberries	200,000	100.0	15.0	6.7
Raspberries	28,750	14.4	9.1	1.6
Peaches	100,000	50.0	16	3.1
Total	**1,070,250**	**535.2**		**55.8**
OVERALL TOTAL	**8,152,850**	**4076.6**		**351.1**

Sources for Yields per acre data: National Agricultural Statistical Services, USDA, 2003-2011, 8 year average; Sacramento Region County Agricultural Commissioner Reports, 2012; selected UC Davis Cost of Production Studies, 2008-2013.
Note: Average yields per acre might be less for organic crops

SACRAMENTO REGIONAL AGRICULTURE INFRASTRUCTURE PROJECT ILLUSTRATIVE HUB CROP MIX VOLUMES – ACREAGE NEEDED, AT YEAR 6 OF OPERATIONS 3 TONS PER HOUR, 3 LINES (PHASE IV)				
Crop	**Lbs.**	**Tons**	**Yield – tons per acre**	**Acres**
Line 1 – Tender Fresh Produce				
Iceberg lettuce	54,000	27.0	9.3	2.9
Green leaf lettuce	53,500	26.75	9.3	2.9
Red leaf lettuce	53,500	26.75	9.3	2.9
Romaine lettuce	54,000	27.0	9.3	2.9
Spinach	600,000	300.0	9.0	33.3
Broccoli	885,000	442.5	7.7	57.5
Kale	495,000	247.5	8.4	29.5
Tomatoes	845,000	422.5	15.2	27.8
Bell peppers	145,000	72.5	19.3	3.8
Blueberries	62,500	31.25	3.5	8.9
Strawberries	580,500	290.25	15.0	19.4
Raspberries	37,000	18.5	9.1	2.0
Peaches	50,000	25.0	16.0	1.6
Total	**3,915,000**	**1,957.5**		**195.4**
Line 2 – Firm Fresh Produce				
Eggplant	1,015,000	507.5	15.0	33.8
Celery	150,000	75.0	35.6	2.1
Carrots	990,000	495.0	15.7	31.5
Sweet potatoes	155,000	77.5	15.0	5.2
Onions	870,000	435.0	21.6	20.1
Squash	735,000	367.5	10.1	36.4
Total	**3,915,000**	**1,957.5**		**129.1**
Line 3 – Frozen (new, not diverted from lines 1 and 2)				
Spinach	120,175	60.01	9.0	6.7
Broccoli	1,484,375	742.2	7.7	96.4
Bell peppers	350,000	175.0	19.3	9.0
Squash	765,800	383.0	10.1	37.9
Blueberries	234,350	117.2	3.5	33.5
Strawberries	650,000	325.0	15.0	21.7
Raspberries	74,500	37.25	9.1	4.1
Peaches	150,350	75.2	16	4.7
Total	**3,829,550**	**1,915.0**		**214.0**
OVERALL TOTAL	**11,659,550**	**5,830.0**		**538.5**

Sources for Yields per acre data: National Agricultural Statistical Services, USDA, 2003-2011, 8 year average; Sacramento Region County Agricultural Commissioner Reports, 2012; selected UC Davis Cost of Production Studies, 2008-2013.
Note: Average yields per acre might be less for organic crops

SACRAMENTO REGIONAL AGRICULTURE INFRASTRUCTURE PROJECT ILLUSTRATIVE HUB CROP MIX VOLUMES – ACREAGE NEEDED, AT YEAR 7 OF OPERATIONS 4 TONS PER HOUR, 4 LINES (PHASE IV)				
Crop	**Lbs.**	**Tons**	**Yield – tons per acre**	**Acres**
Line 1 – Tender Fresh Produce				
Iceberg lettuce	54,000	27.0	9.3	2.9
Green leaf lettuce	53,500	26.75	9.3	2.9
Red leaf lettuce	53,500	26.75	9.3	2.9
Romaine lettuce	54,000	27.0	9.3	2.9
Spinach	600,000	300.0	9.0	33.3
Broccoli	885,000	442.5	7.7	57.5
Kale	495,000	247.5	8.4	29.5
Tomatoes	845,000	422.5	15.2	27.8
Bell peppers	145,000	72.5	19.3	3.8
Blueberries	62,500	31.25	3.5	8.9
Strawberries	580,500	290.25	15.0	19.4
Raspberries	37,000	18.5	9.1	2.0
Peaches	50,000	25.0	16.0	1.6
Total	**3,915,000**	**1,957.5**		**195.4**
Line 2 – Firm Fresh Produce				
Eggplant	1,015,000	507.5	15.0	33.8
Celery	150,000	75.0	35.6	2.1
Carrots	990,000	495.0	15.7	31.5
Sweet potatoes	155,000	77.5	15.0	5.2
Onions	870,000	435.0	21.6	20.1
Squash	735,000	367.5	10.1	36.4
Total	**3,915,000**	**1,957.5**		**129.1**
Line 3 – Frozen (new, not diverted from lines 1 and 2)				
Spinach	120,175	60.01	9.0	6.7
Broccoli	1,484,375	742.2	7.7	96.4
Bell peppers	350,000	175.0	19.3	9.0
Squash	765,800	383.0	10.1	37.9
Blueberries	234,350	117.2	3.5	33.5
Strawberries	650,000	325.0	15.0	21.7
Raspberries	74,500	37.25	9.1	4.1
Peaches	150,350	75.2	16.0	4.7
Total	**3,829,550**	**1,915.0**		**214.0**
Line 4 – Frozen	**(new)**			
Broccoli	1,935,000	967.5	7.7	125.6
Bell peppers	699,650	349.5	19.3	18.1
Blueberries	160,000	80.0	3.5	22.9
Strawberries	910,000	455.0	15.0	30.3
Raspberries	60,000	30.0	9.1	3.3
Peaches	150,350	75.2	16.0	4.7
Total	**3,915,000**	**1,957.2**		**204.9**
OVERALL TOTAL	**15,574,550**	**7,787.3**		**743.4**

Sources for Yields per acre data: National Agricultural Statistical Services, USDA, 2003-2011, 8 year average; Sacramento Region County Agricultural Commissioner Reports, 2012; selected UC Davis Cost of Production Studies, 2008-2013.
Note: Average yields per acre might be less for organic crops

APPENDIX C. Pro Forma Financial Analysis

TABLE C-1. HUB NON-PERSONNEL OPERATING COSTS				
Year 1				
Annual Costs	Bldg. Sq.Ft.	Lease Rate	Monthly	Annual
Building lease and parking	3,000	$0.55	$1,650	$19,800
Forklift rental			$1,150	$6,900
Truck Rental				$3,250
Subtotal				$29,950
One-time Costs	Quantity	Unit Cost	Tax/ Freight	Annual
Forklift battery	1	$3,800	$570	$4,370
Forklift bat. charger	1	$1,400	$210	$1,610
Pallet Jacks	1	$250	$38	$288
Pallets	16	$80	$12	$1,472
Pallet bins	16	$271	$41	$4,977
Plastic crates, collapsible	213	$25	$4	$6,011
Plastic crates, non-collapsible	192	$15	$2	$3,312
Subtotal				$22,039
Year 2 -				
Additional Annual Costs	Bldg. Sq.Ft.	Lease Rate	Monthly	Annual
Forklift rental			$1,150	$13,800
Truck Rental				$3,250
Subtotal				$17,050
One-time Costs	Quantity	Unit Cost	Tax/ Freight	Annual
Pallet Jacks	1	$250	$38	$288
Pallets	7	$80	$12	$638
Pallet bins	7	$271	$41	$2,157
Plastic crates, collapsible	92	$25	$4	$2,605
Plastic crates, non-collapsible	83	$15	$2	$1,435
Subtotal				$7,122
Year 3				
One-time Costs	Quantity	Unit Cost	Tax/ Freight	Annual
Pallets	7	$80	$12	$638
Pallet bins	7	$271	$41	$2,157
Plastic crates, collapsible	92	$25	$4	$2,605
Plastic crates, non-collapsible	83	$15	$2	$1,435
Subtotal				$6,834
Annual Costs				
Additional Truck Rental				$3,250

Years 4-10		
Cost Item		Notes - Factors used in Initial Cost Analysis
Transportation cost	0.50%	of revenue (one truck and three automobiles)
Advertising and promotion	1.50%	of revenue
Insurance and legal	0.50%	of revenue
Permits and licenses	0.20%	of revenue
Misc. annual supplies	0.75%	of revenue (Includes pallets, bins, baskets, hair nets, paper towels, etc.)
Other Misc. Expenses	6.30%	of revenue
Utility Cost	1.50%	of revenue
Subtotal	11.25%	of revenue
Maintenance supplies	2.00%	2% of equipment cost

TABLE C-2. HUB CAPITAL COST AND FINANCING ESTIMATE											
Cost Investment Category[1,2]	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Total Costs**
Real Estate Site Cost		$262,500									
Building Improvements[3]			$1,425,521			$392,000					$1,817,521
Refrigeration			$555,012								$555,012
Processing Equipment		$498,482		$144,966	$245,150	$48,000					$936,598
Other Equipment and Systems[4]		$59,200	$528,490	$275,880	$2,000	$240,000	$328,000				$1,433,570
Produce Handling/Storing Equipment					$175,480						$175,480
Fire Protection			$193,602								$193,602
Hard Costs Subtotal		**$557,682**	**$2,702,625**	**$420,846**	**$422,630**	**$680,000**	**$328,000**	**$0**	**$0**	**$0**	**$5,111,783**
Permits and Testing			$153,893	$2,353	$2,113	$3,400	$3,765				$165,524
Engineering (@8% of capital cost)		$260,825		$33,668	$33,810	$54,400	$26,240	$0	$0	$0	$664,532
Construction Management (@5%)			$163,015	$21,042	$21,132	$34,000	$16,400				
Capital Investment Total		**$818,507**	**$3,019,533**	**$477,909**	**$479,685**	**$771,800**	**$374,405**	**$0**	**$0**	**$0**	**$5,941,839**
Contingency (@10%)		$81,851	$301,953	$47,791	$47,968	$77,180	$37,441	$0	$0	$0	$445,638
Project Grand Totals		**$1,162,857**	**$3,321,487**	**$525,700**	**$527,653**	**$848,980**	**$411,846**	**$0**	**$0**	**$0**	**$6,798,523**
Estimated Equity Investment		$495,071	$664,297	$105,140	$105,531	$169,796	$82,369	$0	$0	$0	$1,622,205
Debt-Financed Capital Costs		$667,786	$2,657,189	$420,560	$422,123	$679,184	$329,476	$0	$0	$0	$5,176,318
Cumulative		$667,786	$3,324,975	$3,745,535	$4,167,658	$4,846,842	$5,176,318	$5,176,318	$5,176,318	$5,176,318	
Estimated Debt Service Costs[5]		($96,028)	($477,185)	($533,879)	($593,982)	($691,048)	($737,460)	($736,991)	($736,991)	($736,991)	

Notes:

[1]Suggested detailed items for inclusion in each category are illustrated in the detailed FoodPro International capital cost estimate.

[2]Investments beyond the first few years are speculative and will be driven by the success in implementing the firm's business plan, achieving sales goals and securing financing.

[3] Includes core and shell improvements, such as structure modifications, general mechanical, engineering and plumbing and most furniture, fixture and equipment.

[4]Includes power services upgrades, crates, pallets, scales and lifts, compressed air, cleaning and maintenance equipment and external improvements, except items included in the operating costs.

[5]Annual debt service estimate is calculated as though a line of credit is expanded each year to accomodate 80 percent the annual increment of capital expense. The remaining 20 percent is assumed to be funded through equity investments.

TABLE C-3. HUB PERSONNEL COST BY EMPLOYMENT TYPE												
			Year 1		Year 2		Year 3		Year 4		Year 5	
	Hourly Rate	Workers Comp, Benefits, etc. @ 0.40*	Total Annual Hours	Annual Cost	Total Annual Hours	Annual Cost	Total Annual Hours	Annual Cost	FTE (Full Time Equivalent)	Annual Cost	FTE (Full Time Equivalent)	Annual Cost (2080 Hrs)
Management Staff												
Facility/Marketing Mgr.	$27.00	$10.80	2,080	$78,624	2,080	$78,624	2,080	$78,624	1.00	$78,624	1.00	$78,624
Supervisor	$20.00	$8.00	910	$25,480	1,820	$50,960	2,080	$58,240	1.00	$58,240	1.00	$58,240
Professional Staff/Services												
Buying Agent	$20.00	$8.00	2,080	$58,240	2,080	$58,240	2,080	$58,240				
Sales and Marketing	$20.00	$8.00	2,080	$58,240	2,080	$58,240	2,080	$58,240	2.00	$116,480	2.00	$116,480
Bookkeeper	$20.00	$8.00	780	$21,840	1,560	$43,680	2,080	$58,240	1.00	$58,240	1.00	$58,240
Admin. Assistants	$12.00	$4.80							1.00	$34,944	2.00	$69,888
Agricultural Advisor	$20.00	$8.00							1.00	$58,240	1.00	$58,240
Outside Accountant	$60.00		96	$5,760	96	$5,760		$0				$0
Skilled Labor												
Operator-Receiving Station	$15.00	$6.00							1.00	$43,680	1.00	$43,680
Truck Driver(s)	$15.00	$6.00	260	$5,460	520	$10,920	1,040	$21,840	1.00	$43,680	1.00	$43,680
Misc. Skilled	$15.00	$6.00							2.00	$87,360	5.00	$218,400
Unskilled Labor												
Full Time Class 1	$12.00	$4.80					4,160	$139,776	2.00	$69,888	2.00	$69,888
Full Time Class 2	$10.00	$4.00							7.00	$203,840	15.00	$436,800
Part Time Class 1*	$10.00	0.1056/$100	1,820	$18,200	1,820	$18,200			2.00	$41,600	3.00	$62,400
Workers Comp Class 1				$19.22		$19.22		$0.00		$43.93		$65.89
Part Time Class 2												$0.00
Workers Comp Class 2												
Total Estimated Personnel Costs			**10,116**	**$271,863**	**12,056**	**$324,653**	**13,520**	**$368,368**	**22.00**	**$894,860**	**35.00**	**$1,314,626**

*For part time employees only workers compensation costs are estimated based on Job Class 2123 (Avg. premium 0.1056/$100 payroll). More information on workers compensation insurance can be found at http://www.dir.ca.gov/dwc/employer.htm

APPENDIX D. Bibliography of Business Model and Financial Analytic Tools – Reports and Resources Guides

- Aubrey, Sarah. Indiana Foods, *Indiana Success: Central Indiana Food Hub Feasibility Study,* Prosperity Ag and Energy Resources. August, 2012
- Barham, James, and Tropp, Debra, et al. *Regional Food Hub Resource Guide*, US Department of Agriculture, Agricultural Marketing Service, Washington, D.C. April, 2012
- Brigham, Eugene F. *Fundamentals of Financial Management, Seventh Edition,* The Dryden Press. Orland, FL. 1995
- California Financial Opportunities Roundtable. *Access to Capital,* a guidebook. August, 2012.
- Cantrell, Patty and Heuer, Bob. *Food Hubs: Solving Local, Small-Farm Aggregators Scale Up With Larger Buyers*, Wallace Center at Winrock International. March, 2014, Retrieved from http://ngfn.org/solvinglocal
- Central Oregon Intergovernmental Council. *Central Oregon Food Hub Feasibility Study*. 2012
- Dane County Planning and Development Department. *Southern Wisconsin Food Hub Feasibility Study*. September, 2011
- Fischer, Micaela and Hamm, Dr. Michael, et al. *Findings of the 2013 National Food Hub Survey,* Michigan State University-Center for Regional Food Systems and The Wallace Center at Winrock International. September, 2013
- Hill, Brian and Power, Dee. *The Pocket Small Business Owner's Guide to Business Plans*, Allworth Press. New York, 2013
- Illinois Department of Commerce and Economic Opportunity, et al*. Building Successful Food Hubs, A Business Planning Guide for Aggregating and Processing Local Food in Illinois*. January, 2012
- Jalonick, Mary Clare. "Locally-Grown Foods Look to Bigger Business," The Wall Street Journal. July 16, 2014
- Klein, Kendra. *Farm Fresh Healthcare Project How-To Guide,* Community Alliance with Family Farmers (CAFF), and Health Care Without Harm, with support of the Kaiser Permanente Community Benefit Program. Spring, 2014
- Leavenworth, Stuart. "What Local Governments can do To Make Farm to Fork Real," Sacramento Bee. September 21, 2013
- Matson, James, Sullins, Martha, and Cook, Chris. *The Role of Food Hubs in Local Food Marketing,* US Department of Agriculture-Rural Development, Washington, D.C. January, 2013
- Ramsey, Dan and Windhaus, Stephen. *The Everything Business Plan Book*, Adams Media, Avon, MA. 2009
- Red Tomato. *Feeding Ourselves: Strategies for a New Illinois Food System*. July, 2004
- Sacramento Area Council of Governments, *Impediments to Supplying Locally Grown Food.* July, 2014
- Sacramento Area Council of Governments. *Sacramento Region Rural Land Use Assessment: Current Conditions and Innovations Summary.* June 2010.
- Sacramento Farm Bureau. "Regulatory Burden," prepared for the Sacramento County Board of Supervisors. 2013
- Tracy, Tage C., CPA and Tracy, John A., CPA. *Small Business Financial Management Kit for Dummies*, Wiley Publishing, Inc., Indianapolis, IN. 2007
- Urban Food Link. *Food Processing in Western Washington: A Review of Surveys on Agricultural Processing Infrastructure and Recommendations for Next Steps*, City of Seattle's Office of Sustainability and Environment. December, 2012
- Vanderburgh-Wertz, Darrow and Malini Ram Moraghan. *Food Hub Business Assessment Toolkit*, Wholesome Wave. March, 2014, retrievable at http://wholesomewave.org/hfcibusinessassessmenttoolkit/
- Zhang, Tara. *A Seamless Online Information Service for Business Regulations*, Prepared for USDA Rural Development California; study conducted for program at the Goldman School of Public Policy, University of California at Berkeley. Draft May 2014, forthcoming

A project of the Rural-Urban Connections Strategy

SACRAMENTO REGIONAL AGRICULTURAL INFRASTRUCTURE PROJECT

Yuba County Specialty Crop Case Study

July, 2014

Prepared by:

Sacramento Area Council of Governments

In partnership with:

Applied Development Economics, Inc.
Foodpro International, Inc.
The Hatamiya Group
DH Consulting

INTRODUCTION

Agriculture is a way of life in Yuba County and continues to be the cornerstone of the local economy. As stated in the County's 2030 General Plan, "agriculture represents the single most important economic activity and most prevalent land use in Yuba County."[1] Even when compared to other farming regions agriculture's contribution to the local economy stands out: over 11.5 percent of gross regional product in the Yuba Metropolitan Statistical Area[2] comes from the direct value of farm output alone (not including agriculture's substantial multiplier effect), a rate significantly higher than the rest of the Sacramento Valley. Indeed, the relative contribution of agriculture to gross regional product in the Yuba area is 50 percent higher than in the Fresno or Bakersfield MSAs, the state's largest agricultural regions by output.[3]

Despite agriculture's centrality to both the local economy and way of life, working landscapes in Yuba County are undergoing major changes as market forces, policy and environmental conditions shift. As a result, agricultural lands often face pressure from competing uses, in particular urban land development. Like other growing areas, Yuba County aims to balance agriculture and other land uses to accommodate long-term population growth, preserve quality of life and foster economic development.

This case study on current and possible future specialty crop production in Yuba County provides information, data and economic modeling results that may help the County in assessing land use planning and economic development strategies. The study applies the tools developed as part of SACOG's Agricultural Infrastructure project to Yuba County. In addition to an updated crop modeling platform these tools include refined local specialty crop consumption and production estimates, fiscal results of various land use scenarios, and financial feasibility tools to respond to market opportunity. While the County is the primary audience for the study, we anticipate these tools will have relevance to local specialty crop growers and investors as well and transferability to other counties or regions.

The first section of the case study identifies existing conditions in Yuba County's agriculture cluster and how possible changes in market and natural resource conditions may affect cropping patterns and agricultural viability. The study also highlights specialty crop production for the local market and associated agriculture infrastructure as a burgeoning economic opportunity. The second section of the case study assesses this local market scenario compared to other possible future cropping patterns reflecting changes in market demand and management objectives. This second section also compares these possible agriculture futures in the context of urbanization using SACOG's fiscal impacts model. The modeling results provide the County data and comparison across numerous fiscal and economic metrics for land use and economic development strategies. Finally, the case study concludes with a section showcasing opportunities to leverage specialty crop agriculture as a form of economic development in Yuba County.

---

[1] Yuba County 2030 General Plan, Chapter 7 Natural Resources Element-16.

[2] The Yuba MSA includes both Yuba and Sutter counties.

[3] Bureau of Economic Analysis, Gross Domestic Product by Metropolitan Area. For year 2011 in current dollars. http://www.bea.gov/regional/index.htm

KEY FINDINGS

Market Scan

- The last two years have provided record levels of agricultural production in Yuba County, helping fuel economic recovery from the recent recession.
- Yuba County's water supply and soil quality can support a broad array of specialty crops. Currently major export commodity production dominates the county's agriculture sector. Between 2008 and 2012 growers added more acres of walnuts than any other crop in Yuba County. The county appears to be well positioned to capitalize on a range of market opportunities.
- Specialty crop production geared to local consumption represents a growing and largely untapped market opportunity in Yuba County and the greater Sacramento region, yet barriers inhibit growth in this market segment.
- Local agriculture infrastructure such as a food hub can help overcome these barriers and capitalize on the burgeoning local food system. The case study shows a conceptual food hub (aggregation, processing, storage, and distribution) in Yuba County is a financially feasible business endeavor, generating a positive annual cash flow of nearly $2 million and over 11 percent return on investment by the tenth year of operation. Even a scaled-down hub that processes only walnuts and acts only as a way station for other specialty crops appears to be economically viable.

Scenario Analysis: Possible Agriculture Futures

- A regional-serving food hub would require around 530 acres of dedicated specialty crop production, depending on the facility's crop mix and number of processing lines; the county's existing crop acreage could easily support this total, even within currently fallow agricultural land. Growers supplying specialty crops to the single facility in aggregate would also earn estimated profits of $2.4 million. The hub could meet the full fruit and vegetable consumption of 13,165 people, or a smaller proportion of that consumption to a larger number of people (e.g., a quarter of annual fruit and vegetable consumption of 52,600 people).
- A variety of future cropping patterns illuminate the full economic potential of the county's agriculture sector as market, natural resource and social factors fluctuate. A shift to high value crops within the existing cropping pattern (e.g., orchard lands stay in orchards, but switch to highest value orchard crop) could increase the sector's gross farm gate value by two-thirds, from about $350 million to reach $591 million a year.
- Further economic objectives include maximizing return on investment (ROI) to farmers. A study scenario that tested crops that have the highest return shows a cropping pattern that produces a 43% ROI on average for farmers. This cropping pattern, however, has a more limited market and may not have the same economic impact on the entire agriculture industry since it supports less diversity in processing and other related businesses.
- In comparison, the scenario that tested extensive specialty crop production generated the highest value by far, as well as a high return on investment. Compared to the base, the specialty crop scenario

quadruples overall value, increases average ROI and actually decreases agricultural water consumption by 78,000 acre-feet. A greater diversity of economic activity could occur in this scenario since processing and other related activities could generate a greater multiplier effect throughout the county. To reach these economic levels, however, the scenario results in significant additional labor demand.

- Environmental considerations are equally as important as economic ones when analyzing specialty crop production. A scenario that tested crops with low water demand cuts water consumption by half, but also reduces agricultural value $73 million from today's base conditions. Likewise, agriculture labor hours in the county fall by nearly 50 percent in the low water scenario compared to the base. This analysis highlights the positive correlation between agricultural value, water consumption and labor demand (i.e., they tend to move in the same direction). Generally, higher agricultural values and returns require more water and labor supply.

- Finally, the project's analysis of land use alternatives illuminates economic and fiscal results of agricultural land conservation in Yuba County. Fully urbanizing all land designated for development would lead to a loss of over $17 million in direct agriculture output, based on current cropping patterns, while adding municipal infrastructure costs. Other urbanization scenarios conserve more working lands; fiscally these scenarios also reduce estimated infrastructure and operational costs For example, the case study's infill scenario has capital infrastructure costs $100 million lower than the full urbanization scenario and lower annual operations and maintenance obligations.

Opportunities to Leverage Agriculture to Expand Economic Development in Yuba County

- **Growers**

    - Yuba County is well positioned to grow a diversity of crops for a range of markets. Expanding national and international demand for agricultural products presents continued opportunity for growers in the county, given that commensurate water and labor supply is available.

    - The local market represents an emerging opportunity, yet the success of this system is predicated on a sufficient supply of local specialty crop production. Growers in Yuba County have noted that they need to see a strong market signal to decide to produce specialty crops for the local market.

    - The regional Agricultural Infrastructure project being conducted by SACOG provides detailed evidence of the burgeoning local market opportunity, including untapped local demand and price points for local specialty crops. The financial pro forma shows farmers in aggregate will be profitable growing at estimated prices offered by a prototypical food hub facility. This work helps document the competitiveness of specialty crop production.

- **Yuba County**

    - Farmers don't have to shoulder the entire risk of building up the local food system. Yuba County can continue to support initiatives such as the grower-institution matchmaking of the Yuba-Sutter Economic Development Corporation, as well as work to update policy to support local food production such as allowing more uses on agriculturally zoned parcels. The impediments report, which is part of the larger agriculture infrastructure study, highlights other incentives the County could employ to support specialty crop production and a food hub.

- County land use planning plays a paramount role in agricultural viability. The case study model analysis estimates the extent to which economic returns of agriculture production scenarios are diminished as agricultural acres are removed from production. Modeling results also provide quantifiable metrics on the estimated cost and revenue from various urban land use possibilities. Pending work on re-estimating economic multipliers for agriculture will provide a more detailed measure of economic activity related to agriculture.

- **Investors**
  - The Agricultural Infrastructure project provides a suite of business tools that help inform investment decisions. In addition to that project's detailed pro forma and business plan, this case study reports the financial feasibility of an alternative conceptual food aggregation facility customized to Yuba County.
  - The RUCS modeling platform estimates grower revenue and costs by various future conditions such as drought, establishment, or changing market price. These data can also be of use to help steer investment to specialty crop production.
  - A prototypical food hub serving the Sacramento Valley requires a cash investment of $3.5 million and becomes cash positive by the end of the fourth year, rising to a nearly $2 million positive annual net cash flow by the tenth year of operation. Over the course of the pro forma, the facility gives a nearly 25 percent Internal Rate of Return.

YUBA COUNTY'S AGRICULTURE SECTOR

MARKET SCAN

> The region's $2 billion agriculture sector has emerged from the recession well positioned to capitalize on favorable market trends.

During the recent recession agriculture was one of the few bright spots in the regional economy and has helped to fuel economic recovery—in Yuba County the last two years have provided record levels of agricultural production, showcasing the strength of the local agricultural sector.[4] Yuba's neighboring counties in the Sacramento Valley also evince a similar trend of record agricultural value, illustrating the vitality of the regional agriculture sector. For example, Yolo County's gross value of agriculture production in 2012 was at an all-time high and an increase of 17.5 percent from the previous year.[5] In 2011 Sacramento County witnessed its highest ever level of crop production value, a level that was surpassed the following year.[6] Indeed, agriculture in the six county region produced nearly $2 billion of value from farmgate production alone in 2012, the highest level recorded.[7] This total does not include the additional contribution of processing, transport or other value-added activities tied to the agricultural sector, nor the increasing value of ecosystem services provided by working landscapes. In short, the region's agricultural sector has emerged from the recession well positioned to capitalize on growing demand and higher international market prices for commodities.

CURRENT CONDITIONS- COMMODITY PRODUCTION IN YUBA COUNTY

As with other parts of the region, export commodity production currently dominates Yuba County's agriculture industry. SACOG's Agriculture Infrastructure project estimates that 98 percent of the county's estimated $350 million agriculture output is exported, including commodities destined for national and overseas markets.[8] To analyze this current cropping pattern SACOG created a field-level crop map for Yuba County with the most recent 2012 data from the Pesticide Use Report from the California Department of Pesticide Regulation supplemented by satellite imagery. This map is the "base case" scenario against which future scenarios are compared as described below. The crop map results illustrate how specialty crops serve as part of a larger agricultural system in Yuba County. Of the 281,093 agriculture acres in the county, timber encompasses 72,519 and rangeland/pasture another 114,232, with 94,342 acres of crop production. The map on the following page shows the location of major crop production in the county: half of crop coverage in the county comes from rice, but specialty crops round out the next most prevalent, with walnuts, prunes, peaches, almonds and pears the next largest crops by acreage.

---

[4] Yuba County Department of Agriculture, "2012 Crop Report."

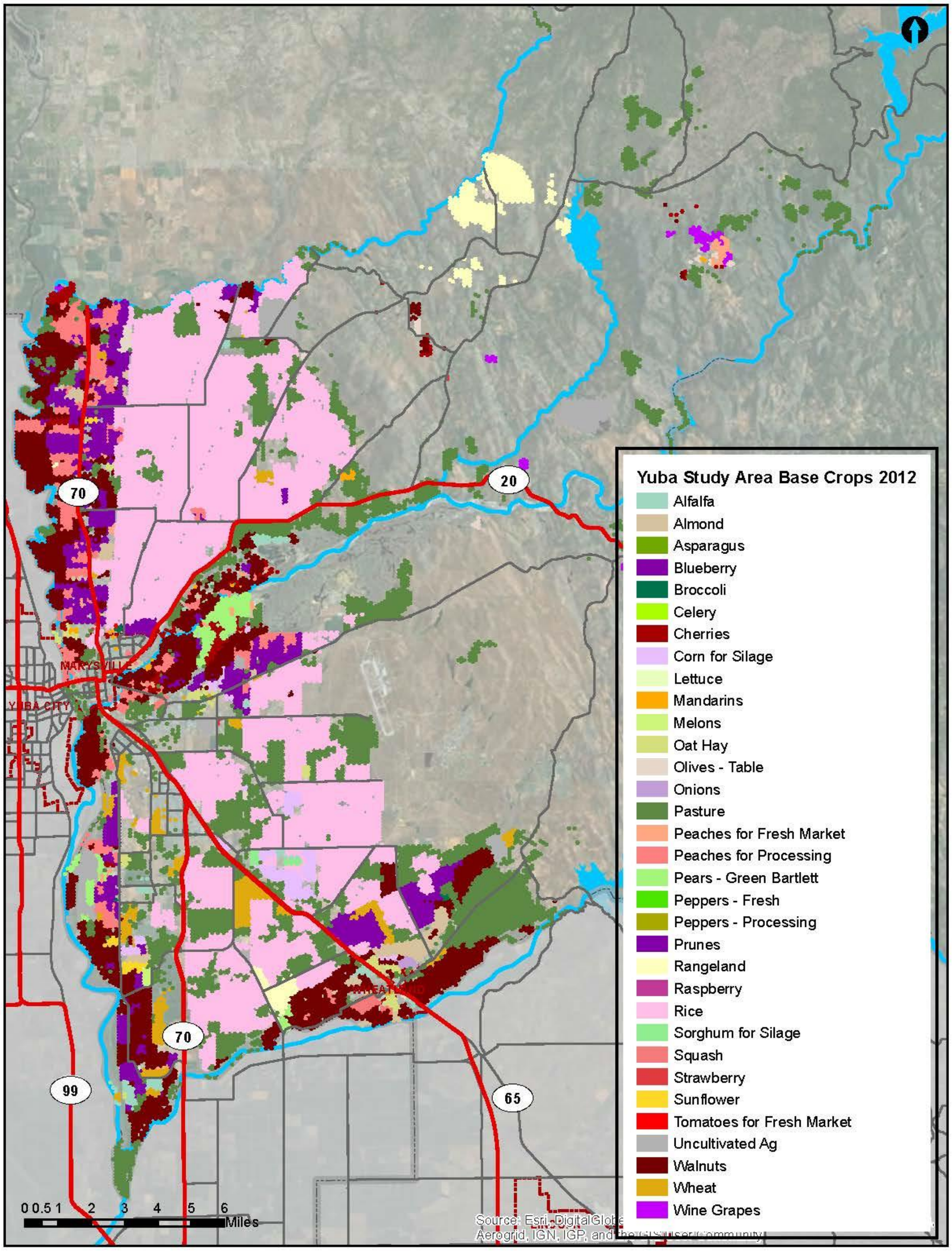
[5] Yolo County Department of Agriculture and Weights & Measures, "Yolo County 2012 Agricultural Crop Report."

[6] Sacramento County Department of Agriculture, "Sacramento County 2012 Crop & Livestock Report."

[7] SACOG analysis of 2012 County Crop Reports.

[8] SACOG Regional Agricultural Infrastructure Project, "Policy Brief: Food Hub Trends and Characteristics." 2014.

2012 Field-Level Yuba Crop Map



The project team compared SACOG's 2012 Yuba Crop Map to the initial 2008 version. The review found the largest change between these periods came from walnut planting, as this crop has exhibited marked increases in market value recently. Since 2008 growers in the county have added around 1,500 acres of walnuts. During this time walnuts have replaced rice as the county's top commodity by value.

2012 Top Yuba County Crops by Acreage

Crop	2012 Acres
Rice	48,972
Pasture	26,612
Walnuts	16,570
Prunes	10,202
Peaches	4,268
Almonds	1,519
Pears	1,410
Source: SACOG 2012 Crop Map	

2012 Top Yuba County Crops by Value compared to 2008 Inflation-Adjusted Levels

Crop	2008 Value (in $2012)*	2012 Value	Percent Change 2008 to 2012
Walnut	$18.6 million	$59.5 million	220%
Rice	$87 million	$57 million	-34%
Prunes	$22.1 million	$25.7 million	16%
Peaches	$12.5 million	$16.5 million	32%
Kiwifruit	$3.5 million	$4.5 million	28%
Pasture	$4.32 million	$4.3 million	-0.5%
Almonds	$1.4 million	$2.8 million	100%
**2008 values adjusted into 2012 dollars to account for inflation. Adjustment based on Bureau of Labor Statistics Inflation Calculator*			
Totals exclude milk, cattle and timber. Source: Yuba County 2008 and 2012 Crop Report			

NATURAL ASSESTS SUPPORTING COUNTY AGRICULTURE

Yuba County's abundant agricultural output benefits from physical attributes such as good soils, mild climate, water availability and transportation connectivity. A look at Yuba County's soil quality and water supply in particular—two of the most important physical factors determining agriculture production in California— provides a measure of what forms of production are feasible in the county. This review shows an environment capable of supporting further specialty crop production, giving local growers a wide range of production modes and crop mix, and flexibility to respond to changing market signals.

WATER

Relative to other portions of California, Yuba County is water-rich.[9] Data provided by the Yuba County Water Agency (YCWA) show the vast majority of crops in the county are irrigated, either through surface water, ground water, or a mixture of the two.[10] Reclamation District 10, one of the county's most productive agricultural areas, is one of the few major agricultural areas in the county still dependent primarily on groundwater. [11] Yet overall, Yuba County agriculture relies primarily on surface water, and YCWA delivers 310,000 acre-feet of water a year to eight local irrigation districts in the county covering 79,590 acres.[12] According to YCWA's most recent budget, the base rate for wholesale water transfer to member units is $1.93 per acre-foot, plus an additional $2 for supplemental transfer.[13] Each individual irrigation district charges its own rate to the end agricultural user, and while costs can vary significantly even between districts within the Sacramento Valley[14], these low wholesale rates can translate to low water costs for agriculture in Yuba County. For example, the current 2014 cost of delivered water in the Browns Valley Irrigation District—one of those wholesaled by YCWA—stands at $16.20 per acre-foot of water for the approximately 1,300 agricultural users in the district.[15] In comparison, a snapshot of recent data from the University of California show much higher water costs for specialty crop production in other major agriculture areas of the state: $170 per acre-foot for production in Ventura County, $260 in the central coast, and $129 in the

---

[9] Yuba Local Agency Formation Commission, "Municipal Service Review Findings." July 24, 2008.

[10] State of California Department of Water Resources, "Metadata for the Yuba County Land Use Survey Data." Division of Planning and Local Assistance, May 20, 2013.

[11] SACOG analysis of DWR data and the 2012 crop map.

[12] Yuba County Water Agency website; Yuba Local Agency Formation Commission, "Municipal Service Review Findings." July 24, 2008 and Yuba County Water Agency, "Agricultural Water Management Plan." December 2012.

[13] Yuba County Water Agency, "Agricultural Water Management Plan." December 2012.

[14] Christopher A. Greet et al., "2012 Sample Costs to Produce Rice: Sacramento Valley." University of California Cooperative Extension, 2012, p4.

[15] Browns Valley Irrigation District 2014 Budget. Approved February 27, 2014; GEI Consulting, "Yuba County Integrated Regional Water Management Plan." Submitted to Yuba County IRWMP Water Management Group.

southern San Joaquin Valley.[16] In interviews conducted for the project, growers noted that the water prices in the state have spiked relative to the above 2011 costs, especially given the recent drought.

An abundant water supply relative to other agriculture areas also provides stability, which is especially beneficial for water-intensive specialty crops. The recently constructed Yuba-Wheatland Canal expands surface water irrigation to a segment of the county previously reliant on groundwater, mitigating groundwater overdraft in the southern portion of the county and helping preserve groundwater aquifers for dry years. The canal improves the reliability of water supply, carrying up to 205 cubic feet per second of surface water to service local growers.[17] On a county-wide level, the recently established Lower Yuba River Accord provides consensus and stability for water diversions moving forward. This accord balances uses on the river, increasing higher minimum instream flows on the lower Yuba River for fish and wildlife purposes while providing steady water supply for irrigation and power generation. Importantly, the accord overcame several decades of litigation to reach consensus on flows on the lower Yuba River. [18]

SOIL

In addition to a relatively enviable water supply, agriculture in Yuba County also benefits from good soil quality that supports major specialty crop production. The project team obtained detailed county soil quality data and information from USDA's Natural Resources Conservation Service. This source covers over 95 percent of the United States and represents the single authoritative source of soil survey information. According to this data source, almost all of the valley floor consists of loam soil with no or slight slopes. The best soils for widespread specialty crop production –based on USDA's Official Soil Definition Series soil quality definitions—come from the multiple river loams in the county. In addition, the project's soil review found that soil on the valley floor farther away from the rivers can also support a wide variety of specialty crop production.[19] For example, with over 57,500 acres in agriculture production (and another 19,000 developed by urban use), San Joaquin loam soil is the most widespread soil in the county. Currently about half of this soil type in the county is in rice production, followed by pastureland, prunes, wheat, walnuts, peaches, almonds and corn, with smaller acreage in olive, citrus, pears, mixed vegetables, strawberries, pecans, persimmons, pumpkins, alfalfa and clover production.[20] This diversity of crop type illustrates growers' ability to produce a wide variety of crops—including specialty crops—on the county's most widespread

[16] Etaferahu Takele et al., "Costs and Profitability Analysis for Bell Pepper Production in the Oxnard Plain, Ventura County, 2012-12." University of California Agriculture and Natural Resources. Mark P. Bolda et al., "Sample Costs to Produce Second Year Strawberries: Central Coast Region." University of California Cooperative Extension, 2011. Neil V. O'Connell et al., "2011 Sample Costs to Establish a Citrus Orchard and Produce Mandarins: San Joaquin Valley- South." University of California Cooperative Extension.

[17] Yuba County Water Agency, "Yuba-Wheatland Canal Project Summary."

[18] Water Education Foundation, "The Lower Yuba River Accord: From Controversy to Consensus." 2009.

[19] The three most widespread soils in the valley floor are San Joaquin, Conejo and Kimball loans. Other prominent soils include Columbia, Hollenbeck, Holillipah, Kilaga and Shanghai loams. See USDA's Official Soil Definition Series for a full classification of these and every soil in the county. https://soilseries.sc.egov.usda.gov/

[20] 2012 SACOG crop map.

soil. Overall, SACOG's recently completed crop map combined with grower interviews show there are over 60 different crops grown at various scales in Yuba County.[21]

Local grower and agriculture stakeholder sentiment captured as part of the case study substantiate how soil capacity is not viewed as a major constraint in Yuba County's valley floor. In interviews, local growers related their capacity to grow almost any crop they wished due to favorable climate, soil and water supply. [22] And while it is harder and more expensive to grow specialty crops on heavier soils, growers could make production work if they saw the end reward of a high market price.[23] In short, growers' production choices on the valley floor have not been dictated primarily by physical constraints but instead by market signals.

In the foothills, soil type and slopes become more of a limiting factor for commodity production, but can still support smaller-scale niche agriculture. The map below shows the ten largest soil types by acreage in the county. Generally, the soils in the foothills starting with the Auburn complex do not support full-fledged agriculture. The work of the North Yuba Grown group however illustrates how smaller-scale agriculture can be successfully conducted throughout the county. The cluster of specialty crop producers near Oregon House, for example, evidence the ability to grow in a variety of conditions: USDA's soil data show this production to occur on gravelly soil with slopes between eight and 15 percent.[24] Farmers who are part of the North Yuba Grown group listed crops in production, including heirloom tomatoes, lettuce, kale, arugula, lavender, mixed vegetables and olives.[25]

In short, the study's review of natural assets supporting agriculture in Yuba County found a physical environment capable of supporting further specialty crop production but that growers need to see a market case to shift. The next section delves into the market case for increased specialty crop production in Yuba County.

[21] SACOG Crop Map and local grower interviews. While many crops are grown on a smaller scale, overall the county is dominated by a few large crops. The three largest by coverage—rice, walnuts, and prunes—account for 80 percent of all crop acres in the county (excluding pasture and timber acres).

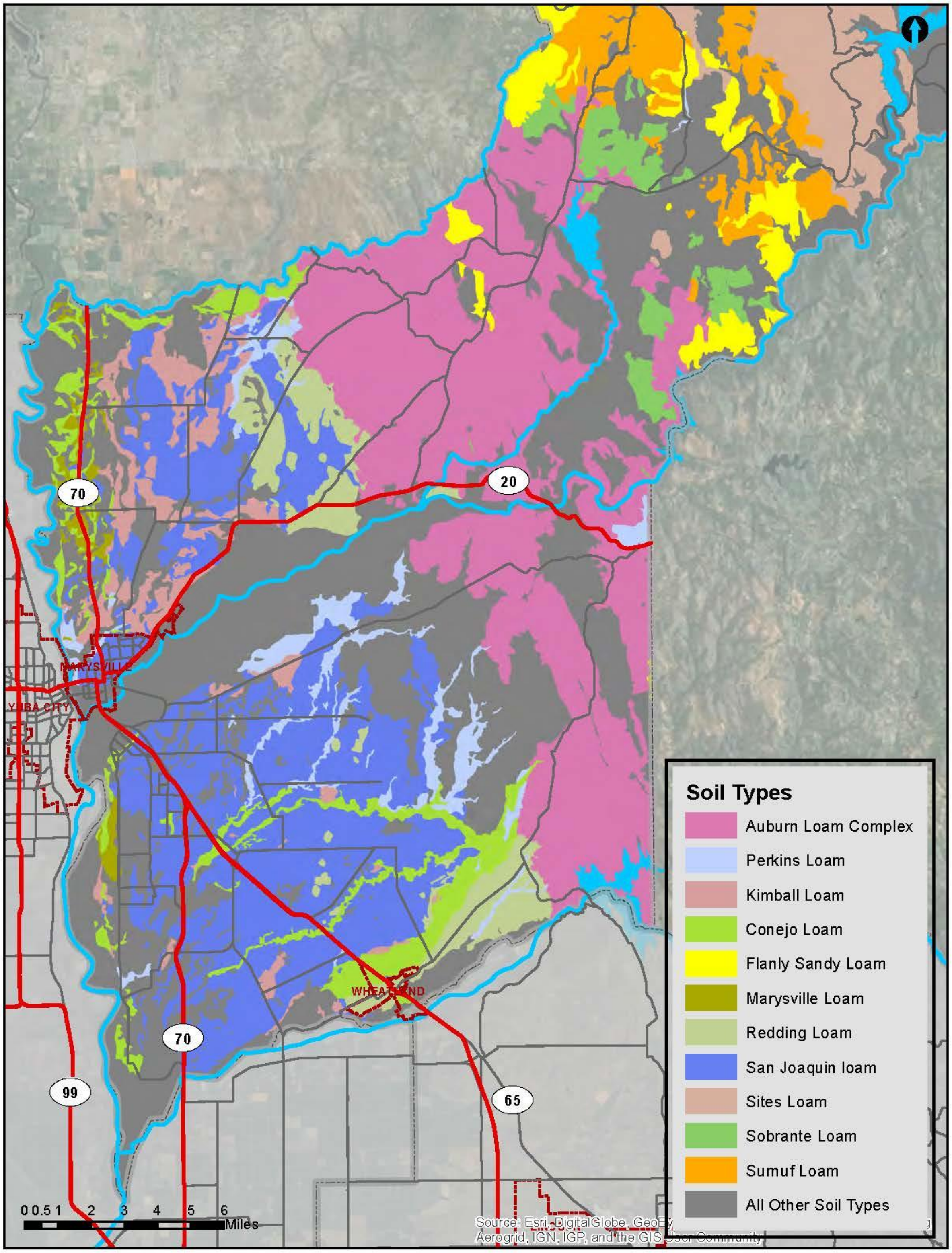
[22] SACOG Regional Agricultural Infrastructure Project, "Interview List." Prepared by Applied Development Economics, Inc. in partnership with Foodpro International, Inc., The Hatamiya Group and DH Consulting, 2014.

[23] SACOG interview with Mark Lundy, Area Agronomy Advisor, University of California Cooperative Extension: Colusa-Sutter-Yuba Counties, July 15, 2014.

[24] USDA Natural Resources Conservation Service and 2012 SACOG crop map.

[25] SACOG interview with North Yuba Grown, March 5, 2014.

Largest Soil Categories in Yuba County



Source: USDA Natural Resources Conservation Service

EMERGING OPPORTUNITY: SPECIALTY CROPS FOR THE LOCAL MARKET

Large-scale commodity production is the dominant form of agriculture in Yuba County. While commodity production for external markets will likely continue to serve as a mainstay of the county's agricultural cluster, growers increasingly can also look to capitalize on the burgeoning local market as a new economic market outlet and means to diversify, and do so on a relatively small amount of land. This section provides a market analysis around local demand, as it is not as well understood as national and international commodity markets.

EVIDENCING LOCAL SPECIALTY CROP DEMAND

Currently the greater Sacramento region consumes overs 1.8 million tons of food each year, with nearly 60,000 tons of this in Yuba County. Yet despite being one the nation's leading agricultural areas, SACOG estimates that only about two percent of food consumed in the region is grown in the region, with the remaining 98 percent imported from elsewhere. As farm-to-fork and similar trends continue to spread, local agriculture stakeholders have stressed the substantial market potential of meeting more local food demand through local production and distribution. The vast majority of this demand is for fresh fruit and vegetable specialty crops.

Several recent studies document the market demand for local product. The National Restaurant Association's 2014 Culinary Forecast identified local sourcing as the top trend in the restaurant industry this year.[26] Yet this development is not limited just to restaurants. A 2012 National Grocers Association survey for example found that over 85 percent of U.S. consumers partly base their grocery store selection on whether it carries local products while a 2014 report found that 70 percent of survey respondents will pay a premium for locally grown produce and prefer retailers that carry more locally produced items.[27] Moreover, according to a Produce Marketing Association survey by the Hartman Group in 2011, U.S. consumers increased their tendency to buy locally grown fresh fruits and vegetables by 30 percent over the previous year.[28] SACOG's interviews as part of the Agricultural Infrastructure project with over 100 growers, distributors and stakeholders in the region echo these findings: local sourcing is a major market trend in the region.

Yuba and Sacramento Region Annual Food Consumption

Food Group	Yuba County Food Consumption (tons per year)	SACOG Regional Food Consumption (tons per year)
Fruits	11,888	384,828
Vegetables	20,642	668,204

[26] Farm Futures, "Local Food Projected to be Hot Trend in 2014," Dec 9, 2013, http://farmfutures.com/story-local-food-projected-hot-trend-2014-0-105820

[27] A.T. Kearney, "2014 Ripe for Grocers: the Local Food Movement Survey." Riemendschneider, Pamela, "Survey: Consumers want local, willing to pay premium," *The Packers*, May 6, 2014.

[28] PMA, "Consumer Survey Reveal Growing Importance of Fresh, Local and Safe Produce," January 2011, http://www.pma.com/resources/research-center/consumer-trends/consumer-survey-article

Meat	6,972	225,678
Nuts	184	5,959
Eggs	1,488	48,178
Grains	3,549	114,877
Fats/Oils	1,030	33,357
Dairy	9,633	311,833
Sugars	3,150	101,978
Total Consumption	**58,536**	**1,894,892**
For primary food weight. Source: SACOG Food Consumption Calculator, 2014		

While definitions vary, market channels for Yuba's 'local' specialty crop production extend at least to the contiguous six counties of the region and can even reach the population centers of the Bay Area.

As the above table illustrates, fruits and vegetable specialty crops account for the majority of total food consumption by primary weight each year in the region. For these specialty crops in particular the region experiences a marked supply/demand imbalance between local production and consumption. The table below estimates the number of acres in Yuba County devoted to several specific specialty crops compared to how many acres would be needed to meet current demand in both Yuba County and the entire six-county region. This analysis shows opportunities to expand local specialty crops to meet demand in the county, but tellingly, also areas to tap into greater regional demand. Local growers and stakeholders interviewed as part of this case study often equated the local market to Yuba and Sutter Counties, but not the other counties of the Sacramento region. This local market conception excludes the nearby consumption centers and thus major market opportunities. SACOG's Agricultural Infrastructure project found that because of its great diversity of crops, favorable climate and other assets, the market shed for a producer to be deemed 'local' in Yuba County is at least 100 miles, and can even extend to neighboring regions such as the Bay Area. As such, the final column in the below table illustrates the significant market opportunity in growing specialty crop for the greater Sacramento region, and the need to increase market channels to tap into this existing demand.

Examples of Local Market Supply/Demand Specialty Crop Imbalance

Crop	Acres in production in Yuba County	Acres needed to match Yuba County consumption	Acres needed to match regional consumption
Apples	19	251	8,129
Asparagus	0	53	1,721
Bell Peppers	1	10	323
Blueberries	2	18	570
Broccoli	3	46	1,497
Carrots	0	29	940
Kale	1	9	307
Lettuce	7	85	2,755
Lima Bean	0	29	940
Onions	4	32	1,028
Spinach	0	16	522
Squash	3	22	729
Sweet potatoes/Yams	1	24	770

Source: 2012 Agriculture Census, USDA NASS 8 year average yields, SACOG food calculator and County Agriculture Commissioner

BARRIERS GROWING FOR THE LOCAL MARKET

Despite the potential referenced above, farmers growing specialty crops for the local market face serious challenges compared to conventional commodity production. A related report included in SACOG's Agriculture Infrastructure study, "Impediments to Supplying Locally Grown Specialty Crops," discusses these barriers at length. The below section summarizes four of those challenges—**policy**, **market access, operating infrastructure** and **farmer reluctance**—most pertinent to Yuba County.

Policy

The rapid expansion in local market demand—epitomized by the region's branding as the nation's Farm-to-Fork capital—represents a relatively recent change that raises new grower needs and support. Stakeholders in Yuba County have made significant strides responding to this new market development. The Yuba-Sutter Economic Development Corporation for example is assisting the North Yuba Grown group with a local Agriculture Tourism project while the Yuba-Sutter Farm Bureau convenes young farmers with an eye towards niche markets.[29]

> Zoning changes supporting flexible mixed use on rural agriculture parcels that allow light processing and agri-tourism uses can help fully capitalize on Yuba County's growing market opportunity.

Even with these steps, current and potential specialty crop growers in Yuba County expressed that more could be done from a policy standpoint to foster a vibrant local market. In particular, interviewees pointed to current zoning as a possible barrier that could inhibit small local operations from expansion. Examples include growers wishing to convert a barn on the property into a farm store, but finding sales on rural agriculture parcels prohibited, or the desire to approve farm stays so agri-tourists coming to the county would have places to stay. Zoning changes supporting flexible mixed use on rural agriculture parcels to allow light processing and agri-tourism uses can help fully capitalize on the growing market opportunity. An estimated 200,000 people a year come to Yuba County for recreation activities; supportive zoning can help channel this recurring demand to the county's nascent local food system. Butte County's agricultural overlay land use and zoning designation allows visitor-serving commercial uses, farm stays, education and specialty produce retail in agricultural areas and serves as one possible model of how a nearby county has supported its local food system.[30]

Market Access

Unlike in contract agriculture, specialty crop growers focused on local markets are seldom provided the security of a guaranteed outlet for their product. While growers expressed concern that some common market outlets—chiefly farmers markets and Community Supported Agriculture (CSAs)—may already be saturated at the regional level, these same channels may be underdeveloped specifically in Yuba County. Furthermore, growers have found it difficult to navigate procurement policies at local institutions.

Operating Infrastructure and Costs

Large-scale commodity production still dominates Yuba County's agriculture sector and the region's current agriculture infrastructure reflects this export orientation. Through interviews, growers identified the shortage of

---

[29] SACOG interview with Brenda Stranix, Yuba-Sutter Economic Development Corporation, and SACOG interview with Megan Foster, Yuba-Sutter Farm Bureau and Yuba County Supervisor Roger Abe, February 21, 2014.

[30] Butte County General Plan, Element 7- Agriculture.

agriculture and food infrastructure tailored to regional aggregation, handling, processing and distribution as a primary constraint in meeting demand for more locally grown specialty crop. In particular, growers expressed the lack of mid-scale produce handling and processing capacity as a major constraint— growers will not produce for the local market if they do not see a viable supply chain infrastructure that enables their product to efficiently reach consumers. The subsequent section focuses on the financial feasibility and structure of a food hub to provide needed local agriculture infrastructure.

In addition to off-farm infrastructure challenges, growers shifting production to new crops incur substantial costs on the farm. Costs of crop conversion include capital establishment expenses as well as the time needed to get the new crop to mature yield levels. These costs do not apply solely to new farmers; even established growers need to make capital investments when switching crops.

The recent increase in walnut production provides valuable insight into the challenges expanding specialty crops in the county. SACOG conducted an in-depth exploration of the economics of walnut production, which is included in this case study as a technical appendix, *Exploring Long-Term Viability of Walnut Growers*. In summary, the review highlighted the implications of converting to crops with high establishment costs and long establishment periods, such as walnuts but also other orchard or vine crops like peaches, kiwis and grapes.

For example, a typical grower must spend around $7,000 an acre the first year converting to a new walnut crop, to prepare the land and purchase and plant tree starts. Yearly costs decrease after the first year but the orchard still must be tended with irrigation, fertilizer and pesticide. The new walnut starts do not produce any harvest until the fourth year, and don't reach full maturity until eight years after planting. In consequence, the grower incurs significant upfront costs with a delayed return. Indeed, the analysis suggests that the average grower does not make back his initial investment in walnut production until the 11th year of operation. And if walnut prices decrease by a third, the analysis indicates the grower would still not have repaid establishment costs by year 25, when he would likely need to re-establish the crop. Overall, the analysis shows that a shift to these types of specialty crops can be financially rewarding in the long-run, but also pose risk to the grower due to high capital investment, long period to maturity and the potential for a decrease in market price. Importantly, given the uptake in walnut planting in the county, the review also shows how growers are willing to take such a risk when they see a long-term market reward. It is worth noting that even specialty crops that produce immediately—such as leafy greens, brassicas, etc.—still have significant establishment costs in terms of the capital investment needed to start or change a farm operation.

Grower Reluctance

Because of the challenges of growing local and the strength of the existing commodity system, many farmers expressed reluctance about increasing the supply of product geared to the local market. Commodity production provides stability through guaranteed contracts and over time farmers have developed strategies and knowhow to deal with this regulatory system. Given this, they have capitalized their operations to grow commodities and would have to make expensive purchases to retool for other crops. With international commodity prices high, growers need to see a strong market case for increasing local production. The various components of the regional Agricultural Infrastructure Project provide metrics and data to help growers gauge local market opportunities. Furthermore, a food hub will rely on a guaranteed steady supply of the products and volumes needed to successfully operate the facility, thus providing one of farmers' biggest incentives, a contract for product.

FOOD HUB: CAPITALIZING ON LOCAL MARKET OPPORTUNITY

Over the past several years, SACOG's RUCS program has engaged local growers and agricultural stakeholders to better understand the extent of the local market opportunity. This process identified the need for expanded agricultural infrastructure for the regional food system as a key way to overcome the above barriers to producing for the local market. In particular, a food hub to aggregate, pack, process, market and distribute local specialty crops would provide a vital piece of infrastructure to help actualize the local market opportunity, especially by offering contracts for locally-grown specialty crops.

SACOG's Agriculture Infrastructure project describes a conceptual design, cost estimate, and operational and financial aspects for a conceptual hub facility in the Sacramento Valley with various operating lines for different types of value-added food processing. The facility would receive different types of fresh produce from various parts of the region (and from adjoining areas), which grow and/or specialize in particular specialty crops. The hub would facilitate access to both local markets/customers across the region, as well as eventually markets outside of the region.

Financial analysis conducted by the project team provides operating costs and annual revenue of this prototypical food hub serving the Sacramento Valley.[31] Initially, the facility requires a cash investment of $3.5 million and runs at a financial loss in the initial years of operation, highlighting the risk involved in the startup. Once the food hub expands from an incubation stage to reach adequate scale it becomes cash positive by the end of the fourth year, rising to a nearly $2 million positive annual net cash flow by the tenth year of operation. Over the course of the pro forma, the facility gives a nearly 25 percent Internal Rate of Return (IRR).[32]

Yet in order to realize these economic gains the food hub needs a steady supply of locally grown specialty crops. The next section of this case study turns to various possible future cropping patterns in the county based on a series of agriculture objectives and land use decisions. The section compares a scenario supplying local specialty crop to a food hub with other cropping patterns—including the existing base case in the county—to see the competiveness of specialty crop production in Yuba County relative to other forms of agriculture and uses of the land. The comparison scenarios include a look at low and high water consumption, labor intensity, revenue and return on investment, showcasing how inputs and possible impacts change across scenarios. In short, the next section's breadth of scenarios analyzes multiple possible agriculture futures in the county across various economic and environmental measures.

---

[31] The technical appendix includes further financial analysis and a cost estimate for an interim food hub model unique to this case study and customized to Yuba County. This alternative model can serve as an immediate, early phase model of a food hub and with a walnut processing line fits well within Yuba County's agriculture sector.

[32] Applied Development Economics, Foodpro Inc., The Hatamiya Group and DH Consulting, "Comprehensive Food Hub Pro Forma," July 25, 2014 edition.

AGRICULTURE SCENARIOS

The first section of this report described the current state of agriculture in Yuba County, including how specialty crops compare to and fit within a larger system. Yet as market forces, policy direction and environmental conditions continue to shift, so too will agriculture in the county to remain a strong element of the county's economy. Using a recently updated RUCS crop modeling platform and fiscal impacts model, this section provides economic and fiscal metrics of various future cropping patterns that reflect changes in market demand, cost of production and management objectives for working lands.

The range of agricultural scenarios include cropping patterns that serve a potential food hub, as well as patterns that reflect other market dynamics that may impact cropping patterns. The scenarios are compared on metrics such as revenue, return on investment, water consumption and labor use. Most of the scenarios evaluate potential changes within the current cropping categories in order to provide a context for comparing a shift to specialty crops.

Each of these agriculture scenarios is also evaluated in the context of urbanization. Changing land use in the county will influence not only the acres available to agricultural production—and thus the economic output of the county's agriculture sector—but also the County's fiscal costs of servicing various forms of development. The fiscal component of the scenario analysis compares additional infrastructure cost and operations and maintenance to current County finances, also set to a base year of 2012. The section first looks at the various agriculture scenarios and then turns to effects of urbanization and land use decisions.

METHODOLOGY

Agricultural scenarios were built for comparison with today's cropping pattern—the base case—in order to illustrate the range of economic and natural resource impacts. The scenarios can also be compared to each other to determine favorable (or not so favorable) futures for the county's agriculture industry. Constructing these scenarios relied on two primary data components: SACOG's field-level crop map and costs and return data for each crop.

The base case was constructed with SACOG's GIS-based crop map updated with 2012 Pesticide Use Report data from the California Department of Pesticide Regulation. California's pesticide reporting program is internationally recognized as one of the most comprehensive, thereby creating an incredibly detailed database of cropping patterns. These parcel-level crop data are underpinned with cost and return data collected and published by the University of California Cooperative Extension (UCCE), which provide costs assumed by growers to establish and produce a given crop as well as the returns gained from their sales. These cost and return data, updated to the most recent figures for this case study, are broken down to line item quantities and prices, allowing detailed analysis of factors such as water consumption and labor demand. When aggregated to the county level, the combination of these crop and economic data provides a powerful and comprehensive snapshot of the agricultural industry's contribution to Yuba County's economy and resource use.

The scenario analysis tool uses per-acre quantity and cost data for production inputs including: water, labor, chemical, fuel, irrigation, etc., as well as operating costs, overhead costs, and establishment costs. These data are multiplied by acreage of a given crop in a scenario and then summed to create county-level scenario indicators of demand for production inputs. Yield and price data are used to determine revenue from production and when compared to cost, provide net revenue and return on investment. For example, if the 4,268 of current peach production increases to 7,000 acres, the model provides a comparison of inputs, outputs and values of today's peach production to that of the future expanded production

Several "dials" were installed in the analysis tool. These dials adjust factors such as establishment costs (modeled in phases including: newly established, producing but still repaying establishment loans, and fully established with loans repaid), land costs, water costs, labor costs, and production yield. These dials allow for analyses to show the variance in costs and returns when, for example, there is outright land ownership versus ongoing land costs, orchards or vineyards are maturity versus first established, there is readily available water versus supply shortages, etc.

SCENARIOS

Scenarios allow comparison between specialty crop production and a range of potential competing uses. Scenario comparison is a powerful tool to test thresholds or "boundary conditions"—economically, environmentally, socially, et cetera. Each scenario estimates the county-wide effects of different crop mixes. Of course, there are many factors affecting cropping patterns that were not considered in this exercise (e.g., market saturation or lack thereof affecting demand and prices). The study only tests high and low extremes for various factors, but offers a starting point from which more refined scenarios can be crafted to test conditions based on assumptions or forecasts of future market conditions. Furthermore, the work reveals general cause and effect conditions that may be helpful in building strategies that capitalize on potential agricultural economic development. The information produced by these scenarios is intended to help decision makers—growers, land owners, policy makers—understand opportunities and challenges from changes in market conditions, cropping patterns and land use decisions. The scenarios described below are not prescriptive—they do not tell what should be grown—and are just a small subset of possible scenarios that could be analyzed. Rather, these scenarios use data to define a spectrum of effects that could be expected from a variety of crop mixes.

Base Case: The base case represents the current cropping patterns as described above and is the baseline against which the specialty crop and various scenarios are compared using indicators noted earlier. Crops currently being grown are represented in the table below, grouped by crop category.

Crops by Crop Category

Forage	Fruits	Fruit Trees	Grains	Orchards	Vegetables	Other
Alfalfa	Blueberries	Cherries	Rice	Almonds	Asparagus	Dried Beans
Silage Corn	Melons	Mandarins	Wheat	Olives	Broccoli	Safflower
Silage Grain	Raspberries	Fresh Peaches		Walnuts	Celery	Sunflower
Oat Hay	Strawberries	Processing Peaches			Eggplant	
Pasture	Wine Grapes	Pears			Iceberg Lettuce	
Silage Sorghum		Prunes			Romaine Lettuce	
					Onions	
					Fresh Peppers	
					Processing Peppers	
					Squash	
					Fresh Tomatoes	

High Revenue: This scenario represents a crop mix that returns the highest revenue to growers while maintaining a diversity of crops across general crop types (vegetables, fruits, orchards, fruit trees, grains, forage and other). Rather than assigning every field with the single highest revenue crop, the highest-return crops within each crop category were assigned to the existing acreage for that category. For example, raspberries return the highest revenue per acre of all fruit crops grown in Yuba County—including strawberries, melons, grapes and blueberries—in total covering approximately 500 acres. Those 500 acres were converted to raspberries in this scenario to test the upper limit of revenue for that crop category. While this scenario does not maximize revenue to its fullest, it provides more realistic and useful information by showing the effects of converting crops to the highest returner within a crop category.

Crop Category	Crop	Gross Revenue per Acre
Forage	Corn for Silage	$1,440
Fruits	Raspberries	$75,000
Fruit Trees	Mandarins	$28,467
Grains	Rice	$1,547
Orchards	Walnuts	$7,200
Vegetables	Tomatoes for Fresh Market	$64,200
Other	Sunflower	$1,360

Low Revenue: Similar to the High Revenue scenario, this scenario estimates an extreme condition but at the lowest end of revenue to growers. It assigns the lowest valued crop to each crop category, again maintaining the same agricultural diversity as current conditions at the broad category level.

Crop Category	Crop	Gross Revenue per Acre
Forage	Oat Hay	$375
Fruits	Wine Grapes	$4,800
Fruit Trees	Pears	$4,567
Grains	Wheat	$950
Orchards	Olives	$3,600
Vegetables	Onions	$3,024
Other	Safflower	$363

High Return on Investment (ROI): Slightly different from the High Revenue scenario, the Return on Investment scenario takes into account the costs of production for the crops grown as well as the revenue (revenue is exclusively the returns from selling products). Using the ratio of net returns to costs, ROI is a standard way to measure profits compared to costs. This scenario represents a crop mix with the highest ROI across the six general crop categories. In tandem with the High Revenue scenario, we can see which crops not only perform well in terms of absolute revenue, but also which will be best at keeping farmers viable, or "in the black".

Crop Category	Crop	Return on Investment
Forage	Grain for Silage	62%
Fruits	Melons	165%
Fruit Trees	Mandarins	17%
Grains	Wheat	13%
Orchards	Walnuts	74%
Vegetables	Peppers – Fresh	54%
Other	Sunflower	85%

High Water Use: Current drought conditions in California make water use an important metric with which to examine cropping patterns. To evaluate water use, per acre water demand was gleaned from UC Cooperative Extension's Cost & Return studies for each crop. Some of these data were collected in regions outside of the Sacramento Valley (e.g. lettuce grown on the Central Coast of California) and will vary for crops grown in Yuba County; however, they provide a vetted basis of comparison from which to start conversations about water use. Furthermore, to be conservative with water use assumptions for crops typically grown on the cooler and damp Central Coast, water demand was increased by 10% from the base data provided in UCCE's cost and return studies. This scenario assigns all acres within a crop category to the crop with the highest per acre water demand—for example, grain acreage assigned as rice; forage acreage assigned as silage corn.

Crop Category	Crop	Water Demand (Ac-Ft/Ac)
Forage	Corn for Silage	4.0
Fruits	Blueberries	3.0
Fruit Trees	Peaches for Fresh Market	3.7
Grains	Rice	4.1
Orchards	Walnuts	3.5
Vegetables	Eggplant	3.3
Other	Beans – Common Dried	2.5

Low Water Use: The Low Water Use scenario frames the lower limit of water use while still maintaining the crop mix across general categories. It is not the bare minimum of water that could be used to produce crops in the county—in which case the entire county would be in dryland oat hay or rangeland—but a scenario that assigns low water crops to each crop category.

Crop Category	Crop	Water Demand (Ac-Ft/Ac)
Forage	Oat Hay	0
Fruits	Wine Grapes	1.5
Fruit Trees	Cherries	2.5
Grains	Wheat	1.7
Orchards	Olives	3.0
Vegetables	Lettuce – Iceberg	1.4
Other	Safflower	0.5

High Labor: The agriculture industry relies heavily on labor to work machinery, manage fields, and harvest crops; however, a survey of agriculture labor has shown shortages in the labor supply in the recent years (SACOG Agricultural Labor Study, 2014). With growers facing challenges to recruit and retain agricultural labor, labor demand is an important metric to take into consideration when comparing scenarios. This scenario represents a crop mix that maximizes labor demand, as specified in the UCCE cost and return studies, across Yuba County, again maintaining the general crop category and distribution.

Crop Category	Crop	Labor (Hours per Acre)
Forage	Alfalfa	6.19
Fruits	Blueberry	2,138.02
Fruit Trees	Mandarins	786.06
Grains	Rice	4.99

Orchards	Olives	27.6
Vegetables	Tomatoes for Fresh Market	4619.16
Other	Beans – Common Dried	5.76

Low Labor: In contract to the High Labor scenario, this scenario minimizes the labor hours across general crop types to find a cropping pattern that represents lower demand of labor demand.

Crop Category	Crop	Labor (Hours per Acre)
Forage	Oat Hay	0.92
Fruits	Wine Grapes	68.05
Fruit Trees	Pears	35.13
Grains	Wheat	1.57
Orchards	Walnuts	7.28
Vegetables	Broccoli	9.56
Other	Safflower	2.68

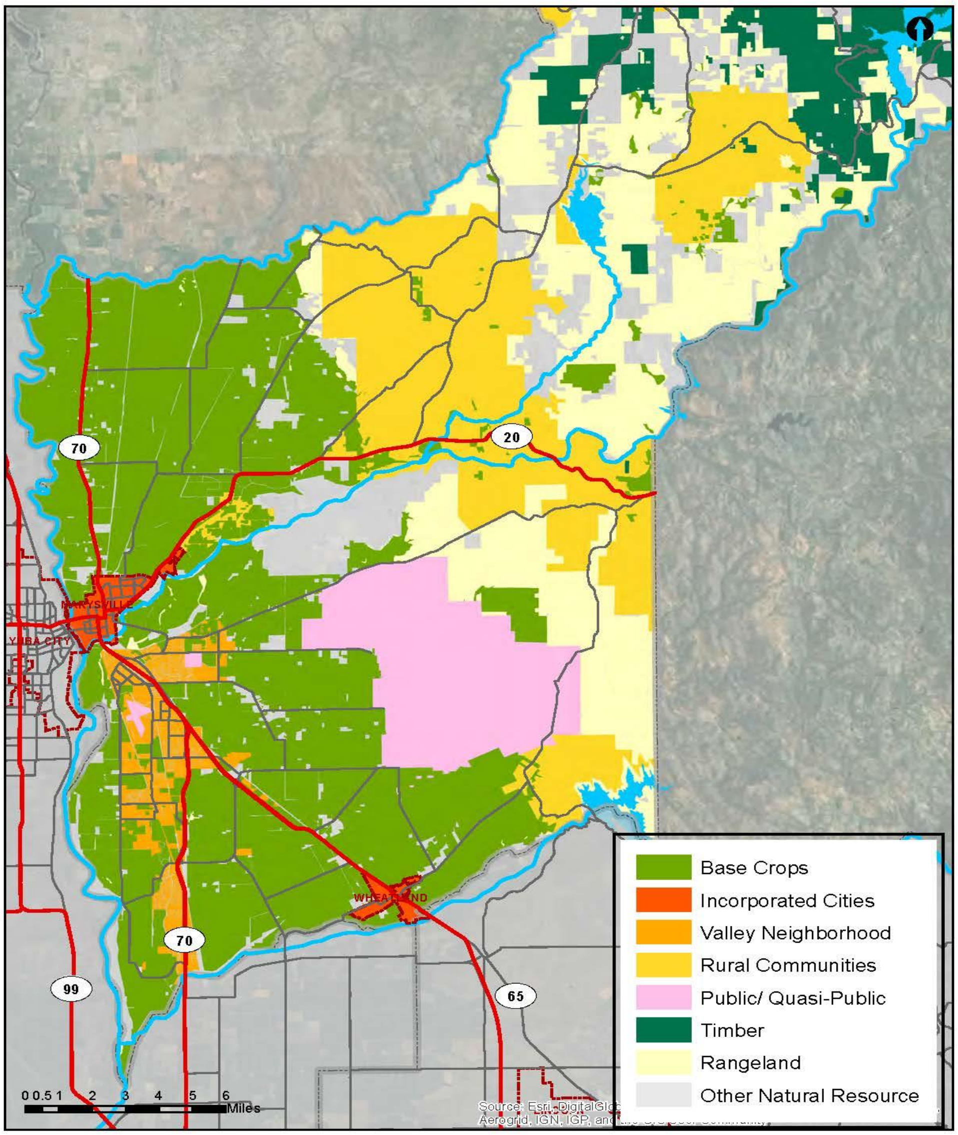
Local Consumption/Food Hub: This scenario is very similar to the Base Case but replaced 530 of its approximately 2,000 fallow acres with specialty crops that would be processed by the proposed food hub. The converted acres have access to irrigation from either surface water or ground water—easily accessed with Yuba County's high water table—and have soil of suitable quality for growing vegetable crops. Fallow fields were assigned crop acres respective to the amount of crop that would be processed by the food hub. Crop acres were calculated using food hub demand and acres required to grow that amount of product. Fallow acres were used instead of replacing other crops to demonstrate that there is capacity within the county's existing cropping patterns and agricultural infrastructure to grow for the food hub without compromising current operations.

Specialty Crops: This is the scenario that explored the impact of shifting entirely to specialty crops in Yuba County, rather than just enough specialty crop production to meet the demands of the food hub. Crop categories were not maintained when analyzing the potential of specialty crops in order to measure an unrestricted conversion away from commodity production, and further because two of the major crop types—grains and forage— are not specialty crops, along with animal products (e.g. meat, dairy, eggs), soybeans, crops used for oils (e.g. safflower, canola, sunflower), among others. Yuba County's current crop acres were summed and divided among 26 specialty crops that are prominent in today's market. Many of these specialty crops—walnuts and prunes, for example—are already grown in the county. Some of these specialty crops are grown elsewhere in the Sacramento Valley and would be viable given Yuba County's similar climate, soil and water characteristics. Some of these specialty crops are currently grown in the Sacramento Valley but at smaller scales than large commercial operations in other regions—strawberries and lettuce on the Central Coast, for example. Acreage assigned to individual specialty crops took into account if they are or are not currently grown in Yuba County or the Sacramento Valley.

Specialty Crop Mix

Almonds	Broccoli	Iceberg Lettuce	Olives	Pears	Raspberries	Walnuts
Asparagus	Celery	Romaine Lettuce	Onions	Fresh Peppers	Squash	Wine Grapes
Dried Beans	Cherries	Mandarins	Fresh Peaches	Processing Peppers	Strawberries	
Blueberries	Eggplant	Melons	Processing Peaches	Prunes	Fresh Tomatoes	

Base Agriculture Acres



The agricultural scenarios model various cropping patterns on the same set of acres, set as the base crops in the above map.

AGRICULTURE SCENARIOS ANALYSIS

SUPPLYING THE LOCAL FOOD HUB

Modeling a local food hub scenario shows that a cropping pattern shift of 530 acres in Yuba County dedicated to specialty crop production would provide sufficient supply to serve a prototypical food hub. This scenario shows that not only would this food hub provide a positive return on investment for the hub operator, but also for growers providing the supply of specialty crop to the hub. To measure grower profitability from supplying the hub, the project team compared the estimated contract prices[33] provided by the food hub to the costs to produce the crop.[34] The analysis shows that overall, growers supplying a single local food hub would share in annual profits of $2.4 million.[35] However, current cost of production data suggest that, at wholesale prices, local farmers would not turn a profit growing certain individual crops for a food hub, such as lettuce or squash.[36]

In aggregate, supplying specialty crops for a single food hub would increase the direct farmgate value of Yuba County's agriculture sector by 2.5 percent compared to the base case. While a 2.5 percent gain may seem small, it derives from a change in only 0.48 percent of the base crop acres. This gain demonstrates the powerful economic potential of specialty crops.

Finally, the regional food hub facility would provide an increase of fresh and locally produced specialty crop fruits and vegetables in the local food system. The hub could feed the full fruit and vegetable consumption levels of 13,165 people; more likely however the hub would meet only a portion of consumers' total specialty crop demand. For example, the hub could provide a quarter of annual fruit and vegetable consumption to 52,600 people or ten percent of demand to 131,000 individuals.

Scenario Comparison: Local Food Hub to the Base Case

	Base Case	Local Food Hub
Annual Ag Value	$360,174,281	$368,495,155
% Change in Ag Value	--	2.5%
Average Ag ROI	26%	25%

[33] The estimated food hub contract prices per pound come from the SACOG's detailed pro forma analysis. The pro forma assumes the hub sells product at wholesale prices so buys for less than wholesale, thus representing a conservative take on prices. See Applied Development Economics, Foodpro Inc., The Hatamiya Group and DH Consulting, "Comprehensive Food Hub Pro Forma."

[34] Growers' costs to produce come from UC Cooperative Extension Cost and Return studies.

[35] Based on a crop throughput of blueberries, broccoli, celery, iceberg and romaine lettuce, onions, peaches, pears, peppers, raspberries, squash and strawberries. The analysis excluded tomatoes due to the discrepancy between processing and fresh market methods of production.

[36] The crops where production costs exceed estimated hub price are eggplant, lettuce (both iceberg and romaine) and squash. The analysis used data from the UC Cooperative Extension where some crops' cost of production were studied in different regions with different growing conditions, such as broccoli, lettuce and celery on the Central Coast. To make these data more applicable to the Sacramento Valley, yield was reduced by 10% and water use was increased by 10%. Updated cost of production data for leafy greens in the Central Valley would provide a clearer picture of the financial feasibility of these crops.

MAXIMIZING REVENUE OR RETURN

To compare specialty crop production in Yuba County to competing uses, the case study analyzed other various cropping patterns testing economic metrics such as gross revenue or return on investment. This comparison helps emphasize the economic potential of specialty crop production in the county.

The high and low-revenue scenarios help frame the economic potential of the county's existing agriculture land within its current major cropping categories. As described in the methodology section, the high-revenue scenario models a shift in production patterns to provide the largest gross revenue to the county's overall farm sector respecting the current distribution by crop type of forage, grain, vegetables, fruit, nuts, fruit orchards and other. This possible agriculture future increases the county's annual farmgate value by two-thirds over the base case value of $350 million to an annual output of $591 million. Conversely, the low-revenue scenario produces an annual agriculture sector value of $213 million, a loss of forty percent of the base case crop value.

For comparison, the specialty crop scenario models a cropping pattern in Yuba County consisting entirely of specialty crops. The specialty crop scenario returns a remarkable $1.8 billion in total agriculture output. The scenario could meet the fruit and vegetable demand of 3.5 million people and supply 200 food hub facilities, underscoring the substantial market opportunities in specialty crop production. The scenario also shows the capacity for continued growth in the overall output of the county's agricultural-based economy through a shift to specialty crop production.

Gross Agriculture Value and Return on Investment by Selected Scenarios

	Base Case	High Revenue	Low Revenue	High ROI	Specialty Crop	Low Labor
Annual Ag Value	$360,174,281	$591,842,338	$213,018,538	$516,796,080	$1,824,343,487	$317,222,288
% Change in Ag Value	--	64%	-41%	43%	407%	-12%
Average Ag ROI	26%	29%	8%	43%	36%	41%

In addition to measuring annual agricultural value, which gauges the gross output of the sector by cropping pattern, the return on investment (ROI) indicator provides a metric of on-farm profitability or efficiency of investment. A comparison of scenarios using this metric illuminates alternative strategies growers can take to increase on-farm profitability.

One strategy to realize the high returns is for growers to shift to high value crops such as walnuts, mandarins, and melons. As discussed in the barriers section above, these crops require significant outlays during establishment and harvest, showing how high returns can sometimes depend on sizable upfront capital investments and reliance on personal equity or the means to secure credit.

The case study's specialty crop scenario quadruples agricultural output over the base while raising average return on investment. Comparison shows how this scenario outperforms competing possible uses that maintain general crop types.

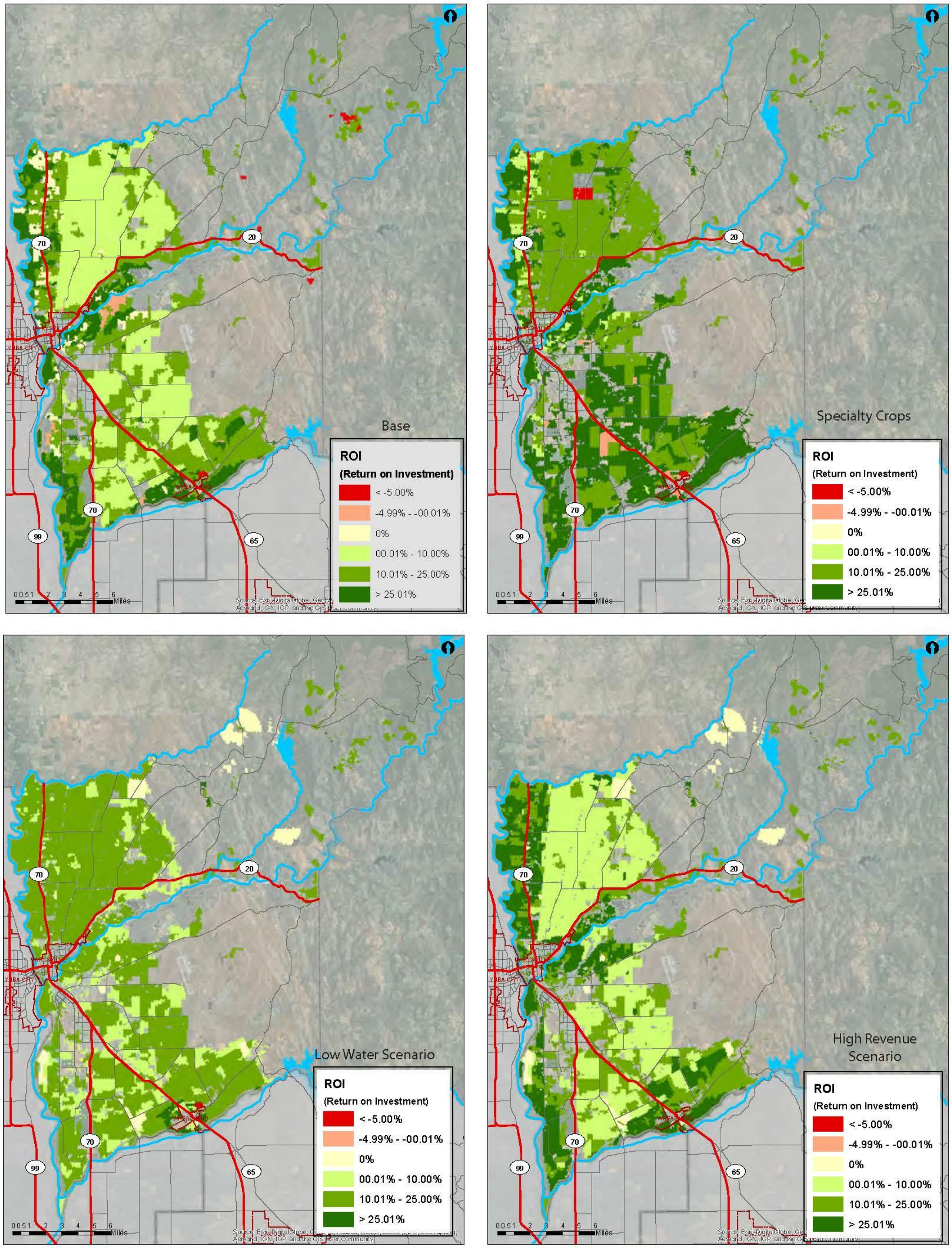
Compared to the high revenue or high return scenarios, the low-labor scenario provides an alternative method to secure a favorable grower return on investment. Unlike the above, the low-labor scenario generates favorable return by shifting to crops that minimize workforce costs. At 41 percent return, the low-labor scenario provides the second highest grower return of any modeled scenario. The tradeoff, however, is in the overall agriculture value, as the low-labor scenario's total output in dollars, at $317 million, falls well short of the high return scenarios. Furthermore, this cropping pattern supports relatively little value-added processing and jobs related to agricultural production and does little to meet the increasing demand for locally grown food. This comparison demonstrates some important trade-offs to consider in determining which strategies the county and its farmers may want to pursue in the future, as well as which metrics to use in evaluating the agriculture sector: ROI and revenue must be considered in tandem to gauge both the cash flow and economic efficiency of the food system.

The maps on the following page further illustrate the link between cropping patterns and ROI. In the top left, the base case shows existing conditions in the county and serves as a point of reference for change. The specialty crop map shows a much wider dispersion of profitable crops. Indeed, the scenario overall provides a 36 percent return on average to local growers after capital investments are paid off and marketable yields achieved.

The third map—low water (see table below)—provides a more even distribution of returns compared to the base case but with a much lower overall ROI. The scenario also results in a total agriculture value less than the base case, emphasizing the link between water availability and economic vitality.

Finally, the high revenue map shows an overall return very similar to the base, with only small differences in the distribution of those returns. This suggests that strategies to enhance grower return or overall agriculture output may require much different cropping patterns than today, not just more valuable crops. The specialty crop scenario modeled above is an example of this cropping pattern shift.

Return on Investment by Cropping Pattern



ECONOMIC AND ENVIRONMENTAL TRADEOFFS: AG VALUE AND WATER CONSUMPTION

The specialty crop scenario referenced in the above section provides very significant gains in the value of agriculture in Yuba County and profitability of local growers. A look solely at economic indicators, however, masks important natural resource considerations in agriculture production. To showcase the environmental effects of different cropping patterns, the project team calculated water consumption by scenario. This variable helps illuminate an important finding of the scenario analysis, generally that higher-valued crops tend to also require greater water consumption, an important caveat particularly given the state's current drought. For example, while the high revenue scenario increases agriculture revenue over the base, it also raises water consumption by 35,128 acre-feet, an eight percent increase. To further make the point, a cropping pattern shift to low water crops cuts agriculture water use in half, but also reduces agriculture value by nearly $73 million a year—a 20 percent drop.

A look at the high-water scenario helps illustrate the water intensity of the county's current cropping pattern. The high-water scenario only increases by about 10 percent the amount of water consumed compared to the base year. [37] While Yuba County is relatively water-rich compared to other agricultural areas of the state, this tradeoff can help inform future production decisions, especially if drought conditions persist.

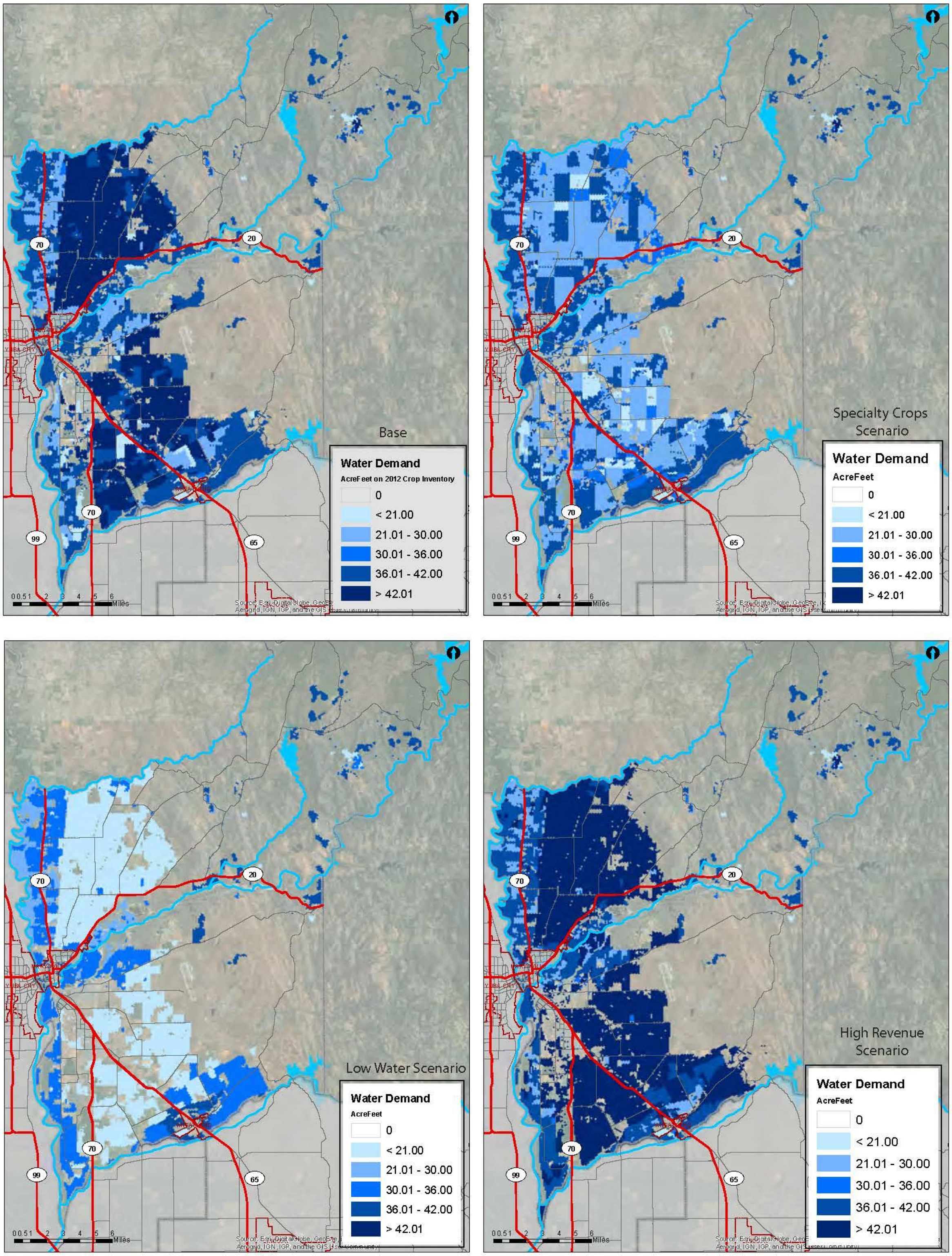
High and Low-Water Scenarios Compared to Base Case

	Base Case	Low H2O	High H2O	Specialty Crop
Annual Ag Value	$360,174,281	$283,246,111	$434,938,759	$1,824,343,487
% Change Ag Value	--	-21%	21%	407%
Average Ag ROI	26%	13%	24%	36%
Ag H2O (acre-ft)	417,671	190,866	461,272	339,940
% Change H2O	--	-54%	10%	-23%

Finally, the maps on the following page help illustrate an important advantage of specialty crop production in the county. The base scenario map shows the current high water use of the sector. Likewise, the high revenue scenario mimics a cropping pattern also demanding a high degree of water availability. In contrast, at about 340,000 acre feet, the specialty crop scenario actually uses less water than these scenarios while providing the positive economic indicators as discussed above.

[37] With nearly 50,000 acres, rice is the county's largest crop by acreage and is also one of the most water-intensive.

Water Demand by Cropping Pattern



LABOR DEMAND

In addition to economic indicators and agricultural water consumption, the project team estimated the annual labor demand of different cropping patterns as the Sacramento region has faced challenges recruiting and retaining agriculture labor in the last decade. The region's agriculture industry relies on workers to tend fields and harvest crops, so labor demand is an important metric on which to measure potential scenarios. Furthermore, there are significant infrastructure demands to take into consideration as the agricultural workforce grows, such as housing, transportation, education, health facilities, et cetera.

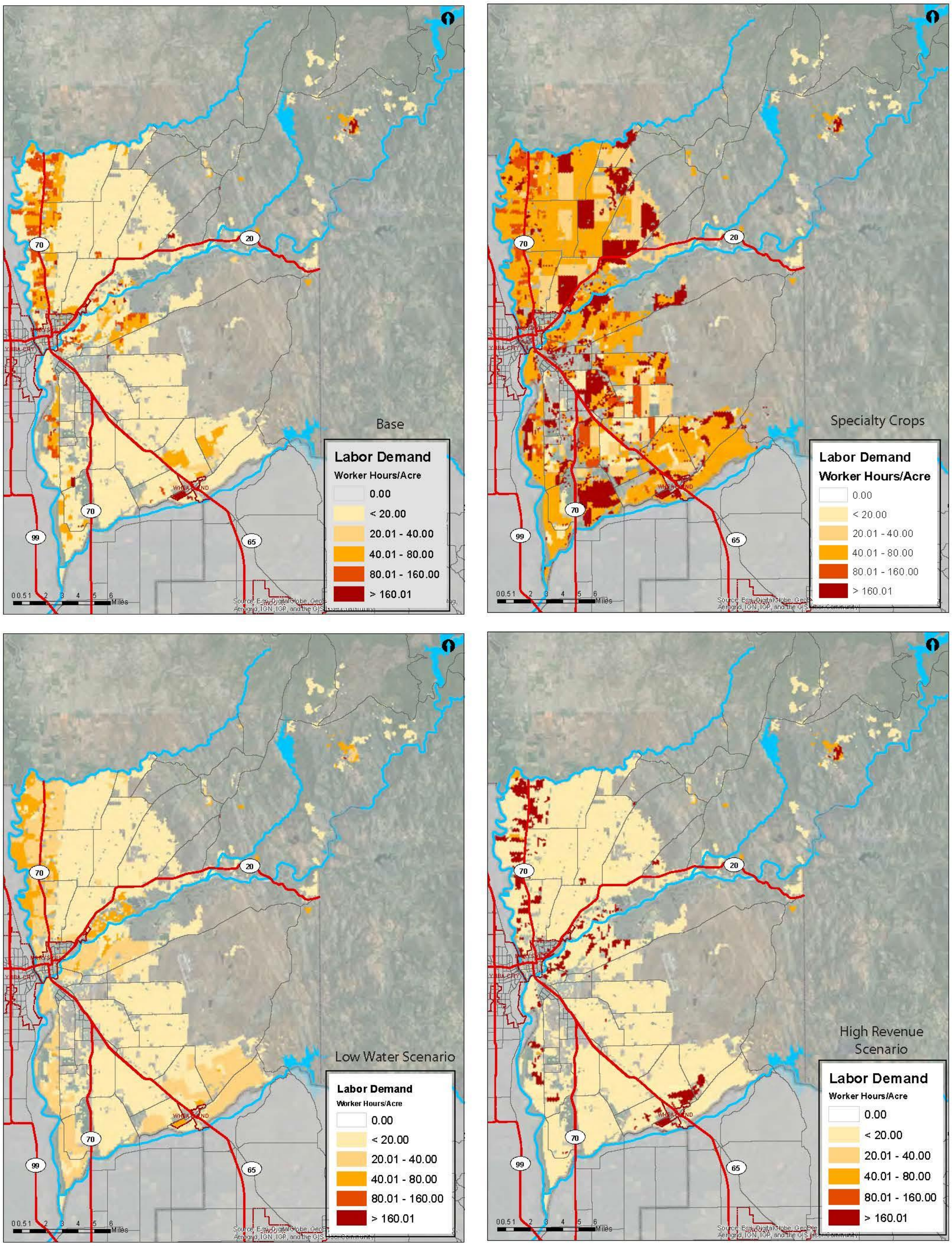
Labor Demand of Selected Scenarios

	Base Case	High Labor	Low Labor	Specialty Crop	High Revenue
Annual Ag Value	$360,174,281	$458,447,698	$317,222,288	$1,824,343,487	$591,842,338
% Change in Ag Value	--	27%	-12%	407%	64%
Average Ag ROI	26%	11%	41%	36%	29%
Ag Labor (hrs)	2,606,789	9,845,138	595,999	32,022,547	8,253,271
% Change in Labor	--	278%	-77%	1128%	217%
Ag H2O (acre-ft)	417,671	371,247	205,757	339,940	452,799
% Change in H2O	--	-11%	-54%	-19%	8%

The high and low-labor demand scenarios show a distinct correlation between high labor demand and high revenue; in other words, crops that require more labor hours tend to be higher value crops. (As noted earlier, these higher value crops also tend to require high amounts of water.) The high labor scenario almost quadruples labor demand (378%) compared to the base case, whereas it only increases labor demand by one-fifth (20%) relative to the high revenue scenario. The high labor scenario also generates revenue almost 30% higher than the base case. However, as referenced above, cropping patterns with low labor demand may be an alternative strategy for increasing return on investment, but not revenue. Labor is often one of the most costly line items on growers' budgets and many crops with low labor demand have mechanized production practices to increase efficiency, resulting in a higher ROI.

As the maps on the following page show, specialty crops are particularly labor intensive: the ten most labor intensive crops are specialty crops and the ten least labor intensive crops are commodity crops. So while the specialty crop scenario would provide higher economic returns with lower water consumption in Yuba County, it would also have to be linked with farm labor housing and services to support and attract an adequate supply of agriculture workers.

Labor Demand by Cropping Pattern



In short, comparing possible future specialty crop production side-by-side with the base case and other possible competing use shows opportunities and trade-offs across economic, water and labor metrics. The specialty crop scenario generates the highest gross revenue by far of any scenario as well as a high return on investment. And compared to the water-intensive base, the scenario would in fact decrease agriculture water consumption in Yuba County. However, the specialty crop scenario would require a significant influx of agriculture labor. While this demand would support numerous food chain jobs, it also raises challenges in a system already facing a constricted labor supply. The matrix below captures these tradeoffs for the case study's specialty crop scenario compared to the base case and other uses.

Summary of Agriculture Scenarios

	Scenarios									
Indicators	Base Case	Local Food Hub	High ROI	High Revenue	Low Revenue	High Water	Low Water	High Labor	Low Labor	Specialty Crop
Overall Agriculture Output (In $ millions)	360	368	516	591	213	434	283	458	317	1,824
Labor (millions of hours)	2.6	2.9	6.1	8.2	1.2	4.3	1.4	10	0.6	32
Water (thousands of acre-feet)	417	418	246	452	191	461	190	371	205	339
Return on Investment (%)	26	25	43	29	8	24	13	11	41	36

URBANIZATION SCENARIOS

In addition to changes in market demand and costs of production tested in the agricultural scenarios, local land use decisions will affect the future of agriculture in Yuba County. In the past decade, the population of Yuba County grew by over 15 percent and growth is expected to continue in the future, adding perhaps between 75,000 and 100,000 people in the unincorporated portions of the county by 2030.[38] The County's General Plan notes how most of the recent growth occurred in unincorporated areas of the valley floor; indeed, today three-quarters of the county's population reside in these unincorporated areas.[39] Yet while the county's valley floor has been the center of most of the current and planned development in the county, the above base agricultural acreage map shows how it is also the site of existing agriculture production.

Differing local land use decisions will influence the acreage available to agriculture production while also resulting in various infrastructure and service costs (call out box). This section first shows the gross revenue impacts to the county's agriculture sector from various possible urbanization patterns. It concludes with a discussion of how the same land uses produce varying fiscal costs and revenue to the County.

Fiscal Impacts of Land Use Decisions

To help better understand the fiscal impact of land use decisions, SACOG conducted a review of national case studies identifying infrastructure and services costs and revenues from agricultural land currently in production compared to costs and revenues related to urban residential development, documenting what local governments earn in revenue, owe in debt, and spend on services. This review of over 200 examples across the nation details the fiscal contribution of agricultural and other working lands. Key findings from this work include:

- Agriculture and working lands are fiscally positive land uses, generating more in local government revenue than they consume in services. Of the studied cases, agriculture cost only $0.45 on average for every dollar generated in revenue.
- Urbanizing agricultural land requires not only significant upfront infrastructure investments, but also ongoing operations and maintenance expenditures, resulting in increased debt service levels and annual operating budgets.
- Converting rural working lands into urban land uses tends to transform a fiscal surplus into a drain on city or county finances. Land converted to residential use requires $1.21 on average in local government expenditure per dollar of public revenue.

Sources: Matthew J Kotchen and Stacey L Schulte, "A Mete-Analysis of Cost of Community Service Studies." *International Regional Science Review*, Volume 32, Number 3. July 2009: 376-399; Farmland Information Center, "Fact Sheet: Cost of Community Service Studies." American Farmland Trust, August 2010; Smart Growth America, "Building Better Budgets: A National Examination of the Fiscal Benefits of Smart Growth." 2013; Roger Coupal, Donald McLeod and David Taylor, "The Fiscal Impacts of Rural Residential Development: An Econometric Analysis of the Costs of Community Services." *Planning and Markets*, Volume 5, Number 1, 2002.

---

[38] U.S. Census Bureau, for period 2002-2012. Yuba County General Plan for estimated growth rates.

[39] Yuba County General Plan, Vision-2

URBANIZATION SCENARIOS METHODOLOGY

The five urbanization scenarios constructed as part of this case study provide comparable metrics and quantifiable data to help inform land use planning. To calculate the fiscal impacts of the land use scenarios, the case study draws on SACOG's Integrated Model for Planning and Cost Scenarios (IMPACS). IMPACS provides local governments and planners a means of estimating and evaluating the fiscal costs of providing infrastructure and service in their communities.[40] IMPACS is tailored to help jurisdictions better understand the fiscal implications of different growth patterns, particularly at the rural-urban fringe.

Following Yuba County's General Plan, the scenarios only look at urban development within the County's Valley Growth Boundary (map on following page). The scenarios do not analyze changing land use in the County's Rural Community land use designation. The urbanization scenarios are divided into two timeframes based on input from county stakeholders: scenarios responding to immediate-term land use decisions and those modeled over the full course of the County's General Plan. The first two land use scenarios compare the economic and fiscal effects of possible immediate-term development patterns: the Magnolia Ranch Specific Plan and a similar-sized development located in the County's Planning Reserve.[41] These two scenarios account for a portion of the remaining major open sites of development within the Valley Growth Boundary.

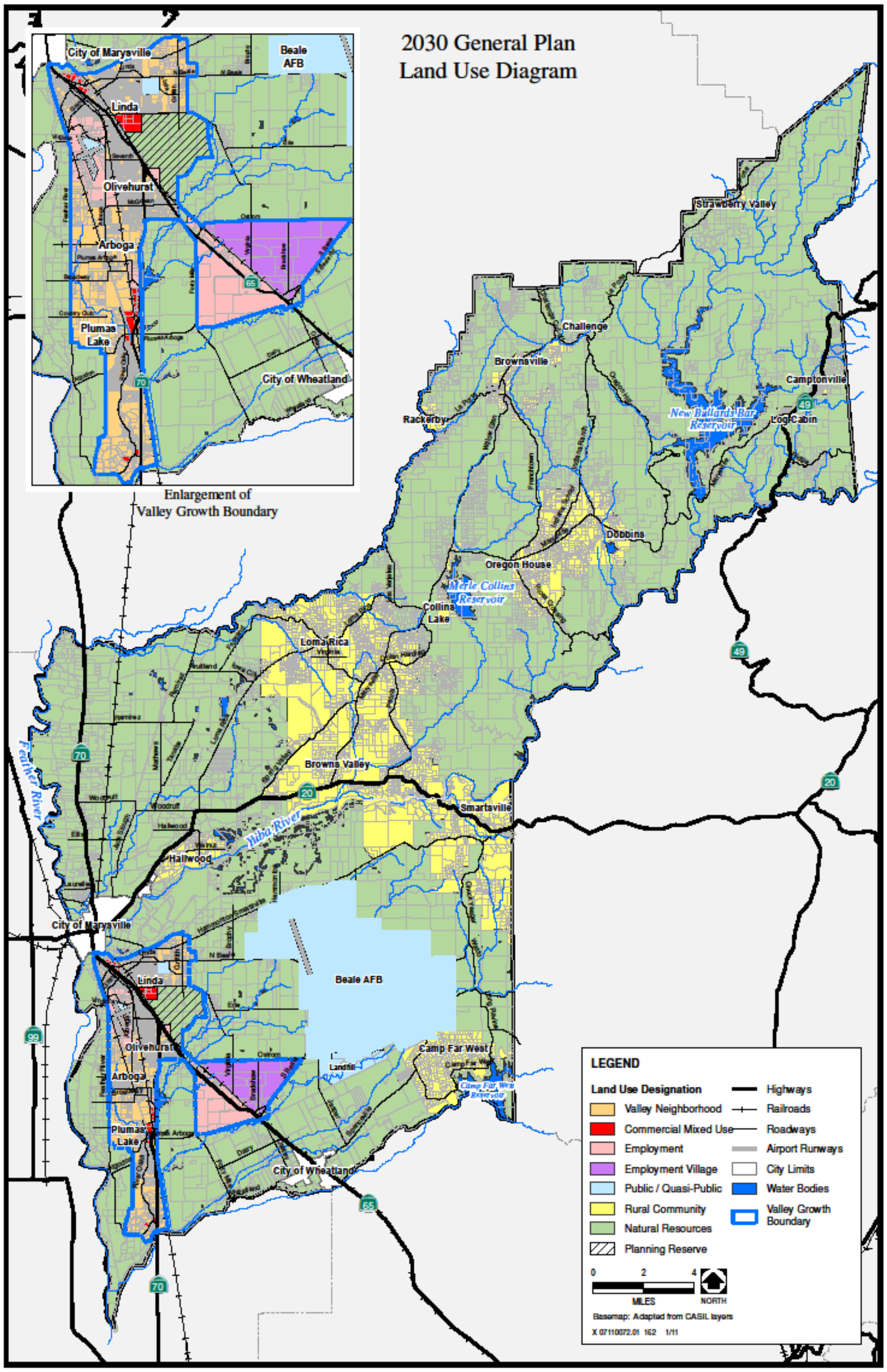
The final three land use scenarios compare possible valley land uses over the course of the General Plan, including a Valley Growth Boundary Full Buildout, a Concentrated Growth, and an Infill Focus scenario. These valley growth scenarios account for approximately 84,000 of the 100,000 population increase (84%) and 66,000 of the 67,000 job increase (98%) in unincorporated Yuba County estimated over the course of the 2030 General Plan (using the high range estimates from the Plan's buildout).[42] The analysis below describes the full specifications of both the short and long term urbanization scenarios in comparison to the base case.

[40] For a full explanation of IMPACS functionality see Aecom's, "IMPACS User Guide." Prepared for the Sacramento Area Council of Governments, June 2011.

[41] The analysis for Magnolia Ranch draws on the project's Specific Plan. In contrast, the Planning Reserve scenario does not reproduce a specific plan, instead analyzing the effects of a similar-sized development to Magnolia Ranch instead located in the County's Planning Reserve.

[42] The remaining 16,000 in population increase and 1,000 jobs are estimated to land in the County's Rural Community designation. Due to the lack of detailed data, the case study did not analyze changing land use patterns outside of Yuba County's valley floor.

Yuba County General Plan Land Use Designations



Source: Yuba County General Plan

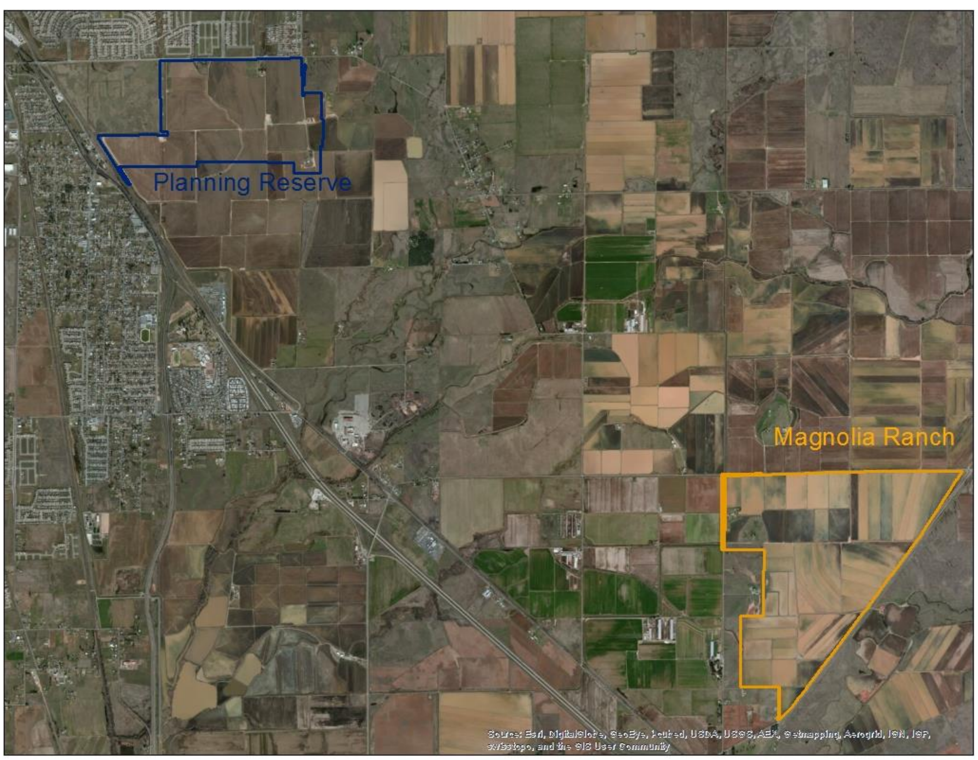
Base Land Use Scenario
The base land use scenario is set as the existing crop production, open space and developed use within the County's Valley Growth Boundary land use designation.

Short Term Land Use Scenarios

1. **Magnolia Ranch**
   This scenario models the Magnolia Ranch Specific Plan, a proposed development approximately 10 miles southeast from Marysville. The project scenario would develop 1,040 acres of predominately rice farming; 733 of these acres would be turned into residential use, resulting in 3,330 dwelling units and around 8,400 new residents to unincorporated Yuba County. The remaining land use is split into 70 acres of commercial development leading to 2,500 jobs, 70 of public use (parks and schools) and 60 of open space.

2. **Planning Reserve**
   The other near term scenario models the impact of a project producing a similar level of jobs and housing located instead in a segment of the County's Planning Reserve. As Magnolia Ranch is only about a third of the larger Employment Village designation of the General Plan, this Planning Reserve scenario encompasses only 600 acres of the approximately 1,770 acre reserve. As for Magnolia Ranch, the majority of the planning reserve currently in dedicated to rice production, but the area also contains about 275 acres of pastureland and 200 acres of uncultivated open space in addition to some smaller crop production. The scenario would add 3,300 dwelling units and 2,619 jobs to unincorporated Yuba County.

Location of the Two Near-term Land Use Scenarios



Low density residential is the largest land use in both scenarios. However, there are significantly fewer low density residential acres in the Planning Reserve scenario given the project's smaller footprint. To reach near the same number of dwelling units and jobs on a smaller project, the Planning Reserve scenario replaces the approximately 110 acres of medium-high and high density residential and commercial users found in the Magnolia Ranch project into the same number of mixed use acres. This represents the second major land use difference between the two scenarios.

Long Term Land Use Scenarios

1. **Valley Growth Boundary Full Buildout**
   This scenario models a full urbanization of the County's Valley Growth Boundary including the nonurban land in the current Valley Neighborhood designation as well as development in the Commercial Mixed Use, Employment, Employment Village and the Planning Reserve designations of the General Plan (the map on the following page visualizes the extent of this and the other two long term scenarios). This scenario would urbanize an additional 15,137 acres on the valley floor, leading to an increase of 85,428 new residents and 66,989 jobs in unincorporated Yuba County.

2. **Concentrated Growth**
   The second of the long term land use scenarios models the effects of a more compact land use pattern. This scenario keeps the Employment Village and nearby Employment land use designation in current predominately agricultural use, incorporating the approximately 10,000 residents and 23,700 jobs slated for the Highway 65 corridor into the contiguous portions of the growth boundary including the reserve area. The scenario urbanizes 9,596 acres to produce 85,919 residents and 66,265 jobs.

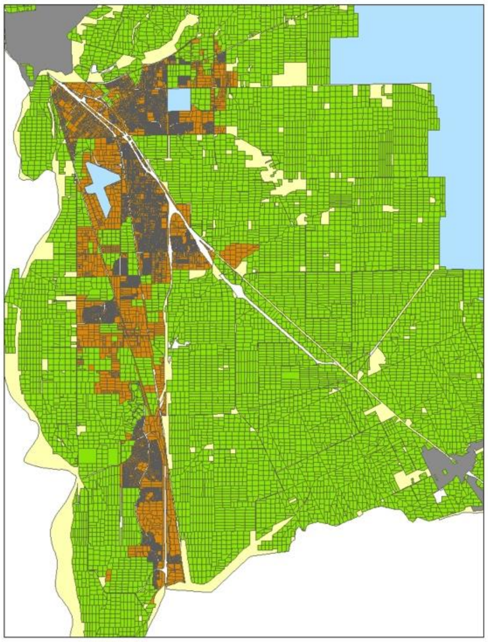
3. **Infill**
   The final land use scenario models a land use pattern based on infill development in existing communities, allocating a full buildout of the Valley Neighborhoods of Linda, Olivehurst, and a nearly full buildout of the Arboga and Plumas Lake area. The scenario preserves the agricultural land in both the Planning Reserve and the Employment Village/Employment designation along Highway 65. The scenario urbanizes 5,225 acres, resulting in 83,388 new residents and 64,462 new jobs. Note that these population and job levels are slightly lower (around three percent) than the other two long term scenarios.

Comparison of Long Term Valley Urbanization Scenarios

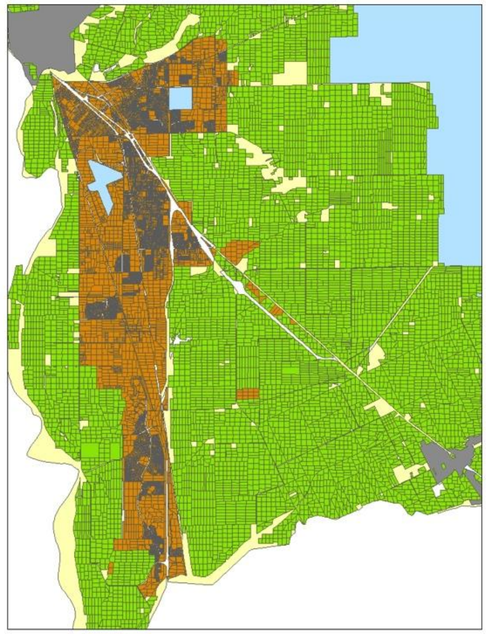
	Valley Growth Boundary Buildout	Concentrated Growth	Infill
New Residents	85,428	85,919	83,388
New Jobs	66,989	66,265	64,462
Additional Urban Acres	15,137	9,596	5,225

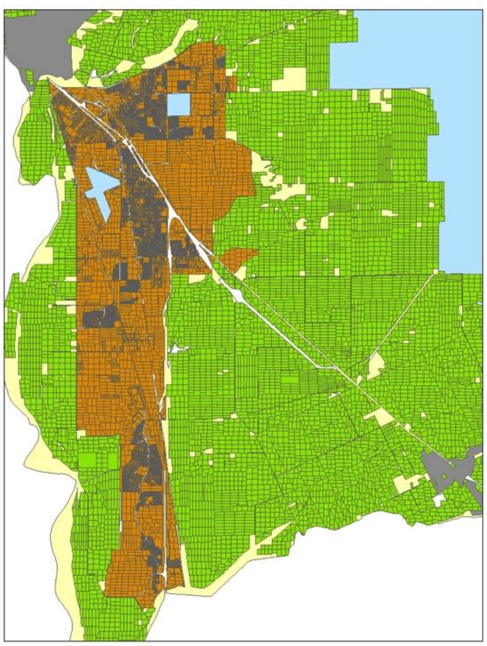
Long Term Valley Urbanization Scenarios in Comparison to the Base

Base Case

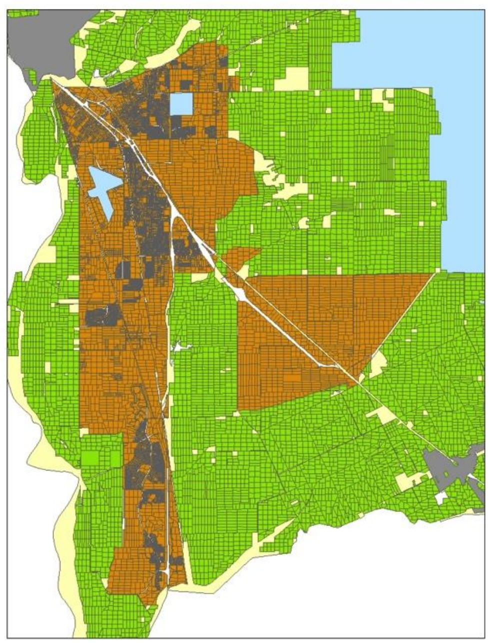


Infill Scenario





Compact Growth Scenario



Full Valley Growth Boundary Scenario

The above maps show the varying urbanization levels of the long term land use scenarios, with orange representing urban land use and green as agriculture production.

SHORT TERM LAND USE: MAGNOLIA RANCH AND THE PLANNING RESERVE

Both the Magnolia Ranch and the Planning Reserve scenarios propose development on current agricultural land. As the table below shows, the existing crop mix varies between sites. Currently the Magnolia Ranch area consists almost exclusively of rice production, with the remaining balance in pastureland. The majority of the Planning Reserve is also in rice production, yet the area also contains pasture, feed, olive production and uncultivated open space.

	Magnolia Ranch Specific Plan	**Planning Reserve Scenario**
Crop	*# of Acres*	
Rice	1,060	456
Pastureland	5	79
Corn	-	5
Olives	-	1
Open Space	-	59

In urbanizing this land, the scenarios would add housing, jobs and their associated economic output. As the two scenarios contain similar levels of new dwelling units and jobs, the economic contribution of each would be similar as well. What differs between scenarios is the current value of agricultural output replaced by urbanization: the Magnolia Ranch scenario would supplant $1.6 million of existing agriculture production, about twice the level of the Planning Reserve scenario ($766,000). The agriculture value differential between scenarios stems from Magnolia Ranch's larger footprint (replacing more acres in production) compared to the 600 acre Planning Reserve segment, as well as the higher crop value of rice relative to pastureland and open space. Note that these values include only the farmgate value of crops produced and do not capture any multiplier effects or economic value-add further along the supply chain, nor the market value or ecosystem services.

The fiscal effects of each land use plan also differ by scenario. SACOG inputted both the Magnolia Ranch and Planning Reserve scenarios into IMPACS incorporating existing conditions and Yuba County-specific revenue and cost data.[43] Both scenarios operate under the same assumptions, including how much of the capital infrastructure

[43] In addition to the land use allocations the major local data points for the scenarios include annual County revenues and expenditures by category; utility district service areas and existing design and capacity for sewer, water and stormwater; existing site infrastructure (transportation, sewer, water, stormwater); and county residents, households, household size and employees (including the portion in unincorporated Yuba County). The sources for these data, reflecting the above order, are: California State Controller's Office, "Local Government Annual Financial Reports: Counties Annual Report, Fiscal Year 2011-12"; MHM Incorporated, "Draft Technical Master Plan: Employment Village Infrastructure," July 12, 2013; Magnolia Ranch Specific Plan, 2013; Olivehurst

cost of development accrues to the County and what portion is paid by the developer. Both scenarios mimic the draft technical master plan for the Employment Village[44] that assigns most capital construction cost to the developer. The developer's share of capital costs includes local street construction; water laterals, distribution and mains; stormwater laterals, collection and detention; and sewer laterals. The model assigns major off-site street upgrades and sewer trunk, collection and treatment as public costs, which become the prominent cost differential between scenarios. The County pays all operations and maintenance on new infrastructure and for the increase in police, fire and other local services.

Based on the above assumptions, IMPACS models a County expenditure of approximately $50 million in capital construction costs to service the Magnolia Ranch scenario compared to $29 million for the Planning Reserve scenario. In addition to the one-time capital costs, IMPACS also provides estimates for ongoing County operations and maintenance (O&M) costs in the project compared to the new revenue generated by the new development. For Magnolia Ranch the model estimates a total annual County O&M expenditure of $7.5 million to cover infrastructure maintenance and general government, public protection, health and sanitation, public assistance, education, and cultural and recreation outlays. The model predicts the Magnolia Ranch scenario would provide $5.7 million a year in County revenues from taxes, licenses and permits, fines, forfeitures and penalties, use of money and property, intergovernmental transfers, charges for services and other revenues. For the Planning Reserve scenario IMPACS models an increase of $6.3 million a year in County revenue with an O&M annual cost of $5.5 million, resulting in a positive fiscal contribution to County finances.

The explanation of the different capital and O&M costs is twofold. First, the relatively compact site design of the Planning Reserve scenario reduces the capital and maintenance costs of laterals and collectors for water, stormwater and sewer infrastructure compared to Magnolia Ranch. Additionally, the Planning Reserve scenario's proximity to existing infrastructure also significantly reduces costs. Notably, the Magnolia Ranch scenario requires the construction of an entirely new water supply, treatment, storage and conveyance system while the Planning Reserve scenario meets the new demand by connecting to the nearby existing utility water supply and treatment system. Likewise, the Magnolia Ranch scenario would need to construct about 3.3 miles of new sewer infrastructure to reach the Oliverhurst Public Utility District's extent of service area at approximately McGowan Parkway and Rancho Road. In the model both scenarios build a self-contained stormwater infrastructure.

The difference in revenue by scenario stems from the assumptions of the fiscal model. IMPACS estimates the dwelling units in the Planning Reserve scenario to produce annual property taxes 18 percent higher than the dwelling units in Magnolia Ranch given the higher assessed value per occupant in the mixed use designation. [45] While residential property taxes account for some of the differential, the largest distinction in County revenue comes from sales tax producing jobs. The majority of employment in Magnolia Ranch comes from its Moderate Intensity Office use: 2,221 jobs compared to the 140 retail jobs in the Community/Neighborhood Retail portion of the specific plan. For the Planning Reserve scenario however, IMPACS models 50 percent retail space in the commercial section of the mixed use land designations, with the remaining portion filled by office. As a result, the Planning Reserve scenario produces far more retail jobs (and thus sales tax revenue) compared to Magnolia Ranch.

Public Utility District and Linda County Water District websites; Yuba County 2030 General Plan; California Department of Finance E5 series, 2012; and the SACOG Employment file, 2012.

[44] MHM Incorporated, "Draft Technical Master Plan: Employment Village Infrastructure," July 12, 2013

[45] AECOM "IMPACS User Guide." Prepared for the Sacramento Area Council of Governments, June 2011.

This represents a major assumption of the model; swapping retail use for office would lower the annual revenue level of the Planning Reserve scenario.

Immediate-Term Urbanization Scenarios

	Magnolia Ranch	Planning Reserve
DUs	3,352	3,294
Jobs	2,496	2,619
Urbanized Acres	1,060	600
Value of Existing Ag Production	$1.6 million	$766,000
County Capital Costs of Development	$52 million	$29 million
Annual County O&M Costs from Development	$7.5 million	$5.5 million
Annual County Revenue from Development	$5.5 million	$6.3 million

AGRICULTURAL VALUE AND FISCAL EFFECTS OF URBANIZATION SCENARIOS

The longer-term urbanization scenarios provide a set of data point estimates that may prove helpful in assessing the link between land use and economic development strategies. The scenarios help show how fiscal and economic indicators could operate based on various future conditions. First, the different modeled development patterns to meet the valley floor population and job increases referenced in the General Plan have significant effects on the overall output of the agriculture sector. The full growth boundary buildout scenario converts 11,127 agriculture acres to urban use. In comparison, the compact growth scenario urbanizes 6,169 agriculture acres and only 2,623 acres are developed in the infill scenario.[46] The development of agricultural land reduces the agricultural sector's total output, ranging from $5.6 million a year in the infill scenario to over $17 million in the full buildout based on current crop production. The case study's agricultural scenarios show how the loss in agricultural value can be greater if future cropping patterns shift. For example, conversion of land in the specialty crop scenario could lead up to a loss of $150 million in agricultural value.

[46] In addition to agriculture acres, each land use scenario also converts current open space and undeveloped land—2,602 acres from the infill, 3,427 from compact growth, and 4,010 from the full buildout scenarios. This brings the scenarios' total new urbanized acres to 5,225, 9,596 and 15,137 respectively.

Urbanization Scenarios Summary

	Infill Focused	Concentrated Growth	Valley Growth Boundary Buildout
New Residents	83,388	85,919	85,428
New Jobs	64,462	66,265	66,989

Loss of Agriculture Land and Value by Urbanization Scenarios

	Infill Focused	Compact Growth	Full Valley Growth Boundary Buildout
Converted Agriculture Acres	2,623	6,169	11,127
Lost Annual Agriculture Production (base scenario)	$5.6 million	$11.2 million	$17.3 million
Lost Annual Agriculture Production (specialty crop scenario)	$39.5 million	$93 million	$150 million

In addition to the changing economic impacts, the project team also analyzed the fiscal results of each urbanization scenario. As for the short-term scenarios, the project team inputted the infill, compact and full valley growth boundary scenarios into the IMPACS model. The results produce general sketch-level estimates of capital investment, O&M costs and new revenue by development pattern that mirror the same trends revealed in the above land use analysis. County infrastructure costs to meet approximately 84,000 new residents and 66,000 jobs in the land use scenarios range from $500 million in the infill focused to $600 million in the full growth boundary buildout scenario. Servicing the new development also varies by land use scenario: IMPACS estimates annual operations and maintenance expenditures of $78 million for the infill scenario, rising to $85 million for the concentrated growth and $89 million in a full development of the valley growth boundary.

Fiscal Costs of Urbanization Scenarios

County Costs	Infill Focused	Compact Growth	Full Valley Growth Boundary Buildout
Capital Infrastructure Costs	$500 million	$530 million	$600 million
Capital Costs per Equivalent Residential Unit (ERU)*	$5,293	$7,174	$11,884
Gap per ERU per year (assumes 20 year payback)	$268	$359	$780
Ongoing Annual O&M	$78 million	$85 million	$89 million

*ERUs include residential dwelling units plus non-residential space converted to an equivalent unit at the rate of one ERU per gross 2,500 sq ft. of non-residential space.

The above analysis provides top-level financial data on the costs of various land use patterns. In addition to these fiscal indicators, each scenario carriers further opportunities and constraints not reflected in the cost analysis. For example, the infill-focused scenario would have to navigate its own unique set of challenges to realize the above financial metrics. Often development plans affecting existing communities face community resistance that can delay, alter, or even prevent the development from moving forward. The new jobs and housing slated for existing communities in the infill scenario would alter the makeup of these neighborhoods, and in the short term also disrupt residents through construction and redevelopment. Finally, the infill scenario may not match qualitatively with the manner of development envisioned by Yuba County stakeholders. The full valley growth boundary scenario has its own unique challenges compared to the infill-focused scenario, with the compact scenario a balance between the two. Notably, the valley growth scenario involves the risk of substantial upfront investment that only pays off if there is a market for the new development. This case study's agricultural analysis suite can provide the county transitional land use strategies as the regional housing market rebounds.

Overall this case study does not delve into the qualitative opportunities and constraints of each land use scenario. Instead, the case study reports data and economic modeling results that may help the County in its broader local assessment of various possible future land uses.

CONCLUSION: OPPORTUNITIES TO EXPAND SPECIALTY CROP PRODUCTION IN YUBA COUNTY

This case study conducted for Yuba County has shown the integral role that agriculture plays in the local economy and the potential for increase through expanded specialty crop production. The study documents current conditions in the agricultural sector as well as an emerging opportunity to both realize economic returns and policy objectives, such as public health and local food sourcing, through local specialty crop production. Through scenario analysis the second section of the study compared specialty crop production with competing possible futures, noting how the specialty crop scenario would raise revenue and return, decrease agriculture water consumption and support food chain jobs.

Capitalizing on the emerging local specialty crop market segment to bolster local economic development will require buy-in from numerous groups. This case study concludes by looking at three—growers, investors, and Yuba County—to showcase challenges and opportunities moving forward. Clear market signals for growers coupled with supportive county policies will be needed to entice the agriculture industry to move toward more specialty crop production. With this backdrop, investors may find Yuba County an attractive place to implement what SACOG's analysis shows to be a promising food hub enterprise.

Overall the economic viability of the local market is predicated on a sufficient supply of local specialty crop production; without growers, there is no local system. Through interviews, growers in Yuba County noted their need to see a strong market in order to dedicate production to local market channels, especially given the strength of the export commodity market. The market scan provides data suggesting the local market is a viable option, documenting consumption levels, supply and demand imbalances, and price points for local specialty crops. The model analysis of a local food hub facility also shows how growing for the local market can be profitable for Yuba County growers in aggregate, but that sufficient water and labor supply is critical. A full suite of business tools helps inform food hub investment decisions including a detailed pro forma customizable by specialty crop throughput and other variables. This case study delivers a conceptual facility situated within Yuba County to address a key infrastructure gap. Together these tools can help guide investment to the local food system.

Furthermore, the study provides data and tools to evaluate scenarios and educate stakeholders about current and future agriculture and its impact on the county. The study estimates grower revenue and profit across various future conditions such as drought, establishment, or changing market prices. While the data and models and corresponding results are certainly not definitive, the work provides guidance on building strategies for agriculture and other land uses, as well as a solid foundation for building even more robust tools for future analyses.

Finally, support from Yuba County can help complement grower and investor decisions. Yuba County's General Plan makes clear the commitment to agriculture and the County can continue to support initiatives such as the grower-institution matchmaking of the Yuba-Sutter Economic Development Corporation as well as work to update policy to support the entire local food value chain from production to processing to consumption. In addition, land use planning plays a paramount role in agricultural viability. The model results of the case study show the potential for both the loss of agriculture revenue and the fiscal impacts of development decisions.

We anticipate these findings will be of use to farmers considering local production both on a full-time or supplemental basis. Through continued stakeholder engagement SACOG's RUCS program will continue to share these data and findings on the local specialty crop market opportunity.

APPENDIX 1. FULL MODELING RESULTS

This appendix provides the full modeling results of the case study. The below matrix reports the economic, water, labor and fiscal indicators of each agricultural scenario across every possible urbanization scenario, resulting in 60 unique scenarios and almost 450 indicators. The fiscal indicators are reported as additions to the County's existing 2012 budget; as such the fiscal indicators in the base year are left blank.

Yuba County Case Study - Scenarios			Urbanization Scenarios					
			Today	2020 - Short Term Land Use		2030 - Long Term Land Use		
		Acreage	Base Case	Magnolia Ranch	Urban Reserve	Infill Focus	Concentrated Growth	Full General Plan Build Out
		Valley Urban	6,075	7,115	6,675	11,300	15,671	21,212
		Crop Acres	120,942	119,902	120,401	118,319	114,773	109,815
		Range, Nat. Resources & Rural Communities	252,801	252,801	252,742	250,198	249,372	248,790
		Public (e.g. Beale AFB)	25,084	25,084	25,084	25,084	25,084	25,084
Agricultural Uses	Base Case	Annual Ag Value	$360,174,281	$358,565,127	$359,408,080	$354,282,154	$348,698,538	$342,579,195
		Average Ag ROI	26%	26%	26%	26%	26%	26%
		County Capital Cost	$0	$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
		Annual O&M	from budget	$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
		Annual Co. Revenue	from budget	$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
		Ag Labor	2,606,789	2,601,600	2,604,273	2,576,815	2,554,185	2,536,467
		Ag H2O	417,671	413,407	415,502	410,811	397,793	380,912
	High Revenue	Annual Ag Value	$591,842,338	$590,233,183	$591,015,825	$583,305,296	$576,545,054	$569,080,373
		Average Ag ROI	29%	29%	29%	28%	29%	29%
		County Capital Cost		$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
		Annual O&M		$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
		Annual Co. Revenue		$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
		Ag Labor	8,253,271	8,248,082	8,250,760	8,215,268	8,198,167	8,177,478
		Ag H2O	452,799	448,535	450,609	442,992	428,786	408,648
	Low Revenue	Annual Ag Value	$213,018,538	$212,030,538	$212,552,113	$209,735,815	$206,465,975	$202,871,000
		Average Ag ROI	8%	8%	8%	8%	8%	8%
		County Capital Cost		$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
		Annual O&M		$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
		Annual Co. Revenue		$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
		Ag Labor	1,196,434	1,194,801	1,195,618	1,177,877	1,167,569	1,161,045
		Ag H2O	191,575	189,842	190,812	191,575	184,350	179,320

Yuba County Case Study - Scenarios		Urbanization Scenarios					
		Today	2020 - Short Term Land Use		2030 - Long Term Land Use		
	Acreage	**Base Case**	**Magnolia Ranch**	**Urban Reserve**	**Infill Focus**	**Concentrated Growth**	**Full General Plan Build Out**
	Valley Urban	6,075	7,115	6,675	11,300	15,671	21,212
	Crop Acres	120,942	119,902	120,401	118,319	114,773	109,815
	Range, Nat. Resources & Rural Communities	252,801	252,801	252,742	250,198	249,372	248,790
	Public (e.g. Beale AFB)	25,084	25,084	25,084	25,084	25,084	25,084
Agricultural Uses: **High ROI**	Annual Ag Value	$516,796,080	$515,808,080	$516,275,732	$509,525,732	$504,643,904	$499,812,512
	Average Ag ROI	43%	43%	43%	42%	42%	43%
	County Capital Cost		$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
	Annual O&M		$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
	Annual Co. Revenue		$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
	Ag Labor	6,104,529	6,102,897	6,103,687	6,064,385	6,054,732	6,047,063
	Ag H2O	246,617	244,884	245,748	241,853	235,967	228,349
Agricultural Uses: **High H2O**	Annual Ag Value	$434,938,759	$433,329,605	$434,112,247	$427,537,806	$420,959,365	$413,494,683
	Average Ag ROI	24%	25%	24%	24%	24%	25%
	County Capital Cost		$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
	Annual O&M		$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
	Annual Co. Revenue		$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
	Ag Labor	4,377,966	4,372,776	4,375,454	4,325,144	4,300,821	$4,280,132
	Ag H2O	461,272	457,008	459,083	451,428	437,220	417,082
Agricultural Uses: **Low H2O**	Annual Ag Value	$283,246,111	$282,258,111	$282,779,686	$279,684,443	$276,414,603	$272,819,628
	Average Ag ROI	13%	13%	13%	13%	13%	14%
	County Capital Cost		$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
	Annual O&M		$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
	Annual Co. Revenue		$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
	Ag Labor	1,425,672	1,424,039	1,424,856	1,406,152	1,395,843	1,389,319
	Ag H2O	190,866	189,132	190,103	187,976	183,640	178,610

Yuba County Case Study - Scenarios		Urbanization Scenarios					
		Today	2020 - Short Term Land Use		2030 - Long Term Land Use		
	Acreage	**Base Case**	**Magnolia Ranch**	**Urban Reserve**	**Infill Focus**	**Concentrated Growth**	**Full General Plan Build Out**
	Valley Urban	6,075	7,115	6,675	11,300	15,671	21,212
	Crop Acres	120,942	119,902	120,401	118,319	114,773	109,815
	Range, Nat. Resources & Rural Communities	252,801	252,801	252,742	250,198	249,372	248,790
	Public (e.g. Beale AFB)	25,084	25,084	25,084	25,084	25,084	25,084
Agricultural Uses: **Local Consumption**	Annual Ag Value	$368,495,155	$366,886,001	$367,728,954	$362,603,028	$357,304,242	$351,319,349
	Average Ag ROI	25%	25%	25%	25%	25%	25%
	County Capital Cost		$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
	Annual O&M		$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
	Annual Co. Revenue		$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
	Ag Labor	2,930,167	2,924,978	2,927,651	2,900,193	2,878,669	2,861,370
	Ag H2O	418,883	414,619	416,714	412,024	399,018	382,314
Agricultural Uses: **Specialty Crop**	Annual Ag Value	$1,824,343,487	$1,808,655,595	$1,816,182,766	$1,784,776,813	$1,731,287,134	$1,656,498,124
	Average Ag ROI	36%	36%	36%	36%	36%	36%
	County Capital Cost		$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
	Annual O&M		$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
	Annual Co. Revenue		$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
	Ag Labor	32,022,547	31,747,179	31,879,303	31,328,037	30,389,137	29,076,372
	Ag H2O	339,940	336,109	338,419	332,567	322,600	308,665
Agricultural Uses: **High Labor**	Annual Ag Value	$458,447,698	$456,838,543	$457,643,745	$452,736,056	$447,136,574	$440,137,733
	Average Ag ROI	11%	11%	11%	11%	11%	11%
	County Capital Cost		$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
	Annual O&M		$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
	Annual Co. Revenue		$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
	Ag Labor	9,845,138	9,839,948	9,842,345	9,765,596	9,733,659	$9,706,584
	Ag H2O	371,247	366,983	369,236	364,405	352,725	336,955
Agricultural Uses: **Low Labor**	Annual Ag Value	$317,222,288	$316,234,288	$316,752,263	$312,078,364	$308,088,524	$304,493,549
	Average Ag ROI	41%	41%	41%	41%	41%	41%
	County Capital Cost		$52,000,000	$29,000,000	$500,000,000	$530,000,000	$600,000,000
	Annual O&M		$7,500,000	$5,500,000	$78,000,000	$85,000,000	$89,000,000
	Annual Co. Revenue		$5,500,000	$6,300,000	$102,000,000	$95,000,000	$80,000,000
	Ag Labor	595,999	594,366	$595,203	587,948	581,703	575,179
	Ag H2O	205,757	204,024	204,994	202,609	198,173	193,143

APPENDIX 2. EXPLORING LONG-TERM VIABILITY OF WALNUT GROWERS

Walnut production has surged in Yuba County and elsewhere in the SACOG region over the last several years as the growing international market has commanded an ever-higher price. High market prices are excellent news for the County's established walnut growers as their incomes grow, and have induced other growers to convert acres to this new cash crop. All seems well if walnut prices stay high and if these acres were to produce a harvest immediately; however, perennial crops like orchards and vineyards go through a period of "establishment", when costs are high and harvests are low to none. During establishment, growers incur costs to prepare the land, plant trees or vines and tend them (prune, sucker, et cetera). Length of establishment depends on the crop—almond orchards return their first harvest in Year 3 and produce at full capacity in Year 7; wine grapes return their first harvest in Year 3 and produce at full capacity in Year 4 (on average). Walnuts are harvested in Year 4 at only 10% of full production and harvest approximately doubles each year until Year 8, when the harvest plateaus at 6,000 tons per acre.

Walnut Harvest, in tons per acre per year

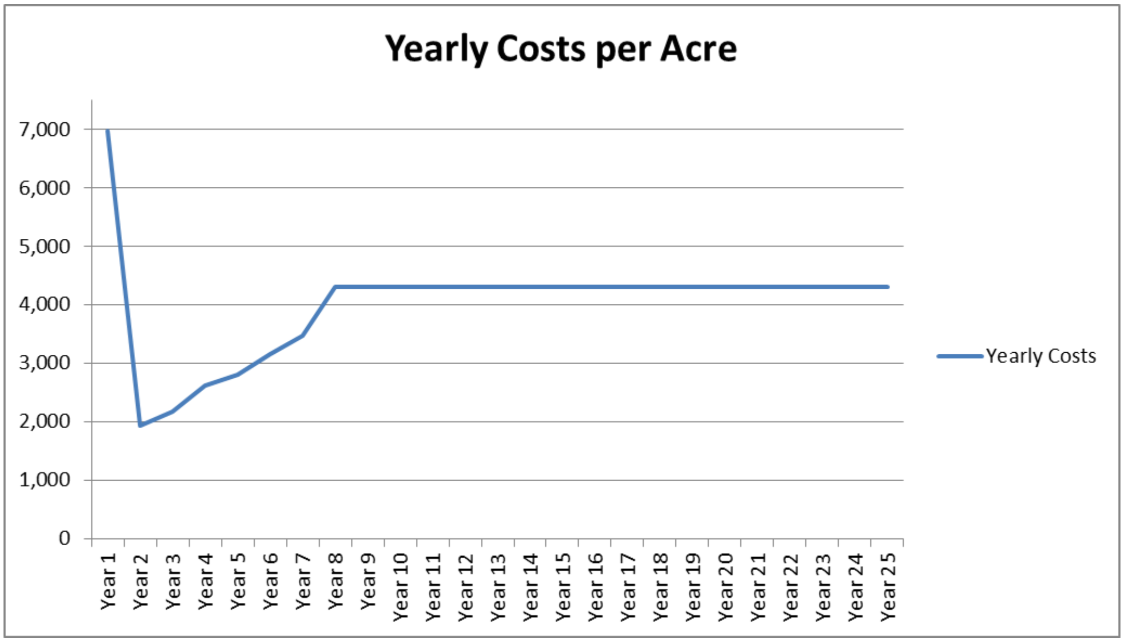
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8+
0	0	0	600	1,200	2,400	5,000	6,000

Walnuts are currently returning high prices in the marketplace and therefore many growers have converted to walnuts; however, these orchards will take up to eight years to start generating a return and even longer for the grower to come into the "black" after the large capital investment of planting. For a time, growers may be in the optimal phase of receiving a full yearly harvest and have repaid the capital loans from establishing the orchards. At approximately Year 25, the orchards' production wanes and growers often tear out old trees to replace with new trees, restarting the cycle of establishment.

The following is an exploration into the long-term financial viability of crops with a high establishment cost, using walnuts as an example. This analysis, however, is relevant for any grower that would need to recapitalize to break into new crop markets, such as the specialty crop expansion outlined in this case study.

Yearly Costs over the Long-Term

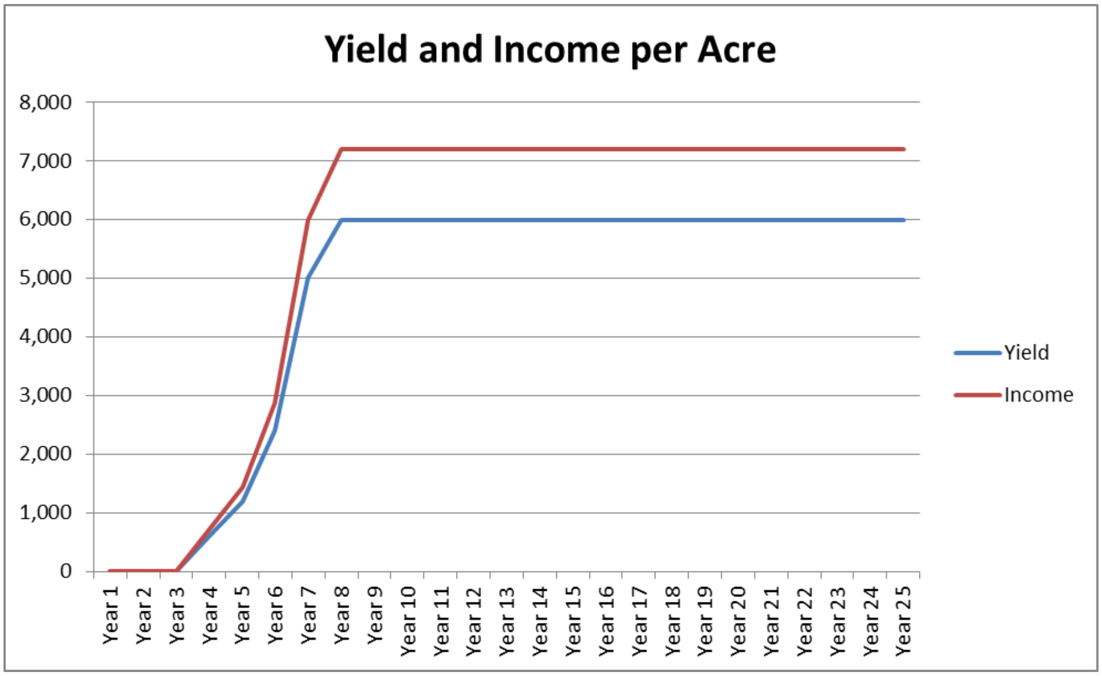
Walnut growers experience on average three phases of yearly costs over a 25-year lifecycle of an orchard (lifecycle may vary, but this analysis uses 25 years). Costs are highest in Year 1 due to preparing land, purchasing and planting tree starts and pruning. Yearly costs decrease after Year 1 as orchards mature but still must be tended with irrigation, fertilizer and pesticide, then rise in Year 4 as growers incur harvest costs . On average, an orchard reaches an average production and harvest year in Year 8, which remains steady for the remaining lifespan of the orchard. In this study, an orchard in an average production year costs the grower approximately $4,300 per acre. These yearly costs are illustrated in the graph below.



This yearly cost analysis would look very similar for other orchard or vine crops such as peaches, kiwis and grapes. While walnuts are used as the example here, the concepts can be readily extrapolated to other specialty crops in Yuba County.

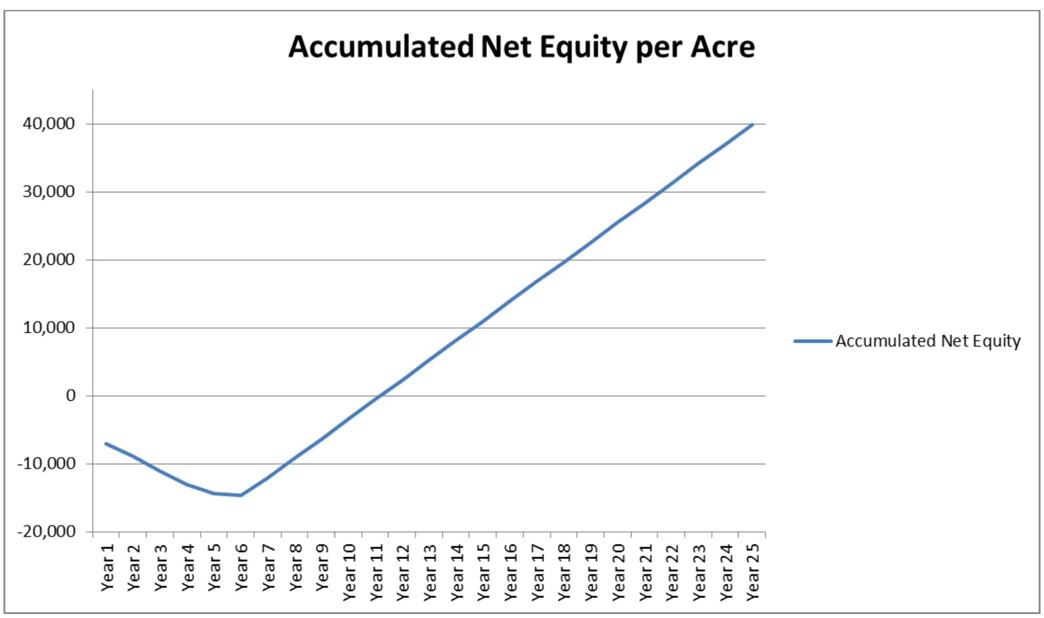
Yields and Income

Yield and the associated income fluctuates over the lifespan of the orchard, as well. In the first three years, yield and income are zero as the orchard is established and matures. With the first harvest in Year 4, income increases yearly until Year 8, when it plateaus at an average yield of 6,000 pounds per acre. At today's market price of $1.20 per pound, this translates to $7,200 return per acre. These yearly yields and income are illustrated in the graph below.

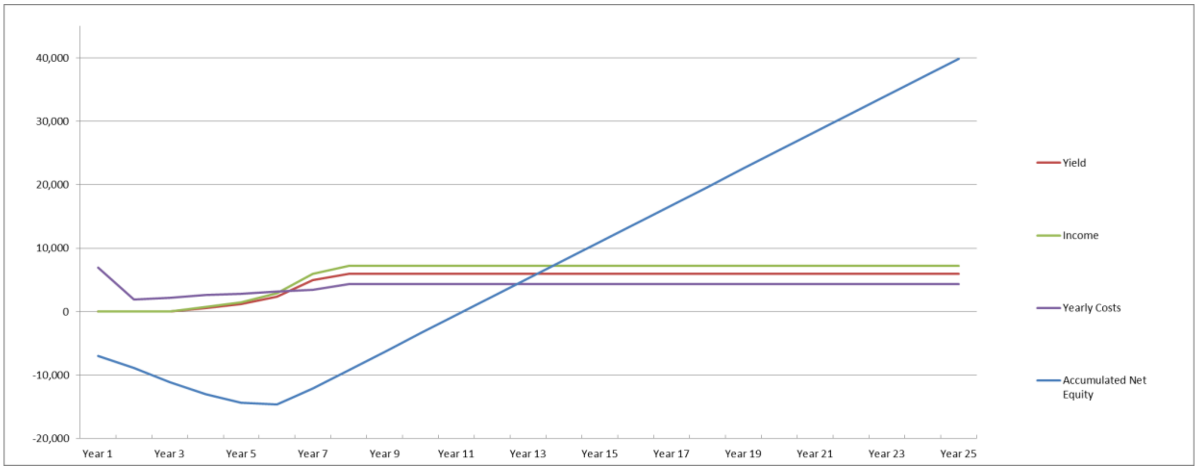


Accumulated Net Equity

Using yearly costs and income associated with establishing a walnut orchard, growers' accumulated net equity—growers' income minus debts over time—can be calculated over the lifecycle of the orchard. This calculation shows accumulated liabilities incurred over the first six years, the point at which growers start to repay these liabilities (Years 7-11), the point at which growers become solvent (repay all liabilities in Year 12), and the growth in net worth over the subsequent 14 years. The market price was held constant and the yield held at 6,000 pounds per year (average yield over the life of the orchard) for Years 8+ over the 25 years in the graph below. The graph below illustrates this cycle in net worth of a walnut production.



When these lines are overlaid, they show the comprehensive timelapse of per acre costs, yield, revenue, and accumulated net equity over the 25-year lifespan of a walnut orchard. This timelapse provides an understanding of the financial landscape of individual growers not seen in the snapshot provided by scenario modeling.

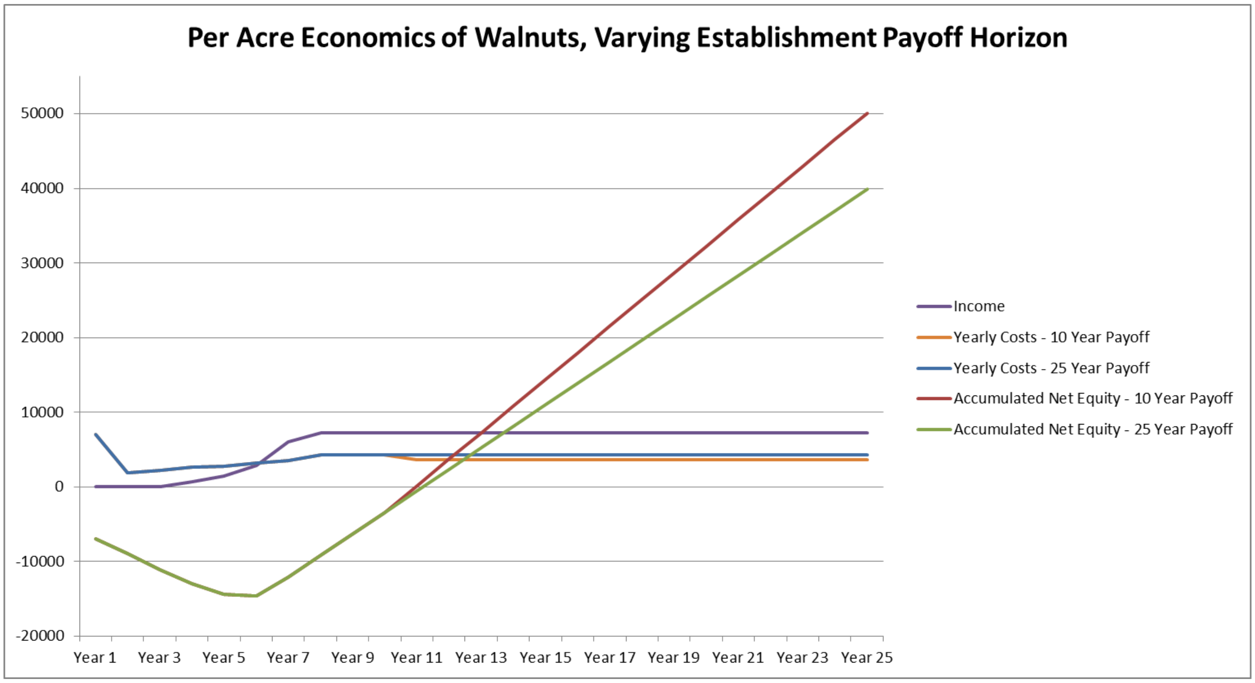


Scenarios

Using the longitudinal platform, we can explore the long-term financial effects of variables such as length of the establishment payback period, land ownership, and orchard re-establishment. These scenarios give a nuanced perspective into the potential financial scenarios of growers given various circumstances.

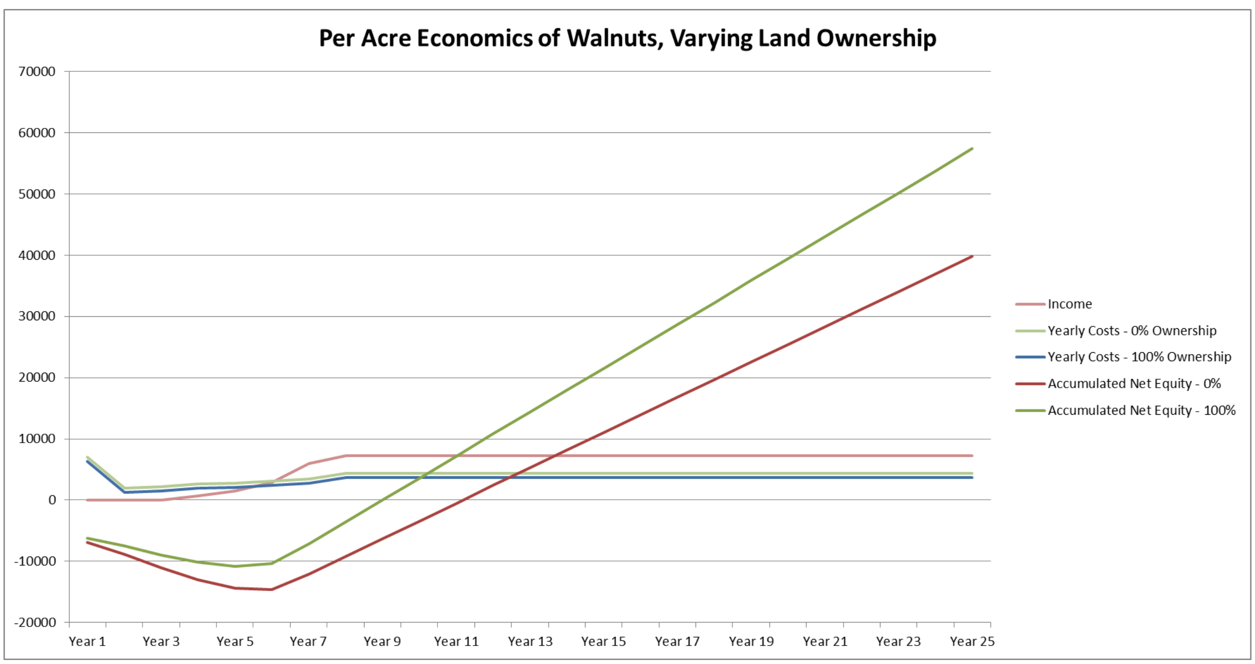
Paying Off Establishment

The graph below illustrates the difference in net equity by Year 25 when a grower repays establishment costs in full in 10 years compared to 25 years. The difference is significant—over $10,000 greater when establishment is repaid in 10 years. A 25-year payback was used by all of UC Cooperative Extension's cost and return studies for orchard crops, in addition to being corroborated by an agricultural lending bank in the SACOG region.



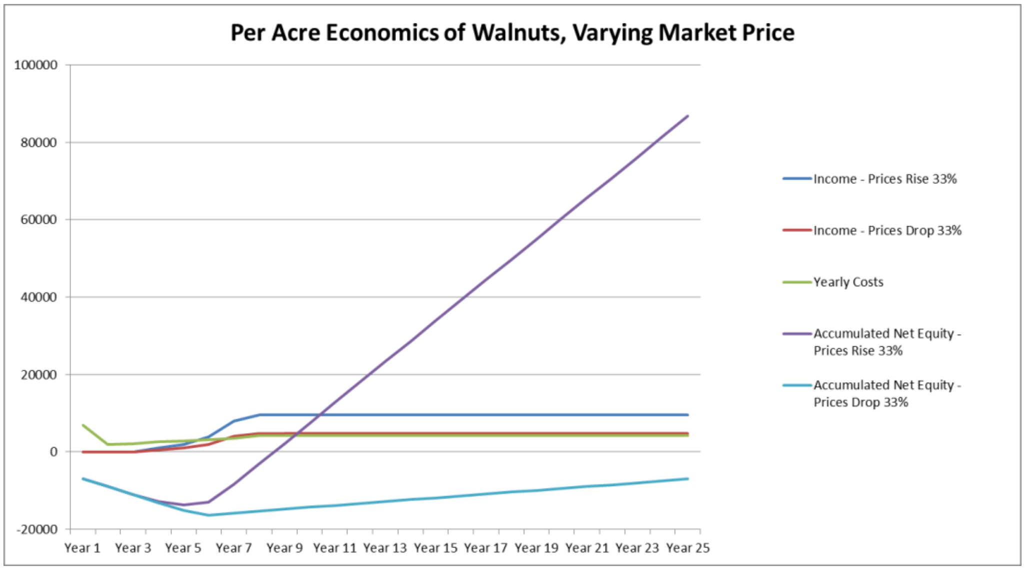
Land Ownership

Land is one of the largest line items in a grower's yearly budget; outright land ownership therefore plays a large role in the viability of certain crops. Growers that own land outright, such as family farmers with inherited land, have lower yearly costs as they are not making rent nor mortgage payments. This yearly savings realizes over $15,000 in net equity over the walnut orchard's 25-year lifecycle.



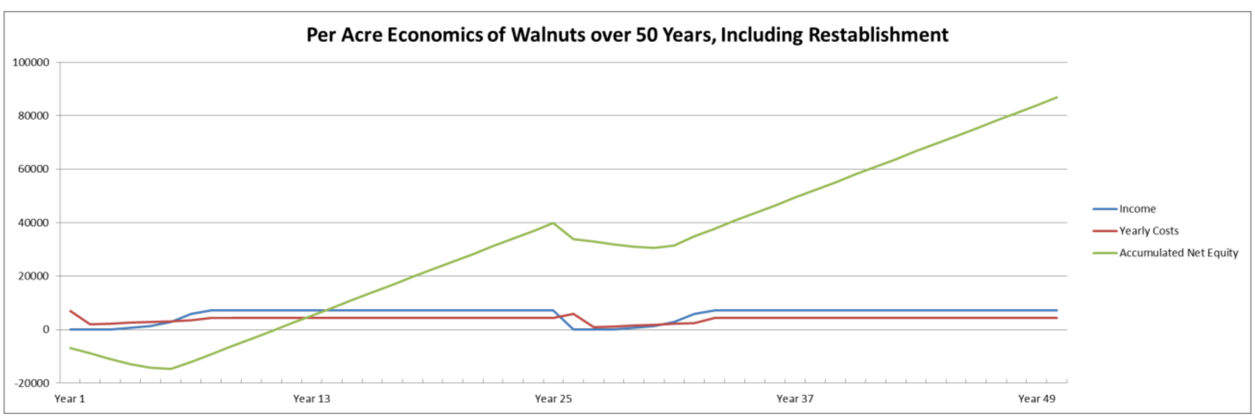
Changes in Market Price

Longitudinal analysis shows what crops will be profitable in the long term, particularly those with high costs to become established, and the market price of walnuts determines viability. As with any good sold, walnut prices fluctuate. Walnut prices have almost tripled in the last 10 years according to the region's crop reports, inducing a surge in walnut acreage. As more and more growers put equity into costly—and potentially lucrative—walnut orchards, an analysis of market prices indicates that these growers are expecting prices to hold if not continue to rise: A 33% increase in walnut prices from today's value shows an excellent return over the 25-year horizon of an orchard; however, a 33% decrease in walnut prices indicate that a grower would not be in the black before Year 25, when they would likely re-establish their walnut crop.



Orchard Re-Establishment

Looking into the second lifecycle of a walnut orchard, a grower tears out their crop at approximately Year 26 and re-establishes it. Years 26 through 30 again have zero harvests and income and costs rise to prepare the land repurchase root stock. Given constant prices, growers' finances over two lifecycles are illustrated in the graph below.



APPENDIX 3. YUBA COUNTY INTERIM FOOD HUB MODEL

As part of this Yuba county case study the project team has prepared a cost estimate and financial analysis of a receiving station and processing facility within Yuba County that can serve as an interim model before construction of a full facility. This technical appendix of the case study presents a proposed conceptual layout and associated cost estimate to construct and equip the facility of approximately 16,800 sq. ft. It also contains an overall estimate for the financial viability of the enterprise. The concept was developed based on:

- An assessment of local and regional market conditions conducted by SACOG and the project team, including site visits and interviews with local government officials, local growers, the Yuba-Sutter Farm Bureau, UC Cooperative Extension, agricultural specialists including lenders and real estate agents, economic development representatives, and North Yuba Grown, a collaborative of growers and value-added producers from Yuba, Sutter and Butte counties.
- The increasing interest on the part of local government officials and agricultural stakeholders in the economic development potential of building local food system infrastructure.
- The role that such a facility could play within the context of broader development of the six-county (and beyond) regional food system infrastructure – the Sacramento Valley Food Hub –providing dedicated market channels for the aggregation, packaging, processing and distribution of fresh local produce.

The conceptual model for the Yuba County facility provides for three core functions, designed to generate revenue from different markets and across seasons as much as possible:

1) To serve as an enhanced receiving station to receive, grade, sort, and aggregate fresh produce for transfer to regional markets;
2) To serve as a local-serving hub to handle the balance of the produce with activities such as trimming and packing for distribution to the local market, especially institutions and businesses;
3) To provide a niche value-added processing line, using as a prototype, walnuts purchased from local sources to produce honey-glazed walnuts.

This piece of added agriculture infrastructure in Yuba County helps address some barriers to growing for the local market. The facility builds market channels for locally grown fresh produce to existing distribution companies and food operations contractors, including those serving schools, hospitals, government facilities and other institutions. In addition, the facility creates a link between growers and Yuba County restaurants, grocery stores and other businesses seeking to increase their selection of local specialty crop. Finally, the Yuba County facility also will provide a market outlet on the grower side, for efforts such as North Yuba Grown.

Overall the Yuba food hub could provide a variety of services. Shown in the table below, some of these activities could generate an additional revenue stream due to the types of services provided, as well as to assist growers in business planning and market development. Research shows that many growers who work with hubs increase the scope and profitability of their farming operations.[47]

---

[47] SACOG Regional Agricultural Infrastructure Project, "Research Analysis of Food Hub Trends and Characteristics." Conducted by Applied Development Economics, Inc. with Foodpro International Inc., The Hatamiya Group and DH Consulting. June 2014.

SERVICES AND ACTIVITIES OFFERED BY REGIONAL FOOD HUBS

Operational Services	Producer Services	Community/Environmental Services
Distribution	Actively linking producers and buyers	Increasing community awareness of “buy local” benefits
Aggregation	Transportation, on-farm pick up	Distributing to nearby “food deserts”
Brokering	Production and post-harvest handling training	Food bank donations
Branding and market promotion	Business management services and guidance	Youth and community employment opportunities
Packaging and repacking	Value-added product development	SNAP (food stamp) redemption
Light processing (trimming, cutting and freezing)	Food safety and good agricultural process (GAP) training	Health screenings, cooking demonstrations
Product storage	Liability insurance	Recycling and composting programs

Source: Regional Food Hub Resource Guide, USDA Agricultural Marketing Service, April 2012, p. 6

Initially the conceptual facility in Yuba County would provide primarily operational services—receiving, grading and aggregating fresh produce to transfer to the regional food hub and distribution to the immediate local market—as well as value-adding activities on the walnut processing line. The table below summarizes assumptions regarding the estimated levels of production and acreage required to support this alternative facility model, for both fresh produce and processing of honey-glazed walnuts.

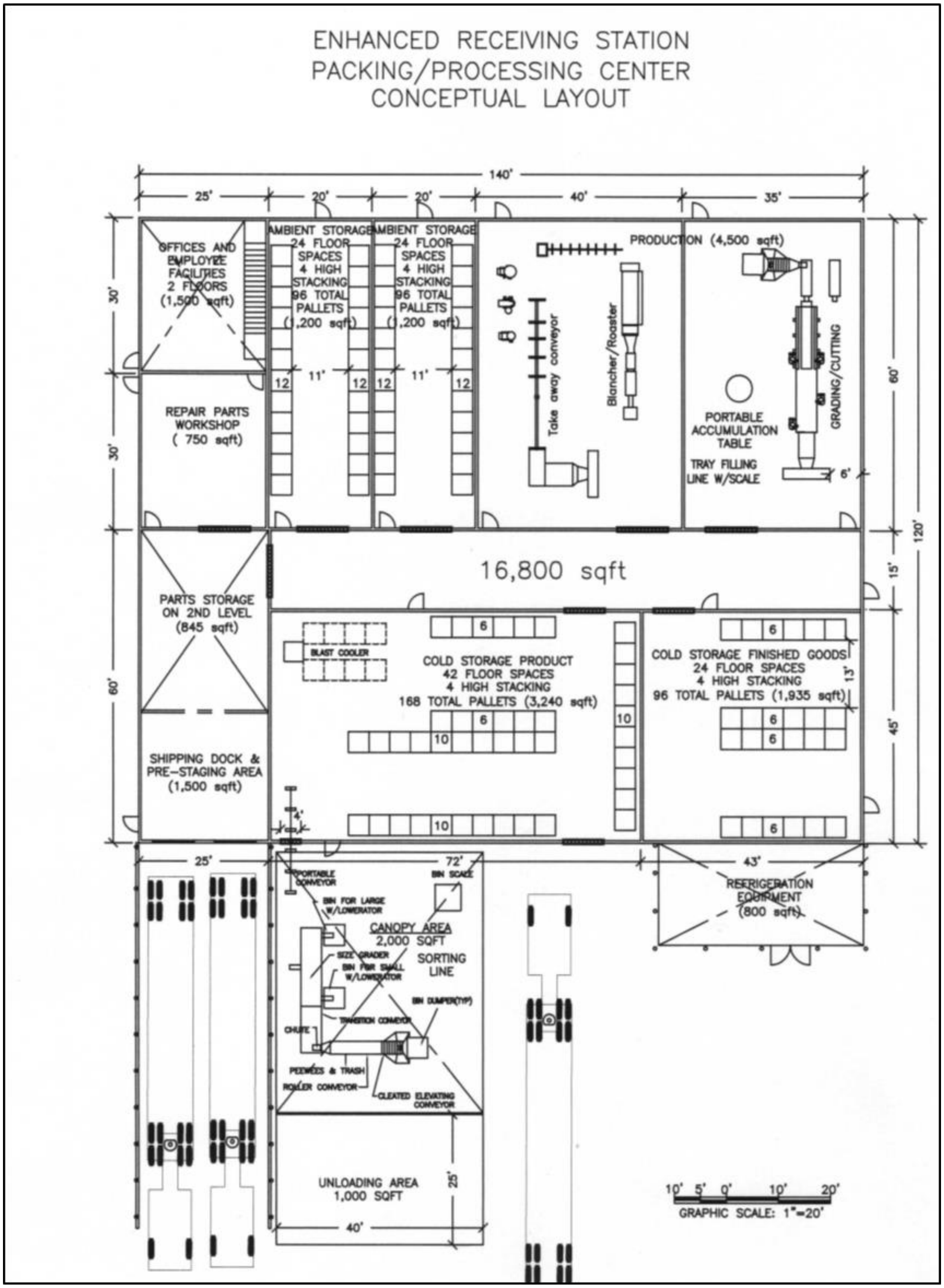
Facility Capital Costs

The graphic below provides schematic of the conceptual layout of a proposed facility to meet these functions. The main body of the facility is 16,800 s.f., with additional second level office space and mezzanine space for parts storage, and additional outside areas. The facility is designed for flexibility to accommodate diverse types of produce. The schematic illustrates areas for unloading, the shipping dock and pre-staging area, sorting line, production space for fresh pack, cold storage for raw produce and finished goods, ambient storage for supplies and walnuts, office space, and workshop (production space).

YUBA HUB FACILITY OPERATING ASSUMPTIONS
Operating Times. The facility would operate 7.5 hours per day, five days a week, 50 weeks per year. It assumes that the growers would drop off their produce at the facility.
Production Levels for Fresh Produce. The facility will aggregate/package 1,000 pounds (lbs.) of fresh produce per hour. That adds up to 937.5 tons per year, or 18.75 tons per week (37,500 lbs. per week and 1,875,000 lbs. per year). The facility also will receive, cool and transfer 1,000 lbs. of fresh produce per hour to a larger, regional-serving hub. This adds up to another 937.5 tons per year, for a total of 1,875 tons per year for the two markets.
Fresh Produce Acreage Requirements. The facility's fresh produce line requires a dedicated supply of local fruit and vegetable crop. While the crop acreage needed to provide this supply will vary on the exact crop mix, the project team estimates the alternative food hub model customized to Yuba County would need between 60 and 270 acres of specialty crop production. The range would fall somewhere in between as the hub would provide for a mix of crop types. Given that there was a total of 6,480 acres of harvested acreage in Yuba County in 2012 for miscellaneous fruits and nuts (not including walnuts, almonds, cling peaches, kiwis, or prunes/dried plums) and miscellaneous field and vegetable crops (not including rice and other crops), the acreage requirements are minimal to start.
Processing Line for Glazed Walnuts. The facility will process 300 pounds per hour of honey-glazed walnuts. That adds up to 281 tons per year (11,250 lbs. per week and 562,500 lbs. per year).
Walnut Acreage Requirements. The average yield per harvested acreage of English walnuts in Yuba County in 2012 was 2.1 tons per acre, with 11,560 acres in production. The facility requirements would require production from 134 acres. While most of the County's walnut crop is exported, the project team validated the availability of locally grown crops for the proposed processing line.
Labor: Three employees for the start up

Data Sources: Estimated tons per acre crop yields: 2012 National Agricultural Statistical Services, USDA, for California, UC Davis Cost of Production Studies, and *2012 Yuba County Agricultural Commissioner's Report*; 2012 harvested acreage: *2012 Yuba County Agricultural Commissioner's Report*

Conceptual Layout of Yuba Hub Facility



The table below provides a summary of the major cost categories for the Yuba Facility construction budget estimate. The facility is proposed to be new construction to best meet the needs for the hub's operational functionality, including for a processing line, as determined by the project team engineers. It is often more expensive to retrofit an existing agricultural-related facility than to build a new facility, especially to meet newer environmental and other regulatory requirements. It also must be centrally located to serve its receiving, transfer and distribution functions efficiently.

Table 3. YUBA FACILITY PROJECT INVESTMENT BUDGET BY MAJOR COST CATEGORY	
Cost Center Category	**Total Cost**
Building (140 x 120 sq. ft.) (includes additional mezzanine space for parts storage and second floor office space, and outdoor unloading area, sorting line and area for refrigeration equipment)	$1,205,366
Refrigeration (includes materials and installation)	$ 248,571
Production Equipment (fresh fruits/vegetables/greens) (includes outdoor pre-grading, packing line, walnut glazing line, production related systems and equipment, contractors services, freight	$ 694,897
Produce Handling/Storage (includes racks in storage areas)	$ 91,200
Fire Protection	$ 3,300
Auxiliary Systems and Equipment (includes power service connections, product moving equipment, utilities, office and employee space equipment)	$ 617,000
Mobilization (includes permits, testing, surveys, etc.)	$ 46,302
Engineering and Management (includes design services and construction management)	$ 348,796
Contingency (at 10%)	$ 325,543
Project Value (capital required to build)	$3,580,976

The project could be developed by a for-profit, nonprofit, or blended model enterprise. A companion document prepared for SACOG on Hub Research Findings provides examples of various hub business models. The total estimated project investment for this hub model is approximately $3,580,976, with $1,926,008 for the total building costs (including permits, testing, surveys – mobilization, design services, construction management, and contingency) and $1,654,968 for production equipment, refrigeration equipment, utilities and other costs. The budget does not include costs for the site (land). It is possible that a subsidy or assistance could be provided by the jurisdiction where the facility would be located, based on the project's economic and social benefits, or that federal or state funding could be secured to assist with project development costs. New state programs are providing resources such as rebates on manufacturing equipment and there are utility programs, which can provide incentives to increase energy efficiencies, including for food processing companies. It is assumed that the facility will be located in an area already serviced with infrastructure, and that water for fire protection will be available at appropriate pressure. The costs for hydrants and associated piping are not included. The budget also does not include produce traceability and inventory software, which would be part of operating expenses. This technical appendix ends with a detailed estimate of the construction budget by major cost category and sub-category.

Facility Operating Expenses and Revenues

In addition to the capital costs of construction, once the facility is up and running it will incur ongoing operating expenses. Major operating expense categories include the purchase of fresh produce inputs (cost of goods sold – COGS), as well as labor, utilities, packing and storage supplies (including pallets, bins, and labeling materials), maintenance supplies, transportation, advertising and promotion, insurance, and produce tracking system. The result of these ongoing operations is value-adding activity through the facility's aggregation and light processing functions that generate revenue to the facility operator. The table below compares the conceptual facility's estimated annual revenue to ongoing costs including amortization of the initial capital investment, including earnings before interest, taxes, depreciation and amortization (EBITDA), an indicator of potential profitability.[48]

Yuba County Alternative Food Hub Model: Estimated Financial Feasibility
Annual Revenue - $4,446,700 ($2,198,700 from fresh produce and $2,248,000 from glazed walnuts)
Estimated Expenditures - $3,433,000 (costs of goods sold, labor, operating costs)
Net Operating Income (EBITDA) - $1,013,700
Annual Profit - $273,000

Source: Foodpro International, Inc.

[48] The COGS include the cost of raw produce and the cost of packaging. As a general rule, the COGS should average about 50 percent of revenue but vary by crop. The project team's screening criteria identified higher margin crops.

The initial financial assessment indicates that the facility would initially provide a positive although relatively small return on investment. This finding imitates the detailed pro forma the project team developed for a generic food hub in the region that realizes increasing returns by scaling up operations.[49] The goal would be to operate the facility eventually for at least two shifts per day, which would provide the opportunity for an even higher rate of return.

[49] The Pro Forma Toolkit prepared for the Sacramento Valley Food Hub provides information on how to conduct a more detailed financial analysis for a food hub facility.

Line-Item Costs of Yuba Facility

Job-Cost-Center Category	Quantity	Units	Unit-Cost	Total Cost
BUILDING* (140 x 120 SF)	**16,800**	**S.F.**	**70**	**1,205,366**
Main Floor Building	16,800	S.F.	50	840,000
Production space, fresh pack	4,500	S.F.		
Cooler, raw produce (product)	3,240	S.F.		
Cooler, finished produce (goods)	1,935	S.F.		
Shipping dock & prestaging area	1,500	S.F.		
Workshop and corridor	2,475	S.F.		
Ambient storage - supplies	1,200	S.F.		
Ambient storage - produce (walnuts)	1,200	S.F.		
1st floor offices	750	S.F.		
Cold Store Doors, Horizontal Slide, 8x10, installed	3	EA.	9,456	28,368
Rapid Rollup Door, Staging Area, 8X10	1	EA.	12,000	12,000
Electrical Single Slide Door, Ambient Spaces, 8x8	3	EA.	4,562	13,686
Rollup Door, Conditioned Production space	1	EA.	5,210	5,210
Metal Rollup Door, Repair Shop, 12x12	1	EA.	3,050	3,050
Man doors, 3x8, cold store, installed	6	EA.	1,605	9,632
Dock equipment (doors, seals, levelers)	2	EA.	12,960	25,920
Offices & Employee facilities on 2nd Level	750	S.F.	50	37,500
Mezzanine (parts storage, second level)	845	S.F.	50	42,250
Depressed truck dock	1,850	S.F.	35	64,750
Slabs on grade w/canopy, outdoor refrigeration	2,800	S.F.	35	98,000
Unloading area	1,000	S.F.	25	25,000
** Includes structures & general MEP (mechanical, engineering, plumbing)*				
REFRIGERATION*	**25.71**	**TR**	**9,667**	**248,571**
Pre-cooler unit, portable	1.00	EA.	30,000	30,000
Raw produce storage, 385 SF/TR	-	TR	8,500	71,532
Finished produce storage, 385 SF/TR	-	TR	8,500	42,721
Staging area & dock, 200 SF/TR	-	TR	8,500	63,750
Process area at 50 dF, 440 SF/TR	4.77	TR	8,500	40,568
** includes materials and installation*				
PRODUCTION EQUIPMENT (FRESH PRODUCE AND VALUE ADDED)				**694,897**
OUTDOOR PRE-GRADING, 10 TONS/HR				***107,044***
Bin Dumper, used	1	EA.	2,000	2,000
Receiving hopper w/take-away conveyor	1	EA.	15,000	15,000
Transition conveyor	1	EA.	10,000	10,000
Size grader (e.g. Kerian)	1	EA.	28,674	28,674
Take-away conveyors, variable speed, 6 ft, 30" w	3	EA.	3,000	9,000
Telescopic transfer conveyor, totes	1	EA.	9,000	9,000

Job-Cost-Center Category	Quantity	Units	Unit-Cost	Total Cost
Bin fill lowerator	3	EA.	10,000	30,000
Floor platform scale	1	EA.	1,620	1,620
Peewees/trash/cull take-away conveyor	5	LF	350	1,750
PACKING LINE FOR FRUITS & VEGETABLES	**2**	**TON/HR**		***141,356***
Receiving hopper w/cleated take-away conveyor	1	EA	5,500	5,500
Peewees/trash/cull take-away conveyor	10	LF	350	3,500
Brush washer	0	EA	24,000	-
Peeler	0	EA	24,000	-
Combo washer/peeler (Magnuson), 1 Ton/Hr	1	EA	36,000	36,000
Sanitation system for the washer	1	EA.	7,560	7,560
Dewatering	1	EA.	7,000	7,000
Transfer conveyor (vibratory)	2	TON/HR	8,000	16,000
Take-away conveyors, variable speed, 6 ft, 30" w	3	EA.	3,000	9,000
Sorting conveyor	25	LF	1,000	25,000
Rotary packing table, 4 ft dia.	1	EA	4,000	4,000
Roller conveyor, caster stand, 12 ft, 30" wide	2	EA	9,000	18,000
Roller conveyor, caster stand, 24 ft, 24"-30" wide	0	EA	15,000	-
Metal detector & check weigher combo, used	1	EA	6,000	6,000
Inkjet coder, industrial	0	EA	1,615	-
Inkjet coder, handheld	2	EA	350	700
Carton closer/sealer, mechanical	0	EA	2,160	-
Carton sealer, handheld	2	EA	200	400
Labeler	1	EA	1,296	1,296
Manual scales	4	EA	350	1,400
WALNUT GLAZING LINE	***200***	***LB/HR***		***83,766***
Belt feeder	1	EA	8,359	8,359
Conveyor	1	EA	12,636	12,636
Blancher/roaster	1	EA	15,044	15,044
Spreading conveyor	1	LF	1,296	1,296
Take-away conveyor, variable speed, 6 ft, 30" w	2	EA	3,240	6,480
Kettles (sugar solution, cooking, oil solution)	3	EA	5,130	15,390
Coating tumbler	1	EA	2,160	2,160
Tray dryer	1	EA	10,000	10,000
Bagger, semi-mechanized, used	1	EA	5,000	5,000
Manual scales	4	EA	350	1,400
Metal detector & check weigher combo, used	1	EA	6,000	6,000
PRODUCTION RELATED SYSTEMS & EQUIPMENT	***200***	***LB/HR***		***19,900***
Traceability hardware (computer, scale, printer, etc.)	1	SET	8,000	8,000
Drip pans	80	LF	80	6,400
QC check weighing cart	1	EA.	1,500	1,500
Metal detectors	1	EA.	4,000	4,000
Box making machine	0	EA.	34,560	-

Job-Cost-Center Category	Quantity	Units	Unit-Cost	Total Cost
CONTRACTOR SERVICES	***200***	***LB/HR***		***332,866***
Mechanical Installation, Process Equipment	40	percent	324,766	132,866
Electrical Installation	800	Amps	250	200,000
FREIGHT	***3***	***percent***	***324,766***	***9,965***
PRODUCE HANDLING/STORAGE				**91,200**
Racks, Cooler, raw produce	168	position	200	33,600
Racks, Cooler, finished produce	96	position	200	19,200
Racks, ambient storage	192	position	200	38,400
FIRE PROTECTION				**3,300**
Sprinkler system	-	SF	2.8	-
Fire extinguishers - allowance	11	EA	300	3,300
Fire hydrant system	0	LF	200	-
Water tank	0	EA	52,000	-
Pump house	0	EA	50,000	-
Sprinkler system	-	SF	2.8	-
AUXILIARY SYSTEMS & EQUIPMENT				**617,000**
Power service (PG&E), 3/480, 1000 Amps	1	cnnct	50,000	50,000
NG service (PG&E), 2000 MBTUH, allowance	1	cnnct	50,000	50,000
CIP skid	0	EA.	75,000	-
Hot water pressure washer, electric, portable	1	EA.	12,000	12,000
Forklift trucks, electric, w/misc. attachments	1	EA.	36,000	36,000
Pallet jacks, electric	1	EA.	12,000	12,000
Pallet jack, manual	2	EA.	2,000	4,000
"Big Joe" lift truck	0	EA.	15,000	-
Forklift battery charging station	1	EA.	10,000	10,000
Floor scale, for pallets	1	EA.	12,000	12,000
Truck scale	0	EA.	75,000	-
Air compressor, packaged unit	15	HP	1,200	18,000
Compressed air piping system, installed	40	CFM	650	26,000
Water well	0	LOT	50,000	-
Water treatment system allowance	0	LOT	40,000	-
Wastewater treatment allowance	1	LOT	25,000	25,000
Septic system (for black sewer)	1	EA.	40,000	40,000
Site grading incl. for retention ponds & bldg pad prep.	1	LOT	80,000	80,000
Spent process water collection system	1	LOT	100,000	100,000
Storm water retention pond	0	EA.	180,000	-
Site fencing	1200	LF	15	18,000
Pavement (roads & parking)	40000	SF	2.5	100,000
OFFICE & EMPLOYEE SPACE				**24,000**
Furniture (allowance)	1	LOT	6,000	6,000
Computers & other hardware (allowance)	1	LOT	6,000	6,000
Lunch room equipment, counters & cabinets	1	LOT	12,000	12,000

Job-Cost-Center Category	Quantity	Units	Unit-Cost	Total Cost
Commissary kitchen (allowance)	0	LOT		-
MOBILIZATION				**46,302**
Permits, 0.5% OF VALUATION	1	prjct	12,326	14,302
Testings	1	prjct	7,000	7,000
Surveys, stacking, temporary facilities, etc.	1	prjct	25,000	25,000
ENGINEERING & MANAGEMENT				**348,796**
Design services	7%	prjct		203,465
Construction Management	5%	prjct		145,332
CONTINGENCY	10%			**325,543**
PROJECT VALUE (CAPITAL TO BUILD)*				**$ 3,580,976**

* Does not include traceability & inventory software

Sales Tax Rate: 8% Yuba County

Local Food Resources Survey
Questions & Standards for Local Food Resources
Standards for farms:

- In County
- family owned and operated
- food must be accessible to County residents for purchase OR willing to sell to institutions
- no wineries

Questions for farmers:

- Contact details
- Address
- Which products do they sell?
- Check appropriate category boxes
- Where can you find/buy their products locally? (at the farm, markets, restaurants, etc.)
- What percent of their product do they sell to sources outside the County? What would enable them to sell their product inside the county instead of going elsewhere?
- Do they sell to any local institutions? If yes, which ones? If not, would they consider it? What would they be likely to grow for local institutions?
- What type of processing facilities do they have or are in need of? Ex: Cold storage, chicken processing, etc
- Are there any activities available on the farm? hours open to the public?
- Do they use GMO seeds or pesticides? What are their growing practices & farming inputs?

Understand many farmers now say no sprays/ pesticides. Ask about pest management and land management practices; if not synthetic inputs, do they use organic sprays? Or organic or non organic fertilizers? Ask in a way that doesn't imply we are looking for a certain answer

- Do you consider your farm to fall under any of the following categories? Organic certified organic, biodynamic, hydroponic, dry farmed or any other category? Check appropriate category boxes
- Does the farm have any additional certifications? Such as GAP (good agricultural practices) Certified. *See link for description*: http://www4.ncsu.edu/~rmrejesu/Food_Safety_Risk/ag-709%20final%20printed.pdf
- Description (bio): Ask if they have one they want to email to us. If not, draft up your own based on interview.
- Photo: Ask if they have one they can email to us. If not, no photo.

Standards for restaurants:

- They source a percentage of goods locally (excluding alcohol)
- They highlight the farm/ origin of local ingredients

Questions for restaurants:
-Location, hours, phone #, any special or unique qualities of the restaurant ("Description 1")
-Type (breakfast, lunch, dinner)
-Do they have a menu that gets updated or changes with the seasons?

-Which products do they source locally and who do they buy them from? i.e. direct from farmer or through distributor. Percent of menu or items sourced locally?
-Who makes sourcing decisions? EX: chef, owner
-What is the procedure for procurement? Finding sources, reaching out to them, placing orders, how many different accounts, online or over phone or in person? Etc.
-What would make sourcing locally easier? To achieve a more consistent supply on menu, greater quantity, etc.
-If there were an aggregated source where larger quantities of local produce could be ordered, would they be interested? Would this service be worth paying a slightly higher price?

Standards for grocers

- They source a percentage of goods locally (excluding alcohol)
- They highlight the farm/ origin of local ingredients

Questions for Retail/ Grocers?
-Location, hours, phone #
-What percent of their products do they source locally?
-Who do they buy from i.e. direct from farmer or through distributor?
-Who decides where to source products from? Procedure for procurement?
-What would help them in having a more consistent source of, or a larger portion of what's on their shelves, be sourced locally?
-What's the major challenge in sourcing locally?

Questions for Farmers' Markets
-Location, hours (& year round or seasonal?) bio/ highlights
-What are their parameters for accepting vendors into their market?
***Not on Civi:*
-Is there an updated list of vendors, farmers and/or products available?
-Can we check back in with you seasonally to get an updated list of vendors?

5-14-14 Local Food Resources Summary

The Local Food Resources survey was conducted during the Fall 2013 and Winter 2014 academic quarters by four Cal Poly students interning with Central Coast Grown. For the purposes of the survey, local food resources (LFRs) are defined as a farm, farmers' market, restaurant or retail business that makes locally grown food readily available to purchase within San Luis Obispo County. Local was defined as food that is grown or produced within San Luis Obispo County.

The survey targeted: farmers who grow and sell at least a portion of their produce within San Luis Obispo County via direct sales or through restaurants and retail business; restaurants and retail businesses located in San Luis Obispo County that purchase locally grown food to use in their dishes or sell to the public; and the twenty three farmers' markets that take place within the county (with the exception of one market in Santa Maria).

Before conducting each survey, the interns matched each potential LFR with a set of criteria conveyed in the Survey Questions & Standards document. This document illustrates who was surveyed and what questions were asked.

The intention behind conducting the Local Food Resources Survey was twofold. The first was to develop a database of locally grown food that is available for purchase within the County as a resource for the public. The information is captured on our website where anyone can search within the four LFR categories for a place to buy and eat local food. The second purpose was to assess the available supply and existing demand of locally grown products and to build a foundation of knowledge surrounding these resources. This information will inform the conversation as Central Coast Grown ramps up their farm to cafeteria efforts in the County.

Key Findings

1. Farms
    a. Many do not sell to local institutions because of the perception that they will not receive high enough prices
    b. The predictability, consistency and volume of products is also a challenge
    c. Farm A in Santa Maria sells salad mix to Costco. This was the only farm that demonstrated this type of volume.
    d. Farm B is selling to Whole Foods in Santa Barbara
2. Restaurants
    a. The majority of restaurants estimate that they source at least 30% of their produce locally, while many reported above 50%.
    b. The majority expressed interest in 3rd party aggregation and of those interested, 3/4 of respondents said they would pay a higher price for this convenience.

Survey Results

1. Overview
    A. Total local food resource contacts updated or added to the CCG contact relationship management database: 138
    B. Contact Type:
        i. Individuals: 22 (owners or employees of LFRs)
        ii. Organizations: 116
            a) Farm: 53
            b) Markets: 23

c) Restaurants: 35
d) Retailers: 2

2. Summary of Responses

FARMS

A. Locations:
North County: 2/3
South County: 1/3
very few in SLO (about 5)

B. Practices:
About half demonstrated strong stewardship of the land through organic or sustainable growing practices

C. Product Categories: about half have fruits and veggies
(Other: meat, specialty, floral, herbs spices)

D. Where can you buy products?
Mostly farm stands, CSAs, markets, grocery stores, restaurants
A couple farms go south or north to markets
1 farm sells to schools in SLO & SB
1 farm distributes nationally

E. What percent sales outside county?
About 10 farms sell between 25-75% outside county
Includes some online sales from meat, oil & specialty products

F. Institutional sales?
New frontiers, local markets and restaurants, wineries, SLO Veg,
Challenges: volume consistency price

G. Processing needs?
Every farm has their own specific processing needs; not many have processing needs at all because of their small scale

H. Needs expressed: certified food processing facility for bottling (balsamic, oil) | processing plant for salads (santa maria) | meat – JNR state certified facility exists wheat/ grain processing | apple processing | 1 farm has state certified facility | chicken processing | olive oil processing on the 41 exists & Templeton | fish processing needed | washer stations

I. Farm activities:
Farms offering similar activities (U pick, classes, tour, tastings, farmstand, etc.) ~15
By appointment only: 5-10

RESTAURANTS

A. Seasonal Menu?
At least some items change: 25

B. Where are your local products purchased from? (produce)

C. % local ingredients?
20-50%: 4 restaurants; More than 50%: 18-20 restaurants

D. What would make sourcing more local goods easier?
product delivery
finding out about new suppliers – directory would be helpful
aggregated distributer of local –can meet volume demand & only have to pay one

entity (Or grower coop)
limited supply of desired items
more communication from farmer about what's available

~20 restaurants interested in 3rd party aggregation
¾ willing to pay slightly more for service

FARMERS MARKETS

A. **Questions asked:**
   Hours, locations, types of products for sale, list of vendors & what they sell, parameters to accept new vendors, market description/ bio
B. **List of vendors & what they sell:**
   11 out of 23 markets provided list of vendors with what they sell
   many lists reflect same vendors
C. **Parameters for new farmers:**
   no explicit guidelines except certified producers license
   if product is lacking, new vendor will be accepted

CERES COMMUNITY PROJECT

Healing Meals for Healthy Communities

Client & Teen Program Evaluation

June 2014

Sara Tickler, PsyD
Principal
Tickler & Thomas

Ceres COMMUNITY PROJECT

Table of Contents

3 EXECUTIVE SUMMARY

8 INTRODUCTION

10 METHODS

13 FINDINGS: TEEN VOLUNTEERS

27 FINDINGS: CLIENTS

We are grateful to the California Department of Food & Agriculture for the California Specialty Crop Block Grant that funded this study as well as a share of our program costs from October 2011 to June 2014.

Ceres Community Project
7351 Bodega Avenue
Sebastopol CA 95472

797·829·5833
www.CeresProject.org

EXECUTIVE SUMMARY

More than 56% of deaths in the United States – from heart disease, stroke, cancer and diabetes – are directly related to poor eating habits, lack of physical activity and maintaining a healthy weight. For people struggling with a serious illness – including nearly 80% of people with some types of cancer, malnutrition is a serious concern. Not having adequate nourishment, either because of the side effects of treatment or because of food insecurity, makes it less likely that people will heal, worsens their quality of life and lengthens the process of recovery. Not surprisingly, insuring that patients have high-quality nutrient-rich meals also lowers health care costs. A study by MANNA, a nutrition service agency in Philadelphia, found that average monthly health care costs dropped by $10,754 after patients began receiving meal delivery. [Gurvey J et al. Journal of Primary Care & Community Health 2013]

Healthy social relationships also play a vital role in our well-being. A meta-analysis of 148 different studies found that those with strong social relationships were 50% more likely to be alive an average of eight years later than those who did not. [Holt-Lunstad J et al. PLOS Medicine, July 2010]

Ceres Community Project is a grass-roots community organization based in Sonoma County, California whose work focuses on strengthening the intersection between a healthy local food system, healthy eating behaviors, youth empowerment, strong social networks and wellness. Ceres' goal is to broaden understanding that healthy whole foods and heart-centered connections with others provide the foundation for a healthy life, and to educate our clients, teens and the larger community about diet and lifestyle factors that create health for us, our loved ones and our planet.

Ceres core program Healing Meals for Healthy Communities provides free nourishing organic and whole food meals to primarily low-income people struggling with a health crisis and their families along with nutrition education and the caring support of the community. All of the meals are prepared by teen volunteers working at our ¾ acre organic food garden and 3 commercial kitchen sites in Sonoma and Marin counties in Northern California. Working under the guidance of adult mentors, youth learn to grow, prepare and eat healthy organic whole foods and about the connection between what they eat and the health of people and planet. The program strengthens youth leadership and develops the competencies youth need to be successful in life and work.

About this Study

This program evaluation study was undertaken as part of a California Specialty Crop Block Grant awarded to Ceres Community Project in October 2011. The two and a half year grant falls under the Healthy Eating category of the Specialty Crop Block Grant program and hence a focus of this study was on measuring changes in consumption of specialty crops (fruits and vegetables) as a result of program participation by both clients and teen volunteers.

The study relies on self-reporting and while the actual data may be over-stated we are encouraged by the increases in whole foods cooking and healthy eating behaviors that both clients and teens report after participating in the Ceres program. This is the first program evaluation study Ceres has conducted since our founding in March 2007 and the first time we have gathered quantitative information about program impact. The information gleaned from this study will inform a more robust ongoing program evaluation protocol moving forward. In the future we will also be able to analyze data by length of time in the program, by age, income and by other relevant criteria.

What we Found

The goal of Ceres' Specialty Crop Block Grant was to increase consumption of fruits and vegetables by 20% among youth participants and by 30% among client participants. These goals were completely speculative as we had no baseline data.

What we found is that youth increased consumption by 16% -- 80% of our goal – and clients increased consumption by 23% -- 77% of our goal. These results stem from a fairly short term investment of time and resources. Clients, on average, receive 14 weeks of meals (four complete dinners, a soup and salad per week) at a cost (not including the value of volunteer labor and donated food) of about $740 per person. Youth in the survey have participated for six months, most often alternating between 3 hours shifts in the garden and kitchen on a weekly basis, at a cost of about $2,300 per youth. These small investments have the potential to reap huge short (for clients) and long-term (for both clients and teens) health benefits that research tells us are related to increased rates of fruit and vegetable consumption and decreases in the consumption of unhealthy fast and processed foods.

During the grant period 740 clients received 126,000 meals from Ceres. Assuming 70% of these clients recover from their illness, we estimate that clients who participated during the grant period will consume an *additional* 226,884 servings of fruits and vegetables over the next year as a result of the changes they made, and an added 2,268,840 servings over the next ten years.

For youth the changes in consumption will have a much longer impact. During the grant period, 465 youth participated in 33,900 hours of service learning at Ceres. Study results show that as a result of what they learned, these youth will eat an *additional* 169,360 servings of fruits and vegetables over the next year, and an added 1,693,600 servings over the next ten years.

The combined additional 3,962,400 servings we estimate that teens and clients from this study will consume over the next ten years will add nearly $2,000,000 in fruit and vegetable purchasing to the local food system.

<u>Youth Participant Findings</u>

Young people learn about Ceres most often from their friends or parents with schools/teachers being a distant third. Youth most often volunteer at Ceres because they are interested in learning about growing, cooking and eating healthy food and about the relationship between food and health, with helping others being a secondary factor. Because many of the youth coming to Ceres are already interested in food and nutrition, in general they are eating a healthier diet than the average person their age.

Despite this healthier diet to begin with, program participation supports significant positive changes for teens in three areas: cooking behavior, diet, and advocacy about healthy eating. While self-reporting likely overstates healthy behaviors we are encouraged by the changes that youth report over time.

Here is a summary of the key findings for youth after 6 months in the program.

Cooking Behavior:

- 98% of youth are either somewhat or very confident that they can prepare a healthy meal from scratch.
- The share of youth who report cooking at home at least once a week increases by 25% from 65% to 81% of participants.
- The share of youth who say they cook full meals from scratch increases by 28% from 47% to 60% of all youth.

Healthy Eating:

- When asked what factors are most important to youth when they are selecting foods to eat, the share that rank Healthy for Me #1 increases 30% from 23% to 30% of all youth.
- Consumption of fresh fruit increases 16% from 3.2 to 3.7 servings per day. All varieties of fruit show an increase in consumption and the average number of fruits that youth report eating increases 5% from 11.7 to 12.3.
- Consumption of fresh vegetables also increases 16% from 3.2 to 3.7 servings daily and there is a 29% increases in the share of youth who report eating at least 3 servings of vegetables each day. All varieties of vegetables show an increase in consumption and the average number of different vegetables that youth report eating increases 27% from 15 to 19.
- Consumption of nearly all categories of unhealthy food decreases, particularly sodas and fast food. The share of youth who say they eat fast food daily, frequently or occasionally drops 54%, from 28% to 13% of youth. The share of youth who drink sodas on that basis drops 38%, from 47% to 29% of youth.

Advocacy:

- Youth are 50% more likely to be encouraging their friends to make healthier food choices on a daily or frequent basis (increases from 20% to 30% of youth).
- Youth are 44% more likely to be encouraging their family to make healthier foods choices on a daily or frequent basis (increases from 25% to 36% of all youth).

Connection to Community, Self Esteem & Leadership Development:

- These two quotes from the open ended questions are good example of the other impacts that program participation has on youth:

I have stronger faith in a community. It has never been so easy for me to build up a community like it has been at Ceres, and I think that is because Ceres motivates our best selves. We're not in competition; we're just doing good and having fun while we do it. It's one of the most relaxed and loving atmospheres I've ever been in. What therapy for young people, especially high schoolers who live in so much 'drama'.

Ceres has helped me be more confident in my cooking. Being able to communicate better with people and having a sense of leadership are two things that have changed me for the better. [Being able to] speak my opinion.

Client Participant Findings

Not surprisingly, the vast majority of clients at Ceres are in treatment when they begin the program. Our demographic profile shows that 88% of these clients have a cancer diagnosis with the remainder facing a wide range of other health challenges. Most clients are low-income with 75% having household incomes below $45,000 annually and about 25% having household incomes below $10,000. Nearly 80% of clients are 50 or older.

Ceres has worked hard to educate health care practitioners about our services and about the importance of good nutrition during cancer treatment and we were encouraged to see that 45% of clients say a healthcare practitioner referred them. Another 45% learn about Ceres from a friend.

Clients are surveyed when they begin the program and again three to four months after they complete meal delivery. This allows us to compare the eating habits clients have established for themselves after program participation compared to those when they began receiving the meals.

A summary of key results follows.

Cooking behavior:

- The percentage of clients who report cooking full meals from scratch either daily or frequently increased by 47% from 59% to 87% of all clients.
- The percentage who describe their diet as only dinners from scratch with lots of fresh vegetables increased by 59% from 18% to 33% of all clients.

Healthy Eating:

- The following percentage of clients report that they are eating MORE of these healthy foods: vegetables – 65%, fruit – 48%, whole grains – 43%
- The following percentage of clients report that they are eating LESS of these unhealthy foods: packaged/processed foods – 74%, sugar – 73%, fast food – 72%
- On a separate question, consumption of all types of unhealthy foods decreased. For example, the percentage who say they eat fast food occasionally or more often (as opposed to rarely or never) drops 41%, from 32% of all clients to 19%.
- Fruit consumption increases 25% from 2.4 to 3.0 servings daily; there is a 29% increase in the percentage eating at least three servings daily.
- Vegetable consumption increases 21% from 2.8 to 3.4 servings daily; there is a 27% increase in the percentage eating at least three servings daily.

Value of Ceres service:

- More than 75% of clients said that each of nine benefits of the program were either somewhat or extremely important to them, with the four most important being:
    - I didn't have to cook – 87% said this was extremely important and 13% said it was somewhat important.
    - The healthy food helped me recover more quickly – 83% said this was extremely important and 17% said it was somewhat important
    - The meals helped me feel cared for and less isolated – 84% said this was extremely important and 9% said it was somewhat important.
    - What I learned about nutrition and healthy eating – 67% said this was extremely important and 28% said it was somewhat important.

Community & Feeling Cared for:

- In the open ended comments, clients were most likely to mention the experience of being part of a caring community and knowing that people were there for them. 38% also mentioned how moved they were that teens were cooking for them. Here are a few examples of these comments:

Strangers cared about me. There is so very much love in everything that Ceres does--delivery of delicious food, flowers and just knowing how much love and energy goes into what you do.

Restored my faith in the goodness of people.

I think it is amazing that teens grow the vegetables and prepare the meals. The lessons they are learning about nutrition and compassion are huge life lessons that they will take with them.

Conclusion

Ceres Community Project's Healing Meals for Healthy Communities program is powerful and cost-effective strategy for increasing the healthy eating behaviors and social networks that are the foundation of good health for people and communities. For the low-income people with illness that we serve, research outside of this study has shown increases in health outcomes and significant decreases in health care costs and we look forward to building on that research in the future. In addition to adopting healthier cooking and eating habits, teens who volunteer at Ceres gain important lessons related to volunteerism, community, teamwork and leadership.

INTRODUCTION

Ceres Community Project, a nonprofit based in Sebastopol, California, provides direct services – including nourishing meal support for people dealing with illness, a youth development program, and an array of classes on healthy eating and lifestyle choices – in Sonoma and Marin counties. In addition, the organization supports other communities around the country in replicating its core program, *Healing Meals for Healthy Communities*, by providing a Start Up Tool Kit, four day on-site training, operational manual and data base system and monthly support calls.

Ceres' mission is to build healthy communities by restoring fresh, whole and organic food to its place as the foundation of health, empowering youth, and by creating heart-centered ways for people to connect with themselves, others and the earth.

Healing Meals for Healthy Communities, the core program offered by Ceres Community Project, integrates the following components:

- Supporting individuals dealing with serious illness with free, delivered and nutrient-rich prepared meals, nutrition education, and a community of caring.
- Involving young people as volunteer gardeners and chefs, giving them direct, hands-on experience of the difference that fresh, healthy foods and community make, and of their own capacity to contribute.
- Educating the broader community, including health professionals, about the connection between fresh, healthy food, strong social networks, healing and wellness.
- Connecting people of all ages and from all walks of life to one another, and to their value as an integral part of the community.

In late 2011, Ceres was awarded a $348,000 2½ year California Specialty Crop Block Grant. The grant ran from October 1, 2011 through June 30, 2014. The primary goal of the grant is to increase consumption of California Specialty Crops (fruits, vegetables and fresh herbs) as a primary strategy for improving health outcomes among Ceres' two primary populations: 8th – 12th graders and low-income adults who have been diagnosed with cancer or another serious illness such as heart disease or diabetes. While the USDA recommends consumption of nine servings of fruits and vegetables daily, only 55% of adults and 21% of teens in Sonoma County report eating even five servings of these food groups combined each day.

As part of the grant, Ceres developed a process for evaluating how program participation is impacting the cooking behavior and eating habits of both teens and clients. The survey also captures some information about how the program strengthens the feeling of connection; another factor strongly associated with positive health outcomes. This report summarizes the results of this program evaluation..

<u>Teens</u>

Teen participants make a three-month commitment and work at least three and up to eight hours a week at Ceres. Work involves growing California Specialty Crops at Ceres' ¾ acre food production garden and/or preparing nutrient-rich whole foods meals with on average 75% California Specialty Crops in Ceres' commercial kitchen. All teens spend ½ hour on each shift in a focused education program that includes nutrition education, the importance of local and organic food, visits with clients, food security and social justice issues, and the environmental impact of food choices.

The goal for the grant period was to engage 350 - 400 8th to 12th graders with each spending a minimum average of 40 hours each in the program learning about growing, cooking and eating specialty crops. During the grant period 464 young people spent 33,905 hours in the Ceres garden and kitchen, an average of 73 hours per youth.

Teens learn the health benefits and how to prepare dozens of California Specialty Crops including kale, broccoli, asparagus, sweet potato, chard, spinach, summer and winter squash, parsnips, mushrooms, garlic, beets, Brussels sprouts, cabbage, beans and carrots. Students also taste all of the food that is prepared and recipes for each dish are provided to encourage home preparation.

The expected measurable outcome for the grant is that teen participants will increase their consumption of California Specialty Crops by at least 20% when evaluated six months after participating in the program compared to levels measured prior to joining. What we found is that teens increased consumption by 16% -- 80% of our goal.

Clients

Clients receive 8 to 24 weeks of free weekly food delivery featuring a high proportion of California specialty crops. Each week's delivery includes four complete dinners, soup, hearty salad and a dessert – with enough for everyone in the family. Clients receive nutrition information during their intake conversation and home visit, in their New Client Packet, and through a weekly Nutrition Tip provided with their meals. The primary learning comes from their direct experience of eating specialty crops included in the meals.

The grant goal was to have 500 to 600 adults with serious illnesses and their immediate family members participate in the program during the grant period. During the grant period, Ceres provided 126,160 meals to 740 distinct clients plus an estimated 520 family members, or 1,260 people total.

The expected measurable outcome is that clients will increase their consumption of California Specialty Crops by at least 30% when compared with normal dietary habits prior to program participation. What we found is that clients increased consumption by 23%, 77% of our goal.

METHODS

Upon receiving the California Specialty Crop Block Grant in late 2011, Ceres hired a researcher to design, administer, analyze and report data related to the grant's expected measurable outcomes. A series of meetings took place in November 2011, where the researcher, with Ceres' leadership, determined that a survey would be the appropriate instrument to gather data from both teen volunteers and client participants.

A set of questions was developed and reviewed related to intake and follow up surveys for both populations. Pilot surveys for Teen Intake and Follow Up and Client Intake and Follow Up were then constructed in Survey Monkey. A total of 14 teens and clients participated in the pilot to gather feedback regarding the surveys. A focus group was also conducted with clients to better understand how their illness affected their eating habits. Minor adjustments were made as per the input provided and a final set of surveys was launched in Survey Monkey on January 1, 2012.

Because there were many teens already participating in Ceres' Healing Meals for Healthy Communities Program, separate "Long Term" Teen Intake and "Long Term" Teen Follow Up surveys were developed to retrospectively capture their attitudes and behaviors before and after joining Ceres. The final set of surveys included:

- Teen Intake
- Teen Follow Up
- Client Intake
- Client Follow Up

Data was collected electronically for all of the teen surveys using computers at the Ceres Community Project office. A tracking system was used to insure that all new teens complete the Intake survey within their first two weeks in the program, and the Follow Up survey during their seventh month in the program. The surveys were provided via electronic link to both Long Term Teen Intake/Follow Up and Teen Intake/Follow Up.

During the first week or two that the client receives meals, they complete a paper Intake Survey on their own during a home visit conducted by Ceres volunteer Client Liaison. Ceres' office staff and/or adult volunteers input the data into Survey Monkey. Data was gathered between January 1, 2012 and June 15, 2013. Data for the Completion Survey was collected by including a survey and self-addressed stamped envelope in the client's final meal delivery and then following up to insure that the survey was completed and mailed in. To address the low response rate on the Client Follow-up Survey, Ceres implemented a phone follow-up survey using volunteers and a paid intern.

During the time first six months that data was collected, several revisions to the surveys were made. Those changes and the rational for each follow.

Teen Surveys

1. The Teen Volunteers who had been at Ceres for more than six months when data collection began on January 1, 2012 completed both the Intake and Follow Up surveys between January 1st and March 30th 2012.

Client Surveys

1. The original Client Follow Up Survey was administered when the client's participation in the meal delivery service was complete. It was designed to measure changes in client attitudes and behaviors before and after participating in the program. Since clients had just completed the program, they indicated that they did not yet know to what extent, when making their own food choices that their diets had changed. It became clear that at this point clients had not yet established their own new eating behavior since the majority of their meals had been coming from Ceres.

   A focus group of five previous Ceres clients was convened. Their input was used to revise the previously named Follow Up Survey to a Three Month Follow Up Survey when clients could report more accurately how their diets had changed after receiving the meals from Ceres Community Project. Only the Client Follow Up Survey would be mailed to the known address of the participant.

2. At that time, a Completion Survey was also designed to provide feedback specifically about the quality, quantity and satisfaction of the food received and was administered upon program completion. That survey was administered only between April and June 2012 and was discontinued, as it fell outside the scope of this evaluation and was deemed more appropriately handled internally by Ceres.

3. In September 2012 when the Client Follow Up Surveys were mailed, the response rate was very low. Out of 79 participants only 8 completed and returned their surveys. A group of five interns and volunteers were trained, provided with an interview protocol and asked to phone the other 71 participants. A total of 33 clients eventually responded to at least part of the survey. This methodology for gathering Follow Up Survey data was used for the remainder of the survey period.

There are two important reasons for the low response rate: 1) about 18% of Ceres' clients complete the meal service because they pass, move into hospice or an assisted living facility, are too sick to eat, 2) another 7% of the clients cancel the service at some point because they don't like the whole food meals or end up on a very restricted diet, 3) some additional number of clients pass, move into hospice or an assisted living facility, or are too sick to eat during the three months between the time they complete the meal service and when they are contacted to complete the follow-up survey, and 4) even three months after completing the meal service, about 30% of clients are still in treatment for their illness which is impacting their eating habits and limits their capacity and motivation to complete the survey.

RESPONSE RATES

The number of survey responses that were logged between January 1, 2012 and June 15, 2014 were recorded and appear in the following table.

	Response Rates					
Collection Dates	Long Term Teen Intake	Long Term Teen Follow Up	Teen Intake	Teen Follow Up	Client Intake	Client Follow Up
Total	**37**	**36**	**331**	**141**	**442**	**218**

For the Client Follow Up Survey, the percent of clients able to complete the follow-up survey because their illness is not preventing them from cooking and eating as they choose appears in the table below.

	My Illness is not preventing me from cooking and eating as I choose	My Illness is preventing me from cooking and eating as I choose
Percent	71%	29%
N=198*	140	58

*Twenty respondents skipped this question.

Therefore, the final total aggregate number of responses used in this report appears in the following table. Overall, we have a 48% response rate for teens and a 32% response rate for clients.

Aggregate Number of Responses			
Teen Intake	**Teen Follow Up**	**Client Intake**	**Client Follow Up**
368	**177**	**442**	**140**

Number discrepancies within the report appear because some respondents did not answer every question.

CERES COMMUNITY PROJECT

FINDINGS:
Teen Volunteers

Ceres COMMUNITY PROJECT

FINDINGS: TEEN VOLUNTEERS

1. Ceres Teen Volunteers were asked on the Intake and Follow Up Surveys to report their age. All Teen Volunteer responses by percent follow. Not surprisingly there is an increase in age at the time of follow-up. About half of teens are 13 to 15 when they enter the program with the other half being 16 or older.

What is your age?

	Percent	
Age	**Intake N=365**	**Follow Up N=176**
13	21%	10%
14	15%	20%
15	14%	15%
16	21%	19%
17	19%	21%
18	4%	8%
19 or older	5%	7%

2. Teen Volunteers were asked to identify their gender on Intake and Follow Up Surveys. Their responses follow.

What is Your Gender

	Percent	
Gender	**Intake N=363**	**Follow Up N=174**
Female	62%	62%
Male	38%	38%

3. Teen volunteers were asked on the Intake Survey to indicate how they heard about Ceres Community Project. Parents and friends are the primary way that youth hear about the program, with teachers/school being a distant third.

Intake: How did you hear about Ceres Community Project (check all that apply)? N=363

Answer Options	Percent
Friend	54%
Parent	62%
Website/Facebook	5%
Newspaper	5%
Radio	1%
Teacher/school	16%
Other (please specify)	8%

4. Teen Volunteers were asked on the Intake Survey to indicate why they were interested in working at Ceres Community Project. The three primary reasons center around 1) liking to cook and/or wanting to learn about cooking and nutrition; 2) having a friend that works at Ceres; and 3) wanting to help others and/or wanting or needing to volunteer.

Why are you interested in working at Ceres Community Project (check all that apply)? N=363

Answer Options	Percent
I like to cook	83%
One of my friends works at Ceres	76%
To help people	75%
I want to learn to cook	59%
To volunteer	53%
My parents want me to volunteer	31%
I want to learn about food and nutrition	30%
To meet other teens	30%
Other (please specify)	27%
For school or community service hours	10%

5. Teen Volunteers were asked on the Intake Surveys to indicate what they hoped to learn while working at the Ceres Community Project. Not surprisingly, the majority of youth are interested in learning about cooking and growing food, and about the connection between diet and health.

What do you hope to learn at Ceres Community Project (check all that apply)? N=363

Answer Options	Percent
How to cook	75%
About different specific cooking skills, how to use a knife, sauté, etc.	73%
About why food makes a difference in health	66%
About volunteering	47%
About eating healthy foods	46%
About growing food	40%
Gain confidence working with people and in groups	30%
Other (please specific)	2%

6. Teen Volunteers were asked on their Intake and Follow Up Surveys how often they cook at home. After six months in the program, all responses increase except Occasionally and Never, with a 24% increase in the share of youth who report cooking either daily or several times a week. After six months in the program, 81% of youth say they cook at least once a week.

How often did you cook at home?

Answer Options	Intake N=362	Follow Up N=173	Change	Percent Difference
Almost daily	25%	30%	5%	20%
2-3 times a week	25%	32%	7%	28%
About once a week	15%	19%	4%	27%
Occasionally	29%	16%	-13%	-45%
Never	6%	3%	-3%	-50%

7. Teen Volunteers were asked on their Intake and Follow Up Surveys how often they cook particular types of foods at home. The largest increase (28%) is in the number of teens who report preparing full meals from scratch, a good indication of increased motivation and skill level among the teens.

WHICH OF THE FOLLOWING DO YOU COOK AT HOME (CHECK THE BOX THAT DESCRIBES HOW OFTEN YOU COOK THAT TYPE OF FOOD AT HOME)?

	At Least Once Per Week			
Answer Options	**Intake N=344**	**Follow Up N=175**	**Change**	**Percent Difference**
Make full meals from scratch	47%	60%	13%	28%
Partially help prepare a meal from scratch	76%	80%	4%	5%
Reheating or preparing foods like frozen meals, or boxed and canned foods	60%	62%	2%	3%
Easy things like eggs, pasta and grilled cheese	90%	91%	1%	-1%
Baked goods/cookies	31%	39%	8%	26%

8. Teen Volunteers were asked on the Intake and Follow Up Surveys to rank factors of importance when making decisions about what to eat. There is a 30% increase in the share of youth who rank "Healthy for Me" as their top priority after having been in the program for at least six months.

WHEN MAKING A DECISION ABOUT WHAT TO EAT, WHICH OF THE FOLLOWING FACTORS ARE MOST IMPORTANT TO YOU? PLEASE RANK THE FACTORS FROM 1-5 (1 BEING THE MOST IMPORTANT). WERE THESE THE ONLY 3 WE ASKED? I THOUGHT THERE WAS MORE?

Healthy for Me

Ranking	Intake N=362	Follow Up N=174	Change	Percent Difference
1	22%	30%	8%	36%
2	31%	28%	-3%	-10%
3	20%	18%	-2%	-10%
4	15%	12%	-3%	-20%
5	12%	12%	0%	0%

Tastes Good

Ranking	Intake N=362	Follow Up N=174	Change	Percent Difference
1	39%	41%	2%	5%
2	23%	25%	2%	9%
3	12%	13%	1%	8%
4	12%	13%	1%	8%
5	14%	8%	-6%	-43%

Fast/Easy to Prepare

Ranking	Intake N=362	Follow Up N=174	Change	Percent Difference
1	13%	11%	-2%	-15%
2	26%	16%	-10%	-38%
3	34%	33%	-1%	-3%
4	18%	23%	0%	28%
5	9%	15%	6%	67%

Teen Volunteers who ranked "Healthy For Me" as most important increased 30% from 23% at Intake to 30% at Follow Up.

Healthy for Me

Ranking	Intake N=362	Follow Up N=174	Change	Percent Difference
1	22%	30%	8%	36%

9. Teen Volunteers were asked about how often they make their own food choices. Reponses by percent for each survey follow as well as the change from Intake to Follow Up. It appears that youth who participate at Ceres become more active and directed about their food choices.

Overall in your life, how often do you make your own food choices as opposed to your food choices being chosen by a parent, such as dinner or what is offered at school, such as lunch? I make my own food choices:

Answer Options	Intake N=362	Follow Up N=174	Change	Percent Difference
Daily	39%	46%	7%	18%
Frequently	38%	37%	-1%	-3%
Occasionally	19%	10%	-9%	-47%
Rarely	4%	5%	1%	25%
Never	0%	2%	2%	200%

10. Teen Volunteers were asked how often they talk with their friends about food choices and what is healthy, as well as how often they encourage their friends to make healthier choices. It appears that youth in the program become more confident in talking about healthy food choices, and more willing to encourage their friends to make healthier choices. There is a 28% increase in the number of respondents who say that they talk about food choices with their friends either daily or frequently, and a 50% increase in the number of respondents who encourage friends to make healthier food choices. Nearly one-third of teens engage in these behaviors after participating in the Ceres program for six months.

How often do you talk with your friends about your or their food choices and what is healthy or not?

Answer Options	Intake N=360	Follow Up N=172	Change	Percent Difference
Daily	3%	4%	1%	33%
Frequently	22%	28%	6%	27%
Occasionally	31%	29%	-2%	-6%
Rarely	33%	29%	-4%	-12%
Never	11%	10%	-1%	-9%

Teen Volunteers who indicated that they spoke with their friends about their food choices either "daily" or "frequently" increased 28% from 25% to 32%.

Answer Options	Intake N=360	Follow Up N=172	Change	Percent Difference
Daily or Frequently	25%	32%	7%	28%

11. Teen Volunteers were asked how often they encourage their friends to make healthier choices. Reponses by percent for each survey follow as well as the change from Intake to Follow Up.

How often do you encourage them to make healthier food choices?

Answer Option	Intake N=360	Follow Up N=172	Change	Percent Difference
Daily	4%	3%	-1%	-25%
Frequently	16%	27%	11%	69%
Occasionally	37%	29%	-8%	-22%
Rarely	27%	29%	2%	7%
Never	16%	13%	-3%	-19%

Teen Volunteers who indicated that they encourage their friends to make healthier choices either "daily" or "frequently" increased 50% from 20% to 30% of teens.

Answer Options	Intake N=360	Follow Up N=172	Change	Percent Difference
Daily or Frequently	20%	30%	10%	50%

12. Teen Volunteers were also asked how often they talk with their family about food choices and what is healthy, and how often they encourage family members to make healthier choices. Again we see an increase of 18% in the share of youth regularly having conversations about healthy food and an increase of 44% in the share of youth encouraging family members to make healthier choices on either a daily or frequent basis.

How often do you talk with your family about your or their food choices and what is healthy or not?

Answer Options	Intake N=360	Follow Up |N=174	Change	Percent Difference
Daily	11%	14%	3%	27%
Frequently	39%	45%	6%	15%
Occasionally	33%	22%	-10%	-33%
Rarely	12%	10%	-2%	-16%
Never	5%	9%	4%	80%

Answer Options	Intake N=360	Follow Up N=174	Change	Percent Difference
Daily or Frequently	50%	59%	9%	18%

13. Teen Volunteers were asked how often they encourage their family to make healthier choices. Reponses by percent for each survey follow as well as the change from Intake to Follow Up.

How often do you encourage them to make healthier food choices?

Answer Option	Intake N=360	Follow Up N=174	Change	Percent Difference
Daily	6%	7%	1%	17%
Frequently	19%	29%	10%	53%
Occasionally	32%	31%	-1%	-3%
Rarely	26%	17%	-9%	-35%
Never	17%	16%	-1%	-6%

Teens who encouraged their family to make healthier food choices daily or frequently increased by 44% from 25% at intake to 36% at follow up.

Answer Options	Intake N=360	Follow Up N=174	Change	Percent Difference
Daily or Frequently	25%	36%	11%	44%

14. Teen Volunteers were asked on the Intake and Follow Up Surveys to indicate how many servings of fruits they eat per day. Data shows that teens in the program increased their average fruit consumption from at least 3.2 servings per day to at least 3.7 servings per day after six months in the program, a 16% increase. The percentage of teens eating at least 3 servings of fruit increased 11% from 70 – 78% of youth. On average, how many servings of fruits do you eat daily?

Answer Options	Intake N=377	Follow Up N=175	Change	Percent Difference
More than 6	4%	3%	-1%	-25%
5-6	13%	26%	13%	100%
3-4	53%	49%	-3%	-8%
1-2	28%	20%	-8%	-29%
None	2%	2%	0%	0%

The percentage of Teen Volunteers who indicated that they eat three or more servings per day increased by 11%.

	Intake N=377	Follow Up N=175	Change	Percent Difference
At least three servings per day	70%	78%	8%	11%

15. Teen Volunteers were also asked to indicate what types of specific fruits they consume on the Intake and Follow Up Surveys. The number of Teen Volunteers who indicated they consume specific fruits increased in every type of fruit surveyed. The average increase in consumption per fruit by Teen Volunteers was 8% and teens increased the number of different kinds of fruits that they ate from an average of 11.7 to 12.3.

PLEASE CHECK ALL OF THE FRUITS THAT YOU EAT AT THIS POINT IN TIME.

Answer Option	Intake N=358	Follow Up N=172	Change
Apple	95%	97%	3%
Orange	87%	88%	1%
Banana	83%	85%	2%
Grapefruit	42%	58%	16%
Kiwi	46%	59%	13%
Plum	48%	61%	12%
Pear	68%	76%	8%
Melons such as cantaloupe or honey dew	64%	67%	3%
Watermelon	72%	77%	5%
Grapes	81%	84%	3%
Mango/papaya	57%	74%	17%
Peach/nectarine	69%	79%	10%
Strawberries	86%	93%	7%
Blueberries	70%	79%	10%
Raspberries	77%	88%	11%
Blackberries	71%	81%	10%

16. Teen Volunteers were asked on the Intake and Follow Up Surveys to indicate how many servings of vegetables they eat per day. Data shows that teens in the program increased their average vegetable consumption from at least 3.2 servings per day to at least 3.7 servings per day after six months in the program (a 16% increase) and that the percentage of teens eating at least 3 servings of vegetables increased 29%.

On average, how many servings of vegetables do you eat daily?

Answer Options	Intake N=358	Follow Up N=172	Change	Percent Difference
More than 6	4%	6%	2%	50%
5-6	16%	22%	6%	38%
3-4	41%	51%	10%	24%
1-2	39%	19%	-20%	-51%
None	0%	2%	2%	200%

At least three servings per day	Intake N=358	Follow Up N=172	Change	Percent Difference
	61%	79%	18%	30%

17. Teen Volunteers were also asked to indicate what types of specific vegetables they consume on the Intake and Follow Up Surveys. Consumption increased for each vegetable, and the overall variety of vegetables eaten by teens increased 27% from 15 to 19.

Please check all of the vegetables that you eat at this point in time.

Answer Options	Intake N=358	Follow Up N=172	Change
Asparagus	46%	58%	12%
Beets	43%	58%	15%
Broccoli	86%	92%	6%
Brussels sprouts	37%	53%	16%
Cabbage	48%	68%	20%
Carrots	78%	98%	20%
Cauliflower	43%	71%	28%
Celery	47%	65%	18%
Chard	43%	65%	21%
Corn*	70%	84%	15%
Cucumber*	79%	84%	5%
Eggplant	13%	23%	10%
Green beans	60%	76%	16%
Green or red leaf lettuce	81%	90%	9%
Kale	57%	78%	21%
Mushrooms like button or shiitake	57%	70%	13%
Onion	58%	77%	19%
Peas	62%	73%	12%
Potato	91%	96%	5%
Sea vegetables like seaweed	43%	56%	13%
Spinach	66%	79%	13%
Sprouts	36%	52%	16%
Summer squash like zucchini	53%	65%	13%
Sweet potatoes or yams	61%	78%	17%
Tomato*	76%	77%	1%
Winter squash like butternut or pumpkin	44%	64%	20%

*Seasonality of these vegetables greatly impact consumption.

18. Teen Volunteers were asked on the Intake and Follow Up Surveys to indicate how often they consume snack foods and drinks. The percentage of teens who reported that they eat these foods Never or Rarely increased slightly in every category except Cookies, pies and cake.

	Never or Rarely		**Occasionally, Frequently or Daily**	
	Intake N=359	**Follow Up N=173**	**Intake N=359**	**Follow Up N=173**
Candy	35%	43%	65%	57%
Energy Drinks	91%	94%	9%	6%
Soft drinks – Coke	53%	71%	47%	29%
Soft drinks – Crystal	67%	70%	33%	29%
Sweetened Coffee	50%	61%	50%	39%
Cookies, pies, cakes	24%	22%	76%	77%
Snack foods like chips	21%	29%	79%	71%
Fast food	72%	85%	28%	13%

19. Teen Volunteers were asked on the Follow Up Survey to indicate how confident they are that they can prepare a healthy meal. More than half feel extremely confident and nearly 100% say they are at least fairly confident they can do this.

Follow Up: How confident do you feel about your ability to prepare a healthy meal?

Answer Options	**Follow Up N=173**
Extremely confident	56%
Fairly Confident	42%
Not at all confident	2%

Among the 39 "Comments," these were the most frequent categories of responses:

Percent
68%
18%
9%

20. Teen Volunteers were asked on the Follow Up Survey what the three most important things were that they learned while participating in the Ceres Project. In their 168 comments, their answers focused on healthy eating, cooking techniques, community and helping others, teamwork and the importance of positive energy in the kitchen.

The Importance of Eating Healthy – 56%

- Learn to love healthy foods. Most healthy vegetables I don't "naturally" enjoy, but all you gotta do is keep trying it until you like it. Sometimes you need to get used to it (like kale) and sometimes you gotta find the best way to prepare it (like zucchini!)
- The one most important thing is that food is medicine, which I knew before but never took into consideration

- I learned that sugar feeds on Cancer cells, being happy when making the food transfers into the food we cook, and there are A LOT of sugar in drinks like apple juice.
- How important healthy food options are for a community, what sort of foods are really healthy, and that as a community, we can help others if we all work together.
- I learned a great deal about how what you eat matters in the sense of your daily health, overall wellness, and emotional as well as physical situation. I also learned how certain foods can strengthen and protect a person's immune system, especially in times of illness. Lastly, I learned how important it is to take care of one's own body by feeding it organic, non-processed foods.

Cooking Techniques – 23%

- Cooking is not at all scary. Failure can be intimidating, but with cooking, it's okay to fail every once in a while. I'm afraid I don't have the time to cook sometimes but I've learned it's not always a lengthy process. You can quickly make healthy meals, too!
- Knives hurt when they connect with flesh.
- How to blanch greens for them to cook faster, how to take bones out of fish, how to prepare good, food for other people.
- How to prepare for making a meal by checking for ingredients, washing ingredients, and setting up with the right tools, and how to keep your work-space and food clean and sanitary.

Community and helping others – 21%

- A tight knit community is essential to human experience.
- The value of community service and a principled support system.
- Obviously, there is more to Ceres than the buckets of kale they prepare. Ceres is about helping. We're helping the sick by preparing meals and teaching them about healthy food (and how to enjoy it.) We're helping the community by gathering and growing stronger, together. And we're helping our Ceres friend, every time we team up to chop or stir or harvest or water.
- How much you can change and help someone just by cooking them a good and nutritious meal!

Team Work – 18%

- The simple fact that together teens are powerful, strong, and giving.
- How to work together as a team in situations that demand attention to detail and time.
- How to work as a collective group to better serve the community

The importance of positive energy in the kitchen – 4%

- I've learned that the love and care that you put into preparing the food goes into the food that the clients eat.

21. Teen Volunteers were asked to describe the ways in which Ceres changed them. In their 157 comments, they noted the importance of eating healthy, the importance of their community and helping others, their knowledge in and enjoyment from cooking, their improved social and team skills and that their confidence has been improved.

The importance of eating healthy – 43%

- It has helped me learn how to cook with more nutritious food and opened my eyes to how easy it is to help people and make change.
- I realized the importance of nutrition and how healthy foods can help people who are sick. It is so important to have nutrient-rich food when you are sick and Ceres has taught me the importance of helping other while incorporated my interest in cooking.
- Ceres has changed the way I view food and improved my choice in diet. I have influenced my family and friend's to eat healthier. I have realized the role food plays in a person's life and how improving it even a little can make the biggest difference.
- Working at Ceres has taught me to be more aware of what I eat and to be creative when it comes to cooking. Also to be aware of where my food waste goes, this is why I have convinced my family to get a compost area.

The importance of community and helping others – 16%

- I have stronger faith in a community. It has never been so easy for me to build up a community like it has been at Ceres, and I think that is because Ceres motivates our best selves. We're not in competition; we're just doing good and having fun while we do it. It's one of the most relaxed and loving atmospheres I've ever been in. What therapy for young people, especially high schoolers who live in so much 'drama'.
- It has made me realize how important helping your community is, and it makes me want to help others more often as well as help myself choose the right and healthy food options.
- It has made me feel like I'm giving back to the community and that's very rewarding.

Knowledge in and enjoyment of cooking – 17%

- I got to know two of my closest friends at Ceres. I enjoy cooking, and therefore cook more at home. I'm a much more social person.
- Working at Ceres has changed me into a person that loves making food and making new friends. It has also made me wonder about what kinds of food I like to cook.
- It has changed me because now I cook much more than I used to and am a lot more caring with my food.

Improved social and team skills- 10%

- I feel like a better person working in here and being around so many friendly people.
- Working at Ceres has made me a more open individual-- I am typically a shy person who keeps to myself, but now find myself talking to people I would have never meet outside the kitchen.
- I can comfortably work in group settings.

Increase in confidence – 9%

- I have more confidence in myself and can admit when I don't know something.
- I'm a lot less shy. I feel more confident around new kids my age.
- Ceres has helped me be more confident in my cooking. Being able to communicate better with people and having a sense of leadership are two things have changed me for the better. Speaking my opinion.

22. Teen Volunteers were asked to share if there was anything else they wanted to tell Ceres that wasn't asked. Their categorized and ranked 64 responses follow.

Ceres is a positive experience – 32%

- My time with Ceres has taught me to think for myself when it comes to making food choices, and has inspired me to lead a much healthier life than I had been leading prior to joining. Essential cooking skills, learning to work efficiently in a cooperative environment, the immeasurably rewarding feeling of knowing that I am helping to change- to save- the lives of so many in the community. Because of Ceres, I feel a greater connection to my health, to the food I eat, and to the community than I've ever felt before. Thank you so much!
- Ceres gives and gives - it gives me strength, confidence and compassion.
- I emphatically recommend any person from pre-teen age to old age to participate in a project in Ceres or a project like it - what may at first appear to be a generic community experience may blossom into a wealth of knowledge, experience, and love as I've soaked in in my fantastic, fantastic time with the Ceres Community Project.
- Ceres is a wonderful and positive place where many passionate people come to cook and help others. Its unique approach to helping out in the community is quite special. I love leaving the kitchen knowing that I have helped someone in my community.
- I have found it a nice place to be and everyone here is friendly. There is a good energy in Ceres that helps relieve the stress of school.

Met friends and learned how to get along better with people – 14%

- I've learned how to get along with my peers. Something I've been struggling with due to low self-esteem.
- Ceres teaches more about leadership than any leadership class or other curricular or extra-curricular experience I've taken part in.

I learned the importance of making better food choices – 12%

- Teaches one to be disciplined with food, appreciative of health and life, meeting peers, being immersed in a positive and open environment often.
- Ceres also helps influence my decisions when deciding the quality of foods I need to incorporate into my meal and what it took for each ingredient to become available to me.

Helping people in the community – 10%

- It's remarkable that seven months working here has made me feel so connected to people whom I've never even met; it's an experience I'll cherish for life.
- It has made me an overall better person and opened my eyes to the opportunities this community offer young teens.
- I think Ceres is a very good way to make teens realize what a good cause is while teaching them to make better food choices for themselves.

It's fun – 10%

- I don't only like to come to Ceres because I can help people and learn how to cook, but because it is really fun!

CERES COMMUNITY PROJECT

FINDINGS:
Clients

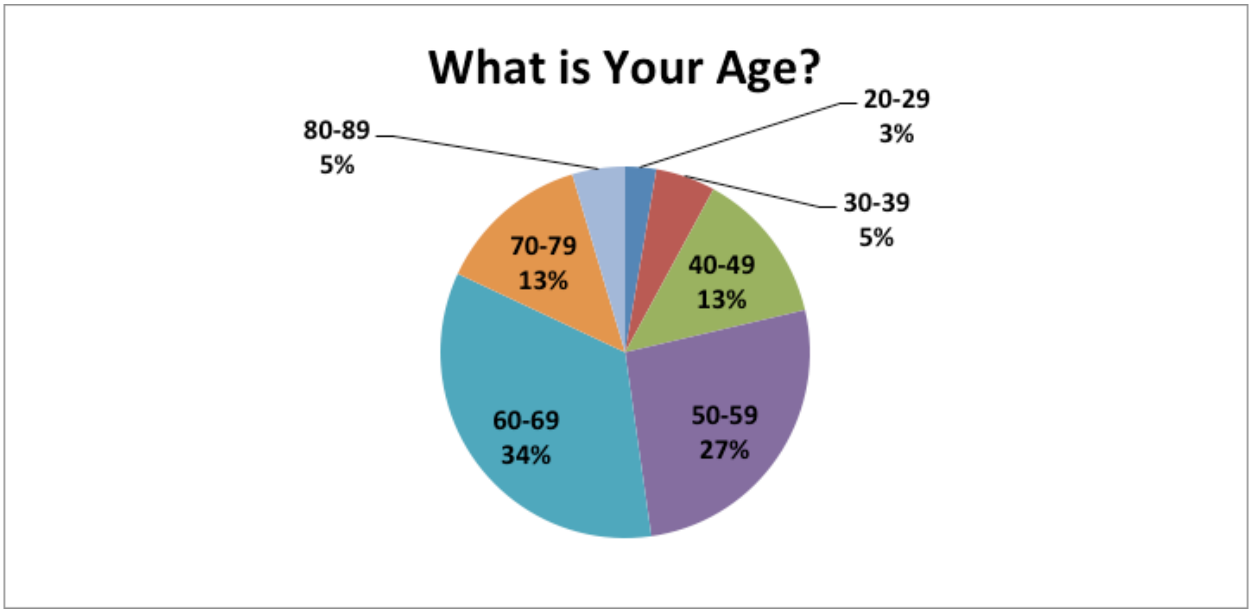
Ceres COMMUNITY PROJECT

HEALING · FOOD · COMMUNITY · YOUTH

FINDINGS: CLIENTS

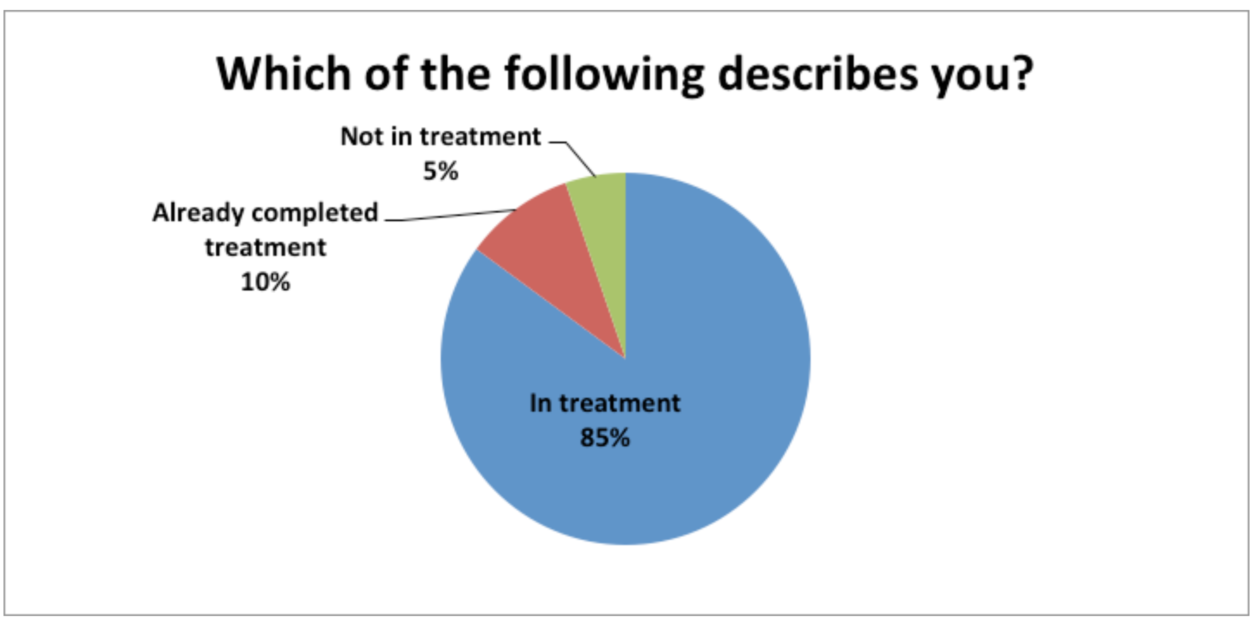
1. Ceres clients were asked on the Intake Survey to report their age. Just 21% of Ceres clients are under 50, with 61% being between the ages of 50 and 69 and 18% being 70 or older.

INTAKE: WHAT IS YOUR AGE? N=439



2. Another question on the client Intake Survey asked clients to indicate if they were in treatment, not in treatment, or had already completed treatment. Not surprisingly, 85% of clients are in treatment. Their responses follow.

INTAKE: WHICH OF THE FOLLOWING DESCRIBES YOU? N=436



3. Clients were asked to indicate how they heard about Ceres Community Project. Nearly half of clients are referred by Healthcare practitioners and another half by friends and family members.

INTAKE: HOW DID YOU HEAR ABOUT CERES COMMUNITY PROJECT (CHECK ALL THAT APPLY)? N=398

Answer Options	Percentage
Friend	45%
Healthcare Practitioner	45%
Family member	12%
Ceres Client	10%
Ceres Board or Staff Member	5%
Church/Community Organization	5%
Website/Facebook	3%
Newspaper	3%
Radio	1%

4. Clients were asked on the Intake and Three Month Follow Up Surveys to indicate how often they prepared meals from scratch at home. After participating in the Ceres program there is a significant increase in the share of clients who report preparing meals either daily or almost every day.

HOW OFTEN DID YOU PREPARE FULL MEALS FROM SCRATCH AT HOME?

Answer Options	Intake N=430	3 Month Follow Up N=140	Change	Percent Difference
Daily	34%	53%	19%	56%
Almost every day	25%	34%	9%	36%
2-3 times a week	22%	10%	-12%	-56%
About once a week	5%	1%	-4%	-80%
Occasionally	11%	1%	-10%	-91%
Never	3%	1%	-2%	-67%

5. Clients were asked on the Intake and Three Month Follow Up Survey respectively to describe their diet before they were diagnosed and their current diet. After participating in the Ceres program there is a significant increase in the share of clients who say they only eat dinners from scratch with lots of fresh vegetables, and a dramatic decrease in the percentage who say mostly or some fast or prepared foods.

WHICH OF THE FOLLOWING BEST DESCRIBES YOUR DIET BEFORE YOU WERE DIAGNOSED AND THREE MONTHS AFTER RECEIVING CERES FOOD?

Answer Option	Intake N=420	3 Month Follow Up N=138	Change	Percent Difference
Only dinners prepared from scratch with lots of fresh vegetables	18%	33%	15%	83%
Mostly dinners from scratch with vegetables	48%	44%	-4%	-8%
Mix of fast and prepared foods like frozen dinners with a few fresh whole foods dinners per week	27%	22%	-5%	-18%
Mostly fast and prepared foods like frozen dinners, canned and boxed foods	7%	1%	-6%	-88%

6. Clients were asked on the Three Month Follow Up Survey to indicate how their diets had changed. Between 39% and 65% of clients report they are eating more of the healthy foods while between 65% and 74% report that they've decreased consumption of unhealthy foods.

3 Month Follow Up: Since receiving food from Ceres, how has your diet changed?

Three Month Follow Up		
Food	**Eat More N=139**	**Eat Less N=139**
Whole grains	43%	9%
Vegetables	65%	3%
Fish, poultry	39%	9%
Fruit	48%	4%

Three Month Follow Up		
Food	**Eat Less N=139**	**Eat More N=139**
Red Meat	65%	3%
Packaged/processed food	74%	3%
Sugar	73%	2%
White Flour	69%	4%
Fast Food	72%	2%

7. Clients were asked on the Intake and Three Month Follow Up Surveys to indicate how many servings of fruits they eat per day. Data shows that clients increased their average fruit consumption by 25%, from at least 2.4 servings per day to at least 3.0 servings per day after receiving meals from Ceres. The percentage of Clients who indicated that they eat three or more servings per day increased by 27% between the Intake Survey and the Follow Up Surveys.

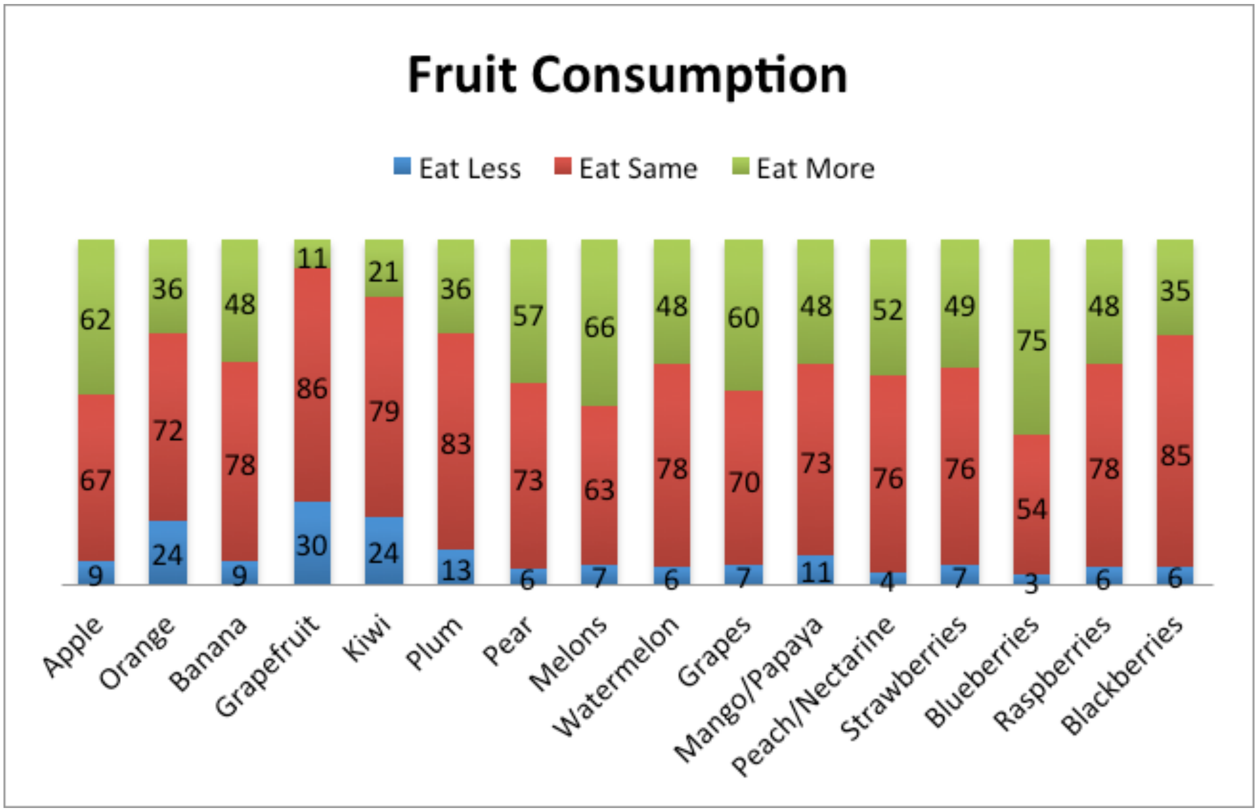
8. On average, how many servings of fruits do you eat daily?

Answer Options	Intake N=411	3 Month Follow Up N=140	Change	Percent Difference
More than 5	3%	4%	1%	33%
5	5%	5%	0%	0%
4	10%	16%	6%	60%
3	27%	31%	4%	15%
2	29%	27%	-2%	-7%
1	24%	16%	-8%	-33%
None	3%	1%	-2%	-67%

The percentages of clients who reported eating at least three servings of fruits per day follow:

	Intake N=493	3 Month Follow Up N=140	Change	Percent Difference
At least three servings per day	44%	56%	12%	27%

9. Clients were also asked to indicate if they consumed more, the same or less of specific fruits. That data is depicted in the table below (N=138).



The client data as to whether they consumed more, the same or less of specific fruits is depicted by individual fruit below (N=138).

Apple	
Eat more	45%
Eat the same	49%
Eat less	7%
Orange	
Eat more	27%
Eat the same	55%
Eat less	18%
Banana	
Eat more	36%
Eat the same	58%
Eat less	7%
Grapefruit	
Eat more	9%
Eat the same	68%
Eat less	24%
Kiwi	
Eat more	17%
Eat the same	64%
Eat less	19%
Plum	
Eat more	27%
Eat the same	63%
Eat less	10%

Pear	
Eat more	42%
Eat the same	54%
Eat less	4%
Melons	
Eat more	49%
Eat the same	46%
Eat less	5%
Watermelon	
Eat more	36%
Eat the same	59%
Eat less	5%
Grapes	
Eat more	44%
Eat the same	51%
Eat less	5%
Mango/papaya	
Eat more	36%
Eat the same	55%
Eat less	5%
Peach/nectarine	
Eat more	39%
Eat the same	58%
Eat less	3%

Strawberries	
Eat more	37%
Eat the same	58%
Eat less	5%
Blueberries	
Eat more	57%
Eat the same	41%
Eat less	2%
Raspberries	
Eat more	36%
Eat the same	59%
Eat less	5%
Blackberries	
Eat more	28%
Eat the same	67%
Eat less	5%

10. Clients were asked on the Intake and Three Month Follow Up Surveys to indicate how many servings of vegetables they eat per day.

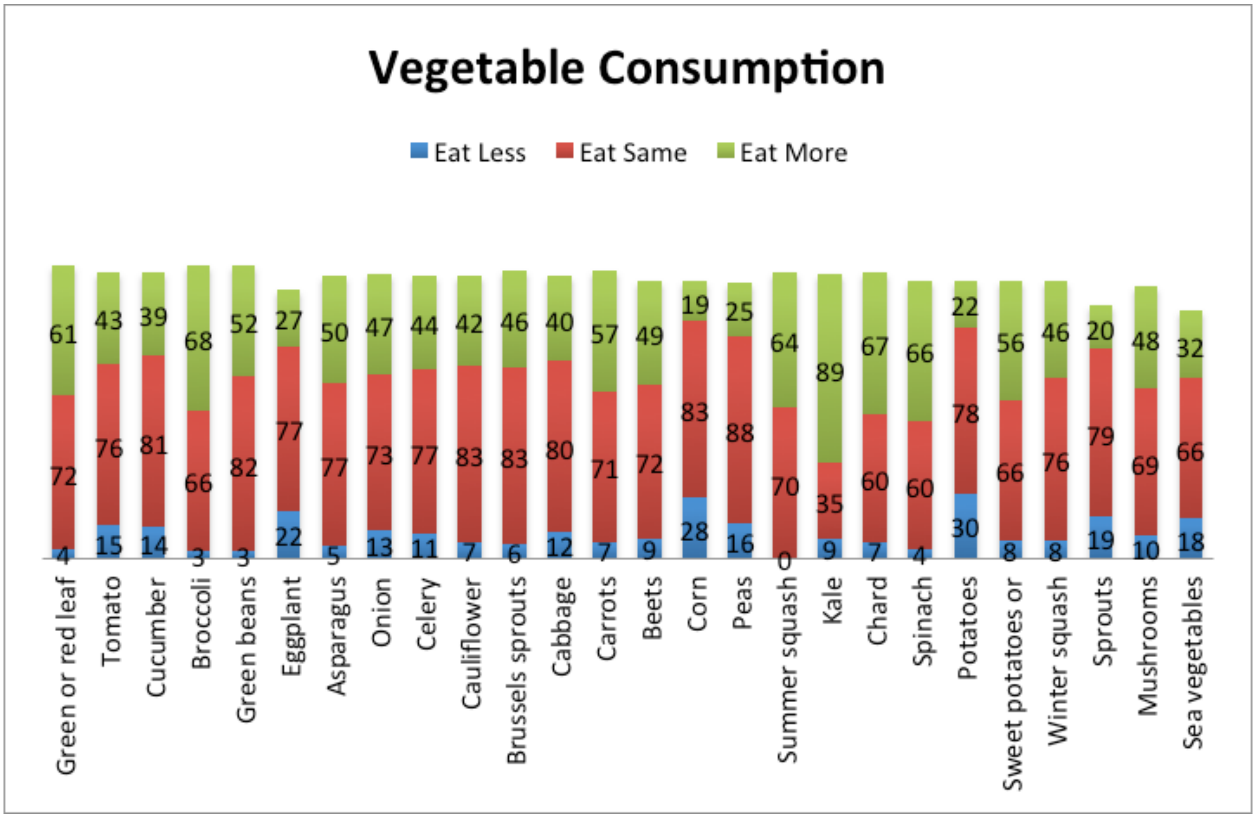
Data shows that clients increased their average vegetable consumption by 21% from at least 2.8 servings per day to at least 3.4 servings per day after six months in the program.

Answer Options	**Intake N=418**	**3 Month Follow Up N=139**	**Change**	**Percent Difference**
More than 5	3%	12%	9%	300%
5	7%	13%	6%	86%
4	17%	17%	0%	0%
3	29%	29%	0%	0%
2	28%	23%	-5%	-18%
1	15%	7%	-8%	-53%
None	2%	0%	-2%	-100%

The percentage of Clients who indicated that they eat three or more servings per day increased by 27% between the Intake and Follow Up Surveys.

At least three servings per day	Intake N=418	3 Month Follow Up N=139	Change	Percent Difference
	56%	71%	15%	27%

Clients were also asked to indicate if they consumed more, the same or less of specific vegetables. That data follows. The only vegetables that show a decrease in consumption are the starchy high glycemic index vegetables peas, corn and potatoes.



The client data as to whether they consumed more, the same or less of specific vegetable is depicted by individual vegetable below (N=138). *Seasonality of these vegetables greatly impact consumption.

Green or red leaf lettuce	
Eat more	45%
Eat the same	53%
Eat less	3%
Tomato*	
Eat more	32%
Eat the same	57%
Eat less	11%
Cucumber*	
Eat more	29%
Eat the same	60%
Eat less	10%
Broccoli	
Eat more	50%
Eat the same	48%
Eat less	2%
Green beans	
Eat more	38%
Eat the same	60%
Eat less	2%
Eggplant	
Eat more	21%
Eat the same	61%
Eat less	17%
Asparagus	
Eat more	38%
Eat the same	58%
Eat less	4%
Onion	
Eat more	35%
Eat the same	55%
Eat less	10%
Celery	
Eat more	33%
Eat the same	58%
Eat less	8%
Cauliflower	
Eat more	32%
Eat the same	63%
Eat less	5%
Brussels sprouts	
Eat more	34%
Eat the same	61%
Eat less	4%
Cabbage	
Eat more	30%
Eat the same	61%
Eat less	9%

Carrots	
Eat more	42%
Eat the same	53%
Eat less	5%
Beets	
Eat more	38%
Eat the same	55%
Eat less	7%
Corn*	
Eat more	15%
Eat the same	64%
Eat less	22%
Peas	
Eat more	19%
Eat the same	68%
Eat less	12%
Summer squash	
Eat more	48%
Eat the same	52%
Eat less	0%
Kale	
Eat more	67%
Eat the same	26%
Eat less	7%
Chard	
Eat more	50%
Eat the same	45%
Eat less	5%
Spinach	
Eat more	51%
Eat the same	46%
Eat less	3%
Potatoes	
Eat more	17%
Eat the same	60%
Eat less	23%
Sweet potatoes	
Eat more	43%
Eat the same	51%
Eat less	6%
Winter squash	
Eat more	35%
Eat the same	58%
Eat less	6%
Sprouts	
Eat more	17%
Eat the same	67%
Eat less	16%

Mushrooms	
Eat more	38%
Eat the same	54%
Eat less	8%
Sea vegetables	
Eat more	28%
Eat the same	57%
Eat less	16%

11. Clients were asked on the Intake, Completion and Three Month Follow Up Surveys to indicate how often they consume snack foods and sugary drinks. After participating in the Ceres program there is an increase in the share of clients who report that they "Never" or "Rarely" eat these foods.

How often do you drink or eat the following?

	Never or Rarely		Occasionally, Frequently or Daily	
	Intake N=426	3 Month Follow Up N=139	Intake N=383	3 Month Follow Up N=139
Candy	49%	63%	51%	37%
Energy Drinks	95%	99%	5%	1%
Soft drinks – Coke	76%	88%	24%	12%
Soft drinks - Crystal	84%	91%	16%	9%
Sweetened Coffee	70%	75%	30%	25%
Cookies, pies, cakes	33%	45%	67%	55%
Snack foods like chips	44%	54%	56%	46%
Fast food	68%	81%	32%	19%

12. Clients were asked to assess the degree of importance some of the benefits of participating in the Ceres Community Project held for them. More than half of clients rated each potential benefit as Extremely Important to them, and at least 84% said that each benefit was at least somewhat important.

Three Month Follow Up: What were the most important benefits of participating in the Ceres Project for you? N=47

Answer Options	Extremely important	Somewhat important	Not that important
The prepared meals meant that I didn't have to cook.	87%	13%	0%
I felt cared for and less isolated.	84%	9%	7%
The healthy food helped me recover more quickly.	83%	17%	0%
I learned a lot about nutrition and healthy eating.	67%	28%	5%
I discovered that eating this way makes me feel better.	64%	29%	7%
I discovered that healthy foods taste good.	59%	32%	9%
The prepared meals encouraged me to eat which I didn't want to do.	56%	28%	16%
The supplemental food like Immune Broth and Ginger Glycerite.	55%	24%	21%
The prepared meals saved me money.	54%	22%	24%

13. Clients were asked what the three most important things were that they learned while participating in the Ceres Project. The two most significant responses within the 84 comments were 1) Knowing that people care and the importance of community – mentioned by 52% of respondents and 2) Eating healthy, learning about food and nutrition and learning to cook – mentioned by 28% of respondents.

Knowing that people are there and the importance of community – 52%

- Ceres brought needed love into my life. Just think of those children cooking for me and the people that give up their time to deliver the meals. Thank you, thank you.
- Generosity in action. Creativity in food!
- People care about me!!Now, I hope to have time to care about others and give back to Ceres and the community. Thank you!
- This food was prepared and given to me with such love. The delivery person was so thoughtful and kind.
- I learned how lovely people can be. The delivery people, the teens, were all acting for my best interests and didn't even know me. I was touched by their kindness.
- Strangers cared about me. There is so very much love in everything that Ceres does--delivery of delicious food, flowers and just knowing how much love and energy goes into what you do.

Eating healthy, learning about food and nutrition and learning to cook –28%

- Good food doesn't have to taste bad.
- Nutrition is the key to feeling better.
- Learned about more grains. Opened eyes to a more healthy eating way in cooking. A wake-up of how home-cooking could be.
- I learned more about good food and I am trying to change my ways. We are what we eat!
- I learned that we could have a meal without meat, eat vegetarian occasionally. The combination of foods were surprising and good especially the desserts. I'm paying attention to ingredients I wasn't so familiar with before. I'm being more careful in what I choose.

14. Clients were asked in what ways receiving meals from Ceres had changed them. The 73 responses centered around two factors 1) the experience of being part of a caring community (57%) and 2) the importance of healthy food and nutrition (55%).

The experience of being part of a caring community – 57%

- Gives us a sense of wellness and hope to get through the rough times.
- Supported and lots of love. Could taste the love from those who made it.
- Being connected is very important. I was not alone and just thinking about myself. I am trying to reach out to others.
- Restored my faith in the goodness of people.
- I so looked forward to the deliveries. Every week it made me so happy. The surprises and knowing that this food was prepared for me by young people who cared. What love!
- You made me feel special.
- I am humbled. I have a new sense of gratitude for others and for my community.

The importance of healthy food and nutrition – 55%

- It opened my eyes that what you put in relates to what you get out.
- Has made me a more informed food preparer. I know that what I eat has a direct impact on my health.
- I am more conscious of what I eat. I eat more vegetables and different types of food. I have friends who are going through illness now and I am making soups and simple things that I can share with them. I realize my time is limited and I need to start helping others and volunteering now.
- It has helped me spiritually and physically.
- It helped me get well. It helped me understand the necessity of good nutrition. That eating to be strong is better than eating for happy taste buds.
- Learning to love good food.
- I realized I deserve to eat well so is more aware of doing that.

15. Clients were asked to tell Ceres anything that they felt was important about their experience with Ceres that they weren't asked. All 69 of the responses related to their gratitude and appreciation about the service and the difference that the food had made for them with the top response being related to the fact that young people prepared their meals.

Love that teens were preparing the food – 38%

- I think it is amazing that teens grow the vegetables and prepare the meals. The lessons they are learning about nutrition and compassion are huge life lessons that they will take with them.
- Having teens work in the kitchen and now the garden is worth an amazing amount. Being fed by anonymous teens who don't even know me was humbling.
- I loved that the teens were preparing the foods. This is important in so many ways - teaching them the value of good food, to be of service to others and how to cook!
- It is important that teens are involved. They are not only learning how rewarding it can be to be of service but also learning to cook and to eat healthy.

Grateful and appreciative of Ceres – 35%

- Very healing to be a recipient of this project. It fosters gratitude - the whole program.
- Very important emotionally because I don't have family.
- Teaching and supporting. Not about learning how to eat but getting the support in doing so when I couldn't put the energy and time into it...that was most valuable part.
- Tears...very emotional reflecting on all the kindness, love and support. Really grateful!!!
- Thank everyone involved in the program! My wife was able to come and thank the students who help. Grateful.
- Ceres has helped to soften my attitude. They have given me much more than the food. People really care!
- Feeling loved by strangers is very wonderful and humbling at the same time.

Amazing program – 10%

- It's like a dream come true. That it's like people should always treat each other. It's an exemplary organization.

Appreciate the volunteers – 9%

- The delivery volunteers were wonderful!
- The delivery angels were all so friendly and I really appreciated that. I looked so forward to the day they came, even the fresh flowers just blew me away.
- Everyone that delivered was so kind.

The flowers – 6%

- I looked so forward to the day they came, even the fresh flowers just blew me away.
- Flowers and everything!

CERES COMMUNITY PROJECT

A Healthy Food System, Caring Connections, Engaged Youth

2013 Annual Report

Why Ceres?

Poor Diet now the #1 Risk Factor for Health Loss

For the first time ever the Centers for Disease Control has named Dietary Risk the number one risk factor for health loss in the United States. When additional risk factors that also have poor diet as a cause (such as high cholesterol and high blood sugar) are included, the number of deaths that could have been prevented with a healthier diet climbs to 1,857,029 annually – 4 times as many as smoking, the next highest risk factor.

Most of Us Still Don't Know that Diet Matters

The World Cancer Research Fund (WCRF) found that 49% of Britons don't know that diet affects people's cancer risk – yet WCRF and American Cancer Society both say that about one-third of all cancers could be avoided by healthier eating habits and maintaining a healthy weight.

Loneliness is as bad for our Health as a Poor Diet

A recent study of people over 50 found that those who reported the highest levels of loneliness were twice as likely to die during the 6 year study. And a review of 148 studies involving more than 300,000 participants found that those with strong social relationships were 50% more likely to be alive an average of eight years later than those without – and that feeling lonely and isolated had a bigger impact on health than obesity.

Our Food Choices Contribute to Climate Change

Our food choices have a big impact on our environment. Here are a few examples from the Natural Resources Defense Council:

- If all Americans eliminated just one quarter-pound serving of factory farmed beef a week, the reduction in global warming gas emissions would be the equivalent of taking four to six million cars off the road.
- The average American meal includes ingredients from five foreign countries, and even domestically grown produce travels an average of 1,500 miles before it gets to your plate. The smog-forming emissions from produce imported to California are equivalent to the emissions from 1.5 million cars.

Dear Friends,

Since our founding in 2007, Ceres Community Project has been addressing the critical interconnection between some of the most pressing problems we face and modeling grass-roots solutions that work. Rising rates of diet-related illness. A food system that doesn't support the health of people or planet. The growing loneliness many of us face. Health care costs spiraling out of control.

As you'll see throughout this year's Annual Report, the research is overwhelming that what and how we eat is at the foundation of improving our health, reducing the burden health care costs have on our economy, and solving the environmental challenges we face.

The kinds of foods Ceres serves and recommends – whole grains, vegetables, legumes, wild caught seafood, pasture raised animal products, and healthy fats like nuts, avocados and olive oil – not only help our clients heal at a crucial time in their lives, they enable all of us to stay at a healthy weight and prevent chronic diseases like heart disease, type 2 diabetes, stroke and many types of cancer.

These food choices also have significant impacts on our environment, including reducing the use of toxic pesticides and herbicides and slowing the pace of climate change. The average food in the supermarket travels 1,500 miles and comes with packaging that ends up in our landfills. Factory farmed meats are a major source of water pollution and one of the leading causes of global warming through CO2 emissions.

And when we come together – all ages and from all walks of life – to prepare and share these foods with neighbors who need us, we forge bonds of caring connection that reduce loneliness and bring meaning to all of our lives.

This year we're launching a campaign to empower action! What are you doing to improve your health, the health of your community and the health of our precious planet? We've shared 10 of our favorite actions on the card included with the Annual Report. We hope it will inspire you to action throughout the year ahead. Let us know what you are doing by emailing your stories, photos and videos to empoweredaction@ceresproject.org. Later this year we'll be sharing all of our stories on a new special section of our website called Empowered Action.

Thank you for supporting Ceres and being part of the solution to some of the most fundamental issues of our time. The following pages tell just some of the stories of how our work together is changing and saving lives, and creating positive action to build healthier communities and a healthier future for all of us – one client, one teen and one nourishing meal at a time.

With blessings,

Cathryn Couch Sharon Keating

Cathryn Couch
Executive Director

Sharon Keating
Board President

Teen Program

At Ceres, teens are the primary chefs and gardeners growing and cooking organic nutritious meals for community members who face serious illness. Through Ceres, teens take their place as contributing members of their community and gain the skills and knowledge to live healthy, productive and engaged lives.

Teen Leaders at Ceres created this description of what it means to be a Ceres Teen Volunteer.

A Ceres Teen . . .

- ♥ Works as part of a unified team
- ♥ Takes responsibility
- ♥ Keeps his/her energy positive & enthusiastic
- ♥ Honors commitments
- ♥ Is caring & welcoming to all
- ♥ Puts passion & love into the food
- ♥ Looks for what is needed & does it

Why Ceres?

Because of what they've learned at Ceres:

- 50% more teens are encouraging friends and family to make healthier food choices
- 29% more teens are eating at least 3 servings of vegetables every day
- 28% more teens cook a full meal at home at least once a week
- 65% fewer teens regularly eat fast food

Alya Bohr
Sebastopol Teen Leader

Working with Ceres has made me realize that there's much more to food than what it tastes like or even how healthy it is. All food has a story–who makes it, what conditions it's made in, where it travels, what ingredients are used, how it affects the environment, etc.

When we have the choice between a bowl of vegetables and a bag of chips, it's so much more complicated than what we feel like eating. Whatever we choose to eat, that's the story we're perpetuating. We can support local, healthy environmentally-conscious farmers and businesses or we can support large corporations that harm the environment, put chemicals in our food, and pay their workers low wages. We, as consumers, have much more power than we think, and it's so important that we realize that and become characters in the right stories.

I truly understand and appreciate the effects that Ceres has because my dad received Ceres meals last year. It's easy to overlook the value of food, but when my dad stopped having the energy to cook and was lacking much-needed nutrition, opening the refrigerator to find container after container of gorgeous healthy food honestly changed our lives.

408 Total number of teens engaged	16,675 Total teen hours

Sebastopol kitchen, serving Sonoma County

304 Teens	14,610 Hours

San Rafael kitchen, serving Marin County

83 Teens	1,580 Hours

Sonoma kitchen, serving Sonoma Valley

21 Teens	485 Hours

Nick Eberhard
Marin Teen Chef

"My 8th grade project was to figure out how to cook healthy meals that were tasty. I needed to spend 10 hours volunteering, and my mom found Ceres. That was six months ago! With my friends, I saw how food impacted their lives. Eating fast food made them tired. Food affects how teens feel and how they interact with other people.

The most important lessons I've learned at Ceres are to be grateful for what I have, and that it's important to give back to your community. Ceres is the first place I've ever volunteered. It feels good to give back, and I was surprised by how much fun it is. I know I'll continue to make volunteering a part of my life."

Cyrus Borden
Sebastopol Teen Chef

"I come to Ceres because of the person I am when I walk into the kitchen. It allows me to show up fully as the best person I can be."

Client Program

Ceres' mission is to support people in crisis due to a serious health challenge with nourishing meals, nutrition education and the caring support of the community. The meals we deliver relieve stress and strengthen clients' foundational health to improve their quality of life and give them the best chance of recovering. They also help clients learn about healthy eating and make the changes that can help them – and their family members – live a long and healthy life.

In 2013 Ceres launched a second Sonoma County program site to better serve both clients and teens in the Sonoma Valley area. Operating out of the catering kitchen at the Hanna Boys Center, Ceres Sonoma Valley will provide more than 4,000 meals in 2014 to 25 to 30 client families and engage 40 to 50 youth.

Why Ceres?

Three months after completing the meal program our clients report:

42% increase in vegetable consumption

35% more likely to cook a meal from scratch at least several times a week

81% are eating less fast and processed food

100% say that the meals and what they learned were extremely important for their healing

Bridget Dorcy

Marin County client recovering from Breast cancer treatment

"The healing Immune Broth was priceless. I found it highly addictive. It helped me recover my energy post-surgery. I truly, profoundly believe I could not have made it through this without Ceres and the incredible support of the meals and my liaison, Mary."

Robert Karcie

Sonoma County client undergoing treatment for cancer recurrence

"Ceres has given me permission to try to eat in a different way. The other times (I was in treatment) it was just hard. I didn't even want to eat. About all I could handle was cold popsicles. The Ceres food is just delicious. When the food was delivered, I enjoyed reading all the papers that came with it. It was so informative. When I learned that the food was being made by teens who are volunteering, what struck me was that everybody wins because we're all learning together. It's a community. What a gift!

I can't believe that all of a sudden this has entered into my life because of illness. I can't believe how powerful it is and how many people it touches. I'm real grateful."

72,809
Total number of meals delivered to

451
clients in 2013

Sebastopol kitchen, serving Sonoma County

59,858 Meals | 362 Clients

San Rafael kitchen, serving Marin County

12,068 Meals | 78 Clients

Sonoma kitchen, serving Sonoma Valley

883 Meals | 11 Clients

75%
share of clients whose household income is below $45,000 a year

25%
share of clients whose household income is below $10,000 a year

Fasih Hameed, MD

Associate Medical Director, Petaluma Health Center

"Imagine a world in which every person in crisis and battling severe illness was supported by a community that provided delicious, life-sustaining, immune-boosting, locally-sourced food, prepared with love and care. Perhaps we'd see cancer cure rates skyrocket. Perhaps we'd see people empowered for the fight...empowered to heal. And when they were well, these people would be inspired to pass the healing on. They'd share the wellness with their community. Their habits would be forever changed. They'd never look at food the same way again. And slowly, the world would change until we all ate this way all the time. When I see the Ceres Project and the impact it has on individuals, I dream of the slow impact it is having on the world. I wish every community could have a Ceres.

The last patient I referred to Ceres was a young woman in the midst of a 24 week treatment for Hepatitis C. She was losing hair, severely fatigued, depressed, and most dangerously, her white blood cell counts were dropping to the point where she would need hospitalization. But then something miraculous happened. She started to receive food and extras from Ceres. She started to feel better and I was amazed when her labs showed a normalization of her white blood cell count! In the eight years that I have been treating Hepatitis C, I'd never seen such a dramatic improvement. Thank you, Ceres. My patient is now cured of her Hepatitis C and I bet we wouldn't have made it through without your support."

Community Building & Education

Ceres' work engages the whole community, building bonds of caring connection that help make all of us healthier and more whole. Volunteers are the heart of Ceres Community Project, and we couldn't do our work without them. Our adult volunteers play dozens of vital roles week in and week out, from mentoring teens in our kitchens and garden, to supporting our clients as Client Liaisons and Delivery Angels. And while we're incredibly grateful to our volunteers, they often assure us they feel they "get" more than they give from the experience.

Our *Nourishing Connections Cookbook* and Educational Programs help us reach thousands of people throughout our community and across the country with the information and inspiration they need to change their eating habits and improve their health. Ceres' daily Teen Circles; our Healing Foods Basics class, offered regularly at our Sebastopol site; and the Nutrition for Wellness class we offer every other week at West County Health Center's Forestville Wellness Clinic, reached 850 people during 2013.

As interest in our model has spread across the country we've created training and support programs to aid new communities in successfully replicating our model. In each of these communities, Ceres' message about the relationship between food, connection and health has reached thousands more teens and adults

Why Ceres?

Ceres impact on our adult volunteers includes:

63% say volunteering at Ceres gives their life meaning

47% are eating more vegetables thanks to what they've learned

59% are eating less fast food

Morgan Hewitt
Sebastopol Volunteer Client Liaison

"I am humbled and honored to serve our clients. It makes me appreciate the very precious nature of life and strive to live fully each day.

I met a client who has two different forms of cancer-both stage 4. He is of very modest means and is extremely bright. He loved the Ceres food and the flowers, cards and thoughtfulness that was conveyed in every food delivery. Our conversations each week were deep and thought provoking. His tumors shrank and his health improved. He has studied nutrition and continues to learn more throughout his illness. He taught me a lot about courage and the tender aspects of accepting help. We have to let go of the medical model that says we are successful only when there is a cure. The quality of both this man's life and mine improved through our Ceres friendship."

Volunteer Power

$705,193
Value of teen and adult volunteer contributions

449
Total number of adult volunteers

24,070
Total number of hours adult volunteers contributed

Community Outreach

1,019
Number of new families cooking from *Nourishing Connections Cookbook*

8
Ceres' Trained or Affiliated Projects nationwide

309
Hours of educational programming

850
Number of people reached with educational programming

1,500,000
Number of people reached with healthy eating messages through media coverage including 26 separate television, radio, print and online stories

Kellie Noe
Board Member

"Ceres Community Project has created one of the richest youth development programs that I've seen. As someone with over 10 years of experience in the youth development field both locally and nationally and as a school board member, I know first-hand the long-term difference this program is making – not only for the young people involved but for our whole community. This is a program that needs to be scaled both here in Sonoma and across the country."

Donors

$100,000+ • California Department of Food and Agriculture • Kim Barber Trust • **$25,000-$50,000** • Ernest L. & Ruth W. Finley Foundation • Gregory Young & Jean Davis • The Kimball Foundation • Whole Foods Market Northern California (Sebastopol, San Rafael, Blithedale, Santa Rosa, Coddingtown, Sonoma, Petaluma, Novato Mill Valley) • **$10,000-$24,999** • Anonymous • Anonymous/Lamb & Barnosky, LLP • Clif Bar Family Foundation • Heart/Land Fund of RSF Social Finance • La Gloia Fund of Community Foundation Sonoma County • Lynn Fritz & Anisya Thomas Fritz • Medtronic Foundation • Nan Fuchs • Peter E. Haas Jr. Family Fund M • Robert A. Day Foundation • Sonoma Wine Country Weekend • The Bothin Foundation • The John Jordan Foundation • To CelebrateLife Breast Cancer Foundation M • UNFI Foundation • Willametta K Day Foundation • **$5,000-$9,999** • Bank of America Charitable Foundation • Brickyard Berridge Fund M • Cooking with Kids Foundation • Craves Family Foundation M • Daniel Shanahan KC • Exchange Bank • Farallon Capital Management LLC • Impact 100 Sonoma • Jack & Marilyn Jones • Jackson Family Wines, Inc. • Jody Snyder & Noel Littlejohn • Julia & Will Parish • Junior League of Napa-Sonoma • Ken & Sharon Maiolini • Morris Schapiro & Family Foundation M • Pascal Rigo • Ron Bartholomew & Sharon Keating • Shinnyo-En Foundation • Steve & Ellen Beckwith • Terry & Joanne Dale • Zazu Restaurant & Farm • **$2,500-$4,999** • County of Marin M • David & Suzie Cosper • Diane R. O'Neal • Dorie Beron & Eva Bender • Exchange Bank Foundation • Jacques & Barbara Schlumberger • Jane & Gary Facente • Jeannie & Mike Morawski M • Jill & Hall Sanford • Jim & Kathleen Dolinsek • Karen Knudson & Terri Tachovsky • Kate Schaffner • Kathy Boyd & Stan Nussbaum • Morning Glory Family Foundation • Osmosis Day Spa Sanctuary • Preservation Foods • Redwood Hill Farm & Creamery, Inc. • Robert & Paula Brent • Ron Treleven & Bill MacElroy • Rotary Club of Sebastopol • Scott McDougall & Ray Goodenough KC • Sutter Health Foundation • Suzi Schroll • Unbroken Chain M • Willow Creek Wealth Management • **$1,000-$2,499** • Aceves-London Family Fund, Santa Fe Community Foundation • Alan Siegle & Shelley Marie Brown • Alida Morzenti • Amanda Wagner & Tom Shores • Anne French & D L Ordaz • Anonymous • Backyard Restaurant • Barbara Grasseschi & Tony Crabb • Barbara Shilo • Bernadette Burrell • Bruce B. & Janet Allen M • Carol & Andy Carciere • Carolyn A. Mayes, CPA • Chantal Vogel & Darrell Luperini • Cheryl Thomas & Patrick Stewart • Christopher & Anne Gibson • Crutcher Family Foundation • David Friedland • Deborah Vogan • Dennis & Deborah Vossen • Don Townsend & Myra Widen • Elizabeth Patterson • Ellen Klarberg • Eric & Heather Friedlander • Evergreen 161 Sebastopol • Frank Howard Allen Realtors Fund M • Gary Barth & Kevin White • Gary Smith & Jamie Studley • Gravenstein Lions Club • H.S. Restaurants M • Heck Foundation • Human Race • James Reed • Jane & Del Frances • Jeffrey Zankel & Simma Chester • Jennifer Cobb & Stephen Eisenberg • Jennifer Lynn Bice • Jim & Sandy Shelton • Joan Brady • Joan Musgrave • John Stierch & B.J. Bischoff • Joshua Weil & Claire Mollard • Judy Withee • Julia Gombos • Julie & Stan Burford M • Kaiser Permanente Santa Rosa • Karen Leung • Kathleen K. Broderick • Keith & Cheryl Hughes • Kevin & Nancy Cooper • Laurie & Michael Jacobvitz KC • Laurie Dibble & Lili Gunter • Making it Big, Inc. • Margit Lowenstein M • Marin Resource Recovery Center M • Mark & Heather Grismer • Mark Altman • Mark Short & Cari Ray KC • Mary & Brian McCue M • Mitchell Savitsky & Cheryl Smith • Nancy & Bob Aita • North Coast Association Of Health Underwriters • Patricia Charlton • Perforce Foundation M • Premier Organics/Artisana Organic Foods • Redwood Credit Union • Renate & George Lee • Reuben Weinzveg & Padi Selwyn • Richard & Judith Markoff • Richard & Trish Power • Robert & Karen Lowenstein M • Rotary Club of Sebastopol Sunrise • Sandra Austin • Santa Rosa Sunrise Rotary Club • Saralee & Richard Kunde • Sherry & Peter Swayne • Sonoma Compost Company • Steve & Lee Heath • Sue & David Sawtelle • Teresa & Vern Losh • The Fred Gellert Family Foundation M • The Girl & The Fig • Tietz Family Foundation • Tony Schmoll • Westamerica Bank • **$500-$999** • Agilent Technologies • Alan & Gail Ross • Alea Woodlee • Amgen Foundation • Andy's Produce Markets • Ann Austin & Lawrence Jaffe • Ann & John Watchen M • Arlene & Bob Harchut KC • Barbara Bernstein M • Bill & Wendy Cole • Bruce & Susan Dzieza • Cara Brown • Carrie Taylor M • Chaney & Les Claypool • Cheryl & Howard Blake KC • Cheryl & Kem Sisson • Cheryl Simien M • Clarmarie Rosso • Darylan Stratten • David Haydon M • David Vidaurri • David Weinstein M • Debie Faulkner • Ed & Laura Dangers • Ed & Wendy Grudzien • Elizabeth Cohen • Elizabeth Lang • Ellen & Kenneth Ziffren M • FoodLogic • George Petersen Insurance Agency • Glenn Filshie M • Gourmet Mushrooms • Grace Marketing • Hanna & Marin Wildenberg M • Harold C. Appleton • Helene & Timothy Wallace • Help On The Way Fund • Jamie Spooner • Jan & Vincent Lawson • Jane Meyers • Jason & Tiffany Gittins • Jeanne Romano M • Jody & David Suchard KC • Joe & Pam Marshall • Julie & Jeff Austerweil • Julie & Billy Carmen • Kerry Brady • Lisa Rogers M • Liz & Mario Uribe • Lois Leal • Lorene Irizary & Lisa Carreno • Luanne Buchanan KC • Lucy Davaly • Marco & Esmeralda Vailetti • Mark Law M • Marlene Stein • Martin Lowenstein M • Mary Farha • Maryanne Jacoby M • Melissa Shaw • Michael Dean M • Michael Kirby M • Mike Clementi • Moss Adams LLP • North Bay Reclaiming • Nutiva • Pat Harrison • Paul Stamets • Peggy Tourje & Jane Krensky • Rebecca Katz M • Regina Spindler & Joshua Dvorson M • Reyna Cook M • Richard Bernstein M • Robyn Hettrich • Rolf & Becky Nelson • Roni Simon • S. B. Fischer Group M • Sackett & Associates Insurance Services • Sarah Dole • Sebastopol Chapter Of Realtors • Sebastopol Community Cultural Center • Sebastopol Kiwanis Club • Silk Road Teas • Sonoma County Oncology Nursing Society • Stephanie & Michael Poley KC • Stephanie Brennan • Stephen McNamee M • Sue Zee Poinsett • Susan Carpenter & Chris Rosell • Sushi Hana • Suzanne Wandrei • Todd & Sally Cutler • Tony & Karen Chu • Trystan Nash Shelly Legacy Fund • Wendy Remer M • Will Bakx & Claire Victor • **$250-$499** • Ad-Vantage Marketing • Aldo Cima • Allan Rappaport M • Allen Losh • AMC Network LLC • Anna Antoniucci • Anna Ransome & Cary Fargo • Barbara Coen • Betsy Hall & Gene Wright KC • Bill & Kathy Harris • Boutique V • Brian & Denise Swimme • Brian White • C. J. Layton • Carol Harvey • Carolyn & Donald Crosby KC • Catherine Rosoff • Cathy Maupin M • Chris Black • Christine Newton • Colin & Mia Davidson • Columbia Sportswear • Craig & Marcia Gummer • Cristina Munoz • Daniel Curran M • Deborah Adams • Dennis & Linda Rear • Donna Bunn KC • Doris Meyer • Douglas Loudon • Duckworth-Dixon Charitable Fund M • Ed Ryden • Elizabeth Patterson M • Emma Chapa • Erich & Tunde Gaiser • Gabrielle Scherzer • Gale Niess M • Gary & April Scharlach M • Gary Woods • Geri L. McMurray M • Heidi Stewart & John Weinstein • Howard Burt • Howard Rosner • Howard S. & Christa Ortman M • Ian Morris • Iron Springs Pub & Brewery M • Jacqueline & Stephen Zwick • James & Deborah Ritzenthaler • Jason Almirol • Jeanette McFall M • Jeanne & Greg Carter KC • Jeffrey & Kathleen Lovold M • Jenya Bohr & Jennie Rose • Jim & Ethel Snarski • Joanna Cedar • Joseph Rafferty M • Judi & Matt Pereira KC • Judith Heiler & John McCollister • Karen Gifford • Kimberley Tyner • Lagunitas Brewing Company • Leff Construction • Linda & Roger Delgado • Lois C. Johnson • Lori Buckley M • Lucy Sutter • Lynn & Michael Davis • Lynn Silva • Margaret Anne Spindler M • Margaret Barkley • Marian R. Pena • Marianne & Bill Gagen • Marie Gewirtz • Marilyn Webster • Mark & Patty Jackson • Marsha Greenfield & Peter La Force • Mary Sue Ittner & Robert Rutemoeller • Matt & Trish Poole • Mela Angleman • Michael Bluestein M • Michelle Aheron M • Molly Underwood • Nancy Niche M • National Heirloom Exposition • Northbay Motorsport • Olga & Joseph Vallarino • Pam & Tim Chanter • Paul & Janis Mahoney M • Pizzalina LLC M • R.S. Technical Services, Inc. • Rachel Flug • Ralph & Martha Harmon • Richard Flaster M • Richard Stephens • Robert Nisco • Sheila Durst M • Shirley Feigenbaum M • Sleepy Hollow Presbyterian Church M • Steve & Marcia Messinger • Steven Rikli Construction Company M • Susan Forrest M • Susan P. Hagen & Mary Carouba KC • Suzanne & Jack Waxman • Tara Butler Floch & Eric Floch KC • The Pasha Group M • Tim Struckmeier M • Trudy Schafter M • Twila & Michael Chase • Veronica & Gary Reed Fund • Victor & Karen Trone • Wally Shambaugh • **$100-$249** • Abby Platter M • Adam Goldberg & Tina Howa • Adventure in Well Being • Agency C. G. • Aimee Westbrook M • Alan Clarke • Aldo & Lois Borin • Amy McIntosh • Amy Tarantino M • Andrew Pawlowski • Ann & Paul Tamminen • Ann Beier • Ann Boatright • Anne & Gary Iocco KC • Anne O'Brien Martinez • Antique Society • Arthur Jaseau • Barbara Holleran • Barbara Jones • Barbara McDaniel • Barbara Wallace • Betsy & Jim Flack • Betsy & Stratton Danes • Bill Prange • Birdie Lane • Bischoff Performance Improvement Consulting • Bloody Bob's • Bob Baty • Buckingham Asset Management, LLC • Carla Boyd • Carlo Rossi • Carol & Joseph McLaughlin M • Carol & Van Athanasakos M • Carol Sarner • Carole Bibeau • Carrie Wilksen M • Carrie Zinn & Chett Zinn, Jr. • Carroll Estes KC • Cathie Irwin • Cathryn Couch & Jeff Black KC • Cecelia & James Donahue • Cecily Clover • Celia Peterson M • Center For Spiritual Living KC • Charles Fleshman & Lori Christani • Charlotte Reiter • Cheryl DeMarta KC • Cheryl M. & Richard Brandon M • Chris Landwehr • Chris Leet • Christa B. & Howard Ortman M • Christina & Steven Dick KC • Christine Esters • Christine Yaeger • Cindy Duim • Claire Fitzgerald & Tracey Gregg • Connie Duncan • Connie Petty • Cora Stewart KC • Corinne Nakao • David Cannington M • David Parsons • David Sewell M • Dawn Dowd • Deanne Bonta • Deborah Greene-Jacobi & Robert Jacobi • Dena & Patrick McDonald • Denis & Kate Quinlan • Dennis Bayer M • Diana & Daniel Rich • Diana S. Poulson • Diane Constantine • Diane Land • Diane Mott M • Dianna Grayer & Sheridan Gold • Dianne Smith • Donald I. Abrams • Donna DeRosa • Donna Warrington • Dorothea & Paul Geiger • Dorothy & Gerald Peinkofer • Dorothy Duncan • Douglas & Debra Noren KC • Eileen & Forrest Jang • Eileen Stucky • Elaine & Greg Cassel • Elinor & Gary Biller • Elizabeth & Jiori Orfanos • Ellen Tamalis Thompson M • Elli & John Gray • Ellia & Matt O'Donnell • Ellie Dwight • Evodia Perez-Rocha & Alberto Rocha • Fay Gallus • Frances Anacleto & Lisa Stumpf • Frances Fagan • Frances Fuchs • Frank & Pat Schueler • Frank Caligiuri • Fred & Beverly Kandel • Gabrielle Klatsky KC • Gail Anne & David Perin M • Gary Fiedel M • Gary Pace & Margaret Howe • George & Denise Heeg • George Janson M • Greg Englar • Greg Sternik • Gretchen Savidge • Gretchen Whisenand • Grooming Gallery • Harold Sunderland • Heidi & Ted Lemon • Hill Country Smokehouse • Ina & Bob Selwyn • Irema & Dragan Sivcevic KC • Jacqueline L. & Robert Young M • Jacqui Viola KC • James & Sharon Connolly • James R. Dunn M • Jane Flanagan M • Jane Huneke • Janet Lowry-Cole • Janice Andrus • Jean Gustafson M • Jeannine Bressie • Jeffrey & Kathleen Lovold M • Jennell Parr • Jennifer Cook Sterling & Robert Sterling M • Jennifer Taylor • Joan Lateer & Kathleen Moore • JoAnne & Michael Mann • Joanne Ferris • JoEllen & Henry DeNicola • John Coursey • John Novick & Tracy Rosner Novick M • John Yamaguchi M • Jonathan Greenberg • Joseph O'Hehir M • Judith Walsh • Julie Bova • Julie Mager • K. Bruce & Lois Friedman M • Karen & Steven Boga • Karen Johnson KC • Karen VanSant • Karla Colteaux • Kathleen & Robert Richards • Kathleen Brennan & Tom Waits • Kathleen Ecker & John Mackie • Kathleen Lowe M • Kathleen McDonough M • Kathryn Holland KC • Kathy & Bill Hogencamp • Kathy Charvat-Klopp • Kathy Fogleman • Kathy Taraban M • Kellie Noe & Dennis Rosatti • Kent Wood • Kevin & Kerry Tayor M • Kim Barber • Kumon North America, Inc • La Tierra Community • Laura Haman M • Laura Mc Cullough • Laura Rowbottom • Laura Shafer & Paul Schwebel • Laurie Leveque-Ingram • Laverne Cislo M • Lena Cox • Lena John Chyle • Leona Judson • Leticia Duenas • Lincoln Park LLC DBA/Eat Chaka M • Linda & William Ramelli • Linda Stanley • Lindy Rose Graham M • Lisa & Matthew Wertheim M • Lisa Olson • Lisa Wolper • Lorraine Ashton • LPL Financial M • Luann Galeazzi • Lucy & Emanuel Aron • Lynne Silbert • Lynne-Marie Frame M • Lynnette Barlesi KC • Maggie McDonald • Marc Krafft • Marcia Burkart • Margaret Andalib M • Margaret Sherry M • Margery Cahn • Margo Porter • Marie Ann Mulligan • Marilyn Baty • Marilyn Fujiyoshi • Marin Produce Co., Inc. M • Mark Lancaster & Barbara Sayler • Marlane Spillinger • Marlene & Brian Bonham M • Marlene & Brian Bonham M • Marlene Alves • Martha Lavin • Martin & Marianne Weil • Marty Peinkofer • Mary Ann Weklar • Mary Beth Rosenthal • Mary Fitzpatrick M • Mary Lou Carson & Melissa Fike • Mary Pierce & W.C. Baty • Mary-Louise & Bill Reinking • Matheson & Son • Maura & Jesus Avila • Max McAlexander • Micaela Porte • Michael & Tammi Bernd • Michael Baty • Michael DuBois M • Michael Gothelf M • Michael K. Plimack M • Michael Stusser • Mildred Lynn McDonald • Mimi Carroll • Moonlight Brewing Co • Morgan Denker M • Moses Goldberg & Sari Singleman KC • Nancy Hoffman • Nancy Mathews • Nona Passalacqua • Olenka Villareal • OMW Corporation M • Pamela Jasper • Pat Nalley • Patricia Plude • Patricia Walsh • Patricia Zentner M • Patrick & Ellie Reeves • Patsy & Daniel Wright • Paul & Sherrie Corbett • Pauline Minser M • Peggy Bianchini • Peggy Calkins • Peggy Klaus • Peggy Lee • Penny & Jason Bacharach M • Penny & Paul Millar • Peter Greeley M • Peter Lee M • Phyllis DeNicola • PJ's Foreign Automotive • Priscilla & Joe Vivio • R.C. & Phyllis Clement • Rae & Michael Mayer • Randy & Louise Lieb • Raymond & Ann Brown M • Rebekah & Michael Goodall • Richard A. Brenner M • Richard Nowlin & Donald Strand • Robert & Susan Rosenberg M • Robin & Barry Weinzveg • Robin & Brad Calkins • Ron Karp • Rotary Club of Russian River • Russell Schmidt • Sandra & Michael Turner • Scott Brown • Scott Sklar M • Sharon McCurdy • Shelley Pearlman & Sheila Horowitz KC • Sherri Anderson • Sherri Carrigan M • Skye Woodward • Stanley Cohn M • Stat Systems, Inc. M • Steve & Kathleen Amend • Steve Armstrong • Steve Elliott • Steven Fabian • Steven Wolf & Ruth Jaeger M • Susan & James Cochran • Susan & John Feder M • Susan Hendrickson M • Susan Wilcox • Sylvia & John Melrose • Theresa & Peter Mahoney • Thomas & Irene Bachelder • Thompson Brooks Inc M • Tiffany Wood • Tom Rigsbee • Toni D'Angelo • Tricia & Irby Schexnaydre • Vera Korkus • Vicki Gonzalez • Virginia Hughes & Cecily Cahill • Warren & Maile Arnold • Whimsy & Tea • Yousef & Nicole Saadeh • **Up to $99** • A.J. Kamp M • Able Banking • Adele Tierney M • Alan Kashiwagi • Alex & Irene Saschin • Allis Teegarden • Andrea Pierpont M • Ann & Fran Garzoli • Ann & Jeffery Walsh M • Ann & Ronald Holz M • Ann Delaney • Anna Kemps • Anna Taylor • Anne Cook M • Anthony & Jezra More • Anthony & Robin Casadidio • April Lynch M • Arcadia Mojica • Auer-Jordan • Balboa Cafe Mill Valley Partners M • Barbara & Ray Perkins M • Barbara L. Baer • Barbara Spain M • Beth Ann & Kevin King • Beth Miller M • Beverly & James Scheskie • Birdland Creations • Bob Greenebaum • Bonnie B. Walner • Boyd Bel • Brenda Berg M • Brenda Kinsel M • Brian Botel M • Brittany Swingle • Bruce Swartout M • Camille & Mark Keating • Candice D. Gold M • Carol & James Laveroni M • Carol Newman & Bradley Wardwell • Carol Roselle • Carole & Francisco Peccorini • Carolyn Dwyer, M • Casey Beck • Cassandra Shafer KC • Catherine & Ari Reisman • Cathleen & Robert Cummings • Cathy La Varta • Charles & Barbara Baker • Charles & Barbara Billings M • Charlotte Hoffman • Charlotte Siemans • Cherilyn Milton KC • Cherro Noel • Cheryl Bruns M • Chris Bekins • Christina Decker M • Christine & Matthew Sullivan M • Christine Hourscht • Chuck Horasco • Chuck Pyle & Tina Hittenberger • Cie & Rob Cary KC • Cindy Tucker • Ciri Giromini • Clare & Daniel Ritter • Craig Given • Craig Stephens • Creta Pullen • Cris Galli • Cynthia Denenholz • Dan Burton • Dana & Robert Feldman • Daniela Manning M • David & Vivian Weinberg M • David Goodman • David St. Aubin Cousins & Sashi Cousins • Deborah & Randy Myers • Deborah Friedman • Deborah Kraft KC • Deborah Ramelli KC • Deborah Simonds • Debra Kahn • Dena Bliss • Dennis Bayer M • Dewey & Susan Watson • Diana Badger • Diana Comfort • Diana Glassman • Diane & William Petersen • Diane Alabaster • Diane Nadler • Diane Rooney • Dianne & Joseph Clendenin • Dianne Namkung • Dick & Linda Dondanville • Dolores & Albert Markarian • Don Chigazola • Donald Bardole • Donna Fore • Donna Noyes, K • Donna Tobiassen Baitinger & Zachary Baitinger • Doug Lee • Duane Baker • Dyer Grote M • Eddie & Karen Guthman • Edith Ullman • Elaine Weil • Eleanore Lyle Christensen • Eliza Perkins M • Elizabeth Bilich • Elizabeth Brown & Kate Winter • Elizabeth Jennings M • Elizabeth Levy • Elizabeth Marquis • Elizabeth Snedden • Enid & John Macken • Eva Frank M • Eve Goldberg & Linda Evans • Ezra Chomak KC • Fidel Chavez Alvarez • Floyd Jasinski • Gail Gretchner • Gerald Freeman M • Gerald Koplan • Geri McCauley • Gretchen Singer M • Guy A. Wilson • H. & N. Curdts • Harold & Virginia Sorensen • Harry Simms & Susanna Simms • Heidi & Mark Krahling M • Heidi Hansen • Helen Baum • Helen Eastabrooks • Herbert Liberman • Hilary McCalla/Avalon Luxury Bed & Breakfast KC • Hope O'Regan M • Howard Ballinger • Htwe Ma • Irmgard & Wayne Martin • J. & J.L. Olson • Jacque & Donald Mielke • Jacqueline & Lawrence Jones • Jade Prospero M • James & Lorene Coconas • James Rogers & Lino Vicente • Jan Rostov M • Jan Turrini • Janet DePree • Janet Tobin • Janice & Carl Jonkers • Janny & Mark Tansil KC • Jazelle Lieske • Jeff Burch • Jeffery Fox • Jeffrey G. Katz M • Jennifer & Robert Hoegerman • Jennifer Koehler M • Jennifer Richardson • Jennifer Ross & Eric Newman • Jennifer Welch • Jesse Boardman • Jessica & Ryan Malmberg • Jessica Lopretta KC • Jim Prior • Joan Galindo • Joan Leopold M • Joan Rojas M • Joan Simon • Joanne Gordon M • Joanne Harwood M • Joanne Skirving • Jody Meese M • John Haller • John Olney • John Riddell • John Verity • Jonathan Gertler M • Joyce & Charles Waldren • Joyce Duffala • Judi Binkley KC • Judith & Mario Gianetti M • Judith C. Rogers M • Judith Miller M • Judith Reimuller • Judith Wildenberg M • Judy Escobar & Charlie Wirtz M • Judy Wachs • Juliana Balistreri • Julie & Roger Klein • Julie Finn • Julie Ralston • Karen & Alan Lett • Karen Bray M • Karen Foley • Karen Thompson • Karla Clark M • Katherine & Joseph Desautels M • Katherine & Robert Carson • Kathleen & Matthew Smyth M • Kathleen Ames M • Kathleen Bourgea • Kathleen Cooke • Kathleen Kraemer KC • Kathleen Riley • Kathy Bray M • Kathy Elmer • Katie Perry • Kay & David Law M • Kelly Thomson • Kevin Driscoll • Kim Elzen • Kim Lupsha • Kim Pistey • Kit & Russel Yarrow M • Kris Nevius • Kristine Cain M • Kyra Janssen • Laura Moss & Paul Layrak KC • Laura Townsend • Laureen & Chris Buettner • Laurel Newmark M • Lauri Luck & Michael Boese • Laurie Gadbois • Laurie Var M • Leah & Scotty Brown • Lee Gooding • Leslie Gattmann & John Maas • Lillie Queen • Linda Cornell • Linda Patterson • Linda Sandoval • Lindsay McGaughey • Lisa Casey • Lisa Kruttschmitt M • Lisa Lim • Lisa Lyn & Tad Houston • Lisa Monroe • Lisa R. Newmark M • Lois Hadfield M • Lori Zaret • Lorrine Musante • Lucille Le Fevre • Lynda McDaniel • Lynn Behling • Lynn Busch • Lynn Lott & Hal Penny • Madeline Schakel • Margaret Stawowy M • Maria & Paul Bachteal • Marian Doyle-Landis • Marian Hopping • Marie & Christopher Tolen • Marie Lindsay • Marilyn Herczog • Marisa Clark • Marjorie & Ross Grossman • Marjorie Seckinger KC • Mark & Gloria Thomas M • Mark Barbara Ihde • Marlene Fink & Stephen Lebbert • Martha McEwen & Donald Oberthur • Mary & Gary Elmstrom M • Mary Ann Graynor • Mary Killian KC • Mary Kowatch • Mary Lopez & Alexander • Mary Lu & Robert Adreveno • Mary Pearlman • Mary Ward M • Maryann Schacht KC • Maureen Karbousky • McCann & Sons, LLC • Meg Ellingson • Megan Correll • Melanie Phoenix • Meme & Peter Scherr M • Mercedes Baltazar • Michael Healy • Michaelynn Meyers M • Michelle Coak • Miriam Lite M • Mohit Gourisaria KC • Mona Steinberg M • Monica Sallouti • Mr. Whitten M • Nadine Narita M • Nancy & Lawrence Goldberg M • Nancy Leavens M • Nancy Moorhead • Nancy Sarris • Neil Ehrlich • Neil Ehrlich • Nicole Canon • Nina Edelstein • Ninotchka Regets M • Nora Lee Pearl • Norma Rhatigan • Nydia Martinez • Ofer & Jennifer Zur • Ole Pilgaard M • Oliver Mangis • Palmeda Day • Pam Moskovitz • Pam Schrode • Pamela & David Tinnin • Pamela Adams • Patricia & Charles Lachman • Patricia & George Bernard KC • Patricia Sanchez • Patty & John Samders M • Paul Davidson & Ursula Davidson Books M • Paul-Andre Schabracq • Penny & Robert Nyden • Penny Wolin • Percy Brandon • Peter & Beth Krohn • Philip & Sara Stanz • Philip Seavey • Phyllis Corner • Portico Wealth Advisors, LLC M • Rachel Jacobs • Rahine Patel-Brady & Michael Brady • Ralph Barbour • Randy Johnson • Raphael Block • Rebecca Porteous KC • Rebecca Ryan • Regina Evans M • Renate Alton M • Renee Crevelli-Gross • Rex Dengler • Riggs Appraisal Co. • Robbie De La Riva • Robert & Eilene Nielsen • Robert Feraru • Robert Silvers KC • Robert Thille • Robin Winton • Rod Sutliff • Roderick & Dawn Larue KC • Rolf Wessman • Ronald Baum M • Rose Jeweler M • Rosemary & Michael Shorrock M • Ruth Johnson • Ruth Robinson • Sandra & Daniel Dexter • Sandra Malcom • Sandra Throne • Sandy Cook • Sandy Marsicano • Santa Rosa Catholic Worker, Inc. • Sara Brown Crowder • Sarah & Mark Oliver M • Satya Levine KC • Shannon Delaney • Sharon & Edward Mirch • Sharon Cashman • Sharon Henning M • Shauna & Mike Harbarth • Shelley & Joseph Stiles • Shelley & Peter Maschwitz • Sheryl Denker M • Skylar Baker M • Sondra Bernstein • Sonny Hogs • Sophia & Thomas Gorman • Spencer Martin • Steffanie Jones • Stephen & Nancy Derr M • Steve Lightman • Sue & Thomas Horstmann • Susan & Michale Painter M • Susan Cronk M • Susan Johnson • Susan Jungfrau • Susan Morgan KC • Susan Poggi • Susan Powers Kane • Suzanna Jacobs-Banks • Suzanne Grant M • Sydney Ferrario M • Sylvia Bray & Bernardo Larque • Sylvia Chipman M • Tara Treasurefield • Teri Sackett • Teri Shaughnessy • Terry Price & Kerry Campbell-Price • Terry Ramsey-Leoni • The Connection Company • Tineke Krist Steinhart M • Todd & Kimberly Cook • Tom Fulton • Tom Gallup KC • Tom Kathleen Kelly M • Tommie Smith • Toni & Ed Elordi KC • Toni Hodenfield KC • Trial By Design, Inc. • Tricia Hoffman • Valerie Nordby • Vicki & Paul Remer M • Victor Rhoten • Victoria Ford • Violetta Fifis • Vivian E. & David Weinberg M • Vivienne Freeman M • Walt & Sandra Bodley • Wanda Cardiff • Wendy Remer M • Will Schoolcraft • William Melton M • William Turner

We are grateful to the following donors for their support of Ceres in 2013. We've made every effort to assure this list's accuracy, and apologize for any omissions or errors.

M=Marin Donor • **KC**=Kale Club Monthly Donor

In-kind Donors

We are deeply grateful to all of our Community Partners whose contributions to Ceres make our work possible. In 2013 we received nearly $200,000 in in-kind donations from dozens of farmers, food producers, grocers and others. Here are just a few examples of how how some of Ceres' Community Partners are making a difference for our teens and clients.

Gourmet Mushrooms

Along with cash support, this local business has donated nutrient-rich organic mushrooms like Trumpet Royales and Maitakes weekly, as well as the mushroom powders we use in our Ceres "Extras", since 2008.

Oliver's Market

Since 2008, Oliver's Markets has given Ceres half off all of our organic poultry and sustainably-caught seafood, saving us more than $13,000 in 2013 alone.

Sonoma Design

These partners put smiles on our teen volunteers' faces with the beautiful embroidery they donate for the personalized aprons teens receive after 6 months, and the embroidered chefs' coats our Teen Leaders wear. The owner's son is one of our past Teen Chefs.

Redwood Hill Farm

Redwood Hill donates all the Goat Milk Kefir we offer to clients each week – more than 2,000 bottles annually – plus cheeses for our entrees and events, and has done so since 2008.


Teen Chef Anja, Colin, Teen Chef Jack, Deli Team Leader Nezar Jabbar

Colin Davidson

Store Team Leader
Sebastopol Whole Foods Market

Two and a half years ago, Colin and Chris Maritzen, the Sebastopol Deli Team Leader at the time, came up with a truly innovative idea – let's sell salads made from some of Ceres Community Project's recipes and donate a part of each sale back to them. A year later the idea scaled to all nine stores in Marin and Sonoma and now generates more than $30,000 annually for Ceres – enough to provide three months of meals to 58 of our clients.

At Whole Foods Market we work to be more than a grocery store. It's in our core values to give back to the communities that support us. That's why we're so proud to partner with Ceres Community Project to help people battle the toughest illnesses, educate our youth on cooking and nutrition, and ultimately build a culture of healing and wellness in our communities and beyond.

Daniel Kedan

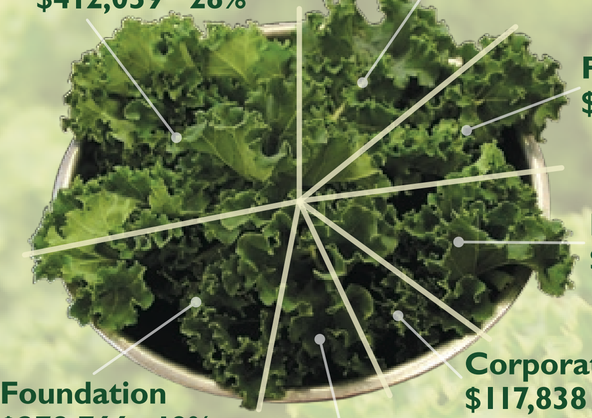
Chef/Owner, Backyard Restaurant

Chef Daniel Kedan's Backyard Restaurant in Forestville features meals completely in line with Ceres' food philosophy – locally raised, whole foods, and made with love. Daniel and his partner Marianna have become huge Ceres supporters. In 2013 Daniel donated his time and food for our Leadership Donor Appreciation event and again at Harvest of the Heart, our signature fundraising event. In November he and Marianna offered Backyard for a benefit with Ceres' Executive Chef and our teens partnering to create an amazing meal that raised more than $2,500 for our work. They've also become a training ground for Ceres' teens interested in culinary careers, with two of our teens working at the restaurant.

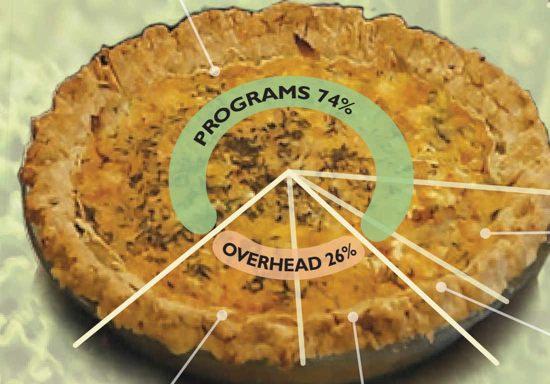
This is an organization that we are grateful to be associated with. Watching Rob and the teen volunteers make meals filled with life and love is one of the most inspiring actions I have ever seen. Thank you Ceres for all that you do.

Over $10,000 • Oliver's Markets • O'Reilly Media • Premier Organics / Artisana Organic Foods • Work Horse Organic Agriculture Farm (WHOA) • **$5,000 - $9,999** • Gourmet Mushrooms • Hanna Boys Center • Redwood Hill Farm & Creamery, Inc. • Ron Treleven & Bill MacElroy • **$2,500-$4,999** • Center for Social & Environmental Stewardship • Jeremy Olsan • Laguna Farm • Whole Foods Market Sebastopol • **$1,000-$2,499** • Nathan Riebli • Howard Blake • Wind Gap Winery • Perry, Johnson, Anderson, Miller & Moskowitz, LLP • Sonoma Design, Apparel & Promotions, Inc. • First Light Farm • Central Valley Builders Supply • The Taste of Tea (Chado-En LLC) • Barbara Hom/Night Owl Catering • Hafner Vineyard • Lagunitas Brewing Company • Russell Sutter • **$1 - $999** • 6th Street Playhouse • Aja DeWolf-Moura • Aletha Soule/Soule Studio • Alida Morzenti • Alive & Healing Temple • Alvarado Street Bakery • Amanda Lane • American Aviation Flight School • American Philharmonic Sonoma County • Anderson, Zeigler, Disharoon, Gallagher & Gray Law Firm • Andy's Produce Market • Anita Bene • Ann Tamminen, LAc • Apple Sauced Cider • Arlyne Charlys • Arnot-Roberts Winery • Arrowood Vineyards • Asante Farms • Baci Cafe & Wine Bar • Backyard Restaurant • Balls & Skeins • Barbara Friedman/Cottage Massage • Bella Ridge Farms • Bella Rosa Coffee Company • Bellwether Farms • Benziger Family Winery • Bill Prange, LAc • Biologique Farm • Bistro 29 • Bistro des Copains • Bloomfield Farms • Blue Whale House/Hilary McCalla • Bob Amiral • Bodega Bay Lodge & Spa • Boonville Hotel • Brad Parker • Brasserie Restaurant at Hyatt Vineyard Creek • Brendan Buss • Brittany Bijan • Buddah Salt Company • Bull Dog Electric • California School of Herbal Studies • Caren Franci • Cathy Kielsmeier • Cecelia Mitchell • Chalk Hill Estate Vineyards & Winery • Chelsea Dicksion • Cherie Lippard • Cheryl Thomas • Christa Gallo • Churchill Cellars • Claypool Cellars • Coneko Industries • Copain Wines • Coturri Winery • Cultivate Home • Darryl Vance • David Mallie • DeLoach Vineyards • Demuth Kemos • Diana De Luca • Donna Connell • Dutton-Goldfield Winery • Eight Cuisine & Wine Bar • Ellie Dwight • EMTU Estate Wines • FEED Sonoma • Ferrari-Carano Winery • Fischer Group • Flavor Bistro • Fop Doodle Farm • Forestville Pharmacy • Fork Catering • Fort Ross Vineyard & Winery • Fountaingrove Golf & Athletic Club • Frame of Mind • Fred Jarvis • Freestone Artisan Cheese • French Garden Restaurant & Bistro Bar • Frizelle-Enos Co • G.B. Vineyards • Gabriel Farms • Galen's Way • Georgetta Lada • Global Student Embassy • Gloria Ferrer Caves & Vineyards • Good Earth Natural Foods • Green Gage Farm • Green Mary Zero Waste Events • Greens Restaurant • Gregg Crawford/The Gopher Guy • Gretchen Chertov • Grindstone Bakery • GrowKitchen/Jeffrey Westman • Guayaki Yerba Mate • Gypsy Cafe • Hawley Winery • Healthy Belly Veggies • Himalayan Tandoori & Curry House • Hirsch Vineyards • Howard Station Café • Indigenous Designs • Indigo Moon Farm • Inn at Occidental • Iron Horse Vineyards • Ivan Redus • Jackson's Bar and Oven • James A. Spicer • Jan Turrini • Jazelle Lieske • Jennie Rose • Jennifer Cobb & Stephen Eisenberg • Jenny Malicki • Jette Franks • Jim Bray • Jim Dolinsek • Jim Glenn • Jim Sullivan • Jody Snyder & Noel Littlejohn • John Ash • John Ash & Company Restaurant • John Paul Norris • Joseph Dean • Julie Finn • K & L Bistro • Karol Kopley • Kathy Hogencamp • KAZ Vineyard & Winery • Keith Giusto Bakery Supply • Ken & Sharon Maiolini • Kindred Fair Trade Handcrafts • Korbel Winery • Kosta Browne Winery • Kutch Wines • La Tortilla Factory • Larry Wagner • Leslie Curchack • Lin Block • Links at Bodega Harbour & Bluewater Bistro • Littorai Winery • Lorrine Musante • Luanne Buchanan • Lynmar Estate • Marcella Friel • Maria Rowell • Marilyn Sommer • Matanzas Creek Winery • Matt Camgros • Max Bridges • Meadow Song Farm • Michael Poley • Michelle Bledsoe-Agost • Michel-Schlumberger Wine Estate • Montecito Heights Health & Racquet Club • Monti's Rotisserie • Moshin Vineyards • Nightingale Breads • North Bay Curds & Whey • Oak Hill Farm • Oaks of Olivet • Osmosis Day Spa Sanctuary • Osprey San Pedrito • Out Post Wines • Padi Selwyn • Pam Davis • Patisserie Angelica • Patricia Stone • Patrick Amiot & Brigitte Laurent • Patrick Hamilton • Patrick Laherty • Paul Lamb • Paul Larkin • Paul Molinari • Paul's Produce • Petaluma Poultry • Peter Lowell's Restaurant • Peters' Chocolates • Phil Persons • Point Reyes Farmstead Cheese Company • Portalupi Wines • Preservation Foods/Wildbrine • Preston Vineyards & Winery • Quetzal Farms • Rack & Riddle Winery • Radio Coteau • Rafter Ranch • Ralph Harmon • Red Horse Pizza • Redwood Credit Union • Regina Silvers • Relic Wine Cellars • Relish Culinary Adventures • Revive Kombucha • Rialto Cinemas • Richard Nowlin • Rocker Oysterfeller's Restaurant • Rodney Strong Vineyards • Ron Bartholomew • Rosemarie Barnwell • Rosemary's Garden • Rosso Pizzeria & Wine Bar • Salmon Creek Ranch • San Francisco Giants • SEA Thai Bistro • Sebastopol Center for the Arts / Sebastopol Documentary Film Festival • Sebastopol Hardware • Seonaid Alma • Shauna Harbarth • Shawna Wolf • Sign of the Bear, Inc. • Silk Road Teas • Slice of Life • Sonoma Compost Company • Sonoma County Poultry • Sonoma Valley Gleaners • Soule Studio • Stacey Smith & Roger Solin • Stark Restaurant Group • Stemple Creek Ranch • Steph Mashek • Steve Whiteman • Straus Family Creamery • Sue Laliberte • Sue Sawtelle • SumBody • Summer Repertory Theatre • Susan Scheskie • Sushi Tozai • Suzanne Griffin • Taylor Maid Farms • Terrapin Creek Cafe • Tessaerae • The Kefiry • The Spa at Montecito • The Spinster Sisters • Thomas Judt • Three Squares Cafe • Thrive Yoga • Tierra Vegetables • Unconventional Moves • Underwood Bar & Bistro • Village Bakery • Vintners Inn • Wells Fargo Center for the Arts • Wendy Cole • Wendy Strawbridge • Western Farm Center • Whimsy & Tea • Whole Foods Market San Rafael • Wildfour Bread • William Gordon Wines • Willie Bird Turkeys • Willow Wood Market & Cafe • Windsor Oaks Vineyards & Winery • Windsor Vineyards • Wine Country Bikes • Wine Country Party & Events • Woodenhead • ZD Wines • Ziggy The Wine Gal • Zin Restaurant & Wine Bar

Where Does The Money Come From?
TOTAL $1,451,780



Where Does The Money Go?
TOTAL $1,286,151



Leveraging Cash Donations
TOTAL $2,156,973

See Ceres Federal Tax Forms at
www.CeresProject.org/FedTaxForms.html

Growth In Meal Volume
TOTAL MEALS 223,245

Growth In Organizational Revenues

Why Ceres?

4,530,745 More Servings of Fruits and Vegetables

According to our surveys, the clients and teen volunteers who participated in Ceres' programs in 2013 will consume 4,530,745 additional servings of fruits and vegetables over the next 10 years thanks to what they learned during their time with us.

Ceres Foods are the Answer

According to the Harvard School of Public Health, "The same healthful food choices and diet patterns that help prevent heart disease, diabetes, and other chronic conditions may also help to prevent weight gain." They recommend the very same foods that we prepare for our clients —whole grains, vegetables, fruits, nuts, healthful sources of protein (fish, poultry, beans), and plant oils.

Small Changes Can Make a Very Big Difference

If all Californians reduced our body mass index by just 5% (10 pounds for a 200 pound person) Robert Wood Johnson Foundation estimates we could prevent 796,000 cases of type 2 diabetes, 657,000 cases of heart disease and stroke, and 53,000 cases of cancer in California over the next 10 years – and save $87 billion dollars in health care costs.

Cooking Keeps You Healthy

According to the journal *Public Health Nutrition*, seniors who cooked five times a week or more were 47% more likely to be alive ten years later. Lead author Professor Mark Wahlqvist summed up the study findings by saying, "The pathways to health that food provides are not limited to its nutrients or components, but extend to each step in the food chain, from its production, to purchase, preparation and eating, especially with others."

Being Engaged in Meaningful Ways is Healing

According to Chris Crowley and Henry S. Loge, MD, "Hundreds of research studies confirm that . . . connection heals us through the same physical mechanisms as exercise and healthy diet. Blood vessels are measurably more elastic, the heart's ability to respond to extraordinary demands is higher, cardiac inflammatory protein levels are lower, and blood pressure response to exercise is better in more connected people. Their stress-hormone blood profiles are also measurably healthier than those of isolated people." [From the book *Why Love Heals*]

On the cover is Ceres' first Teen Garden Leader Maria Walker working in the Ceres Community Garden, the 2013 source of thousands of pounds of teen-grown organic produce to nourish our clients' bodies, and 1,456 bouquets of flowers to brighten their spirits.

BEST OF THE NORTH BAY 2014 BOHEMIAN.COM

Voted Best Sonoma County Nonprofit 2012-2013-2014

HEALING • FOOD • YOUTH • COMMUNITY

Ceres COMMUNITY PROJECT

serving Sonoma & Marin counties

7351 Bodega Avenue
Sebastopol CA 95472

707·829·5833
www.CeresProject.org
info@ceresproject.org

Printing sponsored by UPrinting.com

Printed on FSC certified recycled paper with soy inks

This Annual Report was produced in-house with the help of staff and volunteers.
Editors: Cathryn Couch & Deborah Ramelli • Design & Photography: Kim Stuffelbeam

About Your Meals

Dear Client,

We are honored to provide these nutritious meals to you and we hope you'll enjoy them. We have you in mind when we prepare this food, and send our love and healing wishes along with the meals. We hope you feel supported by the many hands that create your meal and make Ceres possible.

With love and blessings, *~ teen and adult chefs, volunteers, staff and board at Ceres ~*

Ceres COMMUNITY PROJECT

HEALING · FOOD · COMMUNITY · YOUTH

If You Wish to Enhance our Flavors:

Our food is carefully thought out, taking into consideration flavor, nutrition and foods that are in season locally. We acknowledge that our clients have different tastes and so we tend to keep salt and spices at a minimum to accomodate all preferences.

Each week, you might find dishes that are prepared simply, without sauces or strong flavors. Feel free to add spices that suit your tastebuds. If you are inclined to do so when re-heating these dishes, here are a few tips on how to enhance their flavor while maintaining the food's health-supporting qualities:

~ Remember to taste the dish first before adding these ~

- Top dish with the *Ceres' Nettle and Seaweed Spice Blend* for more flavor and healthful benefits *(ask your liaison about ordering this)*

- Sprinkle with some garlic and/or onion powder instead of salt

- Use unrefined sea salt (in moderation), as it contains more healthy minerals than table salt

- Sprinkle with nutritional yeast after re-heating for a nutrient-packed, "cheesy" flavor

- Drizzle some extra virgin olive oil over veggies after re-heating

Re-Heating Your Ceres Food

Soups and stews can be reheated in a small saucepan on the stove.

Grain pilafs, ragouts, side veggies and pasta dishes can also be reheated in a small covered skillet on the stove. Add 2-4 tablespoons of water – enough to prevent the dish from sticking – and warm gently over low heat just until the food is heated through, stirring as necessary.

Chicken and fish dishes and other entrees are best reheated in the oven. Transfer food to a small baking dish, cover with an oven-safe lid (or foil) and heat at 300° F until food is hot and steaming. Heating slowly at a low temperature will keep it from drying out.

Note: If you do reheat the food in a microwave, be sure to transfer it to a glass or ceramic dish. Reheating in plastic can release dangerous toxins.

From the Ceres Garden

We have beets, carrots, parsley, broccoli, arugula, cabbage and kale in the ground, and these vegetables will be around for another couple of months.

However, the frost has taken its toll on the Ceres garden and we are not able to harvest as much as we had hoped for at this time.

Nutrition Information

Orange Vegetables Offer Protection

Antioxidants are compounds that may prevent or delay cell damage, and orange vegetables are rich in carotenoids, which are antioxidants that have been studied for their ability to prevent chronic disease.

According to the American Institute for Cancer Research, foods high in carotenoids protect against cancers of the mouth, pharynx, larynx and lung. Two reviews of their research that looked at blood levels now point to the possibility that carrots, winter squashes, sweet potatoes, tomatoes and the many other colorful fruits and vegetables high in carotenoids may also reduce women's risk of breast cancer.

Featured Vegetable

Winter Squash

- ✓ Anti-inflammatory
- ✓ Boosts cardiovascular health
- ✓ Anti-diabetic and insulin-regulating properties
- ✓ Anti-cancer properties (phytochemicals)
- ✓ Promotes wound repair (Vitamin C)
- ✓ Neutralizes free radicals (manganese)
- ✓ Improves night vision (Vitamin A)
- ✓ High in fiber

This Week's Recipe

Stuffed Delicata Squash

3 delicata squashes
3 teaspoons olive oil
2 bunches chard
1/4 cup diced onion
1 teaspoon garlic clove, minced
1/2 lb mushrooms coarsely chopped
2 cups cooked brown rice
2 teaspoons sea salt
1/2 teaspoon finely ground pepper
3 Tbs grated Parmesan
1/2 cup finely chopped flat-leaf parsley

Makes 6 servings

1 Preheat oven to 350. Cut squash in half; scoop out seeds. Drizzle with olive oil and sprinkle with salt and pepper. Place face down on parchment paper lined sheet pans, and bake for 20-25 minutes, until squash is tender

2 Stem, blanch, squeeze and finely chop chard.

3 On medium low heat in a Saute pan, heat oil. Saute the onions until soft. Add mushrooms and saute until mushrooms release their liquid and liquid evaporates, about 10 minutes.

4 Combine rice, chard, mushrooms, and salt & Pepper and spoon into squash cavities,

5 Garnish with Parmesan and parsley.

Good source of vitamins A, C, B2, B3, and Folate. Notable minerals: Zinc, Iron, Magnesium, Phosphorous
Nutritional Info per serving: 183 cals | Protein 6.3 g | Fat 3.8 g | Carbs 32.7 g | Sugar 7.2 g | Fiber 4.3 g
Recipe Source: Holidays on the Net http://www.holidays.net/christmas/recipes.html

Nutrition Bites

We are talking about Kale again!

One cup of chopped kale has 134% of your recommended daily intake of v itamin C, while a medium orange fruit has 113%of the daily C requirement. Here is the catch: a cup of kale weighs just 67 grams, while a medium orange weighs 131 grams, which means that, gram for gram, kale has more than twice the vitamin C as an orange.

Kale's phytonutrients - which help combat inflammation, fight cancer, and prevent arterial plaque formation - are rendered more effective when eaten in combination with other foods, especially healthy fats like avocado, olive oil or even parmesan cheese, because these fats help us absorb the fat-soluble nutrients. Acid from lemon juice helps make kale's iron more bioavailable as well.

According to the Environmental Working Group, kale is one of the most likely crops to have residual pesticides. The EWG recommends choosing organic kale (or growing it yourself!). If you are using non-organic kale, wash it very well. Kale from Ceres is always organic!

Featured Vegetable

Kale (The most nutrient-rich leafy green vegetable)

- ✓ Anti-inflammatory
- ✓ Anti- cancer properties (phytochemicals)
- ✓ Enhances immune function (carotenes)
- ✓ Promotes wound repair (Vitamin C)
- ✓ Reduces free radicals (manganese)
- ✓ Reduces cataract risks (Vitamin C and carotenoids)
- ✓ Promotes GI health (fiber)

Source:
Huffington Post < http://www.huffingtonpost.com/2013/07/30/kale-facts-nutrition-info_n_3671210.html>
Murray, Michael, ND. *The Encyclopedia of Healing Foods*. Atria Books, 2005.

This Week's Recipe

Tuscan Kale Salad with Garlic & Lemon

6 cups kale, stemmed & cut into thin ribbons

1/3 cup course fresh breadcrumbs (we use organic sourdough or gluten-free bread)

1 sm garlic clove, minced

1/3 cup parmesan cheese

1/4 cup olive oil

1 Tbs lemon juice

1/3 tsp sea salt

pepper to taste

Makes 4 servings | Preparation time: 20 mins

1 Place kale in a large bowl.

2 Combine garlic, 1/2 of the cheese, olive oil, lemon juice, salt, and pepper and whisk until it is creamy,

3 Pour the dressing over the kale and toss well.

4 Garnish with breadcrumbs, additional cheese, and a drizzle of olive oil.

Source: Ceres Nourishing Connections Cookbook

Did you know that Whole Foods Market in Sebastopol sells this prepared dish? A portion of the sales benefits Ceres!

About Your Meals

Dear Ceres Client,

We are honored to provide these nutritious meals to you and we hope you'll enjoy them. We have you in mind when we prepare this food, and send our love and healing wishes along with the meals. We hope you feel supported by the many hands that create your meal and make Ceres possible.

With love and blessings, ~ teen and adult chefs, volunteers, staff and board at Ceres ~

Ceres COMMUNITY PROJECT

If You Wish to Enhance our Flavors:

Our food is carefully thought out, taking into consideration flavor, nutrition and foods that are in season locally. We acknowledge that our clients have different tastes and so we tend to keep salt and spices at a minimum to accomodate all preferences.

Each week, you might find dishes that are prepared simply, without sauces or strong flavors. Feel free to add spices that suit your tastebuds. If you are inclined to do so when re-heating these dishes, here are a few tips on how to enhance their flavor while maintaining the food's health-supporting qualities:

~ Remember to taste the dish first before adding these ~

- Top dish with the *Ceres' Nettle and Seaweed Spice Blend* for more flavor and healthful benefits *(ask your liaison about ordering this)*

- Sprinkle with some garlic and/or onion powder instead of salt

- Use unrefined sea salt (in moderation), as it contains more healthy minerals than table salt

- Sprinkle with nutritional yeast after re-heating for a nutrient-packed, "cheesy" flavor

- Drizzle some extra virgin olive oil over veggies after re-heating

Re-Heating Your Ceres Food

Soups and stews can be reheated in a small saucepan on the stove.

Grain pilafs, ragouts, side veggies and pasta dishes can also be reheated in a small covered skillet on the stove. Add 2-4 tablespoons of water – enough to prevent the dish from sticking – and warm gently over low heat just until the food is heated through, stirring as necessary.

Chicken and fish dishes and other entrees are best reheated in the oven. Transfer food to a small baking dish, cover with an oven-safe lid (or foil) and heat at 300° F until food is hot and steaming. Heating slowly at a low temperature will keep it from drying out.

Note: If you do reheat the food in a microwave, be sure to transfer it to a glass or ceramic dish. Reheating in plastic can release dangerous toxins.

Healing Foods Basics in Spanish

Ceres will be offering a **Healing Foods Basics** class in Spanish on Thursday, June 26th, from 6 to 8 pm.

More information: www.CeresProject.org/HFB

Ceres estara ofreciendo una clase de **Informaciones Basicas de los Alimentos Curativos** en Jueves, 26 de Junio, de 18 a 20 horas.

Para inscribirse: www.CeresProject.org/HFB

Please tell your friends! Por favor, dile a tus amigos!

Ceres Community Project
7351 Bodega Ave, Sebastopol, CA 95472
707.829.5833 x. 126

Attachment 1

Figure 1. Field trials used sentinel navel orangeworm eggs, laid on paper sheets (A) in the insectary and then attached to a standard egg trap baited with almond nuts (B). Sentinel navel orangeworm larvae were created by inoculating almond nuts, rearing the larvae to the 3rd instar in the laboratory, and then attaching the nut to a tree limb, enclosed in a wire mesh (C).

Table 1. Chemicals tested for impacts upon arthropod population dynamics in the almond system.

Common Names	Class	Trade name	Formula	Field Rates	Target pests	Chemical Company
Abamectin	Avermectin	Agrimek	0.15EC	10-20 oz/acre	Mites	Syngenta
Spirodiclofen	Keto-Enol	Envidor	2SC	16-34 oz/acre	Mites, San Jose Scale	Bayer
Hexythiazox	Carboxamide	Onager	EC	12-24 oz/acre	Mites	Gowan
Etoxazole	unclassified	Zeal	WP	.09-.135 lb ai/acre	Mites	Valent
Bifenthrin	Pyrethroid	Brigade	WSB	.05 to .2 lb ai/acre	Aphids, Bugs, Phylloxera, worms	FMC
415 Oil	Mineral Oil	415 Supreme Spray Oil	Oil	4-6 Gallon/acre	-	Britz

Best Management Practices for Bedding and Container Color Plant Production in California

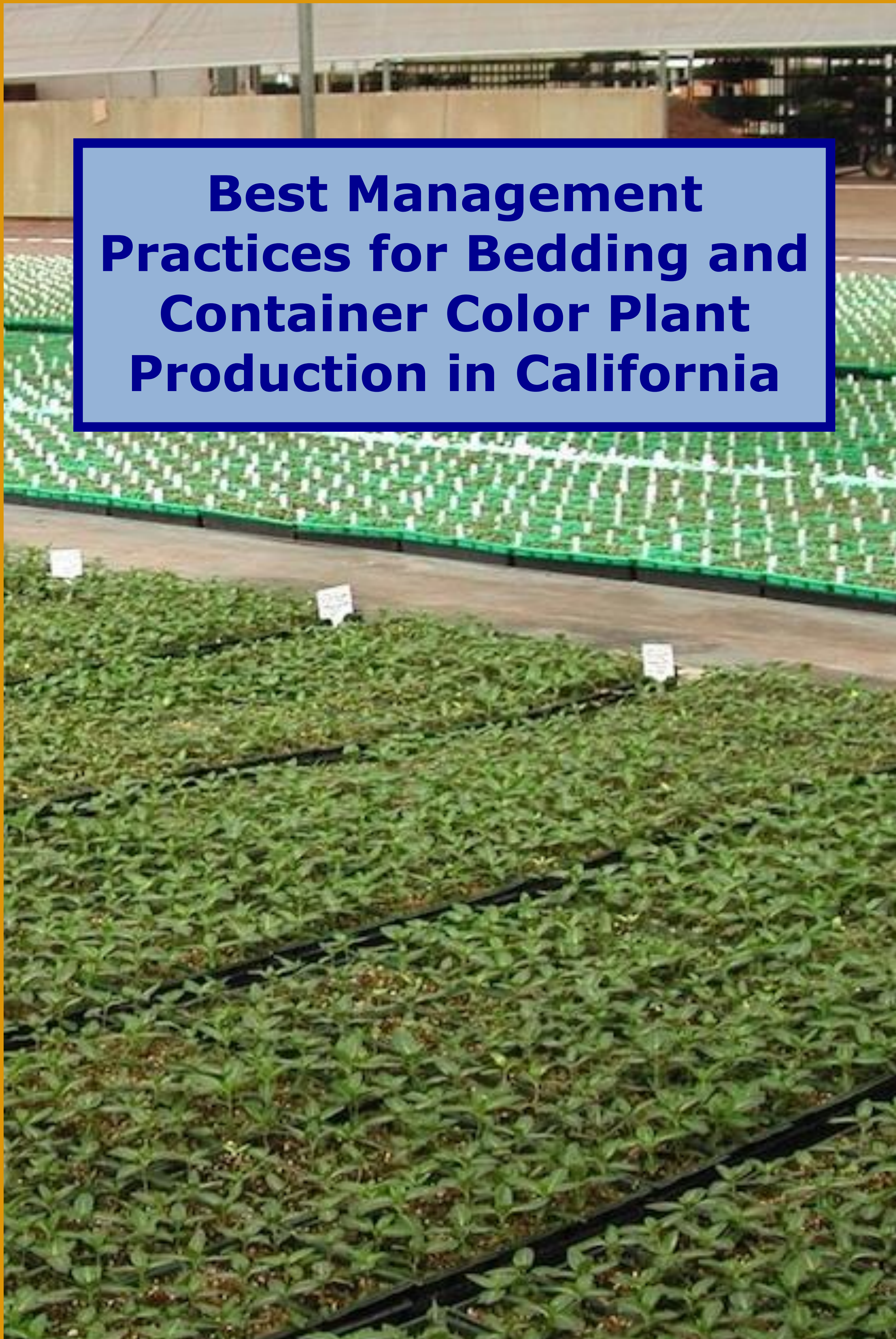


Table of Contents

Acknowledgements	3
Introduction	4
Current Integrated Pest Management Practices in California Bedding and Container Color Plant Production	5
Best Management Practices for Disease Prevention	16
Best Management Practices For Insect And Mite Prevention	19
Impact of Common Bedding And Container Color Plant Production Practices on Pest Management	21
Developing an Effective Insect, Mite, and Disease Monitoring Program for Bedding and Container Color Plants	25
Resources	34
Management Rotations for Integrated Pest Management of Bedding and Container Color Plant Insect and Mite Pests	35

Acknowledgements

The preparation of this document was funded by the California Department of Agriculture Specialty Crops Grant Program. We gratefully acknowledge this support.

We would also like to thank Altman Plants, Vista, CA; Ball Tagawa Growers, Arroyo Grande, CA; Cal Color Growers, Morgan Hill, CA; and the Center for Applied Horticultural Research, Vista, CA for allowing demonstrations at their facilities that tested many of the ideas outlined in this guide.

Christine Casey, editor
January 2014

Introduction

This guide is the result of a bedding and container color plant integrated pest management (IPM) demonstration conducted in California greenhouses between 2011 and 2013. Our goal is to provide a resource for bedding and container color producers who wish to develop their own best management practices approach to IPM. It is intended to serve as a general reference, so rather than provide extensive information on pest biology we refer the reader to other resources where this information can be found in greater detail. Whenever possible, specific pests or problems are linked to more detailed University of California IPM program resources.

While all chapters pertain to best management practices and IPM, they are written so they may be used independently of each other. This manual assumes a basic familiarity with ornamental plant production and pest management. A glossary is included for terms that may be unfamiliar to the reader.

Current Integrated Pest Management Practices in California
Bedding and Container Color Plant Production

Christine Casey, Department of Entomology and Nematology, University of California, Davis
Ann Chase, Chase Agricultural Consulting, Cottonwood, AZ

Bedding and potted color plants are produced for use in the outdoor landscape (bedding plants) and for interior decoration (potted color). This commodity group encompasses about one hundred plant species and several hundred varieties. Not every grower produces the same plant mix, although there are some plant species common to every grower. Some of the same species of plants may be produced for either bedding plants and potted color, while others are grown solely for indoor or outdoor use. The common arthropod, disease, and weed pests occur on all plant species grown. In California, production of these plants is rapid; an eight to ten week crop cycle is typical. Most growers make their profits from rapid turnover of large numbers of plants, which results in low tolerance for pest injury and limited options for biological control.

Insect/Mite Control:

There are several key arthropod pests that affect bedding and potted color plants. They are described below in order of severity.

Western flower thrips (*Frankliniella occidentalis*)

The western flower thrips is a small (1/16 inch), highly mobile, polyphagous insect. Thrips can blow into greenhouses through vents and doorways, be imported on clothing or infested plants and cuttings, or be maintained year-round on weeds. Thrips damage usually appears as scarred, stunted, or distorted foliage or flowers, or as white areas on leaves or petals. Black fecal material may be visible on damaged tissue. Thrips often feed inside developing buds so that injury is not seen until the flower opens, at which point the plant may be too damaged for sale. Thrips are vectors of the tospoviruses - impatiens necrotic spot virus (INSV) and tomato spotted wilt virus (TSWV).

Thrips can be expected on every bedding plant crop at numbers high enough to cause plant loss, although thrips pressure is lower in spring and fall. They will be found on every plant unless control measures are taken. If INSV or TSWV is present the entire crop may be lost.

Monitoring programs for thrips include the use of sticky cards (either yellow or blue) and direct plant inspection. Sticky cards can be used to track population changes to initiate controls in advance of plant injury. An action threshold of 10 thrips/card/week was validated in greenhouse cut roses by the Rose Pest Management Alliance.

Pesticide rotation is essential, as thrips have developed resistance in the past. Recommended active ingredients include spinosad, novaluron, avermectin, neem, and some of the neonicotinoid insecticides. Many growers also still use carbamate (mesurol), organophosphate (acephate), and pyrethroid (fenpropathrin) insecticides despite the availability of effective reduced risk pesticides. Most applications are made with a

hydraulic sprayer, although some growers use specialized application equipment that creates a pesticide fog of much smaller droplet sizes (fogger: 30-60μ vs. hydraulic: 100-400μ).
Greenhouse weeds are hosts of both thrips and tospovirus and can have a significant impact on thrips and virus levels if not controlled. Growers also often leave old, unsold flowering plants in the greenhouse and removing these also helps to control thrips. Replacing soil greenhouse floors with concrete can substantially reduce thrips levels because thrips pupate in the soil, but for most growers this is cost-prohibitive.

There is evidence that use of a potassium silicate fertilizer can make plants more resistant to thrips feeding, but this has yet to be tested widely in commercial production. We propose to incorporate this into our integrated pest management program.

Biological control includes the biopesticide BotaniGard (*Beauveria bassiana*), which is most effective during fall and spring when thrips reproduction is slower and there is little migration into the greenhouse. The soil-dwelling predatory mite, *Hypoaspis miles*, is easily released and can provide long-term control when applied to greenhouse soil floors. This product is incompatible with many fungicides. Effectiveness of the predatory mite *Neoseiulus cucumeris* used in combination with spinosad has been demonstrated in Massachusetts bedding plant production, but it is not widely used in California. The predatory mite Amblyseius swirskii,an effective predator of thrips and whiteflies is gaining wider use in the state. The predatory bug *Orius insidiosus* is also available for thrips biological control, but winter diapause can limit its use and this natural enemy is rarely released into California greenhouses.

Twospotted spider mites (*Tetranychus urticae*)

The twospotted spider mite is a small (1/16 inch) highly mobile, polyphagous arthropod pest. These mites can blow in from outside a greenhouse or move from older infested material to clean plants. They are also easily spread by workers. They will feed on most bedding and potted color plants. Mites create white stippled areas on foliage as they feed and also leave unsightly webbing on plants.

Mites can be expected on every bedding plant crop at numbers high enough to warrant control, and presence of mites in the crop can only be determined by plant inspection. A presence-absence sampling plan based on an action threshold of five mobile mites per leaf was validated by the Rose Pest Management Alliance, and a presence-absence sampling plan has also been validated in the bedding plant impatiens (*Impatiens wallerani*). Because there are a number of effective miticides available, most growers simply start a control program once any mite activity is observed. Applications every ten to fourteen days using a hydraulic sprayer are typical. Rotation of pesticides is essential, as mites have developed resistance in the past. Recommended pesticides include abamectin, bifenazate, acequinocyl, fenpyroximate, spiromesifen, chlorfenapyr, horticultural oil, neem products, and the mite growth inhibitors hexythiazox and clofentazine.

A study in Kansas demonstrated that the predatory mite, *Phytoseiulus persimilis*, was as effective as the pesticide bifenazate at controlling spider mites in impatiens.

Whiteflies -- silverleaf whitefly, greenhouse whitefly (*Bemisia argentifolii*, *Trialeurodes vaporariorum*)

Two species of whitefly may infest vegetative annuals: the silverleaf whitefly and the greenhouse whitefly. Both are small (1/8 inch), highly mobile, polyphagous insects. Whiteflies can blow into greenhouses through vents and doorways, be imported on clothing or infested plants and cuttings, or be maintained year-round on weeds. The presence of whiteflies can be objectionable, and heavy infestations can affect plant vigor. Sooty mold can grow on the honeydew they excrete.

Whiteflies can be expected on every bedding plant crop at numbers high enough to cause plant loss. Monitoring programs rely on yellow sticky cards to monitor adults and visual plant inspection for the immatures. These stages are readily identified on plants but the adults are more difficult to distinguish on sticky cards. Some growers will begin whitefly management as soon as insects are seen on sticky cards or plants, while others will wait until they see five to ten adults per card per week. Recommended pesticides include the neonicotinoids, the selective feeding blockers pymetrozine and flonicamid, the insect growth regulator pyriproxifen, horticultural oil, and insecticidal soap. Depending on the formulation used these are applied as a granule to the pot, a soil drench, or to the foliage with a hydraulic sprayer.

Development of biological control methods for greenhouse whitefly and silverleaf whitefly has been the subject of a great deal of research; the result has been the commercialization of several predators, parasitoids, and pathogens. This work was concentrated in poinsettias, and other than the biopesticide *Beauveria bassiana* , whitefly natural enemies are not commonly used in bedding plants. However (as noted above under WFT), the predatory mite *A. swirskii* has the potential to control whiteflies in bedding plants.

Green peach aphid and melon/cotton aphid (*Myzus persicae*, *Aphis gossypii*)

Two common species of aphids in greenhouses are the green peach aphid and the melon/cotton aphid. Both are light green , while green peach aphid may also appear as red or pink color forms. Other aphids occasionally found in greenhouses include the chrysanthemum aphid, the cabbage aphid, the foxglove aphid, and the tulip bulb aphid. Aphids can blow into greenhouses through vents and doorways, be imported on clothing or infested plants and cuttings, or be maintained year-round on weeds. Aphids give birth to live young, so rapid population increase is possible. Infested plants have individuals or colonies, cast skins of molted aphids, honeydew, and sooty mold on plant leaves, and distorted or stunted new growth. Aphids also vector cucumber mosaic virus (CMV), alfalfa mosaic virus (AMV), and potato virus Y (PVY), all of which affect bedding plants.

Aphids can be expected on every bedding plant crop at numbers high enough to cause plant loss, although it would be unusual for the entire crop to be lost. They will be found on every plant unless control measures are taken. If CMV, AMV, or PVY is present additional plant loss will occur.

Monitoring for aphids relies on direct plant inspection, as the winged form is generally only seen on sticky cards once populations are high enough for plant damage to have occurred.

Pesticides are used for aphid control because their populations can increase so quickly. Recommended pesticides include the selective feeding blockers pymetrozine and flonicamid, neonicotinoids, abamectin, neem, insecticidal soap, and horticultural oil. Many growers also use pyrethroids (cyfluthrin, fenpropathrin, and pyrethrum). Depending on the formulation used these are applied as a granule to the pot, or to the foliage with a hydraulic sprayer.

Weeds in and around the greenhouse can be an important source of aphids and the viruses they vector.

Several biological control agents are commercially available but are often not used because of the perception that they work too slowly. One exception is the banker plant system. Rye plants (*Secale cereale*) are grown in pots on the greenhouse bench to provide habitat for a grass-specific aphid (corn leaf aphid; *Rhopalosiphum maidis*) that will not infest the bedding plant crop. These corn leaf aphids are infested with the aphid parasitoid *Aphidius colemani*, and since these plants remain in the greenhouse continuously, they provide a continual source of aphid parasitism on the bedding plant crop.

Dark-winged fungus gnats (*Bradysia* spp.)

Fungus gnats are pests in the larval stage, when they feed on young roots and cause delayed plant development, wilted foliage, leaf yellowing, and leaf drop. Both larvae and adults can also carry spores of root system pathogens and are thought to contribute to disease epidemics.

Fungus gnats can be expected to occur on every bedding plant crop, with higher numbers under cool, damp conditions. Control measures are typically needed one to three times per eight-week crop cycle. They can cause significant crop loss in propagation.

Fungus gnats are easily detected in bedding plants. Yellow sticky cards are attractive to the adults, which have a distinctive shape that is quickly recognized on the card. Larval activity in the soil can be monitored by inserting 1 in. sq. potato slices far enough into the soil surface to cover the cut edges; larvae are white with a dark head capsule are and will be observed feeding on these after two days. This technique will detect only a small number of the fungus gnat larvae actually present so is not useful for quantifying pest density. However, this technique can be used post-treatment to evaluate control action. Additionally, there are no published action thresholds for this insect, so most growers will initiate control when any fungus gnats are observed.

Chemical controls are targeted at the larvae and are applied to the soil as a drench. Recommended pesticides include chlorfenapyr, imidacloprid, and the insect growth regulators diflubenzuron, pyriproxifen, and cyromazine. These are applied as a drench to the soil. Avoiding excess water in the greenhouse will also help control fungus gnats. To knock down large adult populations, many growers will use an aerosol application of synergized pyrethrin.

Biological control is another good option but it is not widely used. The soil-dwelling predatory mite, *Hypoaspis miles*, is easily released and can provide long-term control when applied to greenhouse soil floors. The nematode *Steinernema feltiae* is also effective. The biopesticide Gnatrol (*Bacillus thuringiensis israelensis*) will give control with multiple applications.

Shore flies (*Scatella stagnalis)*

Adult shore flies spread root system pathogens within greenhouses, and large populations of shore flies leave quantities of unsightly dark fecal material on flowers, foliage, and plant labels. Shore flies can be expected to occur on every bedding plant crop, with higher numbers under cool, damp conditions. Control measures may or may not be needed.

Shore flies are easily detected in bedding plants. Yellow sticky cards are attractive to the adults, which have a distinctive wing pattern that is quickly recognized on the card. There are no published action thresholds for this insect; most growers will initiate control when large numbers of adult flies or flyspecks are seen on plants. Generally fungus gnats, which are controlled by the same pesticides that control shore flies, are seen first and thus shore flies are controlled by default.

Chemical controls are targeted at the larvae and are applied to the soil as a drench. Recommended pesticides are the insect growth regulators diflubenzuron, pyriproxifen, and cyromazine. Shore fly larvae feed on algae, and preventing algal growth in the greenhouse is an effective control option.

The rove beetle, *Atheta coriata*, is available for shore fly biological control but its use is not common.

Tarsonemid mites -- cyclamen mite, broad mite (*Stenotarsonemus pallidus*, *Polyphagotarsonemus latus*)

These yellowish-white mites are visible only under a microscope. They move into and around the greenhouse on plant material and greenhouse workers. These mites feed in the growing tips of the plants, causing stunting and distortion of new growth that is often mistaken for a plant disease. Both mites affect a number of bedding plant crops, although they do not occur regularly. Because their injury may be confused with plant disease they are often misdiagnosed and not properly treated, which can cause significant crop loss.

A regular monitoring program is difficult because a microscope is needed to see these mites, and they do not produce webbing. Once a grower has experienced a significant infestation they may institute a regular monitoring program that would include initiation of control as soon as symptoms are seen.

Chemical controls include abamectin, chlorfenapyr, and spiromesifen, all applied with a hydraulic sprayer. Some growers make prophylactic releases of the predatory mite, *Neoseiulus cucumeris,* on species or cultivars that have experienced regular damage.

Mealybugs -- longtailed mealybug, citrus mealybug, obscure mealybug (*Pseudococcus longispinus*, *Planococcus citri*, *Pseudococcus affinis*)

Mealybugs are soft-bodied insects, 1/8 to 1/4 inch long. Their bodies are covered with a white waxy secretion; egg masses are covered with a fluffy white material. A long tail is usually visible on the longtailed mealybug. All immature stages and adult females are mobile, although slow moving; only adult males have wings and fly to mate. The citrus and longtailed mealybugs are the most common species on bedding and potted color plants.

Mealybugs infest all above-ground parts of a plant, and the obscure mealybug will move up and down between roots and foliage. The white, cottony egg masses and bodies of the mealybugs are objectionable, and infested new growth is sometimes distorted. Mealybugs also leave deposits of honeydew, followed by the growth of sooty mold. Heavy infestations cause yellowing and leaf drop. They are a sporadic pest in bedding plants, but are more likely to occur if the grower is also producing a cut flower crop that is a mealybug host. If control is needed, applications are usually made weekly because this insect is difficult to kill with currently available pesticides.

Monitoring consists of visual plant inspection, and growers will treat when the first mealybug is observed. Recommended pesticides include the neonicotinoids and insect growth regulators (kinoprene and pyriproxifen). The pyrethroid bifenthrin is also often used. These are applied with a hydraulic sprayer.

Natural enemies have been sold commercially in the past, but are currently not consistently available.

Caterpillars (many species)

Many species of caterpillars may occur as occasional pests in bedding and potted color plant production. These include loopers, armyworms, cutworms, leaftiers, and leafrollers. Loopers are generally the most common. These insects enter on infested plant material or as adult butterflies or moths (adults of some species are attracted to the lights in the greenhouse). The larvae are small (1/8-inch) when they first hatch, so plants need to be inspected carefully for their presence. Color will be green, brown, black, or reddish-brown depending on species. Pheromone traps are available for the adults of some species but they are rarely used.

Damage may render plants unsalable if not detected early. Types of injury include leaf eating; feeding on growing points or buds, causing excessive branching; webbing, tying, or rolling together of leaves; and plants cut off at the base. Recommended pesticides are spinosad, chlorfenapyr, or novaluron. These are applied with a hydraulic sprayer.

The biopesticide *Bacillus thuringiensis kurstaki* is most effective when small larvae are actively feeding, so it is best used when there is a monitoring program in place.

Plant Pathogens and Disease Control:

There are several plant pathogens that affect bedding and potted color plants. Because of the high risk for crop loss and the lack of any system for early detection, these are all controlled largely with prophylactic fungicide or bactericide applications. Control of root and foliar pathogens represents the largest use of pesticides in this crop. Common diseases are listed in order of severity.

Root and stem rots (*Pythium* spp., *Rhizoctonia solani*; *Botrytis cinerea; Thielaviopsis basicola*)

Root and stem rot pathogens are the most serious disease problem in bedding and potted color plant production. In propagation these pathogens cause root decay and seedling loss; in older plants they cause both root and stem disease. Infected plants are not salable and epidemics can cause 50% or more crop loss.

These pathogens enter the greenhouse on infected seedlings, or via recycled soil or water that has not been properly sterilized. Even current sterilization treatments are not completely effective at eliminating these pathogens. They are likely to occur in every bedding plant crop and growers routinely apply prophylactic fungicide applications in expectation of this.

Infected plants will appear stunted and wilted despite adequate water. The roots will have dark, rotted areas and the outer layer of tissue will slough off easily. Affected stems will have dark cankers; the mycelium of *R. solani* will appear as webbing in the plant canopy if that pathogen is present.

Currently used fungicides include triflumizole, fludioxonil, thiophanate-methyl, iprodione, and the strobulurins. The last three are classified as high risk for resistance development by the Fungicide Resistance Action Committee. Applications are made every seven to fourteen days as a soil drench.

Proper water management and greenhouse sanitation practices, such as keeping hose nozzles off the floor, can reduce the need for fungicide applications against these diseases but do not eliminate the need for fungicides. Likewise, maintaining correct pH and soluble salts levels in the growing media help reduce, but do not eliminate, fungicide use. Fungus gnats and shore flies can spread spores between plants and should be controlled also.

Two promising alternatives for control of these pathogens are chlorine dioxide used as an irrigation disinfectant and enhanced microbial products that introduce fungi antagonistic to the plant pathogens into the soil. Neither of these has been widely tested in commercial production. We propose to incorporate evaluations of these products into our integrated pest management program.

RootShield is a commercially available fungicide that contains a fungal antagonist to *Pythium* spp.and *Rhizoctonia.solani*. It can be incorporated into the soil prior to planting or applied as a drench after planting, but is most effective when used prophylactically.

Botrytis leaf and flower blight (*Botrytis cinerea*)

Botrytis leaf and flower blight caused by the pathogen *Botrytis cinerea* is another serious plant disease in bedding and potted color plants. The disease appears as dieback and stem cankers accompanied by a grey mold. Botrytis is unusual in that even healthy plant tissue can be infected. Some growers will pull off damaged leaves to make damaged plants salable, but this may do more harm in the long run, as research in Michigan has also shown periods of high *B. cinerea* spore release associated with worker activity in the greenhouse.

B. cinerea spores are ubiquitous in the greenhouse environment, so some degree of disease is expected in every crop. The disease will be most severe under damp, overcast conditions, when significant crop loss can occur.

Fungicides used include chlorothalonil, copper hydroxide, mancozeb, triflumizole, fludioxonil, fenhexamid, iprodione, and the strobulurins. The last two are classified as high risk for resistance development by the Fungicide Resistance Action Committee. Applications are made every seven to fourteen days using a hydraulic sprayer.

Sporulation occurs in response to specific environmental conditions (i.e. the right combination of leaf wetness, relative humidity, and temperature). Good practices that can reduce the need for fungicides include switching to drip irrigation; using a tensiometer to time overhead water applications rather than irrigating on a schedule; watering early enough in the days so leaves are dry at night; heating and ventilating the greenhouse to reduce relative humidity.

The biofungicide *Bacillus subtilis* is also used for Botrytis control.

Bacterial leaf spots (e.g., bacterial leaf spot of geranium; bacterial leaf spot of zinnia; bacterial leaf spot of begonia (*Xanthomonas campestris* pv. *pelargonii; X.c.* pv*. zinniae; X.c.* pv*. begoniae*)

These diseases appear as small (1/16 to 1/8 inch) brown circular lesions that are often surrounded by yellow tissue. Under the appropriate environmental conditions (higher temperatures and overhead irrigation) they can spread quickly to cause extensive crop loss. As with other plant diseases, infected plants cannot be cured and must be discarded.

Bactericides used include copper hydroxide, mancozeb, and the biofungicide *Bacillus subtilis.* Applications are made every seven to fourteen days using a hydraulic sprayer.

Seed-grown plants are less susceptible than those that are vegetatively propagated. Disease spores are spread by splashing water, so switching to drip irrigation or using a tensiometer to time overhead water applications rather than irrigating on a schedule are both useful management options.

Fungal leaf spots (many species)

Symptoms will vary with the affected plant species, but these generally appear as small (1/8 inch) circular lesions that are tan with a brown border. Some of the fungal leaf spots are seed borne. These diseases can be expected to occur regularly in bedding plants but do not cause significant crop loss.

A number of fungicides are used; many are specific for particular fungi. Recommended fungicides include chlorothalonil, copper hydroxide, mancozeb, fludioxonil, myclobutanil, triadimefon, triflumizole, iprodione, and the strobulurins. The last two are classified as high risk for resistance development by the Fungicide Resistance Action Committee. Thiophanate-methyl is labeled but should be avoided due to resistance. The biofungicide *Bacillus subtilis* is also recommended. Applications are made every seven to fourteen days using a hydraulic sprayer.

Since they tend to occur early in the crop cycle, monitoring can help prevent a serious outbreak. Prolonged wetness can exacerbate these diseases, so switching to drip irrigation or using a tensiometer to time overhead water applications rather than irrigating on a schedule are both useful management options.

Powdery mildew (many species)

Powdery mildew can cause significant plant damage, but because the pathogen is host-specific it is unlikely to cause widespread crop loss. Spores move through greenhouse air currents. This disease appears as a white, powdery coating on affected leaves; a handlens is useful to confirm the presence of mycelia to distinguish this from pesticide residue. Mildew interferes with photosynthesis and affected tissue turns grey and necrotic.

Fungicides used include chlorothalonil, neem oil, peperalin, muclobutanil, thiophanate-methyl, and the strobulurins. The last two are classified as high risk for resistance development by the Fungicide Resistance Action Committee. The biofungicide *Bacillus subtilis* is also recommended. Applications are made every seven to fourteen days using a hydraulic sprayer.

Wide temperature fluctuations seem to trigger spore release, so maintaining consistent greenhouse temperature is helpful.

Downy mildew (*Peronospora* spp., *Pseudoperonospora* spp.)

This disease is most likely under cool, humid conditions and is especially problematic in greenhouses near the ocean. Beige to purple spores occur on the undersides of badly distorted leaves; in some plant species leaves and growing tips become chlorotic. The downy mildews tend to be host-specific, so while individual infected plants must be discarded there is little likelihood of widespread crop loss.

Because sporulation occurs on leaf undersides, excellent coverage is important when applying fungicides. Labeled products include copper compounds, dimethomorph, fenamidone, fosetyl-Al, phosphorus acid, thiophanate-methyl, and the strobulurins. The last two are classified as high risk for resistance development by the Fungicide Resistance Action Committee. The biofungicide *Bacillus subtilis* is also recommended. Applications are made every seven to fourteen days using a hydraulic sprayer.

Thrips-vectored viruses (Tomato spotted wilt virus [TSWV] and impatiens necrotic spot virus [INSV])

TSWV and INSV do not occur regularly in bedding and potted color plant production, but when present that can cause substantial crop loss. Plants do not recover from virus infection and cannot be sold. Virus symptoms vary between plant species and include generalized necrosis and chlorosis that is confused with abiotic or fungal disease, which complicates diagnosis.

Infected plants may be brought into the greenhouse or infective thrips vectors may enter the greenhouse from surrounding vegetable fields. It is common practice in bedding plant production to move plants to different areas of the greenhouse as they mature; this practice also moves viruliferous thrips throughout the facility. These viruses are managed by controlling their hosts (weeds and western flower thrips). An ELISA-based diagnostic test kit is available for grower use for both viruses

Aphid-vectored viruses (Cucumber mosaic virus [CMV], alfalfa mosaic virus [AMV], potato virus Y [PVY])

CMV, AMV, and PVY do not occur regularly in bedding and potted color plant production, but when present that can cause moderate crop loss. Plants do not recover from virus infection and cannot be sold. Virus symptoms vary between plant species and include generalized necrosis and chlorosis that is confused with abiotic or fungal disease, which complicates diagnosis.

Unlike thrips, aphids do not persistently transmit viruses, so sources of CMV, AMV, and PVY outbreaks are most likely within the affected greenhouse. Virus management focuses on control of the weed hosts. An ELISA-based diagnostic test kit is available for grower use for CMV.

Nematode Control:

Foliar nematodes (*Aphelenchoides* spp.)

Foliar nematodes are an occasional pest in bedding and color plant production. Nematode infestation causes necrotic leaf spots that are often mistaken for a fungal pathogen or twospotted spider mite injury. Often, growers seek assistance and obtain a correct identification only after repeated unsuccessful fungicide or miticide applications Affected leaves defoliate, leaving a plant that is reduced in value or unsalable. Because many growers do not recognize foliar nematode injury, infested plants may be sold at the retail level, spreading the nematode problem to home gardens.

Nematodes spread in the greenhouse via splashing from overhead irrigation. Drip irrigation, combined with monitoring and removal of infested plants, can eliminate a nematode problem. Spiromesifen is labeled for foliar nematode control but has not been consistently effective.

Weed Control:

Many weed species occur in greenhouses used for bedding and potted color plant production. Some common weeds include chickweed, purslane, and malva, but species composition in an individual greenhouse is determined largely by the species that are present outside the greenhouse. Bedding and potted color plants are grown in an artificial soilless media that is not a source of weeds, but airborne seeds will occasionally germinate in crop plants. If media is re-used and not properly sterilized it can be a source of weed seeds. Most greenhouse weeds occur on the floor, where they are a concern as a source of insects (especially thrips, aphids, and whiteflies) and of plant viruses vectored by those insects. Weeds growing directly in containers will compete with the crop plant for water and nutrients.

Grower tolerance for weeds in the greenhouse varies, but most growers perform some type of weed control. There are postemergent herbicides labeled for greenhouses, but they are not commonly used due to the risk of crop plant injury. Hand weeding is common, as is the use of weed barrier fabric on the greenhouse floor. While retrofitting with concrete floors is often not feasible, new greenhouses may be built this way.

Best Management Practices for Disease Prevention

Ann Chase, Chase Agricultural Consulting, Cottonwood, AZ

The best practices for disease prevention center on creating an environment that favors the plant and not the disease, which is the core of any good integrated pest management program.

Practice good sanitation

This is the first line of defense in the battle against disease in the greenhouse or nursery. Many diseases can be avoided all together if a thorough and consistent sanitation program is in place. It is important that everyone in your business understands the ways diseases spread and the ways they can stop them. Stopping disease before it becomes established is critical. Some of the steps that can be taken to keep the greenhouse or nursery "clean" are described in this article.

Clean all tools, equipment and work surfaces before working with plants. Wash these tools or surfaces first with water and follow-up with a disinfestant. We have tested a number including chlorine products (like bleach and chlorine dioxide), peroxides (like X3 and ZeroTol) and quaternary ammoniums (like GreenShield, KleenGrow and Physan). They all work in some instances but the quaternary products are overall very effective and relatively safe on plants if they are accidentally sprayed. Many disinfestants can prevent pathogens and algae from growing and can even eradicate spores on surfaces but they do not usually have any residual effect to speak of and new spores may not be killed once the product dries. KleenGrow is an exception to this rule and is also labeled for direct use on plants as a bactericide/fungicide making it a good choice in sanitation.

Start with new of clean pots, flats and other containers

Use only new or thoroughly cleaned pots, flats and other containers. Wash and disinfest using the products listed above. We performed some simple tests in cooperation with a nursery operation to determine the actual need for cleaning if a quaternary ammonium soak was used on recycled plug flats. The best control was a thorough washing followed by a 5 minute soak in a quaternary ammonium at labeled rates. Even higher rates used much longer were not as effective when the flats were not washed first. Other research has shown that steaming flats can also be very effective if the plastic will withstand it. This has been especially effective in reducing contamination of flats with the black root rot pathogen, Thielaviopsis basicola.

New potting medium

Try not to reuse any potting media and do not add native soil to any potting medium without steaming or treating with a product like methyl bromide. Think about how potting medium gets into a compost or dump pile. The plants fail to grow and are not salable (signaling the possibility of a disease).

Use only disease-free seeds, cuttings and liners

Finding pathogen-free materials can be a challenge since even the best propagators face disease situations occasionally. Be careful and check all plants when they arrive. If you have your own stock plants, maintain them in a healthy un-stressed state. Take cuttings from the tops of the plants to facilitate rapid rooting and avoid possible contamination. Clean cutting instruments between stock plants. Never use any plants with symptoms on any part of the plants since taking cuttings from a plant that has symptoms anywhere is not safe.

Avoid dipping cuttings

This is an excellent way to spread many bacterial and fungal pathogens including Xanthomonas, Erwinia, Fusarium and Cylindrocladium. Even when effective fungicides or bactericides are used, the spores will spread throughout the entire batch of dipped cuttings. If you suspect a pathogen, a post-sticking sprench will be the most effective way to apply a fungicide. In other cases, spraying the stock plants the day before cuttings are made can be a very effective way to reduce losses from pathogens like Cylindrocladium.

Grow on benches when possible

Do not place containers directly on the ground. Be sure to treat the surface (gravel, concrete or ground pack) with a disinfestant like bleach, chlorine dioxide, hydrogen peroxide or quaternary ammonium. In some cases, pots are placed on concrete blocks, flats or over-turned pots to avoid contamination from water run-off between pots or other areas.

Rogue dead plants

Weekly or even daily removal of dead or dying plants is a very important way to reduce disease spread. Keep the dump pile downhill from any growing or display area and do not maintain it as a source of pathogens. Runoff from the dump pile can spread pathogens into your production area. Worse yet is to position the potting media down hill from a dump pile. Contaminating media before they are even used can happen.

Water treatment for recycled water

This water has the same concerns as reused potting media. Fertilizer, pathogens and pesticides may wreak havoc in your propagation and throughout production of the crop. The most common pathogens that are spread this way are the water-molds, Pythium and Phytophthora. However, Erwinia has been found in southern ponds and I have seen even leaf spot pathogens like Helminthosporium reintroduced into the foliage of palm trees when recycled water is used to overhead irrigate them.

Keep leaves dry

Do not water crops from overhead if at all possible. Splashing rain water or over-head irrigation spreads spores for bacteria and many fungi such as Alternaria, Cercospora, Colletotrichum, Cylindrocladium, Glomerella, Helminthosporium, Myrothecium, Pseudomonas and Xanthomonas. There are only a few foliar diseases that spread and infect without the help of free water on the leaves including rust, powdery mildew and downy mildew. These diseases require a moderate relative humidity but spread via wind or fans and infect leaves with a mere film of moisture. To keep leaves dry:

1. Do not use overhead irrigation or expose to rainfall if possible.
2. Water early in the day or when leaves will dry quickly.
3. Never water late in the day since plants will stay wet all night.
4. Space plants to allow air movement and reduce RH around plants.
5. Use HAF (horizontal air flow) fans to improve leaf drying.

Best Management Practices For Insect And Mite Prevention

Christine Casey, Department of Entomology and Nematology, University of California, Davis

Best management practices for insect and mite management focus on prevention, which applies to plants grown in greenhouses and outside. Exclusion methods such as screening can be useful for greenhouses, but are expensive to install and maintain and require strict control of all people, equipment, and plant movement in and out of the greenhouse to be effective.

Sanitation

As with diseases, sanitation can go a long way towards preventing insect and mite problems. Pots, tools and other equipment should be cleaned immediately after use and stored away from production areas. Workers should always move from clean to infested areas and wash their hands when moving between crops.

Isolation

If possible, hold incoming plant material in an isolated area until it can be inspected for insects and mites, especially if the plants are from a supplier that has sent infested material in the past.

Weed management

Weed in and around growing areas can provide additional hosts for greenhouse insect pests. Whiteflies, aphids, and thrips are especially likely to use weeds as alternate plant hosts. Weeds can also host many of the plant viruses that these insects vector. Use of herbicides in the greenhouse can be problematic, so hand removal of existing weeds may be the best option. Avoid damp areas that may favor weed development, and remember that weed seeds may blow or wash into media and media components left uncovered outside.

Rogue heavily infested plants

Heavily infested plants may not ever recover sufficiently for sale, or may require multiple pesticide applications. Under high population pressure, insects and mites readily disperse to look for new food sources. This makes these plants the most likely serve as a source of infestations in the greenhouse. In most cases, the loss of the plant material balances the savings from preventing new infestations.

Insect and mite movement

Closely spaced plants can facilitate the interplant movement of non-flying pests like twospotted spider mite or the non-flying, mobile immature lifestages of pests such as thrips or aphids. When production demands necessitate close spacing, pay particular attention to these plants for these problems. Workers can also effectively spread pests between plants on their tools, hands, and clothing. Always move from clean to infested areas and wash tools and hands as well. Yellow clothing is attractive to thrips, whiteflies, and aphids and should be avoided.

Water management
We tend to associate water mismanagement with disease problems, but excessively damp areas can also favor the development of fungus gnat, shore fly, and moth fly populations.

Media management
Media with higher organic matter content or excessively damp media both tend to be more favorable for fungus gnat development, so this should be kept in mind as monitoring and management programs are developed. The covers on unopened bags of media can tear or degrade, providing access to insects that have a soil-dwelling life stage. The same holds for media components left uncovered in mixing areas. Cull piles located next to media areas (or re-use of infested media) can also provide routes of infestation.

Impact of Common Bedding And Container Color Plant Production Practices on Pest Management

Christine Casey, Department of Entomology and Nematology, University of California, Davis

Container size

The size of the container in which a plant is grown has a substantial influence on the health of the plant. Choice of container size is generally dictated by the market, meaning that the grower must cope with the limitations imposed by the container. In general, plants in smaller containers tend to have more stress on the root system. There is less media to retain moisture and nutrients; reduced media volume also means less of a buffer from the temperature extreme at the edge of the container. This increased stress can exacerbate disease problems caused by root system pathogens such as Phytophthora and Pythium. Media is smaller containers can also dry out faster, further stressing root systems. Depending on the production time, smaller containers may be more likely to become root bound. These containers will not retain moisture or nutrients as effectively and are more likely to do poorly at the retail level and in the garden.

At the other extreme, plants must sometimes be sold in large containers when the root ball has not yet filled the container. It is easy for the media to remain too damp, encouraging the growth of root system pathogens and providing an ideal environment for fungus gnats and shore flies. There is some evidence from nursery production that plants in larger containers may be more attractive to insects. This may be due to larger leaf area and not the container itself, but this is something to keep in mind when developing a scouting program.

Best management practices to overcome effect of container size:

- Match irrigation to plant species and container size; use irrigation controllers to do this
- Match media to plant species and container size; larger containers might have more porous media while smaller containers will have a media that retains more moisture (i.e. has more organic material)
- Consider use of media amendments that are fungicidal or serve to promote plant health (e.g. *Bacillus subtilis*, *Trichoderma harzianum*, Ag1000™)
- Monitor root system growth and percentage of container filled with roots and plan irrigation accordingly
- Monitor EC via pour-through method and adjust fertilizer accordingly

Production stage

Production of bedding and container color plants is rapid, with an 8 to 10 week production cycle being typical. On the extreme, propagators may have plants for as little as five weeks, while some container plants may take up to 15 weeks. In general, smaller plants are more susceptible to insect, mite, and disease injury. Younger plants are growing rapidly and need large amounts of water, nutrients (which are taken up by roots) and sugars (which are produced in the leaves via photosynthesis) so even a small amount of root or leaf damage has a relatively large impact on plant physiology and capacity for growth. At the same time, young plant tissue may be less durable and more subject to phytotoxicity from pesticides.

Pest levels and damage that can be tolerated in finish will depend in part on the intended use of the plant. Different retail settings and landscapers will vary in their tolerance levels and it is useful to understand these in advance. Some pests and diseases tend to cause fewer problems once the plant is removed from the favorable greenhouse environment and may be tolerated at low levels at the end of production. Aphids feed primarily on succulant new growth that hardens off once the plant is in retail or the landscape. Botrytis is highly favored by the warm, humid greenhouse environment and likewise may die off in the harsher retail or landscape setting.

Best management practices that consider production stage:

- Monitor young and pesticide-sensitive plants most closely so that treatments can be applied when pest levels are low
- Consider discarding heavily infested or infected plants that may be difficult to treat to prevent spread of a problem
- Prophylactic use of natural enemies (e.g *Hypoaspis miles*, *Steinernema feltiae*) or biofungicides (e.g RootShield) that target soil-borne insects or pathogens may provide early control of minor problems

Production location

Whether plants are grown in the greenhouse or outdoors can have a substantial influence on pest management, both in terms of the type of pests and the available management options. Highly mechanized greenhouses afford a great deal of environmental control that permits substantial adjustment of temperature, humidity, and light. In many cases, however, when these conditions are optimized for plant growth they are also ideal for pathogen, insect, and mite development. In some cases, just a small amount of manipulation can tip the balance against the pest. One good example is heating and ventilating in the evening for Botrytis control. Habitat manipulation may also be used to influence success of natural enemies. The insect pathogen *Beauveria bassiana*, for example, needs a relative humidity of at least 45% for mycelial growth, while the spider mite predator *Phytoseiulus persimilis* requires a relative humidity of 70% for egg development. Because these processes occur on leaf undersides where the microclimate may already create a higher relative humidity than in the entire greenhouse, relatively minor changes to the greenhouse environment as a whole may be sufficient.

On the other hand, plants grown outdoors tend to be hardier. Exposure to the elements creates a thicker leaf cuticle and stronger stems, which can reduce the ability of insect mouthparts and pathogen growth structures to penetrate plant tissue. These plants can also be subject to weather damage from wind and rain, and may be more exposed than greenhouse plants to pests like thrips that travel on air currents.

Best management practices that consider production location:

- While the greenhouse provides the most control over the growing environment, the greenhouse environment also tends to be most favorable environment for insect and disease development
- Plants grown outside tend to have thicker leaf cuticle and stems, which may provide some protection against certain insects and diseases
- Plants grown outside are more susceptible to damage from wind and rain that may create wounds through which pathogens can infect the plant
- Not all pesticides are labeled for use in both greenhouse and outdoor settings, and natural enemies may have different efficacy in greenhouse and outdoor settings

Plant location and spacing

Greenhouse structures are capital-intensive, and it makes economic sense for growers to produce plants on multiple levels (hanging, bench, and floor) to fully utilize this valuable space. This practice presents pest management challenges, however. Plants on the ground may be exposed to runoff from plants above them and from plants in adjacent ground areas. Pathogens can travel in water moving between plants, and insects that normally drop to the ground to pupate (e.g. thrips, leaf miners) can move to plants below them. Likewise, plants on the ground may be more vulnerable in infestation by weed seeds since weeds may grow on the greenhouse floor, and airborne seeds may settle on floor-based plants first depending on what plants or cover are over them. If there is not a substantial barrier (such as gravel or intact ground cloth), there is also the possibility that soil-dwelling insects might move into containers from the ground.

On the other hand, plants on the ground are easily accessed for monitoring and it is more likely that subtle changes indicative of a pest or disease will be noticed when large blocks of flats are easily viewed. These plants may also be easier to irrigate effectively if hand watering is used, which can prevent problems caused by excess or insufficient water.

Plants on the ground may grow more slowly than plants on a bench as cool air tends to settle on the ground. This could be exacerbated if a bench and plants above are shading the ground.

Growers often use close plant spacing to capitalize on expensive greenhouse infrastructure. This may lead to conditions that favor disease development, but can provide valuable plant bridges that improve natural enemy movement if biological control is being used. If diseases are an issue and plants must be more widely spaced, flagging tape can be run between pots to provide bridges for natural enemy movement.

Best management practices that consider plant location and spacing:

- Recognize that plants on the ground may have more insect, disease, and weed problems

- Recognize that plants on the ground may grow slower than plants that are raised
- Plants on the ground may be easier to irrigate if hand watering is used
- Plants on the ground may be easier to monitor
- Close plant spacing may facilitate pest spread, but can also enhance natural enemy movement. Natural enemy bridges can provide dispersal corridors if wider spacing is used.

Irrigation system and water source

Water is the most critical production input. While its direct impact on plant survival is obvious, growers may not always consider how irrigation can influence insects, diseases, and weeds. Many growers use hand watering because it requires the least capital investment, but this method can be inconsistent and lead to excessively wet or dry plants. However the person who does hand watering is generally familiar with the crop and can notice small problems or changes before they become significant. Other common irrigation problems include missing or clogged drip system emitters, floor or ground areas with poor drainage that allows water to collect, and leaking faucets or hoses that also create damp areas.

Irrigation water may come from a city system, wells, retention ponds or tanks, or some combination of these. A city system that is blending water from many wells or providing a combination of well and surface water may be the most variable in terms of pH, salts, and nitrates.

Best management practices for irrigation:

- Hand watering can be inconsistent and lead to some plants being too dry or too wet. Consistently wet soil may favor pathogens or fungus gnats, shore flies, and moth flies. Damp areas on floors can also favor these pests and growth of some weed species. Focus scouting on areas of the greenhouse where this has been a problem, and takes steps to correct poor drainage.
- Hand watering is less efficient than drip irrigation, but emitters can become clogged or dislodged. Either of these can go unnoticed until the plant(s) die.
- Overhead irrigation requires the least labor and infrastructure, but may be the most wasteful. Splashing and runoff from overhead irrigation can move pathogens between plants.
- Well water and city water may have pH, salt or nutrient contents that are not ideal for plant growth
- Water from retention ponds or tanks may contain levels of salts or pathogens that are not ideal for plant growth
- Recycled water may vary in availability, cost, and quality

Developing an Effective Insect, Mite, and Disease Monitoring Program for Bedding and Container Color Plants

Christine Casey, Department of Entomology and Nematology, University of California, Davis

Why monitor?

A monitoring program allows you to make informed management decisions because control is based on the actual pest and disease pressure in the growing area. Monitoring is also essential for detecting new pests and for assessing the effectiveness of previous control measures.

Who will monitor?

Scouts might be growers, other greenhouse employees, or private consultants. Most growers find hiring a consultant to be worth the cost. This person is experienced in problem identification and brings an unbiased outlook to the greenhouse, and cannot be diverted to other activities. On the other hand, an employee scout has more flexibility to change the scouting schedule to accommodate pesticide applications or shipping schedules. This means that incoming plants could be inspected immediately as they arrive at the greenhouse, helping to prevent unwanted pest entry. This person would also be at the greenhouse everyday, so problems detected as the crops are handled could be quickly diagnosed.

Once a scout is selected, the grower and scout should agree on the amount of time to be spent scouting, when scouting will take place, and (for independent scouts) what the scout will charge. Some scouts charge by the hour, while others receive a flat fee per visit. Establish an isolated area where plants will be left and examined by the grower after rogueing, or receive permission from the grower to discard them directly. Other details, such as responsibility for sending plants to diagnostic labs (and who will pay for this) as well as purchase of sticky cards, also need to be discussed. The scout and grower should consider the type of information to be left at the end of each session. How much detail does the grower want, and are management recommendations desired? Finally, it is important to establish good communication with the person in charge of pest management decisions and other employees who regularly work with the plants; they will often notice the development of new problems during the time between scouting sessions.

Develop a monitoring strategy

1. Gather background information

The next step before the scouting season begins is to gather background information about historical problem areas, the greenhouse layout, irrigation, pesticide application equipment, and media and fertilizer. All of these factors can interact to affect the development and management of pest problems.

2. Historical problem areas and crops

Find out which crops tend to have pest problems so you can pay particular attention to those plants while scouting. In addition, many greenhouses have spots that have environmental problems, such as poor drainage, limited air movement, or cold spots that can lead to pest problems. These areas should also be noted when gathering background information.

3. Set a scouting route and schedule

Establish a sampling route that will allow you to visit all areas of the greenhouse and inspect different plants each week. The pests that commonly attack bedding plants do not distribute themselves evenly throughout the crop. For example, whiteflies tend to have a clumped distribution; contagious diseases are usually spread by water or air movement, which are rarely uniform. In a typical greenhouse layout, the most efficient route is a zig-zag pattern down the aisle between two benches. Stop at about 10 locations in an area of 1000 ft^2, examining a plant or flat on each side of the aisle as well as any baskets overhead. Start this pattern at a slightly different location each week. The number and density of plants will affect the scouting pattern, as will the location and size of benches in the greenhouse.

4. Understand the layout of the growing area

At the first visit, inspect each growing area for situations that may lead to pest problems, such as watering nozzles left on the floor, areas of standing water, weeds, algae, and plants left from a previous crop. Look for whiteflies and thrips on the weeds, and for shore flies on the algae. Check for weeds outside the greenhouse that will need to be controlled in the spring. A 15-foot border around the greenhouse should be kept free of weeds.

Determine patterns of plant movement during a normal production cycle. For example, do plants move from propagation to a holding house, from which they are distributed throughout all greenhouses? If so, inspect plants carefully before they leave the holding area. Do all greenhouses share a common head house through which all plants pass as they are moved from one range to another? This means that a problem in one house could quickly be distributed to all greenhouses.

5. Create an IPM notebook

The IPM notebook serves as a resource center at each greenhouse. It will contain information used weekly, such as blank scouting forms, greenhouse maps, and all scouting records. This book, which is always kept in the same place, should also contain pesticide recommendations, spray records, MSDS sheets, pesticide labels, and fact sheets or trade journal articles pertaining to pest problems. Other relevant information, such as fertilizer inputs, should also be included here. Establish this notebook before scouting begins, as you are preparing scouting forms and greenhouse maps. Continue to add new information to keep everyone on the IPM team up-to-date. It may be easier to maintain this electronically on a file-sharing site or on a computer or tablet that everyone is able to access.

6. Develop a key pest and disease list

Base your scouting strategy on the grower's schedule for the crop and the pests you expect to encounter. To determine the date that the crop should be pest-free, project backwards from the expected sale date. The pest-free date is affected by the capacity of the insect, disease, or mite to injure a plant at a certain stage, as well as how difficult it is to detect the problem and the likelihood of the problem to spread.

To illustrate, fungus gnat larvae can seriously injure root systems that are less than three weeks old. Older roots, however, can tolerate a higher population of larvae. As a second example, even a small number of aphids—because of their great capacity for reproduction—is a concern on young plants, whereas on mature plants, one or two aphids could be washed off before sale. Thus scouting for these two insects would be a priority during the first few weeks of the crop.

Whiteflies mature from eggs to adults in about one month, so these insects should be under control at least one month before sale. A few geraniums with Botrytis blight can be managed by removing the infected leaves and improving air circulation, yet if a few geraniums have rust lesions, a fungicide is needed. Rust lesions are also more difficult to see than Botrytis blight, so individual plants will need to be examined for rust, whereas Botrytis will usually be visible as you move through the crop.

Sometimes apparent injury is not necessarily related to current pest levels. For example, injury from thrips feeding early in the crop cycle may not be noticeable until several weeks later, when flowers and leaves have expanded.

How to monitor

1. Scouting sanitation protocol

Follow the sanitation protocol outlined below to reduce the possibility of spreading insects or diseases and to minimize contact with pesticide residues. Before leaving one business or house to scout another, wipe off your clothing and wash your hands. Treat plants gently as you inspect them. Another part of being a responsible scout is continuing education. Attend trade and educational shows, read trade journals, and stay in contact with other scouts. New pest problems will always develop, as will new ways to manage them. To remain effective, you need to be aware of these changes. Finally, remember that at times the grower's priorities will be different from yours. Patience and good communication will be essential at these times. Don't expect to see all management recommendations implemented every week, but be prepared to prioritize problems and alert the grower to those that are urgent.

Procedure	**Justification**
Avoid wearing yellow, blue, or light-colored clothing	Light colors attract many insects, which could then be carried on your clothing to another area
Wear disposable gloves	Disposing of gloves helps prevent pathogens from being transferred among plants. Wash or change gloves after contact with contaminated material. Gloves will also help protect against contact with pesticide residues on plants.
Check the pest control record before entering an area	Reduces your risk of pesticide exposure and points you to possible problem areas
Monitor least-infested first, heavily infested areas last. Base this judgment on conversations with the grower and your previous visit.	Minimizes the possibility of inadvertently carrying insects or pathogens from one area to another or from older to younger plants
Examine stock plants first, then cuttings	Reduces the chance of infesting stock plants
Don't carry infected plants to a clean area or another greenhouse	Minimizes the spread of insects and diseases. When rogueing plants or removing dead leaves, place the material in a plastic bag, then remove it from the greenhouse.

2. Monitoring equipment and use

Equipment	Use
Hand lens of at least 10x power Optivisor® (a hands-free magnifier)	Examine suspected arthropod or disease problems under magnification. Optivisor® allows you to keep both hands free as you inspect plants.
Blank scouting and report forms with clipboard and pen	Record scouting observations on forms and report findings to grower. Pen attached to clipboard is useful.
Colored survey flags and flagging tape	Mark indicator plants or problem areas
Sticky cards, stakes, and clothespins	Monitor adult insect flight activity
Potato disks	Monitor immature fungus gnat activity
Hand counter (tally meter)	Fast, accurate way to count large numbers of insects
Plastic gloves	Protect scout from pesticide residues and prevent disease transmission during root system inspection
Garbage bags	Isolate plants that are rogued or sent out for diagnosis
Small plastic and paper bags	Attach plastic bag to belt while scouting to discard leaves and sticky cards. Use paper bags for transporting soil or tissue samples.
Plastic wrap	Wrap sticky cards for later ID or counting
Vials of alcohol, small artist's brush, and tweezers	Collect and preserve insects and mites for identification
QTA Tospo™ detection kit	Test performed by the scout to determine if a plant is infected with INSV or TSWV
Bleach solution (10%) or other disinfectant and rag. Prepare fresh solution weekly and store out of direct light.	Wash plastic gloves between root inspections to prevent disease transmission. Wipe gloves after applying bleach.

Scout the greenhouse once a week by inspecting plants and assessing root system health. Leave information in the IPM Notebook at the end of each session. A consistent schedule is necessary to accurately observe pest activity and trends. Scouting should take place on the same day of each week, and at the same time each week. This way the grower knows when you are coming and can prepare questions or schedule pesticide applications accordingly. It is possible that before a scouting visit, an area of the greenhouse will have been treated with pesticide or plant growth regulator. Always check pesticide application records in the IPM Notebook for the reentry intervals specified by the Worker Protection Standards before entering a greenhouse.

Be sure the grower keeps up-to-date records about the materials sprayed, the date, and the location. Knowledge about these applications will help scouts to evaluate the current pest situation and to protect their personal safety. The time it takes to scout bedding plants depends on the experience and skill of the scout, the level of pest infestation, the size of the greenhouse(s), and the number and kind of plant species. A new scout may require an average of 20-25 minutes to inspect every 1,000 sq. ft. Once the scout is comfortable with pest identification, experienced at making pest counts, and familiar with the greenhouse layout, the time needed for scouting generally drops to an average of 10–15 minutes per 1,000 sq. ft.

As a rule of thumb, allot four hours per week for a greenhouse of approximately 1.5 acres. An additional one to two hours per range each week is optimal but may not be feasible. Allow time to discuss your work with the grower before and after scouting. Growers can guide your scouting by telling you what they've seen or news of problems in other greenhouse operations.

3. Start with an overview of the growing area

Each time you enter an area to begin scouting, scan the entire crop for plants that are off-color, of uneven height, or abnormal in some other way. Make a note of the bench location and be sure to examine that area in detail as you work along your scouting route. Look under the benches for weeds, and check those weeds for insects. Note on the data sheet any presence of insects on weeds. A small weed population can be pulled by hand as you scout.

Do the same outside the greenhouse or field, noting the presence of weeds and ornamental plantings and any insects on them. Usually these weeds are too numerous for hand removal. They should be killed with an herbicide and replaced with a gravel border over weed barrier fabric.

4. Using insect monitoring tools

Use colored sticky cards to monitor changes in adult insect populations and to detect pest populations in new shipments of plant material that has just arrived at the greenhouse.

The color of the trap is attractive to a particular insect, which is caught on the adhesive surface. Sticky traps do not, however, significantly reduce insect populations. Yellow cards are used to detect winged aphids, fungus gnats, shore flies, whiteflies, leafminer flies, and thrips. They will not pick up mites or wingless aphids. They also attract many natural enemies of insects, so try not to release beneficials near yellow sticky cards. Blue sticky cards also attract thrips, although it is more difficult to see the thrips against the blue background. Yellow cards are more practical for the wide range of pests that generally occur in bedding and container color plants.

Examine sticky cards weekly as part of the scouting routine. Identify and count insects, then record this information with the other scouting data. Weekly changes in insect counts indicate general levels and trends of insect activity in a greenhouse. Because there are no guidelines for relating the number of insects on a trap to the population on the crop, you should use plant inspections as the primary source of information for pest management decisions. Place traps in hanging baskets, at bench level, or on the floor (if the greenhouse has soil floors). Place one card per 1,000 sq. ft. Number each card. Correlate the number to a specific location; that location will have a card (or replacement card) for the life of the crop. Use both sides of the card each week. If only a few insects are caught in a week, the card may be reused. Circle the insects with a waterproof marker so they are not counted again. Place cards at the level of the crop canopy, moving them each week as the plants grow.

Sometimes a different approach is used if a specific insect is of primary concern. For example, cards placed horizontally above the soil may be more effective for fungus gnat and shore fly monitoring. For thrips, cards should be placed in areas of air movement because thrips move around the greenhouse primarily on air currents. Attach cards near vents or other openings, on the eastern and western ends of the greenhouse, and near floors and ceilings until you are able to determine the most "popular" spots; continue to place cards in only the spots that collect thrips. In hanging baskets, suspend cards from the support used to hang the baskets. At bench level, clip a card to a stake with double clothespins and place the stake in a pot. At the basket or bench level, set cards vertically. Choose whether cards will be oriented with the short or long side parallel to the ground, and maintain this orientation for the life of the crop. Keep the bottom third of the card below the crop canopy. At the floor level, cards should be placed horizontally, since the purpose of these cards is to catch insects as they emerge from the soil. Another technique that may be used is to coat the inside of a clear plastic shoe box or sweater box with sticky material so the insects are caught as they emerge from the soil. These traps can help to determine the need for soil treatment.

Unusual insects may occasionally be found on these cards. Several species of parasitic wasps may be seen in greenhouses where few pesticide applications are made. Insects not normally seen in the greenhouse may enter from outside through open vents or doors. If an unknown species is trapped more than twice, it should be identified. Always be alert to the arrival of a new pest. Sticky cards covered with insects can be wrapped in plastic to be saved for identification.

Occasionally other types of insect monitoring devices are used in greenhouse scouting. Potato disks may be placed on the soil surface to monitor for fungus gnat larvae. Cut a potato into 1-to 2-inch cubes and press the raw surface lightly into the soil. If larvae are present, they may be seen feeding on the potato when it is lifted from the soil after 24 hours. Duct tape or packing tape may be wrapped sticky side out on bench legs to determine if slugs feeding on benches are moving up from the greenhouse floor; look for their slime trails on the tape. Pheromone traps are occasionally used in greenhouses to detect European corn borer.

Descriptions of insects on sticky cards

Aphid. (varied species) Family Aphididae. These are small (1/8 inch) insects that vary in color from black to green. Only the winged forms will be caught on sticky traps. They tend to shrivel after a few days on the trap, but if fresh will appear stout with cornicles visible near the tip of the abdomen. The wings are often spread out on the trap and a large dark vein will be visible near the front of the forewing. Nymphs may be seen near the body of the adult.

Fungus gnat. (*Bradysia* spp.) Family Sciaridae. These are small (1/16 inch) slender flies that resemble small mosquitoes. Distinguish them by their long legs and antennae. They appear to be hunchbacked and have one pair of clear wings with a Y-shaped vein in the center.

Leafminer. (*Liriomyza* spp.) Family Agromyzidae. These are small (1/16 inch) stout-bodied flies that are mostly black with areas of bright yellow. There is typically a bright yellow patch on the thorax. Being flies (order Diptera), they have only one pair of wings.

Moth fly; drain fly. (varied species) Family Psychodidae. These are small (1/16 inch) flies that appear fuzzy due to a covering of fine hairs. They are often trapped in wet or poorly drained growing areas.

Shore fly. (*Scatella stagnalis*) Family Ephydridae. These are medium (1/8 inch) stout-bodied flies that are dark in color. They have bristle-like antennae that are shorter than the head and not always visible. The wings (one pair) are dark gray and have three to five distinct white spots.

Thrips. (varied species, typically *Frankliniella occidentalis*)
Family Thripidae. Thrips are very small (1/32 to 1/16 inch) slender, elongated insects. They are usually the smallest insect on a trap and may be confused with specks of dirt. Thrips are black to yellow and have hair fringes on their wings. These fringes are not always visible on traps because the wings of the thrips tend to fold over its body.

Whitefly. (varied species) Family Aleurodidae. These are small (1/16 to 1/8 inch) insects with white wings and yellow to orange bodies. The white wings disintegrate quickly, leaving behind only the body, which can easily be confused with thrips. The wingless whitefly body tends to be shorter and stouter than the thrips.

Parasitic wasp. (varied species) Order Hymenoptera. Many parasitic wasps in the order Hymenoptera may be seen on yellow sticky traps. They are generally small (1/16 to 1/8 inch) with bodies that range from slender to stout. They often have long, elbowed antennae. Their abdomens tend to be pointed at the rear. Parasitoid wings tend to be clear, with only one large vein on the forewing. The hindwings are usually without veins and much smaller than the front wings.

5. Scout by key pests, plants, and locations

Be familiar with the key pests, plants, and locations for the crops grown in your greenhouses. Key pests are the insects, mites, and diseases most likely to cause problems on a plant. Key plants are the species or varieties most likely to have pest problems. Key locations are areas of a greenhouse that are most likely to be the site of pest problems, such as spots with poor floor drainage, benches near vents, or production areas near stock plants. Many plants are affected by fungus gnat larvae and damping off, which are a concern primarily during the first few weeks of production. Crop history also plays a role; check for a problem that has occurred regularly in the past until you are certain it is not present. Be vigilant with problems resulting from ongoing environmental circumstances, such as poor air circulation or standing water.

Systematically examine the tops and bottoms of leaves. Some arthropod pests, such as mites and whiteflies, are found primarily on leaf undersides, whereas aphids are most commonly seen on tender new growth. Most disease symptoms will be visible on the upper leaf surface, although downy mildew and powdery mildew can appear first on leaf undersides. For plants with six or fewer leaves, examine the entire plant. For larger plants, look over the entire plant, holding it above your head to see the leaf undersides. An Optivisor® is useful for this purpose. Select six leaves from all parts of the plant (upper, middle, lower) and examine them individually. Examine the length of all stems and branches for insects, mites, and disease symptoms.

Many arthropod and disease problems are specific to certain parts of the plant. Some aphids prefer terminal growth, whereas mealybugs may be located at any point, although often they are visible in leaf axils or where branches and stems meet. Western flower thrips adults and larvae are most commonly found in flowers. Sometimes they are visible on leaves and in leaf axils, or hidden within buds. Check stems and branches carefully for diseased areas—primarily at the root-stem junction, or where branches and stems meet. Leaf spots develop first on the older, lower leaves of seedlings.

Resources

WEB SITES

University of California

UC Integrated Pest Management Home Page: ucipm.ucdavis.edu
UC Integrated Pest Management Floriculture Page:
ipm.ucdavis.edu/PMG/selectnewpest.floriculture.html
Bedding Plant IPM Alliance: ucanr.org/sites/entomology/BPIPM
UC Cooperative Extension: ucanr.org

Biological Control

Koppert: www.koppert.com
Biobest: www.biobest.be

Pesticide Information

Insecticide Resistance Action Committee: www.irac-online.org
Fungicide Resistance Action Committee: www.frac.info
Herbicide Resistance Action Committee: www.hracglobal.com
California Department of Pesticide Regulation (CA DPR): www.cdpr.ca.gov

ELISA test kits for plant pathogens

Agdia, Inc.: www.agdia.com

PUBLICATIONS

UC IPM: Integrated Pest Management for Floriculture and Nurseries:
ipm.ucdavis.edu/IPMPROJECT/ADS/manual_floriculture.html
CA DPR: A Guide to Pesticide Regulation in California:
www.cdpr.ca.gov/docs/pressrls/dprguide.htm

Management Rotations for Integrated Pest Management of Bedding and Container Color Plant Insect and Mite Pests

Christine Casey, Department of Entomology and Nematology, University of California, Davis

Bedding and container color plants have a short cropping time, high quality expectations, and multiple pests. Effective pest management in these crops includes monitoring, fast-acting biological control agents, and pesticide rotation. The following recommendations consider these factors and are intended to be used in conjunction with a monitoring program that uses yellow sticky cards and plant inspections.

MOA group = Insecticide Resistance Action Committee pesticide mode-of-action group

Fungus gnats and shore flies

Treatment	Yellow stick card counts	Trade name	Common name	Life stages targeted	MOA group
First	Release at start of crop	Entomite-M	*Hypoaspis miles*	Larvae	n/a
Second	Low	Gnatrol	*Bacillus thuringiensis israelensis*	Larvae	11A1
Third	Rising	Distance	Pyriproxifen	Larvae/reduces ovipositioning	7D
Fourth	Peak	Citation	Cyromazine	Immatures	17

Twospotted spider mites (TSSM)

Low to normal mite pressure:

Treatment	TSSM lifestages observed	Trade name	Common name	Life stages targeted	MOA group	Compatibility with *P. persimilis*
First	Low	Spidex	*Phytoseiulus persimilis*	all	n/a	n/a
Second	Mostly eggs	Hexygon	Hexythiazox	Eggs/stops ovipositioning	10A	yes
Third	Immatures	Floramite	Bifenazate	All	25	no
Fourth	Adults	Akari	Fenpyroximate	All/stops ovipositioning	21A	no

Normal to high mite pressure with mostly eggs and immatures:

Treatment	TSSM lifestages observed	Trade name	Common name	Life stages targeted	MOA group	Compatibility with *P. persimilis*
First *Select one based on count of eggs and immatures*	Mostly eggs	Hexygon	Hexythiazox	Eggs/stops ovipositioning	10A	yes
	Mostly immatures	TetraSan	Etoxazole	Immatures	10B	no
Second	Immatures /adults	Kontos	Spirotetramat	All/systemic	23	unknown
Third	Adults	Pylon	Chlorfenapyr	All/translaminar	12B	no
Fourth	Adults	Akari	Fenpyroximate	All/stops ovipositioning	21A	no

*Except if applied by drench and there were will be no contact with drenched material

Normal to high mite pressure with mostly adults:

Treatment	TSSM counts	Trade name	Common name	Life stages targeted	MOA group	Compatibility with *P. persimilis*
First	All lifestages with adults predominant	Floramite	Bifenazate	All	25	no
Second	All	Kontos	Spirotetramat	All/systemic	23	unknown
Third	All	Pylon	Chlorfenapyr	All/translaminar	12B	no
Fourth	Adults declining, eggs increasing	Hexygon	Hexythiazox	Eggs/stops ovipositioning	10A	yes

*Except if applied by drench and there were will be no contact with drenched material

Western flower thrips

Low or normal thrips pressure:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Low	Azatin	Azadiractin	Immatures	18B
Second	Rising	BotaniGard or Naturalis	*Beauveria bassiana*	All	n/a
Third	Peak	Flagship or Safari	Thiamethoxam or Dinotefuran	All	4A
Fourth	Adults declining	Pylon	Chlorfenapyr	Immatures	12B
Fifth	Adults declining	Pedestal	Novaluron	Immatures	15

High thrips pressure or tospovirus present, with Conserve:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Low	Conserve	Spinosad	All	5
Second	Rising	Pylon	Chlorfenapyr	Immatures	12B
Third	Peak	Safari	Dinotefuran	All	4A
Fourth	Peak	Mesurol or Tame and Orthene	Methiocarb or Fenpropathrin and acephate	All	1A and 3
Fifth	7 days after adult peak	Pedestal	Novaluron	Immatures	15

High thrips pressure or tospovirus present, without Conserve:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Low	Aria	Flonicamid	All	9C
Second	Rising	Safari	Dinotefuran	All	4A
Third	Peak	Overture	Pyridalyl	All	unk
Fourth	Adults declining	Pedestal	Novaluron	Immatures	12B

Whiteflies

Low to normal whitefly pressure:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Low	BotaniGard	*Beauveria bassiana*	All	n/a
Second	Rising	Distance or Pedestal	Pyriproxifen Novaluron	Immatures/reduces ovipositioning Immatures	7D 15
Third	Rising	Judo	Spiromesifen	Immatures and pupae/translaminar	23
Fourth	Peak	Endeavor or Aria	Pymetrozine or Flonicamid	Immatures and adults	9B 9C

Normal to high whitefly pressure:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Normal to high	Safari Marathon Flagship Celero TriStar	Dinotefuran Imidacloprid Thiamethoxam Clothianidin Acetamiprid	Immatures and adults	4A
Second	Rising	Distance or Pedestal	Pyriproxifen or Novaluron	Immatures/reduces ovipositioning Immatures	7D 15
Third	Rising	Judo	Spiromesifen	Immatures and pupae/translaminar	23
Fourth	Declining	Endeavor or Aria	Pymetrozine or Flonicamid	All/stops ovipositioning	9B 9C

Fall 2012 Bedding Plant IPM results

Christine Casey, University of California, Davis Department of Entomology

Goal: Compare the effect of various IPM treatments for root rots used in two different growing media on plant quality during production and post-harvest. Work was done in October and November 2012 at a grower in the south San Francisco Bay area. Funding for the project was provided by the California Department of Food and Agriculture.

Plants: Iceland poppy; Pansy 'Mammoth Masquerade'; Snapdragon 'Sonnet Rose'; and Viola 'Sorbet Coconut'. Plugs were moved to six packs on October 3 and treatments were applied weekly from October 10 to November 14.

Media: grower's in-house mix (peat/vermiculite) or commercial peat-based biocontrol mix with *Bacillus subtilis* premixed in the media.

Treatments:

Product	Active ingredient(s)	Rate	Target pests
Ag1000™	Multiple organisms	1:500	Plant growth promoter; not labeled for disease control
Cease®	*Bacillus subtilis* QST 713 strain	4 oz./100 gal.	*Phytophthora* spp.
RootShield Plus	*Trichoderma harzianum* Rifai strain T-22 *Trichoderma virens* strain G-41	4 oz./100 gal.	*Pythium* and *Phythophthora* spp.
Untreated control	n/a	n/a	n/a

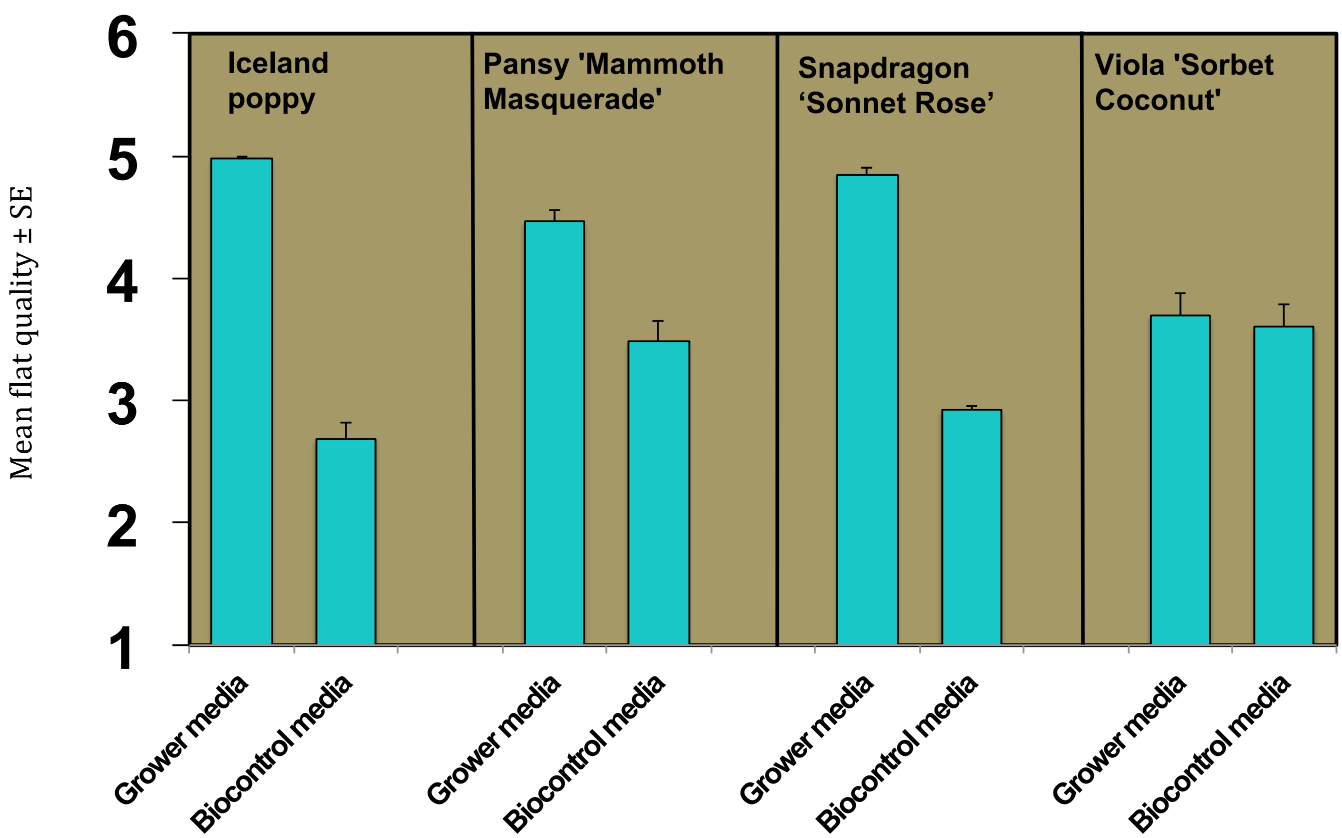
Each sample unit was one flat of 6 six-packs; there were 12 replications of each treatment.

Assessments: Flats were assessed for quality on October 26 and November 9 using a one to five (lowest to highest) visual assessment scale. Soil samples were collected at the end of the trial to determine if any species of pythium were present. Post-harvest evaluations were conducted from November 19 to 28.

Results:

Overall plant quality: As shown below, overall quality was better in the grower media. Testing revealed a fertility problem with the biocontrol media that led to high EC values.

1 = lowest quality and 5 = highest quality.



Effect of each treatment on flat quality in the grower or biocontrol media by crop:

Iceland poppy		
Treatment	**Mean quality grower mix Oct. 26/Nov. 9**	**Mean quality biocontrol mix Oct. 26/Nov. 9**
Control	5/5	3.42/3
Ag1000™	4/4.92	2.67/2.75
Cease®	5/5	2.67/2.5
RootShield Plus	4/5	2.25/2.5

Pansy 'Mammoth Masquerade'		
Treatment	**Mean quality grower mix Oct. 26/Nov. 9**	**Mean quality biocontrol mix Oct. 26/Nov. 9**
Control	4.42/4.25	2.58/3.25
Ag1000™	3.83/4.67	2.58/3.5
Cease®	4/4.67	2.75/3.25
RootShield Plus	3.75/4.25	2.92/3.92

Snapdragon 'Sonnet Rose'		
Treatment	**Mean quality grower mix Oct. 26/Nov. 9**	**Mean quality biocontrol mix Oct. 26/Nov. 9**
Control	4.83/4.83	4.92/2.92
Ag1000™	4.67/4.75	4.08/2.92
Cease®	4.67/4.92	5/2.92
RootShield Plus	4.5/4.92	4.92/2.92

Viola 'Sorbet Coconut'		
Treatment	**Mean quality grower mix Oct. 26/Nov. 9**	**Mean quality biocontrol mix Oct. 26/Nov. 9**
Control	3.33/3.25	3.08/3.75
Ag1000™	3.92/4.33	2.75/3.08
Cease®	3.5/3.17	3.33/3.83
RootShield Plus	3.25/4	3.5/3.75

Post-harvest effects: Only plants in the grower media were evaluated since the poor quality of the biocontrol media plants rendered them unsalable. No differences were observed between any of the treatments.

Plant disease: Soil samples were collected from the control treatments and the potting area on November 9 for *Pythium* spp. analysis. Only the media from the viola plants was found to contain *Pythium* spp.

Conclusions: The plants grown in the biocontrol mix were generally of poor quality due to a fertility problem with the media. The poppy, pansy, and snapdragon plants produced in the grower mix were free of pathogens and of good quality, even when no pesticide was applied. Viola plants did have some *Pythium* spp. infection; both Ag1000™ and RootShield Plus applications resulted in quality that was improved relative to the control. Cease® is not labeled for control of this pathogen.

Management Rotations for Integrated Pest Management of Bedding and Container Color Plant Insect and Mite Pests

Christine Casey, Department of Entomology and Nematology, University of California, Davis

Bedding and container color plants have a short cropping time, high quality expectations, and multiple pests. Effective pest management in these crops includes monitoring, fast-acting biological control agents, and pesticide rotation. The following recommendations consider these factors and are intended to be used in conjunction with a monitoring program that uses yellow sticky cards and plant inspections.

MOA group = Insecticide Resistance Action Committee pesticide mode-of-action group

Fungus gnats and shore flies

Treatment	Yellow stick card counts	Trade name	Common name	Life stages targeted	MOA group
First	Release at start of crop	Entomite-M	*Hypoaspis miles*	Larvae	n/a
Second	Low	Gnatrol	*Bacillus thuringiensis israelensis*	Larvae	11A1
Third	Rising	Distance	Pyriproxifen	Larvae/reduces ovipositioning	7D
Fourth	Peak	Citation	Cyromazine	Immatures	17

Twospotted spider mites (TSSM)

Low to normal mite pressure:

Treatment	TSSM lifestages observed	Trade name	Common name	Life stages targeted	MOA group	Compatibility with *P. persimilis*
First	Low	Spidex	*Phytoseiulus persimilis*	all	n/a	n/a
Second	Mostly eggs	Hexygon	Hexythiazox	Eggs/stops ovipositioning	10A	yes
Third	Immatures	Floramite	Bifenazate	All	25	no
Fourth	Adults	Akari	Fenpyroximate	All/stops ovipositioning	21A	no

Normal to high mite pressure with mostly eggs and immatures:

Treatment	TSSM lifestages observed	Trade name	Common name	Life stages targeted	MOA group	Compatibility with *P. persimilis*
First *Select one based on count of eggs and immatures*	Mostly eggs	Hexygon	Hexythiazox	Eggs/stops ovipositioning	10A	yes
	Mostly immatures	TetraSan	Etoxazole	Immatures	10B	no
Second	Immatures /adults	Kontos	Spirotetramat	All/systemic	23	unknown
Third	Adults	Pylon	Chlorfenapyr	All/translaminar	12B	no
Fourth	Adults	Akari	Fenpyroximate	All/stops ovipositioning	21A	no

*Except if applied by drench and there were will be no contact with drenched material

Normal to high mite pressure with mostly adults:

Treatment	TSSM counts	Trade name	Common name	Life stages targeted	MOA group	Compatibility with *P. persimilis*
First	All lifestages with adults predominant	Floramite	Bifenazate	All	25	no
Second	All	Kontos	Spirotetramat	All/systemic	23	unknown
Third	All	Pylon	Chlorfenapyr	All/translaminar	12B	no
Fourth	Adults declining, eggs increasing	Hexygon	Hexythiazox	Eggs/stops ovipositioning	10A	yes

*Except if applied by drench and there were will be no contact with drenched material

Western flower thrips

Low or normal thrips pressure:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Low	Azatin	Azadiractin	Immatures	18B
Second	Rising	BotaniGard or Naturalis	*Beauveria bassiana*	All	n/a
Third	Peak	Flagship or Safari	Thiamethoxam or Dinotefuran	All	4A
Fourth	Adults declining	Pylon	Chlorfenapyr	Immatures	12B
Fifth	Adults declining	Pedestal	Novaluron	Immatures	15

High thrips pressure or tospovirus present, with Conserve:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Low	Conserve	Spinosad	All	5
Second	Rising	Pylon	Chlorfenapyr	Immatures	12B
Third	Peak	Safari	Dinotefuran	All	4A
Fourth	Peak	Mesurol or Tame and Orthene	Methiocarb or Fenpropathrin and acephate	All	1A and 3
Fifth	7 days after adult peak	Pedestal	Novaluron	Immatures	15

High thrips pressure or tospovirus present, without Conserve:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Low	Aria	Flonicamid	All	9C
Second	Rising	Safari	Dinotefuran	All	4A
Third	Peak	Overture	Pyridalyl	All	unk
Fourth	Adults declining	Pedestal	Novaluron	Immatures	12B

Whiteflies

Low to normal whitefly pressure:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Low	BotaniGard	*Beauveria bassiana*	All	n/a
Second	Rising	Distance or Pedestal	Pyriproxifen Novaluron	Immatures/reduces ovipositioning Immatures	7D 15
Third	Rising	Judo	Spiromesifen	Immatures and pupae/translaminar	23
Fourth	Peak	Endeavor or Aria	Pymetrozine or Flonicamid	Immatures and adults	9B 9C

Normal to high whitefly pressure:

Treatment	Yellow sticky card counts	Trade name	Common name	Life stages targeted	MOA group
First	Normal to high	Safari Marathon Flagship Celero TriStar	Dinotefuran Imidacloprid Thiamethoxam Clothianidin Acetamiprid	Immatures and adults	4A
Second	Rising	Distance or Pedestal	Pyriproxifen or Novaluron	Immatures/reduces ovipositioning Immatures	7D 15
Third	Rising	Judo	Spiromesifen	Immatures and pupae/translaminar	23
Fourth	Declining	Endeavor or Aria	Pymetrozine or Flonicamid	All/stops ovipositioning	9B 9C

Field Identification Guide for

Light Brown Apple Moth

IN CALIFORNIA NURSERIES

Light brown apple moth (LBAM) (*Epiphyas postvittana*) is an important invasive leafroller pest (Tortricidae) currently infesting several coastal areas of California. The moths can migrate from infested wildlands and landscapes into nurseries and other agricultural crops. They are a regulatory concern because they might be shipped long distances with nursery stock or other agricultural commodities to noninfested areas.

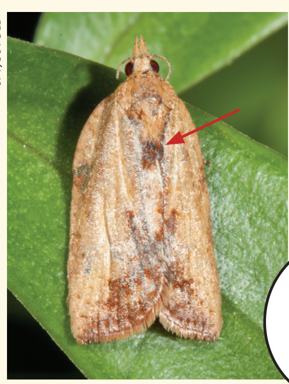
S. TJOSVOLD

ADULTS

LBAM male moths are often trapped with sticky traps containing a specific synthetic LBAM female pheromone as an attractant. Other insects or moths may accidently get stuck in these traps. Moths are sometimes seen flying at dusk, dawn or when disturbed on plants.

- **Males:** 6 to 10 mm (about 0.3 inch), color and markings vary greatly from distinctly two-toned (light brown/dark brown) to light brown with a V-shape or oblique markings across the back (A-D), costal fold, expanded outer edge of forewing that folds over as a flap, present (D).
- If a moth is caught upside down with wings in the trap glue, look for the dark mottling (speckling) on the light-colored hind wing (E).

Male light brown apple moths caught in pheromone traps. The wing-color pattern of males can be highly variable. Males have a costal fold (arrow) on the forewing.



S. TJOSVOLD

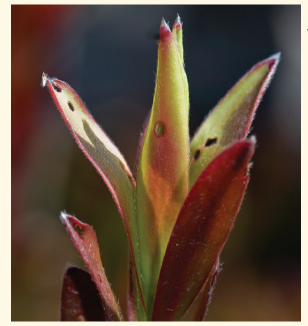
- **Females:** 7 to 13 mm (about 0.4 inch), generally more uniform light brown than the male, when wings are folded back there is a variable single dark wing spot (red arrow) towards the head.

PLANT SYMPTOMS

Look for larval feeding and folded or rolled leaves. These are found on new shoot growth or other soft leaf tissue, often near the tips. Pull apart the shelter and capture the larva to examine it more closely, either with the naked eye or a hand lens in the field, or later with the aid of a dissecting microscope.

S. TJOSVOLD

Symptoms of surface feeding and webbing on the leaf surface by young larvae on *Myrica californica* after webbed leaves were pulled apart.



S. TJOSVOLD

Feeding symptoms on *Leucodendron* by an older larva capable of chewing through leaves when they were appressed (pressed together).

S. TJOSVOLD

Leafroll of *Alstroemeria* leaves formed by an older larva capable of pulling leaves together.

S. TJOSVOLD

Shelter formed from leaves pulled together with silken webs on *Leucodendron* by an older larva.

EGGS

Eggs are not easily observed by nursery scouts or other field inspectors. Eggs are creamy-white to light-green when first laid by the adult and slightly overlapping each other in masses that typically contain 20 to 50 eggs (left egg mass). As eggs develop, they become yellow (middle egg mass) and then have a dark spot as embryos mature (right egg mass).

S. TJOSVOLD

S. TJOSVOLD

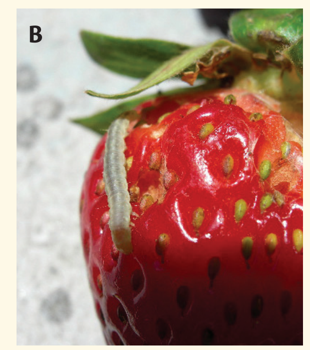
PUPAE

LBAM pupae are found inside leaf rolls and plant material webbed tightly together. Pupae start out green, then turn deep red-brown, and finally translucent golden brown right before eclosion. LBAM pupae and those of other leafroller species have 2 rows of spines on each abdominal segment (arrows).

S. TJOSVOLD

S. TJOSVOLD

USDA



M. BOLDA, UCCE SANTA CRUZ

Fruit feeding usually occurs when a larva creates a shelter by webbing fruit to an adjacent leaf as in blackberry (A) or to the calyx (leafy appendage on top) of a strawberry (B).

For more information, visit the Floriculture and Ornamental Nurseries Pest Management Guidelines http://ipm.ucanr.edu/PMG/selectnewpest.floriculture.html.

UC CE

Authors: Steven A. Tjosvold, Neal B. Murray, University of California Cooperative Extension; Marc Epstein, Obediah Sage, California Department of Food and Agriculture; Todd Gilligan, Colorado State University.

UC IPM

Funding provided by the California Department of Food and Agriculture's Specialty Crop Block Grant.

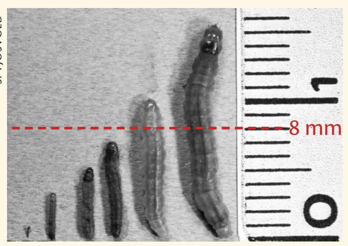
LARVAE

Use the following identification characteristics for larvae 8 mm or larger. These characteristics do not lead to positive LBAM identification. They do provide evidence of a suspect LBAM larva.

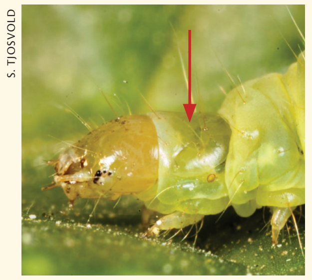
Head, body, legs, and hair color

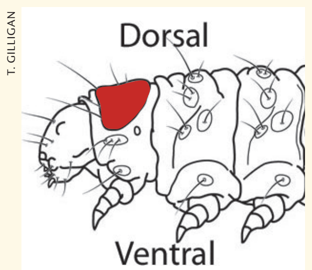
LBAM larvae:

- Yellow to light-brown heads; first instar larvae have dark brown or black heads.
- Yellow to medium-green bodies depending on what they are feeding on.
- Body hairs are light colored.
- Legs are light colored and can have darker (light brown) tips.



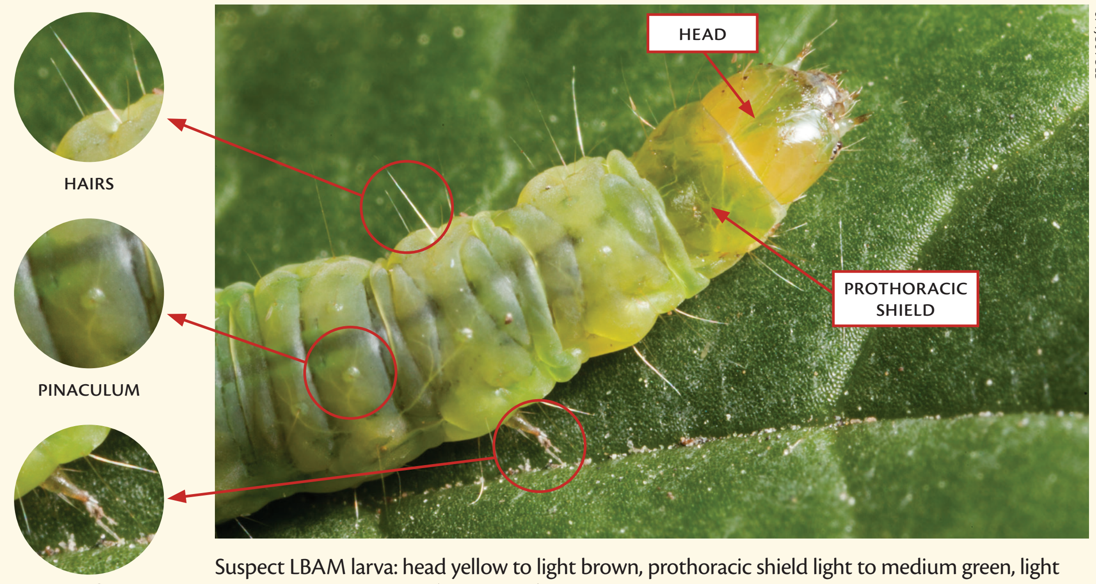
Comparative size (mm) of larvae. Left to right, recently emerged first instar to consecutively later instars (2nd to 6th).





Prothoracic shield

The prothoracic shield is a plate-like structure found on the body segment right behind the head. The prothoracic shield of LBAM is greenish brown and has no dark or distinctive markings.



Suspect LBAM larva: head yellow to light brown, prothoracic shield light to medium green, light hairs, light legs, pinacula (pinaculum) round. Pinacula are flattened hardened plates that bear hairs.

There are other leafroller larvae that look similar and could trigger an unneeded regulatory hold or application of insecticide. This guide covers the most important features seen with the naked eye or 10X hand lens that help field inspectors and scouts distinguish LBAM from other look-alike larvae that are found in nurseries and other agricultural crops.

Field identification is imperfect. For regulatory purposes, identification of LBAM is made by experts using morphological features or genetic markers. More distinguishing features can be found in the online key: Tortricids of Agricultural Importance (TortAI) http://idtools.org/id/leps/tortai/information.html.

	LIGHT BROWN APPLE MOTH *Epiphyas postvittana*	ORANGE TORTRIX *Argyrotaenia franciscana*	OMNIVOROUS LEAFROLLER *Platynota stultana*	WESTERN AVOCADO LEAFROLLER *Amorbia cuneana*	APPLE PANDEMIS MOTH *Pandemis pyrusana*
	 	 	 	 	 
HEAD	Black (1st instar); yellow to light brown (2nd – 6th instars)	Tan to light brown	Black (1st instar); light to dark brown (2nd – 5th instar)	Tan markings, dark band on the side of the head	Tan to light green
SHIELD	Black (1st instar); light to medium green (2nd – 6th instar)	Tan to light brown	Light to dark brown along borders to dark throughout	Green and usually with dark brown border on lateral edges	Light green – early instars may have dark lateral marks
BODY	Light to medium green	Straw to light green	Cream to light green	Cream to green	Medium to dark green
PINACULA	Round	Round	Pronounced, oval, or variable in shape	Round	Round
LEGS	Not dark	Not dark	Not dark	Light yellow to brown	Not dark

P34-4

RAPID DETECTION OF THREE TORRADOVIRUS SPECIES BY USING DIGOXIGENIN-LABELED RIBOPROBES AND TISSUE PRINT HYBRIDIZATION

Inmaculada Ferriol[1], Dorivaldo Marques da Silva Junior[2], Bryce W. Falk[1]
[1]Department of Plant Pathology, University of Davis California, 95616, CA, USA; [2]CAPES Foundation, Ministry of Education of Brazil, 70040-020, Brazil

In a time span of just two decades, a new group of whitefly-borne viruses, the torradoviruses, have been discovered affecting tomatoes (*Solanum lycopersicum* L.) and other *Solanaceae* species in many parts of the world. The newly established genus *Torradovirus* includes the species: *Tomato torrado virus* (ToTV), first found in Europe, and afterward in Central America and Australia; *Tomato apex necrosis virus* (ToANV), present in Mexico; *Tomato chocolate spot virus* (ToChSV) and *Tomato chocolate virus* (ToChV), both found in Guatemala. Recently, a new torradovirus species has been discovered in Europe, *Lettuce necrotic leaf curl virus* (LNLCV). And another torradovirus species found in Southern California (USA) in the mid 1980s has been characterized, *Tomato necrotic dwarf virus* (ToNDV). All tomato-infecting torradoviruses cause very similar symptoms including necrosis of leaves, stems and even fruits, reducing yield and quality. All known torradoviruses are transmitted by whiteflies, which suggests great potential of further torradovirus spread. There is need for rapid, specific and reliable methods of torradovirus identification. In this work, we developed a very rapid and simple procedure to detect and identify three torradovirus species (ToANV, ToChSV and ToTV) based on molecular hybridization of tissue prints with non-radioactive probes. To test specificity, each probe was hybridized to total RNA extractions from isolates with different genetic variability and geographic origin. Our results showed that each probe detected all isolates from the same species with high specificity. To test sensitivity, each probe was hybridized to serial dilutions of RNA giving similar level of detection. Finally, to test the possible use of these probes in fields, each probe was hybridized to tomato and tomatillo-infected tissue prints and total RNA extractions from infected plants. These results show that these digoxigenin-labeled RNA probes can be used for the effective and accurate detection of the torradovirus species: ToANV, ToChSV and ToTV.

P34-5

PEPINO MOSAIC VIRUS RDRP-POL DOMAIN IS A NECROSIS-INDUCING ELICITOR ENCODED BY BOTH SYMPTOMATIC AND ASYMPTOMATIC ISOLATES, WHILE TGP3 MODULATES VIRAL ACCUMULATION

Raquel N. Sempere[1], Cristina Gómez-Aix[1], Beata Hasiów-Jaroszewska[2], María Amelia Sánchez-Pina[1], Miguel A. Aranda[1]
[1]Centro de Edafología y Biología Aplicada del Segura (CEBAS)- CSIC, PO Box 164, 30100 Espinardo, Murcia (Spain); [2]Institute of Plant Protection-National Research Institute, Department of Virology and Bacteriology, ul. Władysława Węgorka 20, 60-318 Poznán (Poland)

Pepino mosaic virus (PepMV; genus *Potexvirus*, family *Alphaflexiviridae*) is an emerging pathogen responsible for significant economic losses in tomato crops. PepMV causes on its hosts a diversity of symptoms, ranging from mild mosaics to systemic necrosis. Recently, the genetic determinant of necrosis induction was shown to be amino acid 67 of PepMV TGBp3 (Hasiów-Jaroszewska & Borodynko, 2012, *Arch. Virol*. 157:337-341). By expressing necrogenic and non-necrogenic versions of PepMV TGBp3 from different genetic backgrounds under different conditions, we have shown that necrosis development correlated with high virus titers, and that glutamic acid at position 67 was necessary but no sufficient for necrosis induction. In necrotized leaf areas, accumulation of reactive oxygen species (H_2O_2 and O_2-), significant cellular damages, and induction of oxylipins biosynthesis genes occurred both in tomato and *Nicotiana benthamiana*. A series of constructs designed for transient expression of each PepMV protein were agroinfiltrated in *N. benthamiana*. Tissues agroinfiltrated with TGBp3 showed symptoms of faint vein necrosis at 3 days post-inoculation, independently of whether the protein belonged to necrogenic or non-necrogenic isolates. Interestingly, the RdRp Pol domain expression triggered a necrosis phenotype resembling a hypersensitive response, again independently of the origin of the protein. When tissues necrotized after agroinfiltration were analyzed, the histochemical modifications induced by RdRp Pol expression clearly resembled those of tissues necrotized after viral infection, whereas TGBp3 expression did not. Altogether, these results suggested that PepMV RdRp-Pol domain is a necrosis-inducing elicitor encoded by both symptomatic and asymptomatic isolates, whereas TGBp3 modulates viral accumulation and, by doing so, RdRp Pol domain expression levels.

P34-6

TRANSCRIPTOME RESPONSES OF LEAFHOPPER VECTORS FEEDING ON MAIZE INFECTED WITH SEMI-PERSISTENTLY AND PERSISTENT PROPAGATIVELY TRANSMITTED VIRUSES

Bryan J. Cassone[1,2], Fiorella Cisneros[2], Saragna Wijeratne[3], Andrew Michel[2], Lucy R. Stewart[1,2], Yuting Chen[2], Pearlly Yan[2], Margaret G. Redinbaugh[1,2]
[1]USDA, ARS Corn Soybean and Wheat Quality Research; [2]Ohio State University; [3]Molecular and Cellular Imaging Center, Ohio Agriculture Research and Development Center

More than 75% of plant-infecting viruses are dependent on insect vectors for transmission to new hosts, but molecular and cellular mechanisms associated with transmission are not well defined. The black-faced leafhopper (*Graminella nigrifrons*) transmits two viruses to maize: the semi-persistently transmitted *Maize chlorotic dwarf virus* (MCDV), and the persistently and propagatively transmitted *Maize fine streak virus* (MFSV). To gain information on the vector genome, and to identify pathways involved in vector – virus – host interactions, the transcriptome response of *G. nigrifrons* to feeding on MFSV and MCDV-infected plants and transcriptomes of competent MFSV vectors, MFSV hosts and non-hosts were characterized using RNA-Seq and RT-qPCR. Within four hours of feeding on virus-infected plants, transcripts implicated in the innate immune response and energy production were induced in leafhoppers. These responses were unexpected for MCDV, a virus that is limited to the insect foregut during transmission. Transcripts for hemocoel and cell-membrane linked immune responses also increased in insects feeding on MFSV-infected maize. After MFSV infection, *G. nigrifrons* showed increased accumulation of transcripts involved in cytoskeleton organization and viral A-type inclusion proteins. In competent vectors, gene expression differences were limited but several key immune transcripts were induced, including a Toll receptor-like transcript. Expression of virus genes in the insects indicated a role for the non-structural MFSV 3 gene in the insect, but not the non-structural MFSV 4 gene. The results of this study begin to define functional roles for specific leafhopper genes and pathways in the virus transmission process.

Specific detection of three *Torradovirus* species with digoxigen-labeled probes.

Dorivaldo Marques da Silva [1], Inmaculada Ferriol [2], Bryce Falk [2]

[1] *CAPES Foundation, Ministry of Education of Brazil, Brasília – DF, Zip Code 70.040-020 - Brazil. CAPES Scholarship - Proc. nº 5582/12-1.*
[2] *Department of Plant Pathology, University of Davis California, 95616, CA, USA*

Torradoviruses are an emerging group of picorna-like plant virus from the family Secoviridae that infect tomato and other Solanaceae species. The genus *Torradovirus* include four species: *Tomato torrado virus* (ToTV), first found in Europe, and afterward in Central America and Australia; *Tomato apex necrosis virus* (ToANV), present in Mexico; *Tomato chocolate spot virus* (ToChSV) and *Tomato chocolate virus* (ToChV), both found in Guatemala. The symptoms caused by these viruses include chlorotic regions on the leaves that may develop to necrotic spots and holes, while the fruits show necrotic lines and frequently cracks on the surface, reducing yield and quality [1]. Even though these viruses have not yet been found in Brazil, the sudden spread of ToTV from Europe to Australia and Central America emphasize the necessity of effective methods to detect them. For that reason, we have developed digoxigenin-labelled RNA probes for the detection of three torradoviruses, ToANV, ToChSV and ToTV, through hybridization. In order to produce those riboprobes, total RNA was extracted from infected *Nicotiana Benthamiana* plants using TRIzol Reagent and used for RT-PCR with the generic primers pair described by Verbeek and colleagues [2], modified with the addition of the T7 promoter to the 5' end of the reverse primers. The RT-PCR products were purified and transcribed *in-vitro* using MEGAscriptT7kit (Invitrogen) and digoxigenin-labeled nucleotides. The RNA probes produced were purified and hybridized to total RNA extracted from plants infected with which one of the viruses and non-infected plants blotted onto nylon membranes. Anti-digoxigenin Fab fragments conjugated to alkaline phosphatase were bound to the hybridized digoxigenin-labeled probes and the chemiluminescent substrate CDP-Star was added in order to produce light. X-ray films were exposed to the membranes and developed. The X-ray films showed that each probe was able to hybridize only to the target virus, while no hybridization was observed for the RNA extractions from non-infected plants or plants infected with other viruses. In conclusion, these results show that the digoxigenin-labeled RNA probes can be used for the effective and accurate detection of the three *Torradovirus*species.

Presentation type: Abstract for voluntary poster presentation

Session: Agricultural biotechnology

References

Gómez P, Sempere RN, Amari K, Gómez-Aix C, Aranda MA: Epidemics of Tomato torrado virus, Pepino mosaic virus and Tomato chlorosis virus in tomato crops: do mixed infections contribute to torrado disease epidemiology?. Ann Appl Biol 2010, 156: 401-410.

Verbeek M, Tang J, Ward, LI: Two generic PCR primer sets for the detection of members of the genus Torradovirus. J Virol Methods 2012, 185:184-188.

Detection and absolute quantitation of Tomato torrado virus (ToTV) by real time RT-PCR

Jose Angel Herrera-Vásquez[a], Luis Rubio[b], Ana Alfaro-Fernández[c], Diana Elvira Debreczeni[b], Isabel Font-San-Ambrosio[c], Bryce W. Falk[d], Inmaculada Ferriol[b, e]

ABSTRACT

Tomato torrado virus (ToTV) causes serious damage and significant economic losses in tomato crops. A quantitative real-time reverse transcription-polymerase chain reaction (RT-qPCR) procedure using primers and a TaqMan® probe specific and conserved for ToTV was developed for sensitive detection and quantitation of different ToTV isolates. A standard curve using RNA transcripts enabled absolute quantitation, with a dynamic range from 10^4–10^{10} ToTV RNA copies / ng of total RNA. RT-qPCR was assayed with ToTV isolates from tomato and Solanum nigrum collected in Spain and Hungary from 2001 to 2008. This RT-qPCR assay enables a reproducible, very sensitive and specific detection and quantitation of ToTV isolates, which can be a valuable tool in disease management programs and epidemiological studies.

Abstract presented at the XVII Congress of Spanish Phytopathology in October (2014), in Lleida, Spain.

Determination of the cleavage sites of the RNA2-encoded proteins for two members of the genus *Torradovirus* by N-terminal sequencing of the virion capsid proteins

Ferriol, I.[1], Marques da Silva, D.[2], Turina, M.[3], Falk, B. W.[1]

[1] Plant Pathology Department, University of Davis California, 95616, Davis, CA, USA

[2] CAPES Foundation, Ministry of Education of Brazil, Brasilia-DF, 70040-020

[3] Istituto per la Protezione Sostenibile delle Piante, Sez. di Torino, CNR, Turin, Italy

Recently, the genus *Torradovirus* was created within the family *Secoviridae* and has several members: *Tomato torrado virus* (ToTV), *Tomato marchitez virus* (ToMarV) (also named as *Tomato apex necrosis virus*, ToANV), *Tomato chocolate spot virus* (ToChSV), *Tomato chocolate virus* (ToChV), *Lettuce necrotic leaf curl virus* (LNLCV) and *Cassava torrado-like virus* (CsTLV). Torradoviruses have bipartite genomes consisting of two single-stranded plus-sense RNAs. The first RNA (RNA 1) is ca. 7 kb and has one open reading frame (ORF), which encodes replication-associated proteins including the protease, helicase and RNA-dependent RNA polymerase (RdRp). The second RNA (RNA 2) is ca. 5 kb and has two ORFs. The ORF1 in the RNA 2 is unique for torradoviruses, but its function is still unclear. The ORF2 has coding regions for a putative movement protein and the three capsid proteins. Other members of the family *Secoviridae* also have a polyprotein strategy, where the polyprotein is cleaved by a 3C-like cysteine proteinase. In addition, the members of the family *Secoviridae* which have a His as the proteinase substrate binding pocket, have a Glutamine (Gln =Q) at the -1 position of the cleavage site. Little is known about the polyprotein strategy and the cleavage site recognition of the proteinase of viruses in the genus *Torradovirus*. In this work, the cleavage sites in the RNA 2 ORF2-encoded protein of two torradoviruses (ToANV and ToChSV) were determined. First, the viral capsid proteins were purified and separated in a SDS-PAGE gel, blotted onto a PVDF membrane and used for N-terminal sequencing. These results showed that the amino acid at the -1 position of the cleavage site is a Gln (Q). Second, amino acid sequence comparison of different isolates of ToMarV confirmed that this Gln (Q) is conserved among different isolates of ToMarV and among members of the genus *Torradovirus*.

This is an example showing the handout on Tomato-infecting torradoviruses. This was distributed to tomato growers in California in February 2014.

Tomato torradoviruses: New and Important Viruses Affecting Tomatoes, but not yet in California

Inmaculada Ferriol and Bryce Falk, Department of Plant Pathology, University of California, Davis, CA 95616. iferriolsafont@ucdavis.edu; bwfalk@ucdavis.edu)

In the early 2000's two new diseases of tomatoes were described: "Marchitez" for a disease found in the Sinaloa state of Mexico and "Torrado" for a disease of tomatoes, originally reported from Spain. Both diseases were subsequently shown to be caused by two new, but related viruses. *Tomato apex necrosis virus* (ToANV) was the name originally used to describe the causal agent of Marchitez and *Tomato torrado virus* (ToTV) was the name used to describe the causal agent of Torrado. Since their discovery, ToANV has continued to be a major concern in Mexico, ToTV has been reported from more countries in Europe, Australia, South and Central America, and some additional viruses causing similar diseases have been discovered. One of these is *Tomato chocolate spot virus*, causing the chocolate spot disease of tomatoes in Guatemala. Most torradoviruses have plant host ranges and cause disease in tomatoes and sometimes peppers and tomatillo, but this year a new torradovirus was discovered from lettuce in Europe. All tomato-infecting torradoviruses cause very similar symptoms. These include necrosis of leaves, stems and even fruits, but if young plants are infected, the apical leaves suffer necrosis and plants may die (See Fig. 1). These symptoms can resemble those caused by other viruses, such as *Tomato spotted wilt virus*, and when these diseases were first discovered, this led to confusion. Now torradoviruses can be positively identified using several laboratory-based analyses. All known torradoviruses are transmitted to plants by whiteflies. What is a little bit unusual, and in contrast to other whitefly-transmitted plant viruses, whiteflies of different genera can be efficient vectors. *Bemisia tabaci*, which is common to southern California, is an efficient vector but so is the common greenhouse whitefly, *Trialeurodes vaporariorum*. As the greenhouse whitefly is common all over California, this raises questions about the potential for spread of torradoviruses into California. So far, viruses that are transmitted by *B. tabaci* (such as *Squash leaf curl virus*) have remained restricted to the southern California growing regions as *B. tabaci* is also restricted there. However, *B. tabaci* and *T. vaporariorum* overlap in southern California raising the potential for torradoviruses to spread north with *T. vaporariorum*, if torradoviruses do enter southern California. One torradovirus has so far been reported from southern California. This is *Tomato necrotic dwarf virus*, which was discovered in the mid 1980's, but failed to establish and only this year was this virus characterized and shown to be a torradovirus.

We have an ongoing torradovirus research effort at UC Davis. We grow torradoviruses only in the UC Davis Biosafety 3 Contained Research Facility (http://crf.ucdavis.edu/) a state-of-the-art facility designed for research on exotic pests and pathogens that potentially threaten California agriculture. We have developed tools allowing for rapid identification of all known torradoviruses and we have collaborated with seed companies to assess tomato germplasm for torradovirus resistance. There is excellent resistance in several tomato breeding lines and even some cultivars. So this short report is meant to bring torradoviruses to your attention. So far so good, but we need to keep on alert. If you have suspicious symptoms in your plants and see whiteflies present, we can test for torradoviruses and give you the results.

Figure 1. Tomato plants infected with *Tomato apex necrosis virus*. Top 2 plants show typical necrotic symptoms in the young leaves. These symptoms typically show necrosis along the veins. Bottom left shows a tomato plant naturally-infected in the field. Note necrotic symptoms which are most common in the apex, or growing part of the plant. Bottom right photo shows typical necrotic ring symptoms on tomato fruits.

Project 62

Grow Your Groceries Training Program Evaluation Report

June 2014

Grow Your Groceries Training Program
Year One Evaluation Report

Submitted to:

Soil Born Farms
PO Box 661175
Sacramento, CA 95866

Submitted by:

LPC Consulting Associates, Inc.
2015 J Street, Suite 205
Sacramento, CA 95811
www.lpc-associates.com

June 2014

Table of Contents

Section 1 Background and Introduction **1**

Section 2 Evaluation Approach **3**

Section 3 Program Description **5**

Section 4 Participants and Program Participation **8**

4.1 Description of Participants 8

4.2 Participation by Program Component 10

Section 5 Evaluation Findings **11**

5.1 Participant Pre-Post Survey Results 11

5.2 Participant Interview Findings 17

5.3 Staff Interview Findings 23

Section 6 Recommendations and Next Steps **28**

Attachments **31**

Section 1 Background and Introduction

Soil Born Farms is a non-profit organization located in Sacramento, California that has a history of serving the region through supporting local food production, community education, and access to healthy food. As one of the only urban farm education centers in the Sacramento region, Soil Born farms receives numerous requests for grower training opportunities each year. Typically, interested individuals have a strong desire to farm, but lack the skills, knowledge, experiences, and relationships to successfully grow food for market. Producing in and for the urban environment requires specialized training, which can help growers farm in small spaces using sustainable practices.

To respond to demand and encourage urban production of healthy food, Soil Born Farms created the Grow Your Groceries (GYG) Training Program. Building on staff's knowledge of urban farming developed over years of experience, the Program provides hands-on farming experience and education on a myriad of agricultural and business topics. The intent is to help participants develop the skills and knowledge to grow specialty crops (fruits, vegetables, and nuts) on urban lands, sell within urban markets, and compete in the agriculture industry. It is the hope that the GYG Program will create a pipeline that draws new farmers to the agriculture industry and directs them into farming opportunities that match their interests and capacity.

In October 2011, Soil Born Farms received a Specialty Crop Block Grant from the California Department of Food and Agriculture (CDFA) to implement the GYG Program, providing instruction geared toward the growth and expansion of urban food production. The Program content and structure directly responded to the increasing interest in and need for urban agriculture opportunities in the Sacramento region. During the first year of implementation, the Program incorporated several core activities, while offering varying approaches and intensity for beginning farmers and home gardeners. The interrelated Program components included: (1) a series of crop production and business courses; (2) site visits to working farms; (3) field hours on an urban farm; and (4) optional one-on-one technical assistance.

The overall objective of GYG is to create a comprehensive and replicable program that trains prospective urban farmers to produce healthy food on urban lands, and process, distribute, and market their crops in urban environments. With GYG, Soil Born Farms aims to establish a systems approach for how new and potential farmers are trained and prepared to enter the market as owners or employees of an operating farm. Increased local production leads to increased supply of fresh produce to the Sacramento region and its residents. Access to more healthy foods grown locally can lead to positive impacts for community health and environmental health, especially for lower income areas.

In June 2013, Soil Born Farms contracted with LPC Consulting Associates, Inc. to conduct a 12-month evaluation study of the first cohort[1] of the Grow Your Groceries Program. The GYG evaluation included a combination of quantitative and qualitative data collection strategies to document the implementation process and determine immediate outcomes of the Program. This report presents findings from the evaluation of the GYG Program during the first year of implementation. It includes analysis of cohort

[1] The first cohort included GYG participants who took the course from March 2013 to February 2014.

one class participation data, participant Pre- and Post-Survey results, participant interview findings, and staff interview findings. Contingent upon additional program and evaluation funding, subsequent evaluation reports will include additional cohorts and the opportunity to compare results of cohorts over time.

Section 2 Evaluation Approach

The evaluation of the Grow Your Groceries Program included a combination of quantitative and qualitative data collection strategies to document the implementation process and determine immediate outcomes of the Program. The primary purpose of the evaluation was to establish a standardized approach for assessing the value of the training program, to identify what participants learn from the program, and to determine how participants implement what they learn. The evaluation also sought to identify successes, challenges, and lessons learned to generate recommendations for program improvement.

Evaluation Design

To initiate the evaluation for Grow Your Groceries, LPC developed an evaluation design in collaboration with Project partners. The evaluation design included both process and outcome components; the process evaluation focused on documenting Project activities and implementation, while the outcome evaluation aimed to discern the impact of the Program on participants, assessing "lessons learned" by training participants, aligned with topic learning objectives, as well as outcomes associated with the application of what participants learned from the training. Based on input from Soil Born staff, LPC drafted a logic model for the Program (**Attachment A**).

Year One Evaluation Activities

The logic model and evaluation design provided a framework to identify data needs, which informed the plans for data collection. The evaluation team developed a number of data collection tools, including participant surveys and interview protocols. Copies of these data collection forms are included in **Attachment B**.

LPC focused the evaluation on the participants of the Grow Your Groceries training program, utilizing process data collected by Soil Born Farms to track the number of participants and class participation rates, and using four additional methods of data collection, which included:

- **Participant Pre-Post Survey:** In order to learn how the program impacts participants, LPC staff developed a Pre- and Post-Test to be administered at the beginning and end of the GYG Program. The questionnaire was developed in close collaboration with Soil Born Farms staff, to ensure the content measures aligned with the intended learning objectives and anticipated outcomes of the Program. The Pre-Survey served as a baseline measure of where participants are when they begin GYG, while the Post-Survey assessed what participants learn or acquire from the Program. The use of pre-post comparison provided a quantitative measure of change on selected participant outcomes. Because the evaluation began after the start of the Program, cohort one participants were asked to complete a retrospective Pre-Survey, so that they had an opportunity to reflect on the trajectory of their learning. It is recommended that all subsequent cohorts complete the Pre-Survey before participation in the Program.

- **Interviews with Program Participants:** LPC staff conducted telephone interviews with cohort one participants who completed the training program. The interviews gathered qualitative data regarding the personal and professional development growth for each of these participants. The interviews elicited personalized information about what participants learned from the trainings and technical assistance, how they have utilized what they learned, and how what they learned will help them in the future.

- **Staff Interviews:** LPC staff also interviewed SBF staff responsible for implementing the training program, to gather information about the implementation process, overall successes and challenges, as well as the lessons learned along the way. Staff interviews helped to document Program activities and gathered reflective input to identify overarching recommendations for improvement.

- **Participant Follow-Up Survey:** LPC staff drafted an online Follow-Up Survey for participants to complete six months post-Program. This survey is intended to augment the immediate outcomes reported after program completion, and solicit input related to ways participants have applied lessons learned, new practices, or how they have accessed new resources through a peer network or other sources. GYG Program staff will administer the Participant Follow-Up Survey to cohort one students in August 2014 (six months following completion of the Program). Survey analysis will identify any changes associated with the trainings related to urban farming expansion, successes, and challenges.

This evaluation report includes the analysis of all data collected with a narrative summary of findings. It contains an assessment of Program implementation and accomplishments, and findings that describe Program components, levels of participation, and changes at the individual level over time. It is the hope that findings from the evaluation inform program development and contribute to program sustainability.

Ongoing Evaluation

Contingent upon additional Program funding and evaluation resources, the evaluation study of the Grow Your Groceries Program will evolve to include additional cohorts, as more participants complete the Program. The evaluation will continue to collect data through the system established during, and may expand to include more detailed technical assistance tracking. Additional data will allow for a comparison of cohort outcomes over time, and provide insight into the effect of programmatic changes on participant outcomes.

Section 3 Program Description

While Soil Born Farms had been growing its apprenticeship program for some time, staff began to recognize the broad spectrum of individuals in the community interested in growing food and aimed to create a program that would create an entry point into agricultural careers. The Grow Your Groceries Program represented an opportunity to expand training to reach more growers in the region. The program initially consisted of a two-day intensive workshop. Soil Born staff expanded that content and developed learning objectives and a course curriculum for the program. Those involved in curriculum development brought years of agricultural experience and expertise to the process. Others also contributed to the curriculum. California FarmLink developed content for a three-part business seminar, and several instructors used content from workshops taught in other settings.

Soil Born Farms' Grow Your Groceries Program utilized a flexible timeframe and comprehensive class series to meet the needs of both the novice and experienced urban grower. The Program focused on specialty crop production and small business management to prepare new growers for a successful career in agriculture. The intention of GYG was to prepare participants to successfully manage their own urban farm enterprise or home garden. All production and marketing classes focused exclusively on specialty crop production and intensive production in small spaces.

Target Population

The participants best-suited for the Program were amateur and aspiring hand-scale farmers and gardeners with an interest in obtaining formalized education on topics related to sustainable cultivation of organic produce. The target population included home gardeners, aspiring market gardeners, beginning farmers, and those starting or managing school and community gardens.

Two-Track Program

Grow Your Groceries offered participants two tracks based on interest and goals:

- **Urban Farmer Track:** This option included instruction on sustainable farming practices and business skills necessary for starting or working on a small farm. The course included: *14* classes, *three* educational farm visits, *16* hands-on field hours, and the opportunity for one-on-one assistance with land access and business planning. Among others, classes geared toward this track included: Goal Setting & Enterprise Analysis; Legalities & Logistics; and Marketing & Record Keeping Essentials. The price of this track was $650.

- **Home Gardener Track:** This option was designed for those interested in growing fruits and vegetables in a home, school, or community garden setting. This track provided in-depth training on garden design and sustainable annual and perennial crop production. The course included: *11* classes, *two* educational farm visits, and *eight* hands-on field hours. Among others, classes geared toward this track included: Irrigation & Water Management and Designing your Annual Vegetable Garden. The price of this track was $375.

Core Classes

The GYG Program was comprised of both core and elective classes, allowing prospective growers to create an individualized plan to meet their personal goals. Core classes were offered twice a year and were designed to help all growers farm successfully. Most classes were three to four hours long and included a combination of classroom presentation, and hands-on, interactive activities. The core set of classes began with a two-day "intensive" introduction to specialty crop production followed by an introduction to the fundamentals of site planning and basic business management.

For students enrolled in the *urban farmer* track, core classes included: Building Healthy Soil, Site Selection & Design, and Crop Planning, as well as basic business skills such as Marketing, Goal Setting & Enterprise Analysis, Enterprise Budgeting, and Legalities & Logistics. For those taking the *home gardener* track, core classes included: Building Healthy Soil, Site Selection & Design, Crop Planning, Fertility Building, and Irrigation & Water Management.

Elective Classes

Elective classes focused on specialty crop production practices, were seasonally based, and were designed to teach prospective growers the skills and practices necessary to be successful. Electives included:

- Crop Planning: Planning for Success in your Garden or Small Farm
- Getting the Season Started: Managing a Greenhouse from Seed to Field
- Integrated Pest Management
- Irrigation and Water Management
- Designing your Annual Vegetable Garden: Crop Rotations, Seasonality, Care and Harvest
- Weed Management
- Bringing Fruit Trees into your Landscape: Designing Perennial Cropping Systems in the Garden or Small Farm
- Organic Systems Compliance: Creating and Maintaining a System Plan
- Harvesting, Grading and Packing for Retail, Wholesale and Direct Markets
- Seasonal Fruit Tree Care
- Carpentry
- Welding
- Mechanics
- Perennial Propagation
- Value Added Products
- Growing Grapes and Berries
- Introduction to Mushroom Cultivation
- Seed Saving
- Small Scale Flower Production
- Wrapping Up the Season: Fall tasks and their timing to help you in the following year
- Farm Equipment Care and Maintenance

Class Instructors

To administer class content, Soil Born Farms contracted with instructors who had extensive experience in the subjects taught. Each instructor of the GYG Program was expected to complete a detailed lesson plan based on a template provided by Soil Born. Along with the template, Program staff provided a list of learning objectives for each lesson. Each instructor was encouraged to plan a class that contained hands-on and interactive elements, made use of the farm site when appropriate, and was adapted to the interests of students, allowing time for questions.

Partner organizations that provided instructional services or technical assistance for the GYG Program during year one included: California FarmLink; Agricultural Sustainability Institute at University of California, Davis; University of California Cooperative Extension; Asian Resources, Inc.; and the National Sustainable Agriculture Information Service (ATTRA).

Farm Site Visits

Visits to working farms were a major component of the GYG Program. Each participant had the opportunity to visit different farms in the region to learn first-hand about various techniques and practices used by growers. Program staff aimed to offer visits to a variety of farms ranging in size and production methods.

Field Hours

In addition, GYG students were asked to complete field hours as part of their participation in the Program. The purpose of the field hours was to provide participants with hands-on experience working on a farm. Soil Born Farm apprentices had a field hour requirement of over 1,000 hours as part of the apprenticeship, while other GYG participants had a requirement of 16 field hours.

One-On-One Technical Assistance

Lastly, participants had the option to request and receive one-on-one technical assistance both during and after the Program. Although Soil Born staff conducted initial outreach to inform participants about the opportunity, it was at the discretion of each individual to follow-up for support. Three organizations provided the technical support. California FarmLink provided assistance related to access to land and capital; the Agricultural Sustainability Institute at University of California, Davis provided support related to marketing, business planning, and legal aspects; and Soil Born Farms provided support with crop production.

Although the contractors provided individualized technical assistance to a number of participants, the information about the number of participants served and the number of hours of technical assistance provided was not tracked during year one. Project staff plan to begin tracking this data in a more systematic manner moving forward.

Section 4 Participants and Program Participation

To recruit participants for the Grow Your Groceries Program, SBF staff publicized the opportunity through various channels. The primary recruitment strategy was to host two free promotional events informing potential participants about the opportunity and generate interest in the Program. These events included a short class, a farm tour, and an informational presentation about the Program. Although Soil Born Farms also publicized the Program through partner organizations and in the farmer training community, staff reported that the promotional events were the major source of enrollments. Because Soil Born aimed to make the program open and inclusive, there was no application process or criteria for participation. However, staff may discuss changing this in the future.

4.1 Description of Participants

The first cohort of the Grow Your Groceries Program consisted of 27 participants: 12 home gardeners and 15 urban farmers (including four Soil Born Farms apprentices). Based on Pre-Survey responses, the demographic make-up of the cohort was primarily female (73%) and white (67%), although 20 percent of participants identified as Hispanic and 14 percent as Asian.

Figure 1 - Gender of Participants

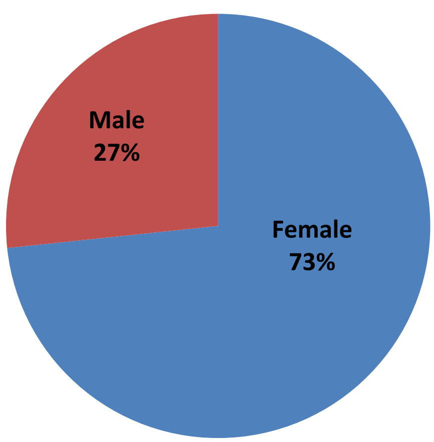
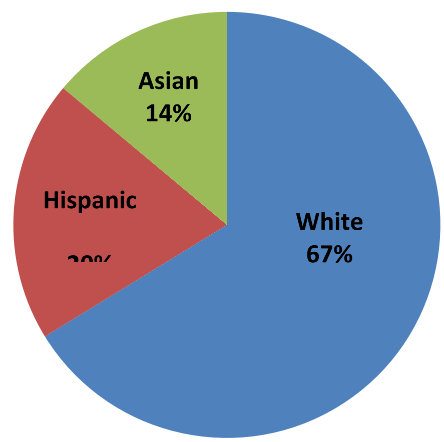


Figure 2 - Ethnicity of Participants



One-third (33%) of respondents were age 25 to 30, and another 27 percent were age 46 to 50. Average monthly income for the group ranged as well, with 40 percent earning more than $3,000 a month and 27 percent earning less than $500 a month.

Figure 3 - Age of Participants

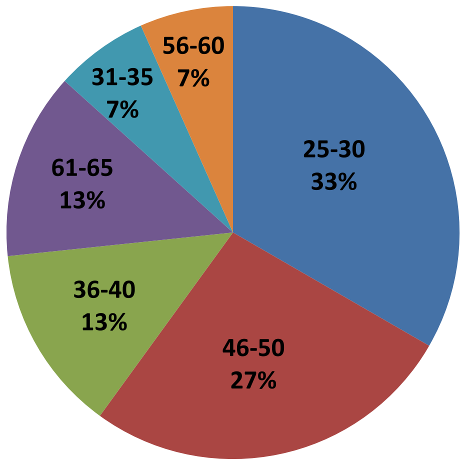
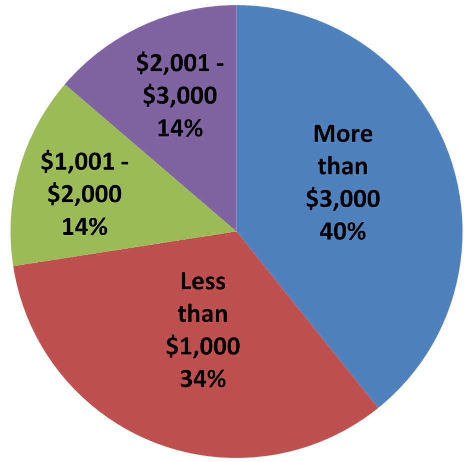
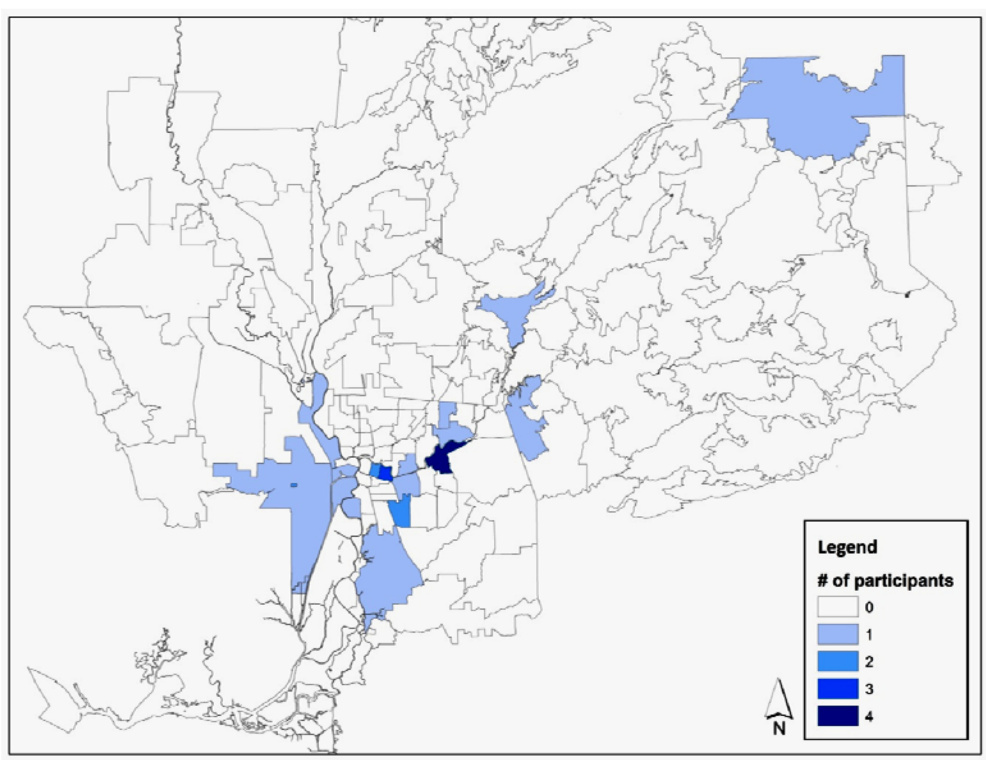


Figure 4-
Average Monthly Income of Participants



Cohort one participants were relatively inexperienced with growing food. Of those who completed a Pre-Survey, half (50%) had been growing food for less than one year, 35 percent had been growing food for one to four years, and only 14 percent (2 participants) had been growing food for more than four years. Among respondents, ten grew on a space 1,000 square feet or less, while three farmed on one or more acres of land. Participants had gardens and farms across the region, representing 14 different zip codes, as shown in Figure 5.

Figure 5 – Location of Participants in Sacramento County



4.2 Participation by Program Component

Soil Born Farms staff tracked participation in the three main components of the GYG Program: (1) classes, (2) farm visits, and (3) field hours. A summary of cohort one student participation in these components is presented below.

Classes

Every participant in the GYG Program attended classes. However, individual attendance ranged greatly, from a total of five classes to 16 classes. The average number of classes attended varied by track and participant type, as shown in the table below. Overall, participants attended an average of 11 classes. For a full list of Grow Your Groceries attendance by class, see **Attachment C**.

	Average # of Classes Attended
Home Gardener	9
Urban Farmer	12
Soil Born Farms Apprentice	13

Field Hours

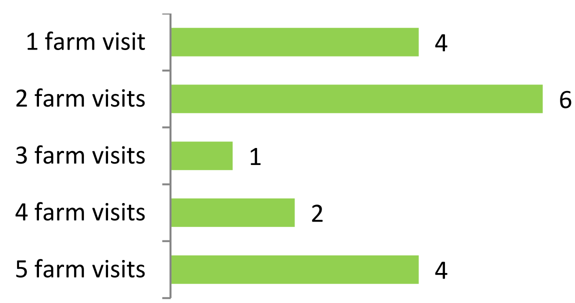
Participants were required to fulfill field hours as part of the program. In total, 12 participants completed the field hours.

Farm Visits

Cohort one participants attended eight site visits to seven different farms during the first year of the program. These farms included:

- Hank's Hens & All Things Good
- Humble Roots CSA
- Full Belly Farm
- Riverhill Farm
- Raphael Gardens
- Good Humus Produce
- Woodleaf Farm

Overall, 17 of the 27 cohort one participants attended at least one farm visit during their time in the program, but the number of farm visits attended varied across participants.



Section 5 Evaluation Findings

As mentioned, data collected for the Grow Your Groceries evaluation consisted of a Pre- and Post-Participant Survey, individual interviews with participants, and interviews with Program staff. The results of these evaluation activities are detailed in the following section, and indicate that participants experienced positive outcomes as a direct result of the GYG Program. However, qualitative data suggests there are challenges associated with Program implementation, and a number of recommendations for how to enhance the Program moving forward.

5.1 Participant Pre-Post Survey Results

One of the primary evaluation methods employed by the research team was a Pre- and Post-Survey administered to participants at the beginning and end of the Grow Your Groceries Program. Because LPC came onboard after the first cohort of participants had already started the Program, cohort one participants completed a retrospective Pre-Survey instead of a traditional Pre-Survey taken prior to Program start.

In total, 16 participants completed the Pre-Survey and 14 completed the Post-Survey. For the purpose of pre and post analysis, 14 matched surveys were eligible for comparison. A summary of the survey results is presented below. To view all survey results by question, see the data tables in **Attachment D**.

5.1.1 Growing Space Development

One measure of success of the Grow Your Groceries Program, is the increase of participants' growing space and the productiveness of that growing space. While those farming on one or more acres of land prior to the Program did not increase their growing space, survey results show that for participants growing in smaller areas the average number of square feet increased from **372** square feet to **615** square feet (an increase of 65%). The total growing space of all participants combined increased from **70 acres and 3,830 square feet** before the Program to **70 acres and 6,270 square feet** after the Program.

5.1.2 Growing for Market

The most common way participants used the produce they grew was to feed themselves and their family (86%). This percentage did not change between the Pre- and the Post-Survey. However, the percentage of participants who shared the produce with others outside their family increased from 36 to 64 percent. The percentage that created value-added products with their produce also increased slightly, from 21 to 29 percent.

While only one participant was growing for market before the program, the percentage of participants that planned to grow for market in the future increased from 38 to 58 percent. Of those who reported they plan to grow for market, 29 percent planned to start growing for market in less than one year and

71 percent planned to start in two to five years. On the Post-Survey, some respondents specified that their plans to grow for market were to:

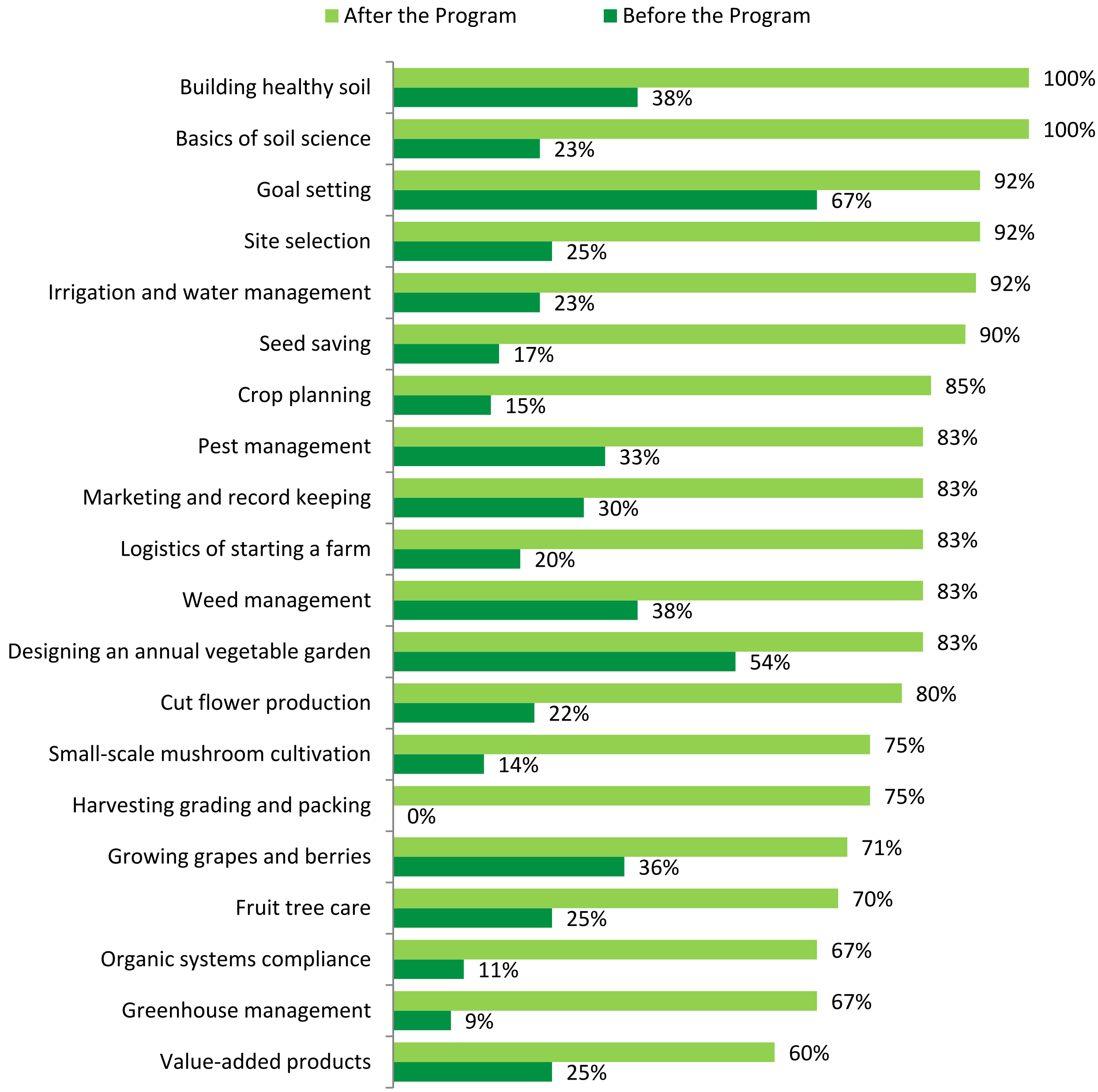
- Have a half acre community style garden with enough product left over after feeding ourselves to take to the local farmers market
- Sell goat milk and related products, honey, and fruit and vegetables for preserving
- Have two acres of wine grapes, two acres of fruit trees & perennials, three acres for sheep, and a kitchen garden
- Expand to 600 square feet in 2014, develop market with local restaurants and/or schools, and hopefully move to larger space
- For the 2014 season, I plan to sell at farmers markets, at a farm stand, and wholesale

Evaluation results show that a valuable outcome of the Grow Your Groceries Program is that some participants begin the Program as home gardeners and based on their experiences in the Program, their goals shift to include growing for market.

5.1.3 Skill and Capacity Development

The GYG Program is aimed at increasing participants' skill level and capacity to successfully and sustainably farm in small, urban areas. The Pre- and Post-Survey measured these outcomes by asking respondents to report their skill level before and after participating in the Program. Figure 6 presents the percentage of participants who felt "very" or "somewhat" skilled before and after the Program on a number of indicators.

Figure 6 – How Skilled Do You Feel in Each of the Following Areas?
Percent of Participants Reporting "Very" or "Somewhat" Skilled



The survey also allowed respondents to acknowledge how their participation in GYG helped them achieve their farming or gardening goals. Participant comments indicated that the Program was invaluable in building the confidence and skills needed to enhance their farm or garden:

- *After taking all the courses, I feel I've gained basic information to start my own home garden.*

- *[The program] gave me more knowledge of managing a garden space and I was able to get some plants to grow that I haven't been able to in the past.*
- *I am more confident and have some idea about where to start or look for help.*
- *I have a better understanding of daily mechanics and what sort of resources I'll need.*
- *I know how to grow food, manage soil and pests and care for food during the harvest process.*
- *The program provided me with a basic understanding of the foundations needed, like healthy soil, site selection, crop rotation, etc. and also with confidence to just dig in!*
- *I am clearer on potential uses for acreage and the potential for partnering with others. I have a better understanding of the commitment needed. My confidence in being able to get help when needed is greater.*
- *Showed me the need to put together a business plan, even if I'm growing for myself.*
- *The experience has given me much more confidence in pursuing my growing/farming goals. I feel far more comfortable. Learning that growing anything is and can be a learn as you go experience.*
- *Not having any agricultural experience, it launched me into a new career. I was able to learn from educators and farmers that have been in the industry for many years. Being able to learn from them was an experience I wouldn't have learned from books or on my own.*
- *[The program] has helped me to create a business plan and to transition out of my current job.*
- *I can now talk intelligently to our vineyard manager and I'm not afraid of killing our vegetables.*

During GYG, participants also received support to obtain elements that are critical for farming enterprise. Pre- and Post-Survey data shows that more participants had secure capital, secure markets, and a business plan after completing the Program, as show in Table 1 below. Interestingly, the percentage of respondents who had secure land decreased from before to after the Program. This may be due to participants deciding to increase their growing space and needing additional land to do so.

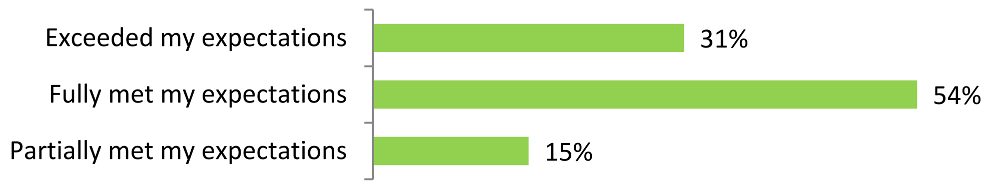
Table 1 - Which Do You Currently Have for Your Farm or Garden?

	Before the Program (n=8)	After the Program (n=10)	Change
Secure capital	38%	60%	+22%
Business plan	25%	40%	+15%
Secure markets	13%	20%	+7%
Secure land	88%	50%	-38%

5.1.4 Program Feedback

Overall, GYG participants had positive feedback about their experiences in the Program. A vast majority (85%) of survey respondents reported that the Program "fully met" or "exceeded" their expectations, as shown in Figure 7 below.

Figure 7 - How Well Did the GYG Program Meet Your Expectations?



Most Useful Program Topics

Most participants rated each GYG Program component as "very useful," with farm visits reported as the most useful, followed by field hours, classes, and the business planning workshop series. Figure 8 below shows the percentage of participants who found these components "very useful."

Figure 8 - How Useful Was Each Program Component?
Percent Responding "Very Useful"

In general, participants noted that the farm visits and field hours were both "critical to making the program work." Participants particularly found that "talking to other farmers in an open format while also being able to walk around was very helpful." As one participant noted, the farm visits "gave me a chance to see how different farms operate and the philosophy behind why they farm." Those who did not complete the field hours felt they did not get as much out of the program as they might have, indicating that this program component was essential to skill development:

> *"Most topics were very useful, though I didn't take advantage of the field hours which is why I feel I lack practical knowledge and skills for actually producing and running a farming business."*

The most useful class, according to participants, was Building Healthy Soil, followed by the Business Planning Series, Crop Planning and Rotation, Pest Management, and Seed Saving. Other classes mentioned as useful were: Water and Irrigation, Harvesting, Weed Management, Beekeeping, Welding, and Carpentry. One participant especially enjoyed the two-day intensive workshop at the beginning of the program:

> *"The first intensive weekend was super helpful for an overall understanding of soil; I feel like I could take the classes over again after having a year under my belt of getting my hands dirty in the soil and get even more out of it."*

Least Useful Program Topics

Participants noted that there were some elements of the GYG Program that were less useful, not because of the content, but of because of how the content was delivered. For instance, one participant mentioned that during a crop planning class, there was "poor preparation from the presenter," and as a result "not much objective information was discussed." Another participant noted that the irrigation class was not as useful because there was "so much technical information thrown at us in a short amount of time."

Suggestions for Improvement

Suggestions for improvement largely fell into three categories: (1) timing and logistics of classes, (2) hands-on instruction, and (3) course content and structure.

Several participants noted that it would be helpful for more classes and farm visits to be scheduled on the weekends. Participants who were working or had children found it difficult to attend Program activities on weekdays. Another participant suggested offering field hours on days when classes were scheduled to save participants travel time to and from Soil Born Farms. In addition, one participant suggested that it would be beneficial to shorten class times to two hours during the weekdays, and host longer classes on the weekend. Because most instructors covered similar content about organic farming during the first hour of class, informing the instructors that this information has already been covered would save valuable class time and make classes shorter in length, said one student.

Second, a number of participants felt that the program could be improved with more hands-on work. As one participant noted, activities should be "all hands-on whenever possible," while another mentioned, "I would have enjoyed more field hours and less classroom time."

> *"I think that field hours, getting more hands-on experience, would be much more beneficial than sitting in the classroom for four hours."*

In addition, participants felt that the courses should be more coordinated into a comprehensive curriculum. "It would have been helpful to have the material standardized so that everyone could understand," noted one student, "Some of the material was not comprehensive and I felt very lost with some of the more advanced subject matter." Another respondent acknowledged that it would be beneficial for courses "to be more integrated and coordinated into a curriculum so that there is a progression of learning that can be articulated," although he noticed that the Program already seemed to be evolving in that direction. With a more standardized curriculum, GYG might provide course materials to participants in a printed binder or electronically via an online resource repository.

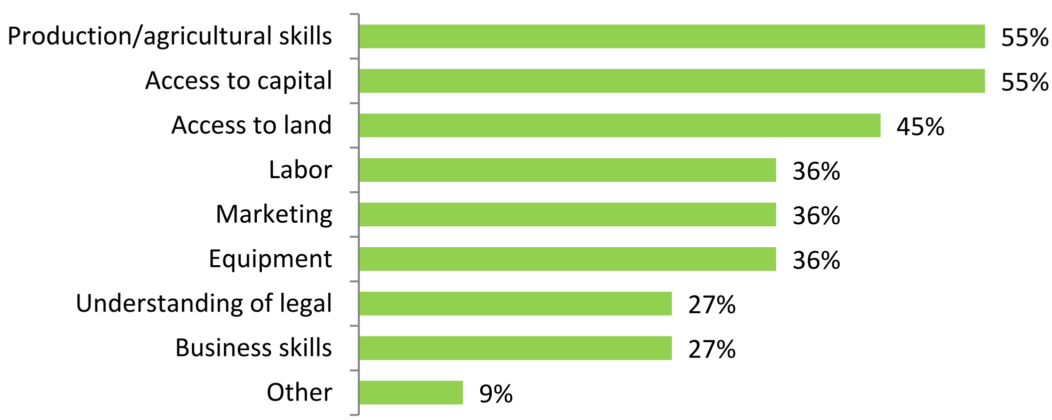
Lastly, respondents mentioned additional topics that they would have liked to cover in the GYG Program. These included classes on: machinery and tractor use, selling products, growing succulents and herbs, farm administration, and water conservation strategies.

> *"It would have been helpful to include farm administrative shadowing as field hours. That's the primary area that's holding me back. It overwhelms me and I just don't want to deal with any paperwork."*
>
> *"I am deeply concerned about water usage and wanted to see a different take on how we manage our water in food production. I feel like the info just scraped the surface."*

Additional Comments

Participants reported that after participating in the GYG Program they felt "very" (38%) and "somewhat" (62%) prepared to pursue their farming or gardening plans. Current challenges with their growing operations included lack of additional production skills and access to capital, as shown in Figure 9 below.

Figure 9 - Participant Obstacles to Starting/Running a Commercial Growing Operation



Overall, 77 percent of Post-Survey respondents indicated they would be interested in receiving additional help related to growing food or running a business. The top three areas of interest for additional assistance included: production/agricultural skills (56%), marketing (56%), as well as access to capital and legal compliance (both 44%).

5.2 Participant Interview Findings

To learn about participants' experience in the Grow Your Groceries Program, the evaluator conducted individual interviews with five cohort one participants in May and June 2014. Three of the interviewees were urban farmers, one was a home gardener, and one worked at a school garden.

Respondents reported that they first heard about the GYG Program through word of mouth and through information they received at the Sacramento Co-op. They decided to participate in the Program for various reasons. Some had land that they planned to grow on, but did not have an agricultural or business background. Others liked the concept of the comprehensive training course and the idea of meeting others in the farming community. One participant researched the Center for Land Based Learning's training program, but determined it was a bigger commitment than desired and the GYG Program better fit her needs.

> *"Having a business plan is critical, so I wanted to know all the elements to make the property productive. I want the work I do to be sustainable."*

All of the interview respondents participated in each element of the GYG Program, including courses, farm site visits, and field hours. However, none of the respondents received one-on-one technical assistance through the program, although most acknowledged that it was offered to them. In general, participants did not seek out the option for technical assistance because it was not needed at the time.

5.2.1 Most Helpful Program Components

Several survey respondents reported that they thought the program components "were equally important," as all the elements were integrated and built off one another. Participants were able to first attend classes, then visit farms and complete field hours to see and experience what they learned. "The elements worked together well; I got something from everything," said an interviewee.

Two respondents felt that the farm site visits were most helpful because of the close interaction with career farmers. Participants gained a lot from these visits because "each farm has a different style and farms a little differently." One participant particularly enjoyed talking to farmers about the tangible business aspects of their farm, including costs of operation and supplies. For these participants it was "easier to learn" in this experiential manner.

> *"Seeing the tools they use and talking to someone who is growing food and who is in the business was very valuable."*

> *"The farm visits are sometime daunting because people are so far advanced than I will ever be, but its critical to understand what I might be capable of."*

Other participants found the field hours to be their favorite part of the program. "That was the most fun," noted one interviewee, "I love being out in the garden." Another participant felt the field hours were beneficial because they allowed students to confront the physical aspects of farming. Another participant had an especially positive field experience at Soil Born's Hurley Farm location because it was a smaller group of people. Participants appreciated that the staff at Hurley Farm were "willing to jump in and interact" with the GYG students.

> *"Getting information from classes and the farm visits was enjoyable, but putting that information to use in the field was the most helpful."*

In regards to class instruction, respondents felt that the classes taught by actual farmers were helpful because they could impart real life examples, while "some of the college professor instructors were more about theory." As one participant noted, "Life experience outweighs book learning." Participants especially enjoyed the three part business series and classes on: soil, composting, fruit trees, produce handling, and carpentry.

One aspect of the classes that participants found helpful was the networking and relationship building between students. Participants were able to meet people with similar goals and "feed off the energy" of one another. "Since I didn't have a farming or agriculture background, the program allowed me to get into the culture and meet other similar minded people and make connections with other students," said an interviewee.

> *"One thing I really liked was that the apprentices that work at Soil Born take the classes with you. I thought that was extremely valuable. I got to talk to apprentices about what they were doing, and hear their stories. I got close with the other people in class, and still keep in touch with some of them."*

Overall, participants agreed that hosting the Program at a working farm with your "hands in the dirt" was very helpful. "It was critical, at the third or fourth class that we went from going from just class to hands-on learning," said an interviewee. One participant specifically mentioned that the three-part business workshop taught by a representative from California FarmLink was much improved from the first business seminar. "Her refinement of the more amorphous previous classes was an improvement because it was hands-on," noted the respondent.

> *"Just talking about a business plan is good, but I didn't have to wrestle with the actual thing in the first classes. The woman from California FarmLink gave us assignments and went beyond simply informational content to pushing us to think and problem solve. The more that that can be done is helpful. The original format has value, but people can be pushed to learn more if it's less informational and a little more thinking through problems."*

5.2.2 Least Helpful Program Components

While most respondents reported that "there wasn't anything that wasn't helpful" and that the Program components "all went together really well," others had feedback about elements of the program that were not as helpful. One participant felt that although the field hours spent at Hurley Farm were extremely valuable, the field hours at Soil Barn Farms' ranch were "fast paced" and participants were just "thrown in the mix" because the farm had orders to fill. "When we were working with them, we didn't get to ask too many questions," he noted. This may have been because there was such a large group of volunteers to manage. Although participants were able to sit down with one of the farm managers afterwards to address questions, more interaction in the field throughout the day would have been helpful.

> *"The farm crew is too busy working to spend the time to answer some of my questions. I know it's not their fault because they have deadlines to meet but it would have been helpful to spend a few minutes before and after the field hours."*

5.2.3 Program Outcomes

All of the participants surveyed reported that they had been able to apply the information they gained from the GYG program in their own growing operations. Paraphrased examples of how participants changed their gardening or farming practices based on the information received included:

- I have been able to use the knowledge I have to help family and friend with their gardens, and when working my yard the knowledge I have of soil, drainage, and where plants should be.
- I’ve been able to put what I learned into use at the school garden and find myself more comfortable doing it and sharing it with others.
- Because of the weed control information I received, I purchased a particular breed of sheep for weed control.
- Before, I would go down to Home Depot and buy fertilizers and weed killers. So learning how to grow without those kinds of products and grow more organically is huge.
- I pay more attention to the seasons and how to rotate crops.
- After learning about tractors, I am much better about the way I talk to people about mowing and which of the fields are still salvageable for mowing. Our cooperative effort to think through what we want to plant, planning ahead, and record keeping, has helped.
- The program helped a lot in terms of learning about the soil and what things to look for. The classes also gave me things I didn’t know about before that I could research afterwards.
- I didn’t like using pesticides before, but the program reinforced and made me a stronger advocate for people to go about their yard work with a longer term goal in mind. Being more sustainable. Taking better care of the soil, instead of using and abusing it. It’s a living thing and it needs to be nurtured and how to do that. The program gave me knowledge to back up things that I already knew.
- We never had done irrigation with a drip system before. Managing the pests and things like that in a more natural way. Just about everything. Because we hadn’t done it before.
- The program gave me the step forward I needed. Coming from a non-agricultural background, I learned beginning level things, like soil knowledge, cover crops, and crop rotation. I did implement some of the techniques farming wise. Seed saving we implemented here, the layout of the packing shed, and picking methods. We are now able to prune our own trees. There wasn’t one class I didn’t pick something up from.

Participants noted that the program impacted their skill level “tremendously.” As one respondent reported, “I think what I’ve received from the Grow Your Groceries Program is a lot of knowledge and self confidence to follow through to grow your own food and provide healthy food for your family.”

5.2.4 Program Challenges

Although participants did not identify many challenges while in the Program, the challenges that did arise included issues around class schedule, confusion about the two different course tracks, and information overload:

- **Class Schedule:** One participant felt that the class schedule was too "random" and "scattered," which made it hard to remember class times. For people coming from farther away, this was sometimes a challenge. As one participant reported, "There was one time I showed up and there wasn't a class." Another participant thought that although it was good for classes to be held at the end of the day to accommodate those who were working, sometimes the duration of the classes was too long.
- **Confusion about the Different Tracks:** One participant enrolled in the urban farmer track when she should have been in the home gardener track. Because of this, she chose to miss some classes: "I learned they were beyond the scope of what I could do."
- **Information Overload:** One participant felt that because there was so much information taught during classes, "it was hard to keep track of and keep on top of particularly when I was just learning."

5.2.5 Recommendations

Interview participants had several suggestions for how Soil Born Farms might improve the Grow Your Groceries Program. Recommendations included:

- Create a program website where current and potential participants can go to see a schedule of classes, access information about the program and individual classes, and send messages to program staff. Not only would posting general information online be helpful to students, it might also alleviate staff time and resources to respond to general questions.
- Provide copies of all PowerPoint presentations shown in class to students either before or during the class so that participants can more easily follow along and take notes. As one participant noted, "I am a very visual learner, and that would have been really helpful."
- Improve the continuity of content between classes. Instead of bouncing from one topic to another, have a more intentional flow of classes where the learning and content of one class builds off the previous class.
- Develop a "masters program" where growers who have already taken the entry level classes can access more advanced classes. This way, participants who wanted to continue to build their skill level have another step they can take.
- Schedule the classes to be at a certain time every month, and shorten the class time, as some classes were too lengthy.

- Ensure classes include "hands-on" experiential learning. The more instructors go beyond information giving and ask participants to think through ideas and problem solve, the more helpful the class. The classes that offered hands-on learning were most popular among participants. Students can be pushed to learn more if the class is less informational and more focused on thinking through problems.
- Offer an additional track that stretches the program out over two years instead of one year. This way, participants have more time to absorb the material and practice on their own in between classes.
- Include site visits to more farms in the region.
- Create a forum for ongoing questions or advice from Soil Born about how they address issues at the farm. "There are questions that have arisen, and if there was some way to have a follow up conversation about recommendations, that would be helpful."
- Create a venue for alumni from the program to stay connected and further develop the class spirit. This could be something as simple as a reunion day at the ranch, or an online community where participants could interact through social media.

Several interview respondents also acknowledged current challenges with their farm or garden, and identified additional support they would like. Participants would welcome advice or assistance on topics such as:

- Growing from seed
- Eradicating Bermuda grass
- Accessing additional land to better ensure financial security
- Planting and placement techniques for water conservation
- Harvesting produce and getting it to market

5.2.6 Additional Comments

Each respondent acknowledged that they would "absolutely" recommend GYG to other farmers and gardeners, even to youth and those with more advanced skills. Two participants reported that they already had recommended the Program to others.

> *"[I would recommend] GYG even to young people if you are really into learning about growing. It's a great program and its user friendly."*
>
> *"I am an absolute advocate of this program. I would love to see it in other communities as a formalized curriculum."*

Participants reported that there are numerous benefits of offering a program like GYG to local growers. In particular, interviewees acknowledged that the Program gives community members the skills to grow their own food, giving them more control over the way their food is produced and providing healthy food for themselves and others. The following quotes illustrate some of the ways Grow Your Groceries benefits local growers and the community at large according to participants:

"It is a great thing for our community, which is the farm to fork capital, and helps build that foundation. The more people that are involved in things like this, even if they don't grow commercially, they gain the knowledge and a whole new appreciation of putting food on the table."

"People are becoming more aware of the ill effects of some practices in the way our produce is being produced commercially. In general, people want to be more careful about how their produce is being grown. Because of the awareness, people are more interested in growing their own food. I find it exciting that that there are a lot of young people interested in doing this."

"I think it's ever more important to get people aware of growing your own food, whether its ten acres or a raised garden bed. It's the idea of having healthy food locally, and thinking about how much energy and gas it prevents from being used. It gets people to eat healthier and have less health issues."

"It demystifies something that isn't a mainstream activity. It also feeds on, an incredible hunger for people to have more control of their diet and how they eat, so it encourages people to take that control. Grow Your Groceries is about having the food you would want to eat right there. That was really a big part of the value."

Lastly, almost all of the interviewees mentioned the quality of Soil Born Farms as an organization and the helpfulness of the staff. One reported that "Soil Born is a tremendous, amazing operation," while another expressed that the staff "was welcoming and nurturing." Another participant said, "I felt like I was part of Soil Born Farms."

"I have to give double thumbs up to every person at Soil Born that we dealt with. It is the best organization with the best people. It's rare you come across such nice people."

"Out of ten, I'd rate the program a nine. It's nice to know people in Sacramento that you can rely and call to help you out."

"I love the relaxed and friendly approach; the hands on and working with the Soil Born crew was truly fantastic and they were all very encouraging. Farming is hard work, but so rewarding and gratifying. I love that kind of job."

5.3 Staff Interview Findings

The evaluation of the Grow Your Groceries Program included staff interviews at the end of the evaluation study, to gather qualitative data on the experiences, challenges, successes, and lesson learned regarding the program and training components. In May 2014, the evaluator held interviews with the GYG Program Manager and the Executive Director of Soil Born Farms. The following summary describes the findings based on their interview responses.

5.3.1 Program Successes

Staff identified the primary successes of the Grow Your Groceries Program during the first full year of implementation, which included positive responses to the Program, instruction on business topics, more participants selling for market, and support of the overall Soil Born Farms mission.

Positive Responses to the Program

Staff agreed that one of the major successes of the Program thus far was the positive response it generated in the grower and gardener communities. As staff noted, "our biggest success has been less on the numbers side, and more on responsiveness and being well-received." The Program especially received immense interest from home gardeners and "really positive feedback" from all types of participants.

Offering Business Instruction

Incorporating a business training series was a "major enhancement" to the GYG Program, acknowledged Soil Born staff. In general, participants "come in without a business background or an eye for business," and these courses fill a great need among the new farmer community. The instructors who are knowledgeable about the topic contribute to the effectiveness of this program component. Business training is especially valuable for those who are apprentices, as it enables these individuals to study concepts in a more in-depth way. That is "something you can't get when you are just learning about it in the field," noted staff.

Participants Selling for Market

Staff observed that an outcome among alumni of GYG has been an increase in new agricultural activities, such as selling for market. While the original focus of the Program was on urban agriculture, participants are taking the skill sets gained from the program to impact all different areas and environments. Even though some participants moved to more rural or peri-urban environments, it is likely that they will still sell a portion of their produce to urban markets.

Supporting and Accelerating the Soil Born Farms Mission

Lastly, GYG helped Soil Born Farms to "accelerate" its mission as an organization, noted staff. "We are trying to get more people growing food in a way that's sustainable, and hoping that a good portion grow in the city," said staff. Although Soil Born Farms was modeling these farming practices as an organization, "now we are creating a broader pool of folks that are doing the work we want to have happen." Indirect benefits of the program are that it brings more people to Soil Born sites, creating a space in the community for this training to occur. In addition, by understanding and perfecting Soil Born's role as a trainer, it has allowed the organization to reach other funding partners that may not have been accessible otherwise. As staff acknowledged, other organizations now "see us less as farm and more as a community asset," leading to potential partnerships with entities that seek out job training for their clients.

5.3.2 Project Challenges

Despite successes, there were also a number of challenges that Soil Born Farms encountered with Program administration. The primary challenges associated with implementing the Grow Your Groceries Program centered on: staffing resources; diversity of participants; achieving program outcomes; and program sustainability.

Staffing Resources

Staff acknowledged that the GYG Program takes a significant amount of staff time to plan and operate. The Program Manager noted that: "The division of labor made Program management challenging." Oftentimes, addressing the deeper Program vision and strategy received less attention because staff were consumed with managing logistics and day-to-day operations. Sometimes, noted the Manager, "I feel I'm working in a vacuum" and it would be beneficial to include other Soil Born Farms staff who have valuable input and ideas about Program enhancement and sustainability.

> *"Having a full-time program manager and a full-time farmer-educator would make it easier to more closely manage relationships with growers and increase program capacity and development."*

Soil Born staff also acknowledged that there must be more staff resources dedicated to providing technical assistance to participants after completion of the courses. As one staff said, "that technical assistance needs to be present to help someone move from concept to implementation." Thus far, technical assistance has occurred with apprentices on-site at Soil Born Farms, but less so with other participants on their own properties. Moving forward, Soil Born hopes to hire a farmer educator with the flexibility to provide training and technical assistance both on-site and via participant site visits.

Diverse Participants

The Grow Your Groceries Program provides training to a broad range of growers, including beginning farmers, home gardeners, and apprentices. Although there were benefits to having such a diverse pool of participants, it was also a challenge. As staff reported, the course content that would be delivered to a home gardener is very different from that delivered to a beginning farmer. Although many of the participants enter at the same skill level, the subject matter must evolve to meet individual goals. With a program that is open to everyone, this is an inherent challenge.

While Soil Born Farms addressed this challenge by choosing to host different classes for home gardeners and beginning farmers, staff plan to strategize further on the best way to structure the program to serve all types of participants. Part of that, mentioned staff, is to reflect on the recruitment strategy, target audience, and type of participants that are attracted to the Program. Thus far, the typical participant is not currently farming and their plans for farming are several years away. Staff hope to shift recruitment to include more people who are currently farming. "The people who have gotten the most out of the program are those who are currently farming," said staff.

Program Outcomes

Staff found that “turning people into farmers is a complicated endeavor.” Because the GYG Program served as a first step for people to explore the idea of becoming a farmer, learning more about farming “might encourage them or turn them off” to the idea, noted staff. Taking the step to grow for market is “really up to the individual and the variables and factors that are happening in their lives.” It is difficult to encourage participants one way or the other because it is such a personal choice and calling. While this challenge might be mitigated if Soil Born Farms shifts their target audience to those who are already farming and seriously pursuing farming as a career path, it is also important to balance other groups interested in growing food, but not growing for market.

Program Sustainability

Another challenge that Soil Born Farms encountered with implementing the Grow Your Groceries Program was securing sustainable funding. The amount the Program charges participants is nominal compared the cost to operate the Program, noted staff. If Soil Born raises the cost, it can be a barrier to participation for lower income individuals. Furthermore, there is no current source of funding that is self-sustaining. To address the issue of sustainability, staff plan to examine the costs of operating the program and the resources available to determine the number of students the Program can accommodate per year. Based on this analysis, staff can then develop a tailored marketing strategy that matches the target cohort, and also apply for specific grants or sources of scholarships for participants.

5.3.3 Lessons Learned

Over the course of the first year of Grow Your Groceries, there were a number of lessons learned about implementing a grower training program, based on staff and participant experiences. Each of these lessons, presented below, are valuable in guiding the direction of the Program, as well as informing other agencies and organizations conducting similar grower education programming:

- **Separation of Tracks:** It is beneficial to have urban farmers and home gardeners take different classes geared toward their purpose and objectives. While the urban farmers and home gardeners in cohort one took the same classes, staff quickly learned that “gardeners and farmers have different needs and priorities, and it did not make sense for them to be in the same classes.” GYG shifted to offer two completely separate tracks, with home gardeners taking courses that were much less intensive. Staff noted that this approach worked much better for tailoring the Program to participant type.

- **Program Evaluation:** Including an evaluation and hiring an outside evaluator is an important element of assessing the impacts and outcomes of the Program as well as making improvements and enhancements. It is useful to have a formal evaluation structure that can be replicated from year to year.

- **Multiple Years of Training:** Providing only one year of training is enough time for participants to gain the skills to grow food for themselves, but not enough time to develop the skills for market-based production. It takes several years of practice and training before someone can become an effective farmer, noted staff. For those whose goal it is to be an owner-operator or an employee of a farm, multiple years of education is essential. For this group, a full educational experience cannot be accomplished in one year in a meaningful way.

- **Inclusive Model:** While the outcomes of the grant were geared toward supporting farmers growing for market, Soil Born's vision was more broad and inclusive. Staff noted that home gardener participation is beneficial to the Program because gardeners represent the recruitment population, and fulfills the overall mission of helping people grow more food in the urban environment. While gardeners might decide not to grow for market, it is important to maintain a home gardener track to support those who want to accomplish growing food for themselves and their family or community.

- **Technical Assistance:** Technical assistance is something that is most useful for people starting their farm or already farming. People will only take advantage of the assistance if it makes sense for them. Because of this, it is beneficial to focus on providing this support to second and third year growers (including Soil Born apprentices and participants who have completed year one of the Program). As staff noted, the technical assistance component of the program is critical to help move someone from concept to implementation.

Section 6 Recommendations and Next Steps

While in previous years, farming knowledge was passed from generation to generation, today that model is vanishing. There is an aging farmer population, and not enough people entering the agriculture profession to replace them. In order to fill this gap, it is critical to draw more people into agricultural careers and bring them the training needed to be successful. Offering the Grow Your Groceries Program to the Sacramento region provides new and potential growers with the opportunity to learn the skills essential to grow healthy food for themselves and others in an urban environment. GYG teaches these skills and competencies in a context-based educational setting that promotes experiential learning, providing a means for people to explore farming as a career, and drawing more people to the agricultural profession.

> *"There is a huge gap in the number of farmers who are retiring and older and the number of people who are entering agriculture. That gap is not going away. Grow Your Groceries is bringing people up to speed who have not grown up on a farm, and doing it in a way that is affordable."*

Results from the evaluation of the Grow Your Groceries Program show that cohort one participants enhanced their skills and competencies related to urban farming and gardening, and gained elements essential for creating a viable farming enterprise. As a whole, participants developed abilities that led to improvements in their growing practices and business knowledge. In addition, participant feedback about the Program was overwhelming positive. As one participant expressed, "[The Program] gave me the step forward that I needed."

Although Soil Born Farms experienced great success with Grow Your Groceries, implementation was a learning experience and evaluation results indicate there may be opportunities for Program enhancement. The following recommendations are based on the findings detailed in this report, from staff and participant experiences, lessons learned, and suggestions for improvement. The intent of these recommendations is to highlight potential strategies to facilitate Program implementation and success moving forward:

1. Revisit the program logic model by conducting a workshop with staff, alumni, and other stakeholders to improve program focus and gain clarity on desired outcomes.

2. Begin to establish the structure for a multiple year program, to support participants in further strengthening their ability to work in the agricultural sector. Provide the option for second-year students to continue to take courses and "round out" their experience. This will also allow students more time to complete field hours and become more advanced by the time of program completion.

3. Hire a farmer educator to provide apprentice training, teach a portion of GYG classes, and provide technical assistance to participants after program completion.

4. Devote more time to case management of participants. This includes more one-on-one communication, developing an Individual Education Plan (IEP) with each participant, and disseminating information about educational or career opportunities. Strive to create and foster mentor relationships between beginning farmers and established or retired farmers.

5. Support participants and alumni by researching and solidifying land access opportunities for those who need secure land. This includes help with identifying available land, negotiating leases, and navigating strategic opportunities.

6. Establish more farm sites for field instruction, where participants who have already completed courses are able to gain experience in leadership and continue their learning past the first program year. This might include designating additional sites operated by Soil Born, or formalizing relationships with other farms to provide this experience.

7. Consider greater formalization of the home gardener and urban farmer tracks, to ensure the appropriate program intensity based on growing and business goals. Part of this may entail developing a formal application process to determine proper program placement.

8. Offer smaller class packages, such as a business planning module, that would cost less for participants and could increase the number of people who commit to participating in the GYG Program.

9. Explore opportunities to collaborate more closely with partner organizations, such as the Center for Land Based Learning and the National Center for Appropriate Technology (NCAT), whose missions and activities overlap with Grow Your Groceries. Consider additional opportunities for representatives from these organizations to serve as instructors for GYG classes.

10. Formalize financial aid policies and procedures for the GYG Program. Explore opportunities to connect applicants to resources and scholarships that may help fund their participation.

11. Establish clear guidelines for provision of technical assistance to participants and alumni. Consider a fixed timeline for follow-up support. Develop a system to track the technical assistance provided, including number of hours and type of assistance by participant.

At the conclusion of year one, Grow Your Groceries staff planned to continue to host two cohorts of home gardeners annually, and shift to offer the urban farmer track once a year with a larger cohort of students. The next cohort of participants will begin in spring 2015, allowing staff time to focus on formalizing the structure of the program and developing a recruitment strategy. A formalization of Program goals, structure, and target audience will help Soil Born Farms pursue grants specific to the work, identify funding sources for participant scholarships, and explore Program accreditation to access workforce training resources.

Moving forward, new partnerships will serve to support and enhance the GYG Program. Soil Born Farms has already begun to establish a relationship with the Farmer-Veteran Coalition (FVC) and the International Rescue Committee (IRC) of Northern California, a refugee services organization. With these partnerships, Soil Born Farms staff see an opportunity to help transition refugees and returning veterans into careers in sustainable agriculture. Participation in the Grow Your Groceries Program would be a natural fit for FVC and IRC clients interested in learning about agricultural enterprise and improving their farming skills. Staff would also like to connect with organizations that serve immigrants, women, and second-career individuals in order to provide job training to these populations. As part of expanding GYG and enhancing sustainability, Soil Born staff plan to explore moving toward Program accreditation. Accreditation would allow students from designated college systems to participate in Grow Your Groceries, and open the door for partnerships with workforce development agencies, such as SETA (Sacramento Employment and Training Agency). "There are a lot of opportunities around career development and career pathways," noted Soil Born staff.

Attachments

A – Grow Your Groceries Program Logic Model

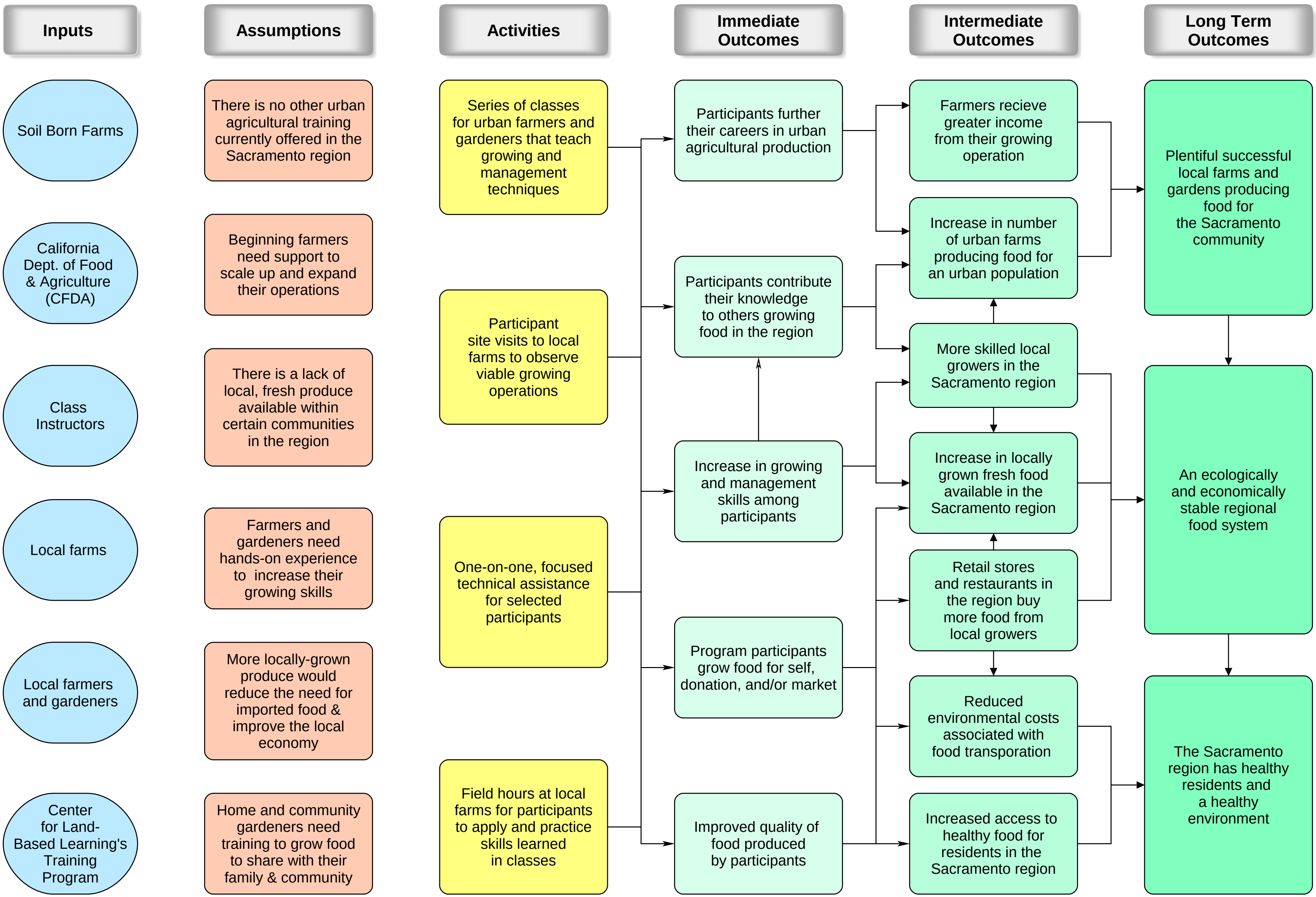
B – Data Collection Forms

C – Grow Your Groceries Attendance by Class

D – Participant Pre- and Post-Survey Data Tables

Attachment A

Grow Your Groceries Logic Model



Attachment B

GROW YOUR GROCERIES
PRE SURVEY

We would like to learn more about your experiences with Soil Born Farm's Grow Your Groceries Program in order to evaluate the program's impact and take steps to improve the training. Thank you in advance for your input!

1. What is today's date? _____ /______ /______

2. What is your first and last name? ____

3. When will you (or when did you) begin the Grow Your Groceries Program? (check one)

☐1 March 2013 - Home Gardener ☐3 October 2013 - Home Gardener
☐2 March 2013 - Urban Farmer ☐4 October 2013 - Urban Farmer

ABOUT YOUR GROWING SPACE

4. How would you best describe your growing space? (check one)

☐1 Farm
☐2 Home Garden
☐3 School Garden
☐4 Community Garden
☐5 Other: ____________________________________

5. What is the address of your farm or garden? Street address: ____
City: ____________________________________ Zip Code: ______________

6. On how many acres (or square feet) do you grow food? __________acres **(OR** __________square feet)

7. During an average week, how many labor hours (from yourself, employees, family members, or volunteers) are spent working on your farm or garden? (check one)

☐1 Under 5 hours ☐4 20-30 hours
☐2 5-10 hours ☐5 30-40 hours
☐3 10-20 hours ☐6 More than 40 hours

8. Please list the crops you are currently growing:

9. Please list other types of produce, forage crops, or livestock you would be interested in incorporating into your operation:

10. How do you use the produce you grow? (check all that apply)

☐1 I sell the produce
☐2 I use the produce to feed myself and/or my family
☐3 I share the produce with others
☐4 I donate the produce
☐5 I use the produce to create value-added products (i.e. sauce, jam, ketchup, etc.)
☐6 Other: ____

11. Are you currently growing for market? ☐1 Yes (Go to Question 12a) ☐2 No (Go to Question 13a)

IF YOU ARE CURRENTLY GROWING FOOD FOR MARKET:

12a. Is farming your primary source of income? ☐1 Yes ☐2 No

12b. Where do you sell your produce or value-added products? (check all that apply)

☐1 Farmer's market(s)
☐2 Farmstand(s)
☐3 Retail Store(s)
☐4 CSA(s)
☐5 Restaurant(s)
☐6 Other: ____

12c. On average, approximately how much money do you receive per year from the sale of your produce?

$__________ per year

IF YOU ARE NOT CURRENTLY GROWING FOOD FOR MARKET:

13a. Do you ever plan to grow for market? ☐1 Yes ☐2 No (Go to Question 16)

13b. If yes, when do you plan to start growing for market?

☐1 In less than 1 year
☐2 In 1-2 years
☐3 In 2-5 years
☐4 In over 5 years

13c. Please describe your plans to grow for market (including planned acreage, crops, etc.).

14. Which of the following do you currently have for your farm or garden? (check all that apply)

☐1 A business plan
☐2 Secure land
☐3 Secure capital
☐4 Secure markets

15. What do you perceive as the main obstacles to starting or running a commercial growing operation? (check all that apply)

☐1 Access to land
☐2 Access to capital
☐3 Production/agricultural skills
☐4 Equipment
☐5 Marketing
☐6 Labor
☐7 Business skills
☐8 Understanding of legal compliance/regulations
☐9 Other: ____

16. What do you hope to learn or gain from the Grow Your Groceries Program?

GROWING CAPACITY

17. How skilled do you feel in each of the following areas?

	Very skilled	Somewhat skilled	Not very skilled	I did not take this class
a. Site selection	☐1	☐2	☐3	☐4
b. Goal setting	☐1	☐2	☐3	☐4
c. Logistics of starting a farm	☐1	☐2	☐3	☐4
d. Marketing and record keeping	☐1	☐2	☐3	☐4
e. Basics of soil science	☐1	☐2	☐3	☐4
f. Crop planning	☐1	☐2	☐3	☐4
g. Greenhouse management	☐1	☐2	☐3	☐4
h. Building healthy soil	☐1	☐2	☐3	☐4
i. Pest management	☐1	☐2	☐3	☐4
j. Irrigation and water management	☐1	☐2	☐3	☐4
k. Designing an annual vegetable garden	☐1	☐2	☐3	☐4
l. Weed management	☐1	☐2	☐3	☐4
m. Fruit tree care	☐1	☐2	☐3	☐4
n. Organic systems compliance	☐1	☐2	☐3	☐4
o. Harvesting, grading and packing	☐1	☐2	☐3	☐4
p. Seed saving	☐1	☐2	☐3	☐4
q. Growing grapes and berries	☐1	☐2	☐3	☐4
r. Value-added products	☐1	☐2	☐3	☐4
s. Small-scale mushroom cultivation	☐1	☐2	☐3	☐4
t. Cut flower production	☐1	☐2	☐3	☐4

18. Would you be interested in receiving help related to growing food or running a business? ☐1 Yes ☐2 No

18a. If yes, which areas would you be interested in receiving assistance? (check all that apply)

- ☐1 Access to land
- ☐2 Access to capital
- ☐3 Production/agricultural skills
- ☐4 Creating a business plan
- ☐5 Marketing
- ☐6 Legal compliance/regulations
- ☐7 Other: ____

ABOUT YOU

19. Approximately how long have you been growing food? (check one)

- ☐1 Less than 6 months
- ☐2 6 months - 1 year
- ☐3 1-2 years
- ☐4 2-4 years
- ☐5 4-10 years
- ☐6 More than 10 years

20. What is your gender? ☐1 Male ☐2 Female ☐3 Transgender

21. Which age group best describes you? (check one)

- ☐1 Under 18
- ☐2 18-24
- ☐3 25-30
- ☐4 31-35
- ☐5 36-40
- ☐6 41-45
- ☐7 46-50
- ☐8 51-55
- ☐9 56-60
- ☐10 61-65
- ☐11 66 or over

22. Which of the following best describes your race/ethnicity? (check one)

- ☐ 1 Black
- ☐ 2 Chinese
- ☐ 3 Filipino
- ☐ 4 Hispanic
- ☐ 5 Hmong
- ☐ 6 Indian
- ☐ 7 Japanese
- ☐ 8 Mien
- ☐ 9 Native American/Alaskan Native
- ☐ 10 Pacific Islander
- ☐ 11 White
- ☐ 12 Vietnamese
- ☐ 13 Other: ________________________________

23. As an individual, what is your average monthly income? (check one)

- ☐ 1 Less than $500
- ☐ 2 $501-$1,000
- ☐ 3 $1,001-$1,500
- ☐ 4 $1,501-$2,000
- ☐ 5 $2,001-$2,500
- ☐ 6 $2,501-$3,000
- ☐ 7 More than $3,000

Thank you!

GROW YOUR GROCERIES
POST SURVEY

We would like to learn more about your experiences with Soil Born Farm's Grow Your Groceries Program in order to evaluate the program's impact and take steps to improve the training. Thank you in advance for your input!

1. What is today's date? _____ /______ /______

2. What is your first and last name? ____

3. When did you begin the Grow Your Groceries Program? (check one)

☐ 1 March 2013 - Home Gardener
☐ 2 March 2013 - Urban Farmer
☐ 3 October 2013 - Home Gardener
☐ 4 October 2013 - Urban Farmer

ABOUT YOUR GROWING SPACE

4. How would you best describe your growing space? (check one)

☐ 1 Farm
☐ 2 Home Garden
☐ 3 School Garden
☐ 4 Community Garden
☐ 5 Other: ____________________________________

5. What is the address of your farm or garden?
Street address: ____
City: ____________________________________ Zip Code: ______________

6. On how many acres (or square feet) do you grow food? __________acres **(OR** __________square feet)

7. During an average week, how many labor hours (from yourself, employees, family members, or volunteers) are spent working on your farm or garden? (check one)

☐ 1 Under 5 hours
☐ 2 5-10 hours
☐ 3 10-20 hours
☐ 4 20-30 hours
☐ 5 30-40 hours
☐ 6 More than 40 hours

8. Please list the crops you are currently growing:

9. Please list other types of produce, forage crops, or livestock you would be interested in incorporating into your operation:

10. How do you use the produce you grow? (check all that apply)

☐ 1 I sell the produce
☐ 2 I use the produce to feed myself and/or my family
☐ 3 I share the produce with others
☐ 4 I donate the produce
☐ 5 I use the produce to create value-added products (i.e. sauce, jam, ketchup, etc.)
☐ 6 Other: ____

11. Are you currently growing for market? ☐ 1 Yes (Go to Question 12a) ☐ 2 No (Go to Question 13a)

IF YOU ARE CURRENTLY GROWING FOOD FOR MARKET:

12a. Is farming your primary source of income? ☐ 1 Yes ☐ 2 No

12b. Where do you sell your produce or value-added products? (check all that apply)

☐ 1 Farmer's market(s)
☐ 2 Farmstand(s)
☐ 3 Retail Store(s)
☐ 4 CSA(s)
☐ 5 Restaurant(s)
☐ 6 Other: ____

12c. On average, approximately how much money do you receive per year from the sale of your produce?

$__________ per year

IF YOU ARE NOT CURRENTLY GROWING FOOD FOR MARKET:

13a. Do you ever plan to grow for market? ☐ 1 Yes ☐ 2 No (Go to Question 16)

13b. If yes, when do you plan to start growing for market?

☐ 1 In less than 1 year
☐ 2 In 1-2 years
☐ 3 In 2-5 years
☐ 4 In over 5 years

13c. Please describe your plans to grow for market (including planned acreage, crops, etc.).

14. Which of the following do you currently have for your farm or garden? (check all that apply)

☐ 1 A business plan
☐ 2 Secure land
☐ 3 Secure capital
☐ 4 Secure markets

15. What do you perceive as the main obstacles to starting or running a commercial growing operation? (check all that apply)

☐ 1 Access to land
☐ 2 Access to capital
☐ 3 Production/agricultural skills
☐ 4 Equipment
☐ 5 Marketing
☐ 6 Labor
☐ 7 Business skills
☐ 8 Understanding of legal compliance/regulations
☐ 9 Other: ______________________________________

GROWING CAPACITY

16. After participating in the Grow Your Groceries Program, how skilled do you feel in each of the following areas?

	Very skilled	Somewhat skilled	Not very skilled	I did not take this class
a. Site selection	☐1	☐2	☐3	☐4
b. Goal setting	☐1	☐2	☐3	☐4
c. Logistics of starting a farm	☐1	☐2	☐3	☐4
d. Marketing and record keeping	☐1	☐2	☐3	☐4
e. Basics of soil science	☐1	☐2	☐3	☐4
f. Crop planning	☐1	☐2	☐3	☐4
g. Greenhouse management	☐1	☐2	☐3	☐4
h. Building healthy soil	☐1	☐2	☐3	☐4
i. Pest management	☐1	☐2	☐3	☐4
j. Irrigation and water management	☐1	☐2	☐3	☐4
k. Designing an annual vegetable garden	☐1	☐2	☐3	☐4
l. Weed management	☐1	☐2	☐3	☐4
m. Fruit tree care	☐1	☐2	☐3	☐4
n. Organic systems compliance	☐1	☐2	☐3	☐4
o. Harvesting, grading and packing	☐1	☐2	☐3	☐4
p. Seed saving	☐1	☐2	☐3	☐4
q. Growing grapes and berries	☐1	☐2	☐3	☐4
r. Value-added products	☐1	☐2	☐3	☐4
s. Small-scale mushroom cultivation	☐1	☐2	☐3	☐4
t. Cut flower production	☐1	☐2	☐3	☐4

17. Would you be interested in receiving help related to growing food or running a business? ☐1 Yes ☐2 No

17a. If yes, which areas would you be interested in receiving assistance? (check all that apply)

- ☐1 Access to land
- ☐2 Access to capital
- ☐3 Production/agricultural skills
- ☐4 Creating a business plan
- ☐5 Marketing
- ☐6 Legal compliance/regulations
- ☐7 Other: ____

PROGRAM FEEDBACK

18. How useful were each of the following program components?

	Very Useful	Somewhat useful	Not Useful	Did not participate
a. Class sessions	☐1	☐2	☐3	☐4
b. Farm visits and tours	☐1	☐2	☐3	☐4
c. Field hours	☐1	☐2	☐3	☐4
d. Business planning workshop	☐1	☐2	☐3	☐4
e. One-on-one Technical Assistance	☐1	☐2	☐3	☐4

19. Which program topics were <u>most</u> useful to you?

20. Which program topics were <u>least</u> useful to you?

21. How well did the Grow Your Groceries Program meet your expectations?

- ☐1 Exceeded my expectations
- ☐2 Fully met my expectations
- ☐3 Partially met my expectations
- ☐4 Did not meet my expectations at all

22. After participating in the Grow Your Groceries Program, how prepared do you feel to pursue your farming or gardening goals?

- ☐1 Very prepared
- ☐2 Somewhat prepared
- ☐3 Not prepared

23. How has your participation in the Grow Your Groceries Program helped you achieve your farming or gardening goals?

24. Do you have any suggestions for how to improve the Grow Your Groceries Program?

25. Were there any topics that were not included in the Program that you would have liked to cover?

ABOUT YOU

26. Approximately how long have you been growing food? (check one)

- ☐1 Less than 6 months
- ☐2 6 months - 1 year
- ☐3 1-2 years
- ☐4 2-4 years
- ☐5 4-10 years
- ☐6 More than 10 years

27. What is your gender? ☐1Male ☐2Female ☐3Transgender

28. Which age group best describes you? (check one)

- ☐1Under 18
- ☐218-24
- ☐325-30
- ☐431-35
- ☐536-40
- ☐641-45
- ☐746-50
- ☐851-55
- ☐956-60
- ☐1061-65
- ☐1166 or over

29. Which of the following best describes your race/ethnicity? (check one)

- ☐1Black
- ☐2Chinese
- ☐3Filipino
- ☐4Hispanic
- ☐5Hmong
- ☐6 Indian
- ☐7 Japanese
- ☐8 Mien
- ☐9 Native American/Alaskan Native
- ☐10 Pacific Islander
- ☐11White
- ☐12Vietnamese
- ☐13Other: ___________________________________

30. As an individual, what is your average monthly income? (check one)

- ☐1Less than $500
- ☐2$501-$1,000
- ☐3$1,001-$1,500
- ☐4 $1,501-$2,000
- ☐5$2,001-$2,500
- ☐6$2,501-$3,000
- ☐7More than $3,000

Thank you!

Grow Your Groceries Program
Participant Interview Questions: Cohort 1

Background

1. Do you have a farm or a garden? Please describe.
2. Why did you decide to participate in the Grow Your Groceries Program?
3. What parts of the GYG program did you participate in? (courses, field trips, technical assistance)
4. What parts of the program were most helpful to you?
5. What parts of the program were least helpful to you?

Technical Assistance

6. What types of technical assistance did you receive from the program?
7. Who provided you with the technical assistance?
8. In your opinion, did the TA enhance the GYG program courses? Why or why not?

Outcomes

9. Have you been able to use the information you gained from the program? If so, describe.
10. How did the program impact your skills related to farming or gardening?
11. Did you change any of your gardening or farming practices based on the assistance and information you received? How so?
12. What would you consider your greatest farming or gardening achievement since completing the GYG program?
13. Currently, what are the main obstacles or challenges with your farm or garden?

Challenges/Suggestions

14. Were there any challenges or barriers you experienced with the program or with the technical assistance?
15. Do you have suggestions for how Soil Born Farms can improve the GYG program?

Reflection

16. From your perspective, what are the benefits of offering a program like this to local growers and gardeners?
17. Personally, how have you benefited from participating in the program?
18. Would you recommend GYG to other farmers or gardeners? Why or why not?
19. Is there any additional assistance or support you would like? If so, please describe.
20. Do you have any other comments or suggestions?

Grow Your Groceries Program
Attendance by Class Type

Class Name	Date	# of Participants
2-Day Small Farms Intensive	3/16/2013	8
Building Healthy Soil	3/30/2013	17
Goal Setting & Enterprise	4/10/2013	12
Site Selection & Design	4/13/2013	12
Crop Planning	4/17/2013	16
Greenhouse Management	4/20/2013	10
Legalities & Logistics	5/1/2013	10
Integrated Pest Management	5/29/2013	14
Irrigation & Water Management	6/1/2013	15
Weed Management	6/12/2013	11
Fruit Trees	6/15/2013	10
Marketing & Record Keeping	6/19/2013	11
Designing Vegetable Garden	6/22/2013	16
Building Healthy Soil (3 classes)	7/20/2013	9
Harvesting, Grading, Packing	7/27/2013	11
Organic Systems Compliance	7/31/2013	8
Seed Saving	8/21/2013	10
Wrapping up the Season	9/7/2013	11
Grapes & Berries	9/25/2013	10
Goal Setting & Enterprise	10/9/2013	4
Small-Scale Cut Flower Production	10/12/2013	9
Site Selection & Design	10/19/2013	9
Marketing & Record Keeping	10/23/2013	10
Crop Planning	11/2/2013	2
Seasonal Fruit Tree Care	11/9/2013	2
Small-Scale Mushroom Cultivation	11/16/2013	4
Building Healthy Soil	11/23/2013	1
Beginning Welding	1/11/2014	4
Value-Added Products	1/25/2014	1
Beginning Carpentry	2/1/2014	6
Beginning Ag. Mechanics	2/8/2014	3
Beekeeping	3/8/2014	1
2-Day Small Farms Intensive	3/15/2014	2
Crop Planning	3/26/2014	1
Plant Propagation & Greenhouse Management	3/29/2014	3
Site Selection & Design	4/12/2014	1
Legalities & Logistics	4/23/2014	2
Marketing & Record Keeping	5/21/2014	3

Matched Pre and Post Survey Analysis
14 Matched Surveys

When will you (or when did you) begin the Grow Your Groceries Program?	Pre	n=14	Post	n=14
March 2013 - Home Gardener	8	57%	10	71%
March 2013 - Urban Farmer	6	43%	4	29%

How would you best describe your growing space?	Pre	n=14	Post	n=14
Home Garden	8	57%	8	57%
Other	3	21%	3	21%
Farm	2	14%	2	14%
School Garden	1	7%	1	7%

What is the address of your farm or garden?	Pre	n=12	Post	n=13
95603	1	8%	1	8%
95616	1	8%	1	8%
95623	1	8%	0	0%
95632	0	0%	1	8%
95758	1	8%	1	8%
95811	1	8%	2	15%
95819	1	8%	1	8%
95826	1	8%	0	0%
95828	1	8%	1	8%
95831	1	8%	1	8%
95864	1	8%	2	15%
96126	1	8%	1	8%
97114	1	8%	1	8%

On how many acres (or square feet) do you grow food?				
Acres (3 have 1+ Acres)	**Pre**	**n=3**	**Post**	**n=3**
1 acre	2	67%	2	67%
69 acres	1	33%	1	33%
Average Acres	*23.67*		*23.67*	
Square Feet (16 have 20+ Square Feet)	**Pre**	**n=10**	**Post**	**n=10**
20 - 99	3	30%	2	20%
100-199	1	10%	1	10%
200	1	10%	1	10%
300	1	10%	2	20%
400	1	10%	0	0%
600	1	10%	2	20%
1000	2	20%	1	10%
3000	0	0%	1	10%
Average Square Feet	*372.2*		*615.2*	

During an average week, how many labor hours are spent working on your farm or garden?	Pre	n=14	Post	n=14
Under 5 hours	6	43%	5	36%
5-10 hours	4	29%	3	21%
10-20 hours	1	7%	4	29%
20-30 hours	2	14%	1	7%
More than 40 hours	1	7%	1	7%

How do you use the produce you grow?	Pre	n=14	Post	n=14
I use the produce to feed myself and/or my family	12	86%	12	86%
I share the produce with others	5	36%	9	64%
I use the produce to create value-added products	3	21%	4	29%
I sell the produce	2	14%	2	14%
I donate the produce	1	7%	1	7%
Other	1	7%	1	7%

Are you currently growing for market?	Pre	n=14	Post	n=14
No	13	93%	12	86%
Yes	1	7%	2	14%

Is farming your primary source of income?	Pre	n=1	Post	n=2
No	1	100%	1	50%
Yes	0	0%	1	50%

On average, approximately how much money do you receive per year from the sale of your produce?	Pre	Post
# responding	1	1
Sales Income	25,000	25,000

Where do you sell your produce or value-added products?	Pre	Post
Farmers market	0	0
Farmstand	0	0
Retail Store	0	0
CSA	0	0
Restaurant	0	0
Other - winemakers	1	1

Do you ever plan to grow for market?	Pre	n=13	Post	n=12
Yes	5	38%	7	58%
No	8	62%	5	42%

If yes, when do you plan to start growing for market?	Pre	n=5	Post	n=7
In less than 1 year	1	20%	2	29%
In 1-2 years	1	20%	0	0%
In 2-5 years	3	60%	5	71%

Which of the following do you currently have for your farm or garden?	Pre	n=8	Post	n=10
Secure capital	3	38%	6	60%
Secure land	7	88%	5	50%
Business plan	2	25%	4	40%
Secure markets	1	13%	2	20%

What do you perceive as the main obstacles to starting or running a commercial growing operation?	Pre	n=14	Post	n=11
Access to capital	8	57%	6	55%
Production/agricultural skills	11	79%	6	55%
Access to land	7	50%	5	45%
Equipment	7	50%	4	36%
Marketing	4	29%	4	36%
Labor	4	29%	4	36%
Business skills	6	43%	3	27%
Understanding of legal	6	43%	3	27%
Other	1	7%	1	9%

Would you be interested in receiving help related to growing food or running a business?	Pre	n=14	Post	n=13
Yes	11	79%	10	77%
No	3	21%	3	23%

If yes, which areas would you be interested in receiving assistance?	Pre	n=12	Post	n=9
Production/agricultural skills	8	67%	5	56%
Marketing	4	33%	5	56%
Access to capital	6	50%	4	44%
Legal compliance/regulations	4	33%	4	44%
Creating a business plan	5	42%	3	33%
Other	1	8%	2	22%
Access to land	3	25%	1	11%

How skilled do you feel in each of the following areas? 1=Not very skilled, 2=Somewhat skilled, 3=Very skilled	n		Average Score		Not very skilled		Somewhat skilled		Very skilled		Not very skilled		Somewhat skilled		Very skilled	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
a_Site Selection	12	13	1.25	2.23	9	1	3	8	0	4	75%	8%	25%	62%	0%	31%
b_Goal Setting	12	13	1.83	2.46	4	1	6	5	2	7	33%	8%	50%	38%	17%	54%
c_Logistics of starting a farm	10	12	1.20	2.08	8	2	2	7	0	3	80%	17%	20%	58%	0%	25%
d_Marketing and record keeping	10	12	1.40	2.08	7	2	2	7	1	3	70%	17%	20%	58%	10%	25%
e_Basics of soil science	13	13	1.23	2.31	10	0	3	9	0	4	77%	0%	23%	69%	0%	31%
f_Crop planning	13	13	1.15	2.31	11	2	2	5	0	6	85%	15%	15%	38%	0%	46%
g_Greenhouse management	11	9	1.09	1.67	10	3	1	6	0	0	91%	33%	9%	67%	0%	0%
h_Building healthy soil	13	13	1.38	2.46	8	0	5	7	0	6	62%	0%	38%	54%	0%	46%
i_Pest management	12	12	1.33	2.08	8	2	4	7	0	3	67%	17%	33%	58%	0%	25%
j_Irrigation and water management	13	12	1.23	2.17	10	1	3	8	0	3	77%	8%	23%	67%	0%	25%
k_Designing an annual vegetable garden	13	12	1.54	2.33	6	2	7	4	0	6	46%	17%	54%	33%	0%	50%
l_Weed management	13	12	1.38	2.17	8	2	5	6	0	4	62%	17%	38%	50%	0%	33%
m_Fruit tree care	12	10	1.25	1.80	9	3	3	6	0	1	75%	30%	25%	60%	0%	10%
n_Organic systems compliance	9	9	1.11	1.78	8	3	1	5	0	1	89%	33%	11%	56%	0%	11%
o_Harvesting grading and packing	10	8	1.00	2.00	10	2	0	4	0	2	100%	25%	0%	50%	0%	25%
p_Seed saving	12	10	1.25	2.00	10	1	1	8	1	1	83%	10%	8%	80%	8%	10%
q_Growing grapes and berries	11	7	1.36	1.86	7	2	4	4	0	1	64%	29%	36%	57%	0%	14%
r_Value-added products	8	5	1.25	1.60	6	2	2	3	0	0	75%	40%	25%	60%	0%	0%
s_Small-scale mushroom cultivation	7	4	1.14	1.75	6	1	1	3	0	0	86%	25%	14%	75%	0%	0%
t_Cut flower production	9	5	1.22	1.80	7	1	2	4	0	0	78%	20%	22%	80%	0%	0%

Change Pre => Post (matched who took class)

How skilled do you feel in each of the following areas?	n	Not very skilled => Not very skilled		Not very skilled => Somewhat skilled		Not very skilled => Very skilled		Somewhat skilled => Not very skilled		Somewhat skilled => Somewhat		Somewhat skilled => Very skilled		Very skilled => Very skilled	
a_Site Selection	12	1	8%	6	50%	2	17%	0	0%	1	8%	2	17%	0	0%
b_Goal Setting	12	1	8%	3	25%	0	0%	0	0%	2	17%	4	33%	2	17%
c_Logistics of starting a farm	10	2	20%	4	40%	2	20%	0	0%	1	10%	1	10%	0	0%
d_Marketing and record keeping	10	2	20%	4	40%	1	10%	0	0%	1	10%	1	10%	1	10%
e_Basics of soil science	12	0	0%	8	67%	2	17%	0	0%	1	8%	1	8%	0	0%
f_Crop planning	12	2	17%	5	42%	3	25%	0	0%	0	0%	2	17%	0	0%
g_Greenhouse management	9	2	22%	6	67%	0	0%	1	11%	0	0%	0	0%	0	0%
h_Building healthy soil	12	0	0%	5	42%	3	25%	0	0%	2	17%	2	17%	0	0%
i_Pest management	10	2	20%	3	30%	1	10%	0	0%	2	20%	2	20%	0	0%
j_Irrigation and water management	11	1	9%	6	55%	1	9%	0	0%	1	9%	2	18%	0	0%
k_Designing an annual vegetable garden	11	1	9%	2	18%	2	18%	1	9%	2	18%	3	27%	0	0%
l_Weed management	11	1	9%	5	45%	1	9%	1	9%	1	9%	2	18%	0	0%
m_Fruit tree care	8	2	25%	4	50%	0	0%	0	0%	2	25%	0	0%	0	0%
n_Organic systems compliance	7	3	43%	2	29%	1	14%	0	0%	1	14%	0	0%	0	0%
o_Harvesting grading and packing	7	2	29%	4	57%	1	14%	0	0%	0	0%	0	0%	0	0%
p_Seed saving	9	1	11%	7	78%	0	0%	0	0%	0	0%	1	11%	0	0%
q_Growing grapes and berries	7	1	14%	2	29%	1	14%	1	14%	2	29%	0	0%	0	0%
r_Value-added products	4	1	25%	1	25%	0	0%	0	0%	2	50%	0	0%	0	0%
s_Small-scale mushroom cultivation	4	1	25%	2	50%	0	0%	0	0%	1	25%	0	0%	0	0%
t_Cut flower production	5	0	0%	3	60%	0	0%	1	20%	1	20%	0	0%	0	0%

Post Survey Question Analysis
14 Post Surveys

How useful were each of the following program components?		
Class sessions	**Total**	**n=13**
Somewhat useful	2	15%
Very useful	11	85%
Farm visits and tours	**Total**	**n=11**
Did not participate	2	NA
Very useful	11	100%
Field hours	**Total**	**n=11**
Did not participate	2	NA
Not useful	1	9%
Very useful	10	91%
Business planning workshop	**Total**	**n=7**
Did not participate	6	NA
Somewhat useful	2	29%
Very useful	5	71%
One-on-one technical assistance	**Total**	**n=6**
Did not participate	7	NA
Very useful	6	100%

How well did the GYG Program meet your expectations?	Total	n=13
Exceeded my expectations	4	31%
Fully met my expectations	7	54%
Partially met my expectations	2	15%

After participating in GYG, how prepared do you feel to pursue your farming or gardening plans?	Total	n=13
Not prepared	0	0%
Somewhat prepared	8	62%
Very prepared	5	38%

Post Survey Open-Ended Questions

Which program topics were most useful to you?
The first intensive weekend was super helpful for an overall understanding of soil; I feel like I could take the classes over again after having a year under my belt of getting my hands dirty in the soil and get even more out of it. Soil, crop rotation, pest management, tree cropping were the most pertinent topics
growing grapes
Beekeeping, seed saving, site selection, welding and carpentry.
Business planning series, River Hill Farm Tour, Pest Management, Building Healthy Soil
Most topics were very useful, though I didn't take advantage of the field hours which is why I feel I lack practical knowledge and skills for actually producing and running a farming business
Everything I learned was useful
the site visits and the field work are critical to making this program work. But among the classes what helped most were building healthy soil, weed management, and crop rotation
crop planning, seed saving, building a healthy soil, greenhouse/seed developement
soil knowledge, crop planning, harvesting, anything that involved hands-on - loved the volunteer hours - wish I was able to do it more often
The farm visits are Amazing! Talking to other farmers in an open formate while also being able to walk around was very helpful. It give me a chance to see how different farms operate and the philosophy behind why they farm.
business planning, soil, water/irrigation, design garden

Which program topics were least useful to you?
They were all useful, but I didn't learn as much in the less hands-on ones.
Crop planning due to poor preparation from presenter. Not much objective information was discussed
irrigation. not because it wasn't useful but so much technical information was thrown at us in a short amount of time.
The field hours. The farm crew is too busy working to spend the time to answer some of my questions. I know it's not their fault because they have deadlines to meet but it would have been helpful to spend a few minutes before and after the field hours to
mushrooms, but I didn't take it because I'm not interested in growing

How has your participation in GYG helped you achieve your farming or gardening goals?
I can now talk intelligently to our vineyard manager and I'm not afraid of killing our veg.
After taking all courses, I feel I've gained basic information to start my own home garden.
more confident and had some idea about where to start or look for help
Better understanding of daily mechanics and what sort of resources I'll need.
I know how to grow food, manage soil and pests and care for food during the harvest process.
It provided me with a basic understanding of the foundations needed, like healthy soil, site selection, crop rotation, etc. and also with confidence to just dig in!
I am clearer on potential uses for acreage and the potential for partnering with others. I have a better understanding of the commitment needed. My confidence in being able to get help when needed is greater.
shown me the need to put together a business plan, even if I'm growing for myself
the experience has given me much more confidence in pursuing my growing/farming goals, I feel far more comfortable. Learning that growing anything is and can be a learn as you go experience. You won't know until you try!
Not having any Ag. experience it launched me into a new career. I was able to learn from educators and farmers that have been in the industry for many years. Being able to learn from them was an experience I wouldn't have learned from books or my own expe
Yes, it's helped me to create a business plan and to transition out of my current job
It did give me more knowledge of managing a garden space and I was able to get some plants to grow that I haven't been able to in the the past.

Do you have any suggestions for how to improve the GYG Program?
Make the farm visits during the weekends; I would have love to have gone on more of those but with two young kids was hard to go during the time allotted on Wednesday.
More hands on work.
All hands-on whenever possible! Better lighting in the barn work area.
A binder with materials pre-printed would be awesome. Shorter class times would work. Maybe 2 hours 6-8pm for the weekday classes and then have longer classes on Saturdays when needed. Many of the instructors covered the same ground during the first hour. Philosophy and arguments for organic and pesticide free farming. It seems like we were all there because we already agree with that. So maybe helping the instructors know what's already been covered or that all the students have already been converted ;-) Then they can just jump right into their focused topics and classes can be shorter. I would have enjoyed more field hours and less class room time.
Offee more field hours during class days
At some point maybe providing online options for some of the classroom classes.
The program is evolving and already seems to be incorporating what my suggestion would be. The courses need to be more integrated and coordinated into a curriculum so that there is a progression of learning that can be articulated.
Have more classes on the weekends as classes during the week are sometimes hard to shedule into school and work
none at this time - I love the relaxed and friendly approach; the hands on and working with the Soil Born crew was truly fantastic and they were all very encouraging. Farming is hard work, but so rewarding and gratifying. I love that kind of job.
Improve the field hours by talking some time to answer questions. It's a great opportunity to learn for someone who is running a farm but not when the farm manager doesn't want to take or answer questions. In the future I would like to take individual classes to improve on my education but the price per class is too expensive. Maybe a discount for Urban farmer graduates :)
hands-on planting, hands-on activities as much as possible. a database or repository of all our class resources. a class roster
It would have been helpful to have the material standardized so that everyone could understand. Some of the material was not comprehensive and I felt very lost with some of the more advanced subject matter. I also think that field hours, getting more hands-on experience would be much more beneficial than sitting in the classroom for four hours.

Were there any topics not included in the Program that you would have liked to cover?
Machinery/Tractor use.
Chickens? I think there is one maybe and I just missed it.
It would have been helpful to include farm administrative shadowing as field hours. That's the primary area that's holding me back. It overwhelms me and I just don't want to deal with any paper work.
not really, it was a well rounded course
Selling products
succulents, how to grow, is there a market for it? herbs
I am deeply concerned about water usage and wanted to see a different take on how we manage our water in food production. I feel like the info just scraped the surface.

Attachment for SCB11063, Final Report

Publications and Presentations

Presentations

To date, we have made two presentations on this project:

- Poster presentation at the 2012 Center for Produce Safety Symposium
- Oral presentation at the 2013 Center for Produce Safety Symposium.

Planned presentations include:

- June 2014 Center for Produce Safety Symposium
- January 2015 Southeast Regional Fruit and Vegetable Conference. This conference is the largest educational conference and trade show in the southeastern United States that unites growers, vendors and suppliers.

Publications

The results from this work have not yet been published, but several publications are in progress and most will either be published or submitted to scientific journals by 30 June 2014. Below is a list of publications *already in progress*.

- Borgato, Camilla. 2014. Correlation of *Salmonella* with physical, chemical, and biological water parameters in irrigation ponds of the Southeastern USA. M.S. thesis, University of Padova, Italy. (We anticipate two journal articles resulting from this thesis)
- Harris, Casey. 2014. Storm runoff and land use related to Salmonella irrigation ponds of the Southeastern USA. M.S. thesis, University of Georgia, Athens, USA. (We anticipate two journal articles resulting from this thesis – one describing the results of the surface runoff study and the second analyzing the relationship between the landscape surrounding the ponds and *Salmonella* measured in the ponds.)
- Journal articles in progress
    - Chemical and physical water quality parameters associated with the presence of *Salmonella* in irrigation ponds
    - Is *E. coli* a good predictor of *Salmonella* in irrigation ponds
    - Effect of precipitation and landscape position on *Salmonella* and *E. coli* in surface runoff around irrigation ponds
    - The relationship between the landscape surrounding irrigation ponds and *Salmonella* measured in the ponds
    - Producer-friendly sampling protocols designed to reflect *Salmonella* concentrations at the irrigation system intake

Tables and Figures

Table 1. Statistical comparison of *Salmonella* Mean log MPN/100L concentrations for the project's five ponds. Means with the same t Grouping letter are not significantly different.

t Grouping		Mean log MPN/100L	N	Pond
	A	1.2166	99	Pond 5
	A	1.1238	102	Pond 4
B	A	0.9959	102	Pond 1
B	C	0.8105	102	Pond 2
	C	0.5474	102	Pond 3

Table 2. Statistical comparison of *Salmonella* Mean log MPN/100L concentrations for 2012 and 2013. Means with the same t Grouping letter are not significantly different.

t Grouping	Mean log MPN/100L	N	Year
A	0.9673	249	2012
A	0.9081	258	2013

Table 3. Statistical comparison of *Salmonella* Mean log MPN/100L monthly concentrations. Means with the same t Grouping letter are not significantly different.

t Grouping			Mean log MPN/100L	N	Month
	A		1.5829	55	Sep
	A		1.4935	25	Oct
B	A		1.2785	54	Aug
B	A		1.1970	25	Dec
B	C		0.9972	54	Jun
B	C		0.9803	55	Jul
B	C	D	0.9655	55	Apr
B	C	D	0.8799	54	May
E	C	D	0.7044	25	Jan
E	F	D	0.4986	25	Feb
E	F		0.2327	25	Nov
	F		0.1370	55	Mar

Table 4. Statistical comparison of *Salmonella* Mean log MPN/100L concentrations for the two sampling strategies evaluated. Means with the same t Grouping letter are not significantly different.

t Grouping			Mean log MPN/100L	N	Month	Strategy
	A		1.2723	44	Edge8	2
B	A		1.1964	45	Composite2	2
B	A	C	1.0841	45	Edge7	2
B	A	C	1.0723	14	Intake2 (subsurface)	2
B	A	C	1.0542	45	Intake2 (surface)	2
B	A	C	0.9889	50	Edge3	1
B	A	C	0.9874	50	Intake1 (surface)	1
B	A	C	0.8631	19	Intake1 (subsurface)	1
B		C	0.7704	45	Edge6	2
B		C	0.7442	50	Edge2	1
		C	0.6915	50	Composite1	1
		C	0.6488	50	Edge1	1

Table 5. Frequency with which the analytical results for *Salmonella* from the intake matched the analytical results for *Salmonella* each for sampling strategy (positive intake = positive composite and negative intake = negative composite).

Metrics	Number of Matching/Not Matching Pairs of Observations (Percent Matching/Not Matching Paired Observations)					
	Pond 1			Pond 2		
	Strategy 1	Strategy 2	Overall	Strategy 1	Strategy 2	Overall
Matched	8 (80%)	6 (67%)	14 (74%0	7 (70%)	6 (67%)	13 (68%)
Not Matched	2 (20%)	3 (33%)	5 (26%)	3 (30%)	3 (33%)	6 (32%)
Total	10 (100%)	9 (100%)	19 (100%)	10 (100%)	9 (100%)	19 (100%)
χ^2	3.6	1	4.26	1.6	1	2.57
P-value	0.05	0.31	0.03	0.2	0.32	0.108

Metrics	Pond 3			Pond 4		
	Strategy 1	Strategy 2	Overall	Strategy 1	Strategy 2	Overall
Matched	5 (50%)	7 (78%)	12 (63%)	8 (80%)	5 (56%)	13 (68%)
Not Matched	5 (50%)	2 (22%)	7 (37%)	2 (20%)	4 (44%)	6 (32%)
Total	10 (100%)	9 (100%)	19 (100%)	10 (100%)	9 (100%)	19 (100%)
χ^2	0	2.77	1.31	3.6	0.11	2.57
P-value	1	0.09	0.25	0.057	0.73	0.1

Metrics	Pond 5			Overall By Strategy		Overall
	Strategy 1	Strategy 2	Overall	Strategy 1	Strategy 2	
Matched	7 (70%)	8 (89%)	15 (79%)	35 (70%)	32 (71%)	67 (70.5%)
Not Matched	3 (30%)	1 (11%)	4 (21%)	15 (30%)	13 (29%)	28 (29.5%)
Total	10 (100%)	9 (100%)	19 (100%)	50 (100%)	45 (100%)	95 (100%)
χ^2	1.6	5.44	6.36	8	8.02	16.01
P-value	0.2	0.01	0.01	0.0047	0.0046	<0.0001

Table 6. Descriptions of sample type classifications and locations. Occasionally more than one sample was collected per location per month.

Sample Type		Pond 1		Pond 3	
		Location	Months sampled	Location	Months sampled
Pond before precipitation	Pond water collected during dry periods, a few hours before expected storms	Near intake	6	Near intake	6
		Pond edges	6	Pond edges	6
Pond after precipitation	Pond water collected immediately following storms	Near intake	6	Near intake	6
		Pond edges	6	Pond edges	6
Pond monthly	Pond water collected at regular monthly intervals, regardless of rainfall	Near intake (alternate months)	4	Near intake (alternate months)	4
		Pond edges (alternate months)	4	Pond edges (alternate months)	4
Inflow streams	Water collected from streams or major ditches flowing into ponds during storms	Intermittent stream	6	Intermittent stream	3
		Large ditch next to paved road	3	-	-
Fields	Runoff collected at the interface between agricultural fields and ponds during storms	Peanut field	6	Miscanthus (biofuel feedstock) field	6
		Tomato field	6	Peanut/Corn fields	4
Forests	Runoff collected at the interface between large patches of non-agricultural land and ponds	House with pines, grass	5	Mixed species forest A	6
		Shrubs, partially wet	6	Mixed species forest B	6
		Mixed species forest	5	-	-

Table 7. Linear mixed-effect model specification for the *lme4* package. The model was fit by a restricted maximum likelihood method. *lmer* Model: Salmonella = Type + (1|Pond) + (1|Month) + (1|Location)

Variable	Variable type	Levels	Transform-ation	Description of variable
Type	Fixed factor	6	-	Identifies the sample type (Fields, Forests, etc.)
Pond	Random factor*	2	-	Identifies sample from Pond 1 or Pond 3
Month	Random factor*	6	-	Date range (out of 6 full sampling cycles) of sample collection
Location	Random factor*	24	-	Identifies specific locations of repeated sampling
Salmonella	Outcome		natural log	Salmonella present in each sample

*Random factors were defined with random intercepts [(1|…) in *lmer* notation], but not random slopes.

Table 8. Using *E. coli* samples above 235 MPN/100mL to predict *Salmonella* presence.

***E. coli* Threshold** (235 MPN/100mL)	***Salmonella***		
	Present	**Absent**	**Total**
Runoff Samples (includes fields, forests, and inflow streams)			
Above	26	22	48
Below	5	8	13
Pond Samples (includes before/after precip. and monthly)			
Above	0	4	4
Below	26	34	60

Table 9. Using *E. coli* samples above 235 MPN/100 ML to predict *Salmonella* presence – percentages.

***E. coli* Prediction of *Salmonella* Presence**	**Sample Type**		**All** (%)
	Pond (%)	**Runoff** (%)	
Correctly positive	0	43	21
Correctly negative	53	13	34
Incorrectly positive	6	36	21
Incorrectly negative	41	8	25

Table 10. Pond size and watershed size for each pond in this study as well as percent cover by various land use types within a 250 m radius of each pond edge.

Pond	Pond Area (m^2)	Pond Area (ac)	Watershed Area (m^2)	Watershed Area (ac)	Cropland (%)	Forest / Wetland (%)	Other (%)	Water (%)	Paved (%)
Pond 1	79,935	20.0	2,745,691	686.4	42.9	40.4	15.9	0.0	0.8
Pond 2	5,799	1.4	6,822	1.7	81.0	15.2	3.8	0.0	0.0
Pond 3	46,722	11.7	658,244	164.6	36.8	53.8	9.4	0.0	0.0
Pond 4	10,955	2.7	204,309	51.1	28.8	31.3	39.9	0.0	0.0
Pond 5	21,637	5.4	877,759	219.4	57.3	33.7	2.8	5.7	0.6

Table 11. Partial serotyping results from surface runoff samples.

Number of months Each Serotype Was Found in Each Habitat					
More Frequent			**Less Frequent**		
Serotype Name / **Sample Type**	**Pond 3**	**Pond 1**	**Serotype Name** / **Sample Type**	**Pond 3**	**Pond 1**
Muenchen			**Gaminara**		
Fields	1	1	Forests	1	
Forests		1	Inflow streams	1	
Inflow streams	1	3	Pond after precip.	1	
Pond after precip.	2	1	Pond before precip.	1	
Pond before precip.	1				
			Braenderup		
Saintpaul			Forests	1	
Fields		2	Inflow streams		1
Forests		2			
Inflow streams	1	3	**Inverness**		
Pond after precip.		2	Forests		2
Pond before precip.		1			
			Anatum		
Bareilly			Inflow streams		1
Fields	1	1			
Forests		2	**Newport**		
Inflow streams		2	Fields		1
Pond after precip.	1				
Pond before precip.		1	**Meleagridis**		
			Fields	1	
Rubislaw					
Forests		1	**Give_var._15+**	1	
Inflow streams	1	4	Inflow streams		
Pond after precip.		1			
Pond before precip.		1	**I_6,7:-:e,n,z15**		1
			Inflow streams		
III_60:r:e,n,x,z15					
Inflow streams		4	**III_16:z10:e,n,x,z15**		1
Pond after precip.	1	1	Inflow streams		
Pond before precip.	1				
			III_50:nonmotile	1	
I_38:k:-			Pond after precip.		
Fields		1			
Forests		1	**III_50:r:-**	1	
Inflow streams		2	Inflow streams		
Pond after precip.		1			
Pond before precip.	1	1	**III_60:r:-**		1
			Pond before precip.		

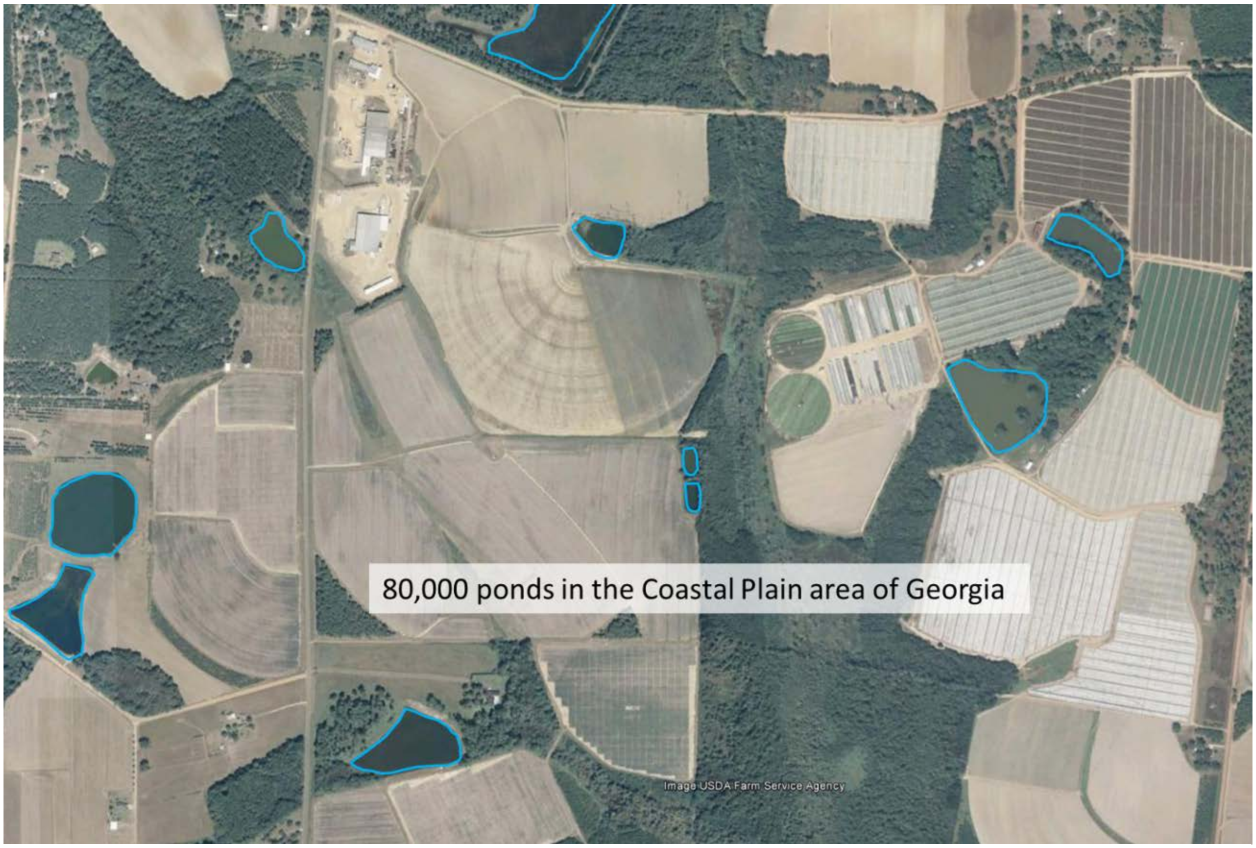


Figure 1. Typical landscape of the Southeastern Coastal Plain (SECP) near Tifton, Georgia. There are 80,000 ponds in the SECP half of which are man-made and used for irrigation.

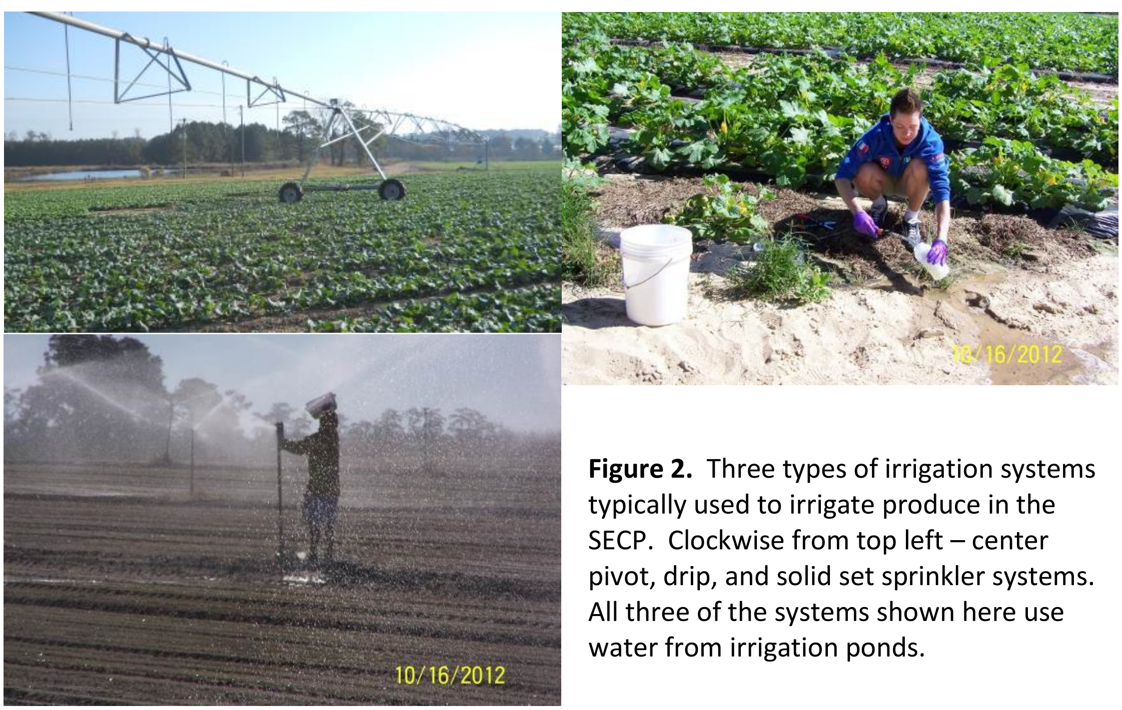


Figure 2. Three types of irrigation systems typically used to irrigate produce in the SECP. Clockwise from top left – center pivot, drip, and solid set sprinkler systems. All three of the systems shown here use water from irrigation ponds.

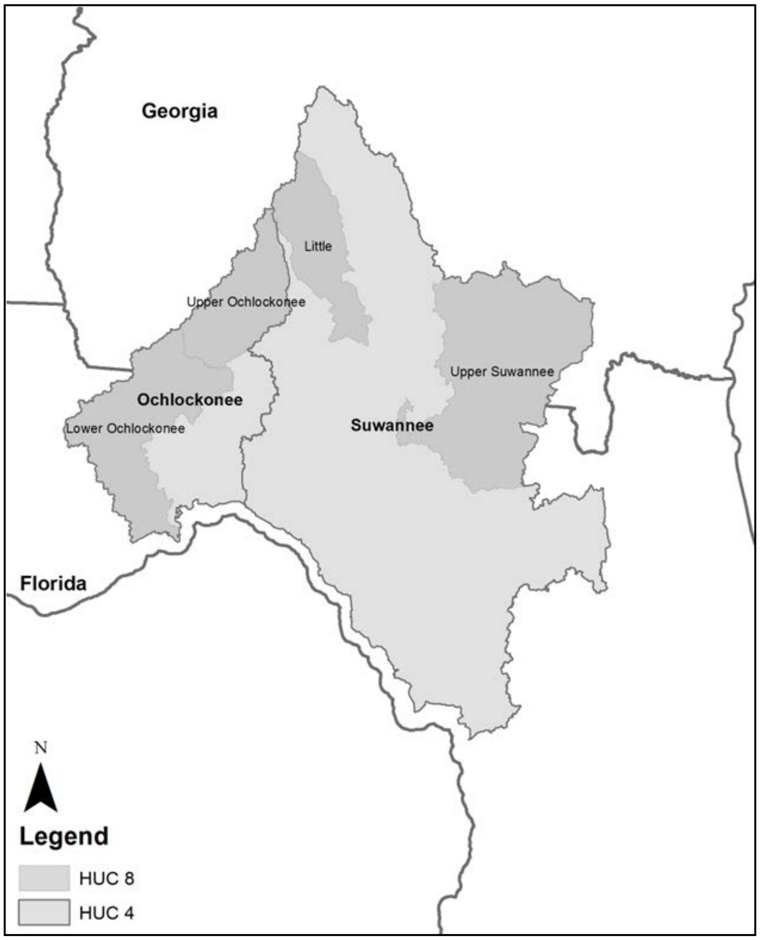


Figure 3. The 10 ponds used by the Wright study were located in the Upper Suwannee, Little, Upper Ochlockonee and Lower Ochlockonee HUC8 watersheds. This study used a subset of 5 ponds located in the Little, Upper Ochlockonee and Lower Ochlockonee HUC8 watersheds.

Figure 4. The intake of irrigation pump stations is usually 10 to 20 ft from the bank and at a depth of 3 to 6 ft. Collecting samples at the intake typically requires a boat, specialized sampling equipment, and time, all of which make it difficult for vegetable producers to collect samples during the growing season.

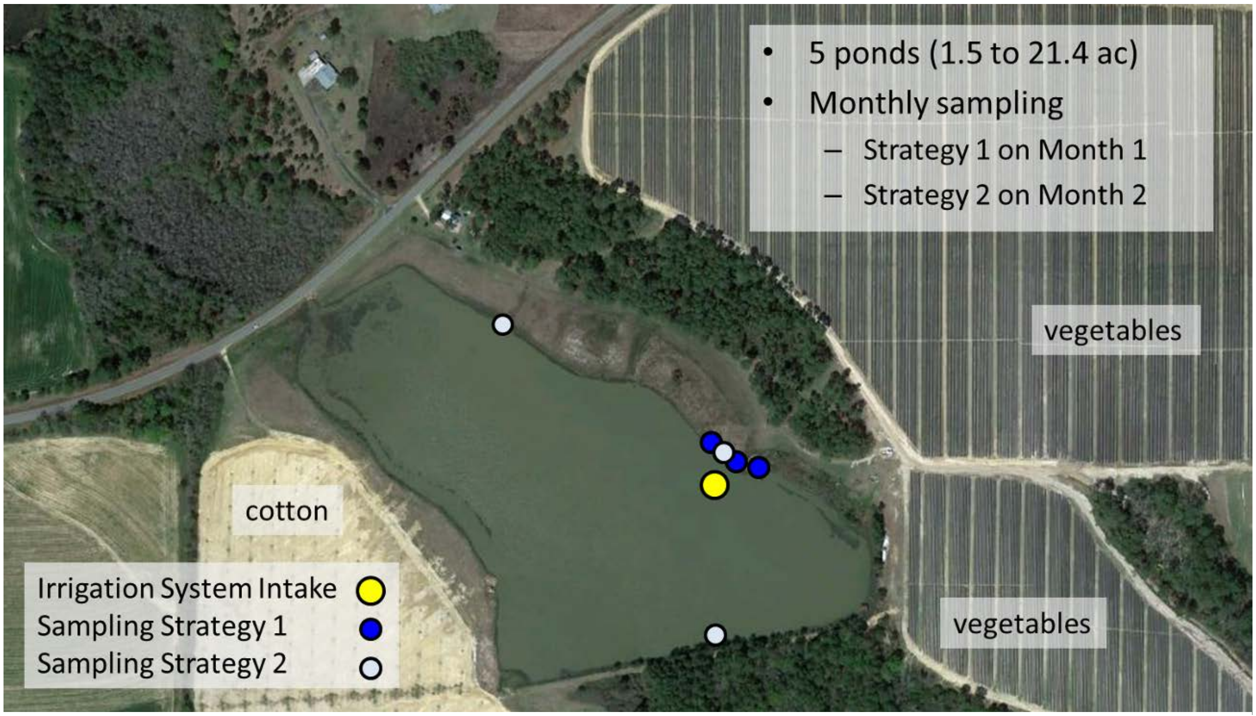


Figure 5. The two strategies used in the study as implemented at Pond 1. Strategy 1 consisted of collecting 3 grab samples (1.5L each) from the bank near the intake of the irrigation system, approximately 10ft apart. Strategy 2 consisted of collecting 3 grab samples along the perimeter of the pond. The three locations were selected to characterize the landscape around the pond (cultivated, marshy, wooded, etc.).

Figure 6. Ms. Camilla Borgato, one of the project's graduate students, collects a grab sample from one of the Strategy 2 bank sampling positions at Pond 4.

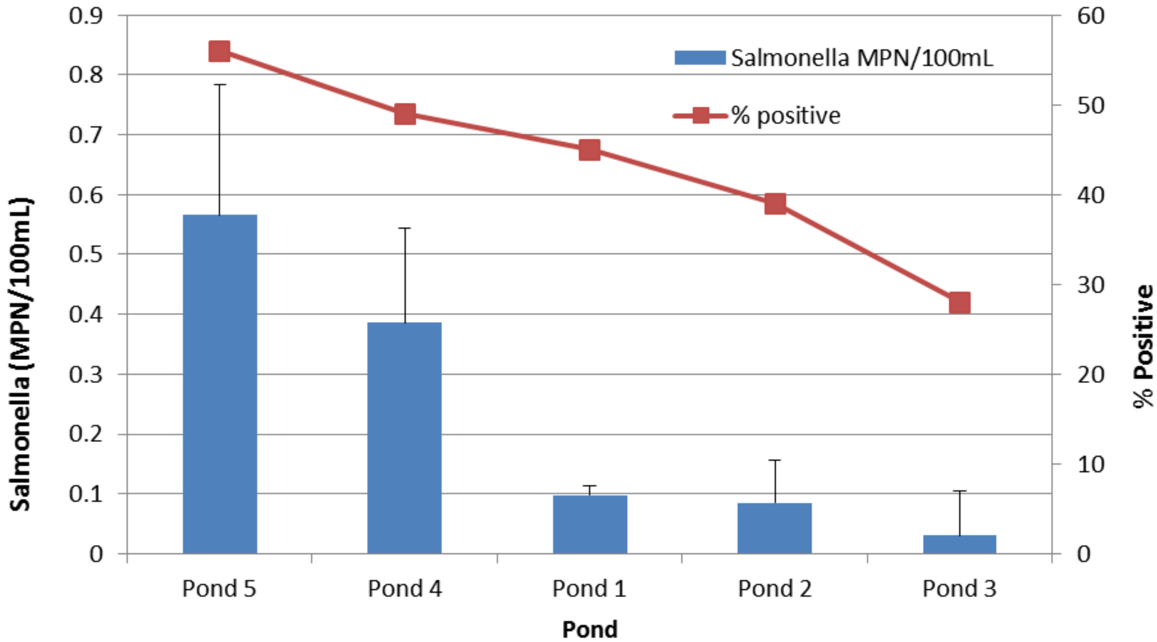


Figure 7. Mean *Salmonella* MPN/100mL concentrations (bars) and percent positives (line) in the project's five ponds.

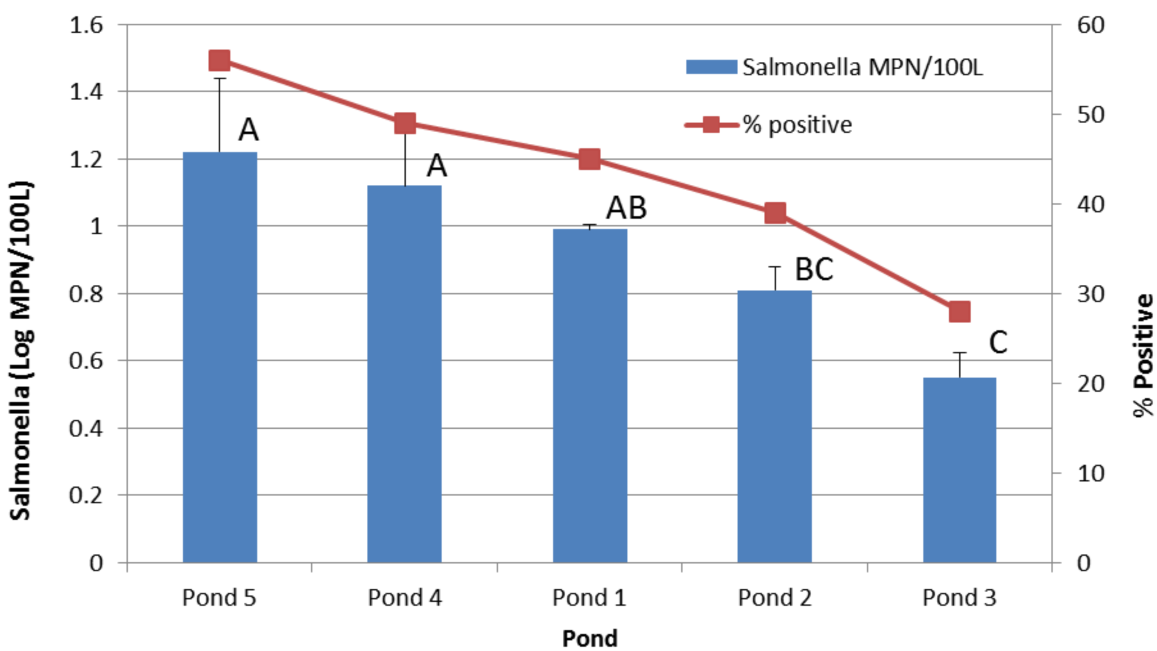


Figure 8. Statistical comparison of *Salmonella* Mean log MPN/100L concentrations (bars) and percent positives (line) in the project's five ponds. Bars with the same t Grouping letter are not significantly different.

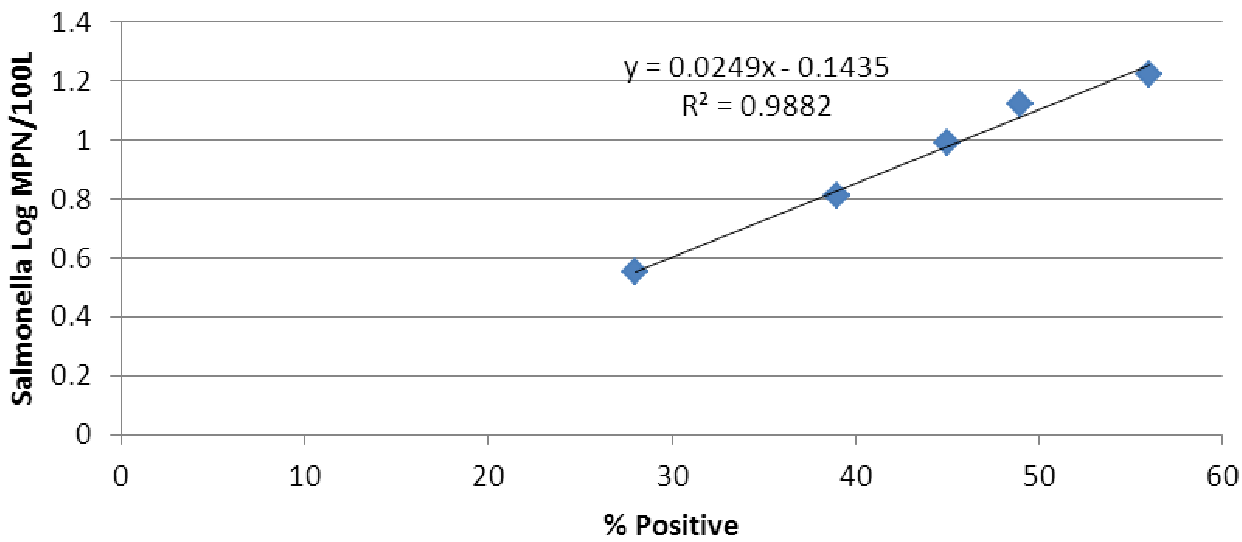


Figure 9. Correlation between % positives and *Salmonella* log MPN/100L for the project's five ponds.

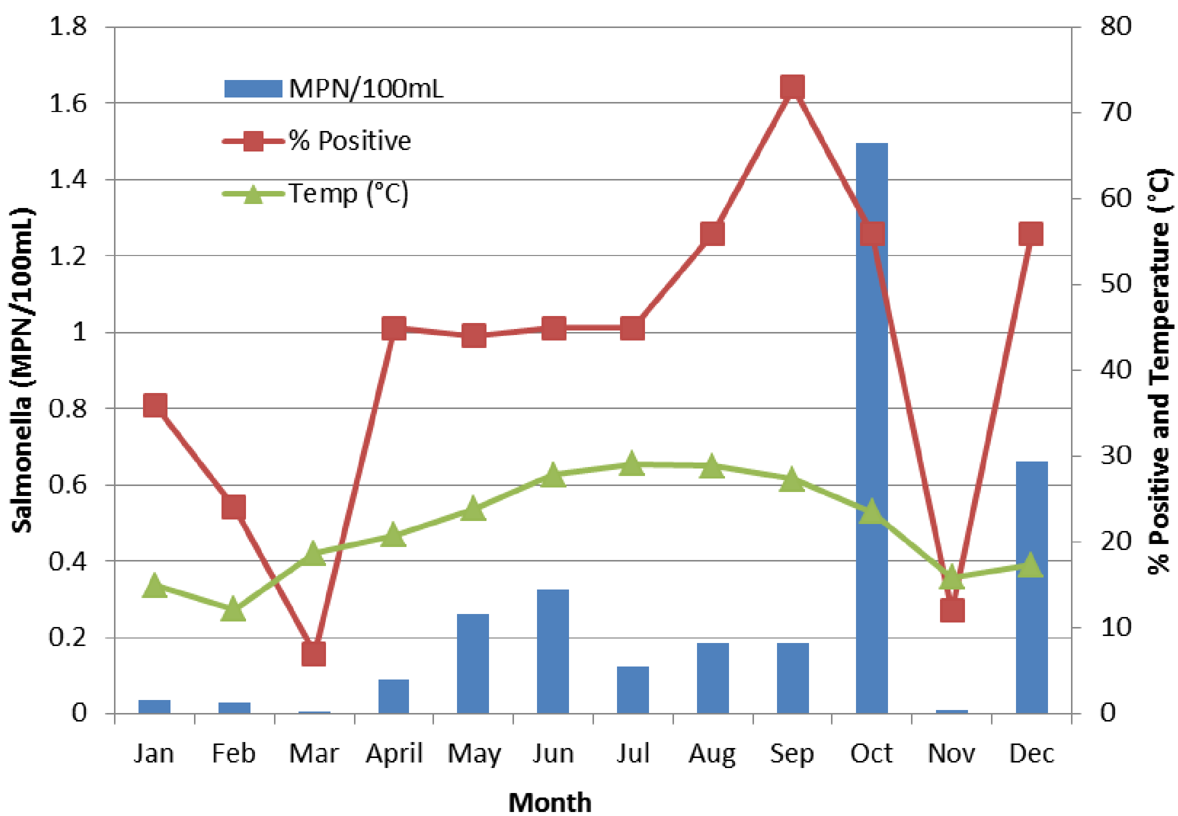


Figure 10. Mean *Salmonella* MPN/100mL concentrations (bars) and percent positives (red line) in the by month. The numbers above the bars indicate months during which concentrations exceeded the upper detection limit. The green line indicates mean water temperature.

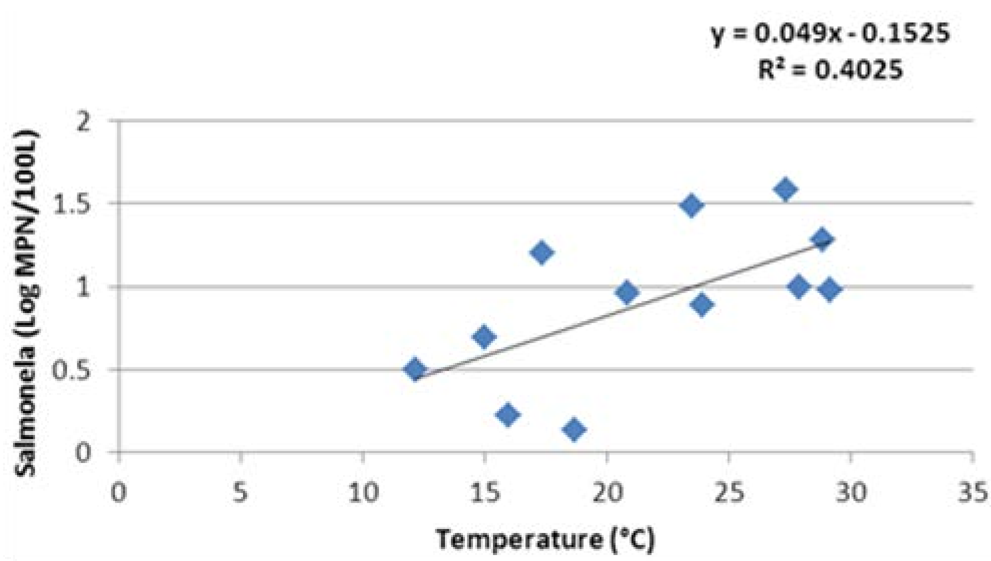


Figure 11. Correlation between monthly temperature and *Salmonella* log MPN/100L.

Figure 12. Pinned sterile 2 L Whirl-Pak® sample bags at Pond 1 prior to and after a runoff event.

Figure 13. Whirl-Pak® bags with runoff samples collected from a forest edge (top) and field edge (bottom) at Pond 3.

Figure 14. In the top photograph, Mr. Rodney Hill and Ms. Casey Harris install sterile Tygon tubing for the ISCO sampler at Pond 1 prior to a precipitation event. The bottom photograph shows the sampler intake installed just above base flow. The vertical position of the intake is easily adjusted.

Figure 15. Approximately 5 L of sample collected with the ISCO sampler at the ephemeral stream at Pond 3 during a precipitation event.

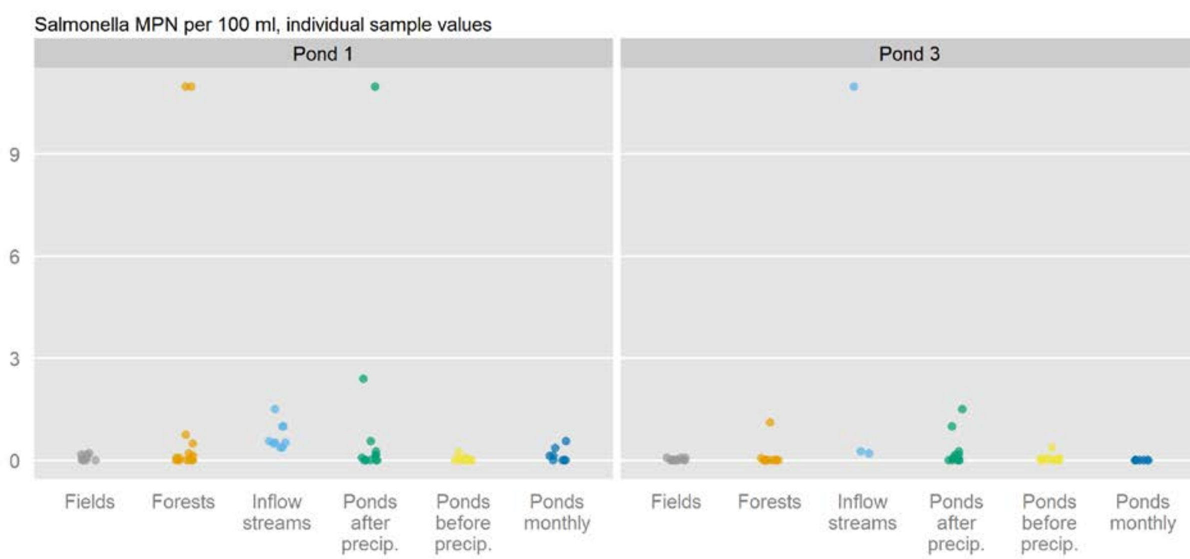


Figure 16. Individual samples collected during this storm runoff portion of the project. Four samples had concentrations above our upper detection limit and were assigned concentrations of 11 MPN/100mL

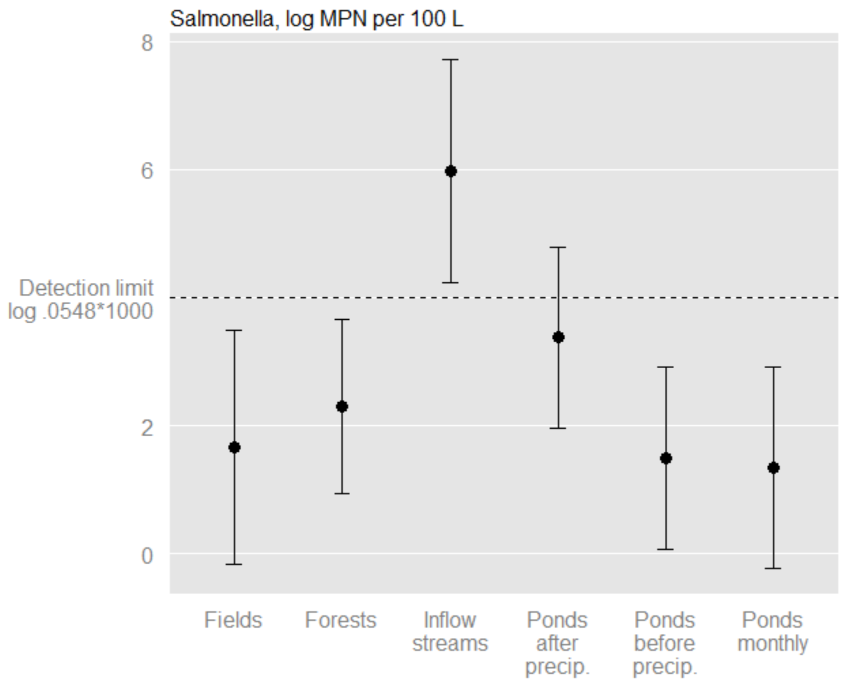


Figure 17. Model-estimated *Salmonella* levels by sample type, shown with 95% confidence intervals.

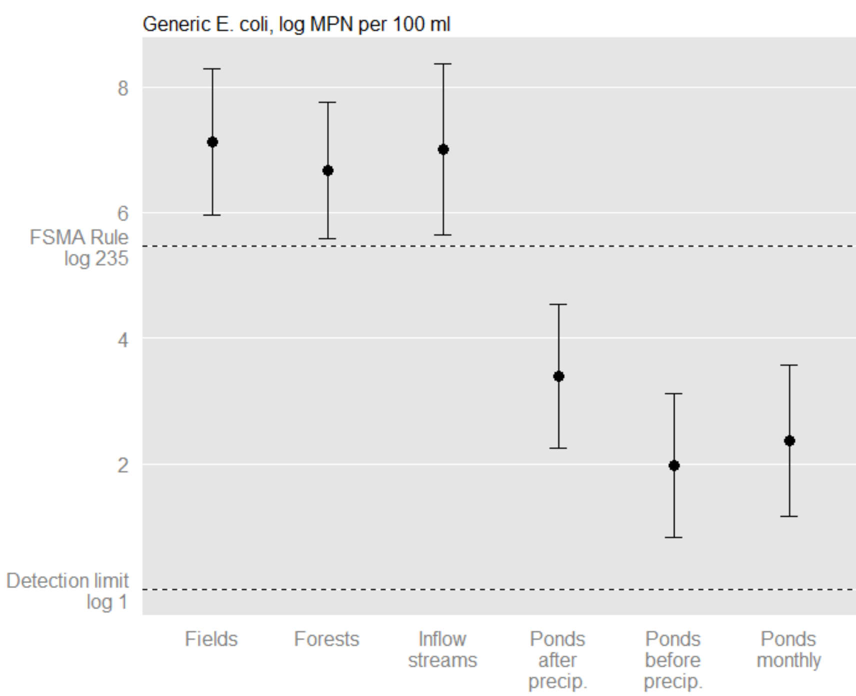


Figure 18. Model-estimated *E. coli* levels by sample type, shown with 95% confidence intervals.

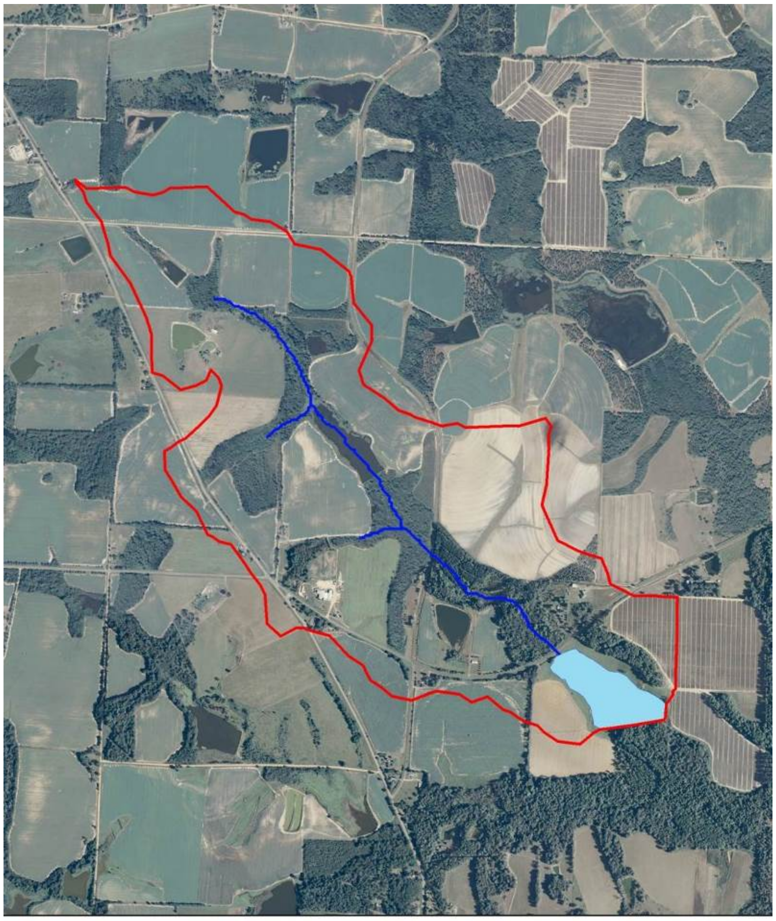


Figure 19. Map showing the watershed boundary of Pond 1. This is the largest pond and the largest watershed included in the study. The watershed's perimeter is indicated by the red line. The pond's area is 21.4 ac and the watershed's area 676 ac.

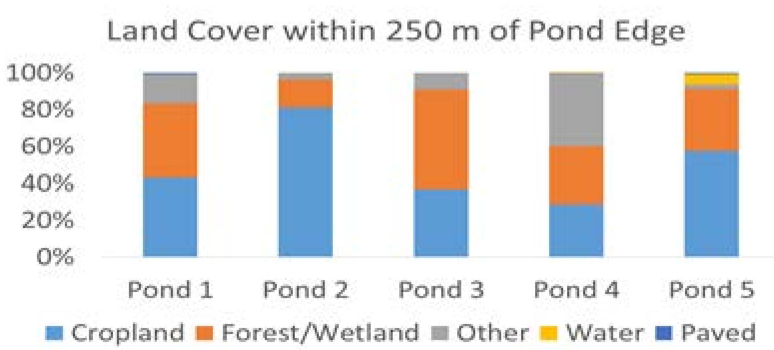


Figure 20. Graphical representation of land cover classification within a 250 m radius of each pond.

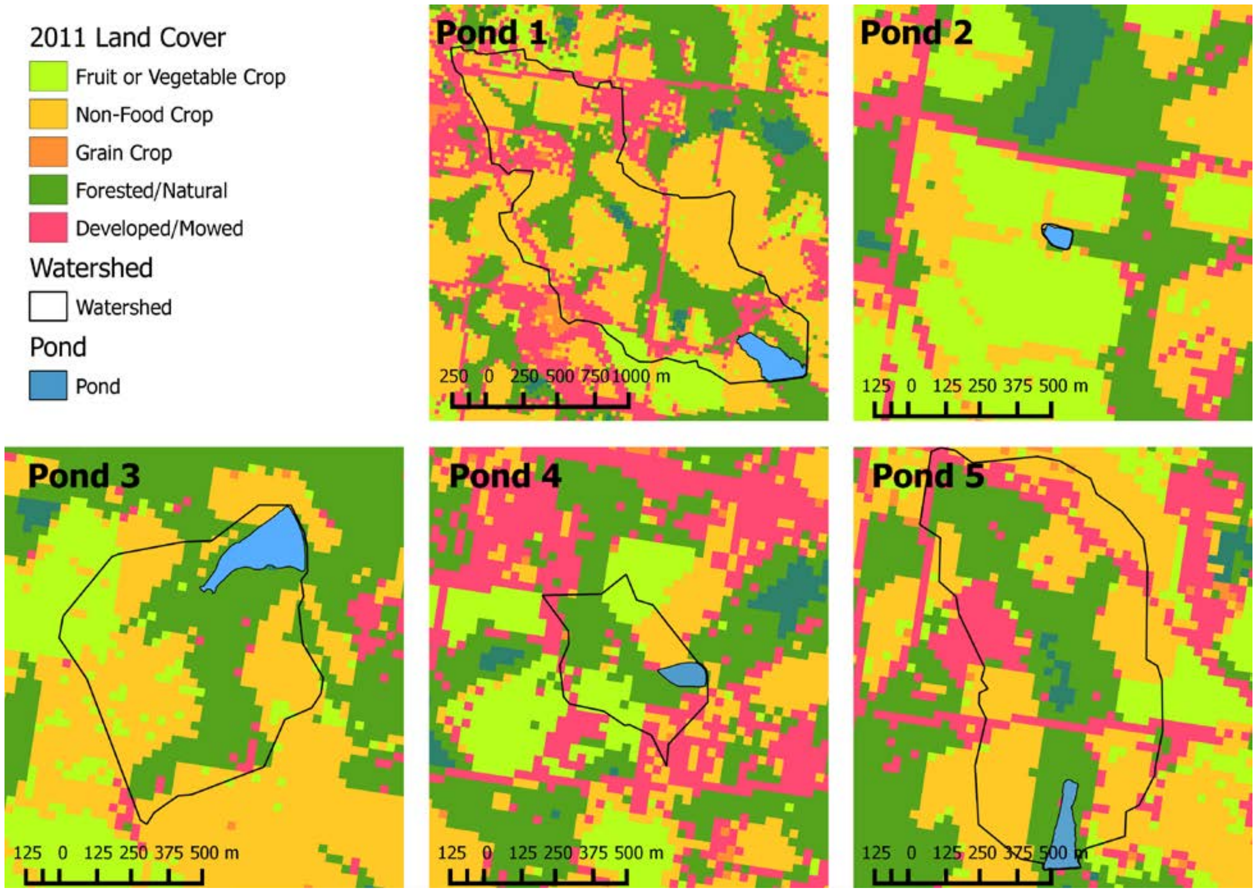


Figure 21. Pond and watershed boundaries and land cover classification. Land cover was classified into five main categories using the 2011 USDA NASS Cropland Data Layer which has a ground resolution of 30 meters.

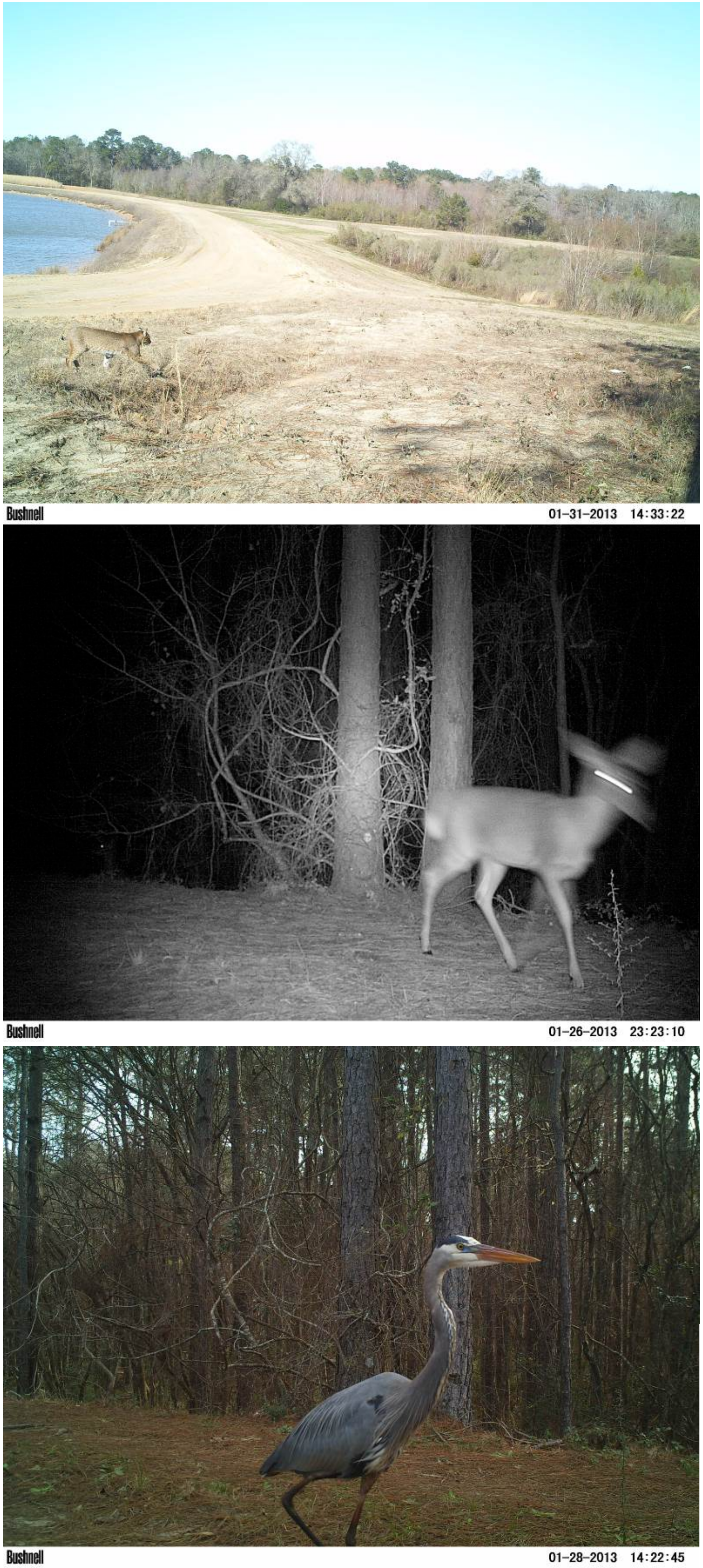


Figure 22. A bobcat near the dam of Pond 3 in late January, 2013 (top) and a deer, a great blue heron, and a coyote on the dam of Pond 1 in late January and early February, 2013 (center and bottom). The images were recorded by a wildlife camera.

Applied and Environmental Microbiology

Evaluation of a Loop-Mediated Isothermal Amplification Suite for the Rapid, Reliable, and Robust Detection of Shiga Toxin-Producing Escherichia coli in Produce

Fei Wang, Qianru Yang, Yinzhi Qu, Jianghong Meng and Beilei Ge

Appl. Environ. Microbiol. **2014, 80(8):2516. DOI: 10.1128/AEM.04203-13.**
Published Ahead of Print 7 February 2014.

AEM Journals.ASM.org

Evaluation of a Loop-Mediated Isothermal Amplification Suite for the Rapid, Reliable, and Robust Detection of Shiga Toxin-Producing *Escherichia coli* in Produce

Fei Wang,[a,b] Qianru Yang,[a,c] Yinzhi Qu,[b] Jianghong Meng,[b] Beilei Ge[a]

Division of Animal and Food Microbiology, Office of Research, Center for Veterinary Medicine, U.S. Food and Drug Administration, Laurel, Maryland, USA[a]; Department of Nutrition and Food Science, University of Maryland, College Park, Maryland, USA[b]; Department of Food Science, Louisiana State University Agricultural Center, Baton Rouge, Louisiana, USA[c]

Shiga toxin-producing *Escherichia coli* (STEC) strains are a leading cause of produce-associated outbreaks in the United States. Rapid, reliable, and robust detection methods are needed to better ensure produce safety. We recently developed a loop-mediated isothermal amplification (LAMP) suite for STEC detection. In this study, the STEC LAMP suite was comprehensively evaluated against real-time quantitative PCR (qPCR) using a large panel of bacterial strains ($n = 156$) and various produce items (several varieties of lettuce, spinach, and sprouts). To simulate real-world contamination events, produce samples were surface inoculated with a low level (1.2 to 1.8 CFU/25 g) of individual STEC strains belonging to seven serogroups (O26, O45, O103, O111, O121, O145, and O157) and held at 4°C for 48 h before testing. Six DNA extraction methods were also compared using produce enrichment broths. All STEC targets and their subtypes were accurately detected by the LAMP suite. The detection limits were 1 to 20 cells per reaction in pure culture and 10^5 to 10^6 CFU per 25 g (i.e., 10^3 to 10^4 CFU per g) in produce, except for strains harboring the *stx*$_{2c}$, *eae*-β, and *eae*-θ subtypes. After 6 to 8 h of enrichment, the LAMP suite achieved accurate detection of low levels of STEC strains of various *stx*$_2$ and *eae* subtypes in lettuce and spinach varieties but not in sprouts. A similar trend of detection was observed for qPCR. The PrepMan Ultra sample preparation reagent yielded the best results among the six DNA extraction methods. This research provided a rapid, reliable, and robust method for detecting STEC in produce during routine sampling and testing. The challenge with sprouts detection by both LAMP and qPCR calls for special attention to further analysis.

Shiga toxin-producing *Escherichia coli* (STEC) strains are zoonotic agents of significant public health concern (1). In the United States, STEC ranked among the top three causes of foodborne disease outbreaks as well as outbreak-associated illnesses, hospitalizations, and deaths from 1998 to 2010 (2, 3). Although *E. coli* O157:H7 remains the single most common STEC strain (4), the clinical importance of certain non-O157 STEC strains is growing worldwide (5). Recent years of FoodNet data in the United States have consistently shown more laboratory-confirmed infections caused by non-O157 STEC strains than O157 STEC strains (6–8). Currently, the U.S. regulation designates seven STEC serogroups (O26, O45, O103, O111, O121, O145, and O157) as adulterants in raw, nonintact beef products (9).

Produce ranked second only to beef in causing the largest percentage of STEC outbreaks, many of which are large-scale, multistate outbreaks (3). In September 2006, tainted prepackaged spinach triggered an *E. coli* O157:H7 outbreak, resulting in 205 confirmed illnesses and 3 deaths in 26 states (10). In 2010, a multistate outbreak of STEC O145 infections linked to shredded romaine lettuce from a single processing facility led to 26 confirmed cases in five states (11). The May 2011 massive outbreak of hemolytic-uremic syndrome (HUS; 852 cases) in Germany and several other countries was attributed to a rare STEC serotype, serotype O104:H4, in sprouts (12). Additionally, several recent multistate outbreaks have been caused by *E. coli* O157:H7 in romaine lettuce, organic spinach/spring mix blend, and ready-to-eat salads and by STEC O26 in clover sprouts (13).

To reduce the incidence of produce-associated outbreaks, a multifaceted approach from farm to table is required. In particular, the industry has drastically increased raw and finished product testing as a tool to better identify contamination risks (14). Nonetheless, STEC detection in produce remains a challenging task (15, 16). Due to the highly perishable nature of produce, a rapid test is critical. Produce items are also diverse and complex, with many harboring assay inhibitors and therefore requiring effective sample preparation and commodity-specific method validation (16). Additionally, pathogens in produce are usually injured cells present at low levels, whereas the normal flora is present at high levels, resulting in the requirement for a highly sensitive and specific assay (15). The need to identify STEC as a group and certain STEC serogroups specifically adds yet another layer of complexity (17).

Owing to their rapidity, specificity, and sensitivity, molecular-based methods, such as PCR and real-time quantitative PCR (qPCR), have gained widespread applications in produce testing (14, 16). Enrichment is commonly used to increase target cell numbers and simultaneously dilute assay inhibitors and the normal flora in produce (15). However, false-positive and false-neg-

Received 18 December 2013 Accepted 5 February 2014
Published ahead of print 7 February 2014
Editor: D. W. Schaffner
Address correspondence to Beilei Ge, beilei.ge@fda.hhs.gov.
Supplemental material for this article may be found at http://dx.doi.org/10.1128/AEM.04203-13.

doi:10.1128/AEM.04203-13

ative results are observed, and few PCR assays for STEC have been validated on a commodity-specific basis (16). Besides, a sophisticated thermal cycling instrument is indispensable to carry out these nucleic acid amplification tests (NAATs), limiting their wider applications.

Recently, a novel NAAT termed loop-mediated isothermal amplification (LAMP) has emerged as a promising alternative to PCR for pathogen detection (18, 19). LAMP uses four to six specially designed primers and a strand-displacing *Bst* DNA polymerase to amplify up to 10^9 copies of target DNA under isothermal conditions (~65°C) within an hour (19). Since it is isothermal, LAMP can be performed in much simpler instruments, such as a heater or water bath. To date, multiple LAMP assays targeting STEC Shiga toxin genes (stx_1 and stx_2) have been developed (20–24) and evaluated in food, primarily beef (25–28), as have several others targeting the *E. coli* O157 *rfbE* gene (encoding perosamine synthetase) (23, 24, 29–31). Very recently, we developed a suite of LAMP assays for STEC (targeting common virulence genes stx_1, stx_2, and *eae*) and the seven adulterant STEC serogroups (targeting the *wzx* or *wzy* gene on the respective O-antigen gene clusters) (32, 33). Although it has been reported to be rapid, specific, and sensitive, the LAMP suite has not been evaluated using a large number of STEC strains harboring various *stx* and *eae* subtypes or tested with a variety of produce items using conditions mimicking real-world contamination events (e.g., low-level surface inoculation, cold storage). In addition, despite the critical role that sample preparation plays, there is a scarcity of data regarding the effectiveness of DNA extraction methods for STEC detection in produce.

The aims of this study were to comprehensively evaluate the STEC LAMP suite against qPCR using a large panel of bacterial strains and various produce items (varieties of lettuce, spinach, and sprouts) under conditions mimicking real-world contamination events and to examine the effect of DNA extraction methods on assay performance. The qPCR assays tested were recently developed by scientists from the U.S. Department of Agriculture (USDA) (34, 35).

MATERIALS AND METHODS

Bacterial strains and target gene characterization. A total of 123 *E. coli* strains representing 41 serogroups and 33 non-*E. coli* strains (Table 1) were used for specificity testing. Among them, seven STEC strains (underlined in Table 1), one from each of the seven adulterant serogroups, were used for sensitivity testing and spiked-produce experiments. All strains were cultured as described previously (33).

E. coli strains were examined for the presence of STEC virulence genes (stx_1, stx_2, and *eae*) by PCR, followed by restriction fragment length polymorphism (RFLP) analysis to determine their respective gene subtypes (36, 37).

LAMP. A LAMP suite of 10 assays recently developed by our research group (32, 33) was evaluated. The first three assays targeted common STEC virulence genes (stx_1, stx_2, and *eae*), while the remaining seven each targeted a gene (*wzx* or *wzy*) on the O-antigen gene clusters of the seven adulterant STEC serogroups. Each LAMP assay employed five to six specially designed LAMP primers (see Table S1 in the supplemental material), two outer primers, two inner primers, and one or two loop primers that recognized specific regions of the target DNA sequences.

The assays were performed as described previously (32, 33). Briefly, the LAMP reagent mix (25 μl) contained 1× ThermoPol reaction buffer (New England BioLabs, Ipswich, MA), 6 mM $MgSO_4$, 1.2 mM each deoxynucleoside triphosphate (dNTP), 0.1 μM each outer primer (Integrated DNA Technologies, Coralville, IA), 1.8 μM each inner primer, 1 μM each loop primer, 10 U of *Bst* DNA polymerase (New England BioLabs), and 2 μl of template DNA. All LAMP reactions were carried out at 65°C (63°C for the O157 LAMP) for 1 h and terminated at 80°C for 5 min in an LA-320C real-time turbidimeter (Eiken Chemical Co., Ltd., Tokyo, Japan). Turbidity readings at 650 nm were obtained every 6 s, and time threshold (T_t) values (in minutes) were determined when the turbidity increase measurements (differential values of the moving average of the turbidity) exceeded 0.1.

qPCR. As a comparison, qPCR assays developed by USDA scientists (34, 35) were performed. Similarly, 10 sets of primers/probes were used; 3 targeted common STEC virulence genes (stx_1, stx_2, and *eae*) and 7 targeted the *wzx* or *wzy* gene on the O-antigen gene clusters of the seven adulterant STEC serogroups.

The qPCR assays were carried out as described previously (32, 33). The reagent mix (25 μl) consisted of 1× PCR buffer, 4 mM $MgCl_2$, 0.2 mM each dNTP, 0.25 μM each primer (see Table S1 in the supplemental material), 0.1875 μM probe, 1.5 U of GoTaq Hot Start polymerase (Promega, Madison, WI), and 2 μl of template DNA. The qPCRs were conducted using 40 cycles of denaturation at 94°C for 20 s, annealing at 60°C for 30 s, and extension at 72°C for 50 s in a SmartCycler II system (Cepheid, Sunnyvale, CA). Fluorescence readings were acquired using the 6-carboxyfluorescein (FAM) channel, and cycle threshold (C_T) values (in number of cycles, with approximately 2 min per cycle) were recorded when the fluorescence readings reached 30 units.

Specificity and sensitivity tests. For assay specificity, DNA templates of the 156 bacterial strains (Table 1) were prepared by heating at 95°C for 10 min. Aliquots (2 μl) were subjected to LAMP and qPCR, and assays were repeated twice.

Assay sensitivity (limit of detection) was determined by using 10-fold serial dilutions of the seven STEC strains of the adulterant serogroups. DNA templates were prepared from stationary-phase cultures as described previously (32). Aliquots (2 μl) were tested by LAMP and qPCR, and assays were repeated three times.

Assay evaluation with produce with high-level inoculation (assay sensitivity for detection of STEC in produce). Eight produce items, including varieties of lettuce (iceberg, romaine), spinach (baby, savoy, semi-savoy), and sprouts (alfalfa, clover, mung bean), were obtained from a local grocery store and analyzed within 2 h of collection. Briefly, lettuce and spinach leaves were cut into 4-cm^2 pieces using sterile scissors, and 25-g samples were weighed out. Sprouts were also divided into 25-g analysis portions.

To determine assay sensitivity for detection of STEC in produce, for each produce item, 35 samples (one sample per strain [$n = 7$] per inoculation level [$n = 5$]) were inoculated and 3 samples were included as uninoculated controls. Spot inoculation on the produce surface was performed as described previously (38). Briefly, 1.5 ml of overnight STEC cultures 10-fold serially diluted from 10^5 to 10^9 CFU/ml was added to each 25-g test sample. For lettuce and spinach, the inoculum was equally divided among the number of leaf pieces. Sprout samples were grouped into three equal portions, and 500 μl of the inoculum was added onto the surface of each portion. Aerobic plate counts were determined for the uninoculated controls ($n = 3$) by the standard pour plate method. All samples were air dried in a laminar flow biosafety cabinet for 2 h, followed by storage at 4°C for 48 h.

After cold storage, each sample was homogenized with 225 ml of buffered peptone water (BD Diagnostic Systems, Sparks, MD) for 1 min in a food stomacher (model 400; Seward, Cincinnati, OH). Aliquots (1 ml) of each homogenate were centrifuged at 16,000 × g for 3 min, and pellets were suspended in 100 μl of PrepMan Ultra sample preparation reagent (Applied Biosystems, Foster City, CA). The mixtures were heated at 95°C for 10 min and centrifuged again at 12,000 × g for 2 min. The supernatants (2 μl) were tested by both LAMP and qPCR, and assays were repeated three times.

Assay evaluation with produce with low-level inoculation. For assay evaluation with produce with low-level inoculation, the same eight pro-

TABLE 1 Bacterial strains[c] used in this study to evaluate the specificity and sensitivity of the LAMP suite and qPCR assays

Strain group	Serotype or species	Strain[a]	stx_1 subtype	stx_2 subtype	Intimin subtype	Origin	Source[b]
STEC strains of target serogroups ($n = 83$)							
O26 ($n = 20$)	O26:H11	CVM 9935	stx_{1a}		β	Animal (antelope)	FDA, CVM
	O26:H11	CVM 9942	stx_{1a}		β	Animal (cow)	FDA, CVM
	O26:H11	CVM 9952	stx_{1a}		β	Animal (pig)	FDA, CVM
	O26:H11	CVM 9953	stx_{1a}		β	Animal (pig)	FDA, CVM
	O26:H11	CVM 9965	stx_{1a}		β	Animal (cow)	FDA, CVM
	O26:H11	CVM 9966	stx_{1a}		β	Animal (cow)	FDA, CVM
	O26:H11	CVM 9967	stx_{1a}		β	Animal (cow)	FDA, CVM
	O26:H11	CVM 9988	stx_{1a}		β	Animal (cow)	FDA, CVM
	O26:H11	CVM 9995	stx_{1a}		β	Human	FDA, CVM
	O26:H11	CVM 9997	stx_{1a}		β	Human	FDA, CVM
	O26:H11	CVM 9998	stx_{1a}		β	Human	FDA, CVM
	O26:H11	CVM 9999	stx_{1a}		β	Human	FDA, CVM
	O26:H11	CVM 10000	stx_{1a}		β	Human	FDA, CVM
	O26:H11	CVM 10001	stx_{1a}		β	Human	FDA, CVM
	O26:H11	CVM 10007	stx_{1a}		β	Human	FDA, CVM
	O26:H11	CVM 10008	stx_{1a}		β	Human	FDA, CVM
	O26:H11	CVM 10112	stx_{1a}		β	Animal (cow)	FDA, CVM
	O26:H11	CVM 10128	stx_{1a}		β	Human	FDA, CVM
	O26:H11	CVM 10224	stx_{1a}		β	Human	FDA, CVM
	O26:H11	SJ3		stx_{2a}	β	Unknown	CDC
O45 ($n = 6$)	O45:H2	05-6545	stx_{1a}		ε	Unknown	Lab collection
	O45:H2	A9619-C2	stx_{1a}		ε	Unknown	Lab collection
	O45:H2	EC1467	stx_{1a}		ε	Human	FDA, CFSAN
	O45:H2	EC1674	stx_{1a}		ε	Human	FDA, CFSAN
	O45:H2	MI4	stx_{1a}		ε	Unknown	Lab collection
	O45:H2	SJ9	stx_{1a}	stx_{2a}	β	Unknown	CDC
O103 ($n = 20$)	O103:H2	7828/95	stx_{1a}	stx_{2a}	ε	Human	Lab collection
	O103:H2	CVM 9260	stx_{1a}		ε	Animal (deer)	FDA, CVM
	O103:H2	CVM 9301	stx_{1a}		ε	Animal (goat)	FDA, CVM
	O103:H2	CVM 9305	stx_{1a}		ε	Animal (sheep)	FDA, CVM
	O103:H2	CVM 9318	stx_{1a}		ε	Animal (cow)	FDA, CVM
	O103:H2	CVM 9322	stx_{1a}	stx_{2d}	ε	Animal (cow)	FDA, CVM
	O103:H2	CVM 9328	stx_{1a}		ε	Human	FDA, CVM
	O103:H2	CVM 9380	stx_{1a}		ε	Human	FDA, CVM
	O103:H2	CVM 9385	stx_{1a}		ε	Human	FDA, CVM
	O103:H2	CVM 9439	stx_{1a}		ε	Human	FDA, CVM
	O103:H2	CVM 9440	stx_{1a}		ε	Human	FDA, CVM
	O103:H2	CVM 9446	stx_{1a}		ε	Human	FDA, CVM
	O103:H2	CVM 9451	stx_{1a}		ε	Human	FDA, CVM
	O103:H2	CVM 9453	stx_{1a}		ε	Human	FDA, CVM
	O103:H2	PMK-5	stx_{1a}		ε	Human	Lab collection
	O103:H11	CVM 9320	stx_{1a}		β	Animal (cow)	FDA, CVM
	O103:H11	SJ12	stx_{1a}		β	Unknown	CDC
	O103:H25	CVM 9340	stx_{1a}		θ	Human	FDA, CVM
	O103:H25	CVM 9353	stx_{1a}		θ	Animal (cow)	FDA, CVM
	O103:H25	CVM 9354	stx_{1a}		θ	Animal (cow)	FDA, CVM
O111 ($n = 19$)	O111:H8	CVM 9467	stx_{1a}		θ	Animal (cow)	FDA, CVM
	O111:H8	CVM 9557	stx_{1a}	stx_{2d}	θ	Animal (cow)	FDA, CVM
	O111:H8	CVM 9574	stx_{1a}	stx_{2a}	θ	Human	FDA, CVM
	O111:H8	CVM 9603	stx_{1a}		θ	Human	FDA, CVM
	O111:H8	CVM 9610	stx_{1a}		θ	Animal (cow)	FDA, CVM
	O111:H8	CVM 9614	stx_{1a}		θ	Animal (cow)	FDA, CVM
	O111:H8	CVM 9617	stx_{1a}		θ	Animal (cow)	FDA, CVM
	O111:H8	CVM 9619	stx_{1a}		θ	Human	FDA, CVM
	O111:H11	CVM 9505	stx_{1a}		β	Animal (cow)	FDA, CVM
	O111:H11	CVM 9529	stx_{1a}		β	Animal (cow)	FDA, CVM
	O111:H11	CVM 9530	stx_{1a}		β	Animal (pig)	FDA, CVM
	O111:H11	CVM 9534	stx_{1a}		β	Animal (cow)	FDA, CVM

(Continued on following page)

TABLE 1 (Continued)

Strain group	Serotype or species	Strain[a]	stx_1 subtype	stx_2 subtype	Intimin subtype	Origin	Source[b]
	O111:H11	CVM 9535	stx_{1a}		β	Animal (cow)	FDA, CVM
	O111:H11	CVM 9548	stx_{1a}		β	Animal (cow)	FDA, CVM
	O111:H11	CVM 9553	stx_{1a}		β	Animal (cow)	FDA, CVM
	O111:H11	CVM 9591	stx_{1a}		β	Animal (cow)	FDA, CVM
	O111:NM	78/92	stx_{1a}		θ	Human	Lab collection
	O111:NM	P1340	stx_{1a}	stx_{2a}	θ	Animal (calf)	Lab collection
	O111:NM	SJ13	stx_{1a}	stx_{2a}	θ	Unknown	CDC
O121 ($n = 3$)	O121:H19	ESC0601		stx_{2a}	ε	Food (lettuce)	FDA, CFSAN
	O121:NM	EC1406		stx_{2a}	ε	Human	FDA, CFSAN
	O121:NM	EC1670		stx_{2a}	ε	Unknown	FDA, CFSAN
O145 ($n = 5$)	O145:H28	CVM 9785	stx_{1a}		γ1	Animal (Cow)	FDA, CVM
	O145:H28	CVM 9790		stx_{2c}	γ1	Human	FDA, CVM
	O145:H28	EC1792	stx_{1a}	stx_{2a}	γ1	Unknown	FDA, CFSAN
	O145:NM	EC1789		stx_{2a}	γ1	Human	FDA, CFSAN
	O145:NM	SJ23	stx_{1a}	stx_{2a}	γ1	Unknown	CDC
O157 ($n = 10$)	O157:H7	85-1	stx_{1a}	stx_{2a}	γ1	Human	Lab collection
	O157:H7	B6903	stx_{1a}	stx_{2a}	γ1	Human	Lab collection
	O157:H7	C8	stx_{1a}		γ1	Animal (sheep)	Lab collection
	O157:H7	E-0019		stx_{2a}	γ1	Animal (calf)	Lab collection
	O157:H7	E-0122	stx_{1a}	stx_{2a}	γ1	Animal (calf)	Lab collection
	O157:H7	E-0342		stx_{2c}	γ1	Animal (calf)	Lab collection
	O157:H7	EC600V	stx_{1a}	stx_{2a}	γ1	Food (steak)	Lab collection
	O157:H7	MDL 3562		stx_{2a}	γ1	Food (produce)	Lab collection
	O157:H7	OH-495-189		stx_{2a}	γ1	Food (beef)	Lab collection
	O157:H7	W2-2	stx_{1a}	stx_{2a}	γ1	Food (poultry)	Lab collection
Other STEC strains ($n = 25$)	O2:H27	SJ5		stx_{2a}		Unknown	CDC
	O5:NM	3143-85	stx_{1a}		β	Unknown	Lab collection
	O5:NM	3812-3	stx_{1c}			Animal (sheep)	Lab collection
	O8:H28	ESC0604		stx_{2a}		Food (lettuce)	FDA, CFSAN
	O15:H16	N5789		stx_{2g}		Food (beef)	Lab collection
	O22:H8	P1330		stx_{2d}		Food (beef)	Lab collection
	O36:H14	ESC0603		stx_{2g}		Food (sprouts)	FDA, CFSAN
	O46:H38	P1332	stx_{1a}	stx_{2d}		Food (beef)	Lab collection
	O50:H7	3056-85		stx_{2a}	ε	Unknown	Lab collection
	O55:H7	5906		stx_{2d}	γ1	Unknown	Lab collection
	O73:H18	ESC0608		stx_{2a}		Food (spinach)	FDA, CFSAN
	O83:H8	N11682		stx_{2d}		Food (beef)	Lab collection
	O88:H49	P1333		stx_{2a}		Food (meat)	Lab collection
	O91:H21	P1334	stx_{1a}	stx_{2d}		Animal (cow)	Lab collection
	O104:H21	94-3024		stx_{2a}		Unknown	Lab collection
	O113:H21	ESC0615		stx_{2a}		Food (spinach)	FDA, CFSAN
	O116:H21	ESC0609		stx_{2d}		Food (spinach)	FDA, CFSAN
	O125:NM	3153-86	stx_{1a}		β	Unknown	Lab collection
	O126:H8	78-4084	stx_{1a}			Unknown	Lab collection
	O128:H16	CVM 9652	stx_{1a}			Animal (okapi)	FDA, CVM
	O146:H21	90–3158	stx_{1a}			Unknown	Lab collection
	O168:H8	ESC0613		stx_{2a}		Food (spinach)	FDA, CFSAN
	O174:H36	ESC0602		stx_{2d}		Food (lettuce)	FDA, CFSAN
	ONT:H7	N5545		stx_{2d}		Food (beef)	Lab collection
	OX25	ESC0606		stx_{2d}		Food (spinach)	FDA, CFSAN
Other *E. coli* strains ($n = 15$)	O1:K1:H7	U5-41				Unknown	Lab collection
	O3:K2ab:H2	U414-41				Unknown	Lab collection
	O9:K103	987				Unknown	Lab collection
	O18:K1:H7	88-766				Unknown	Lab collection
	O44:K74:H18	H702c				Unknown	Lab collection
	O77:K96:NM	E10				Unknown	Lab collection
	O78:H11	EC463				Unknown	Lab collection
	O86:H25	H35A				Unknown	Lab collection
	O111:H11	CVM 9515			β	Animal (cow)	FDA, CVM

(Continued on following page)

TABLE 1 (Continued)

Strain group	Serotype or species	Strain[a]	*stx*$_1$ subtype	*stx*$_2$ subtype	Intimin subtype	Origin	Source[b]
	O118:H16	P1341				Animal (calf)	Lab collection
	O124:NM	EC230				Unknown	Lab collection
	O145	CVM 9818			γ1	Animal (cow)	FDA, CVM
	O145:NM	EC1790				Unknown	FDA, CFSAN
	O145:NM	EC1793				Unknown	FDA, CFSAN
	O157:H7	G-13			γ1	Animal (sheep)	Lab collection
Other bacteria ($n = 33$)							
Campylobacter coli		ATCC 33559				Animal (pig)	Lab collection
Campylobacter jejuni		ATCC 43430				Animal (calf)	Lab collection
Campylobacter lari		ATCC 35222				Animal (dog)	Lab collection
Citrobacter freundii		10053				Unknown	Lab collection
Enterobacter cloacae		95MV2				Human	Lab collection
Hafnia alvei		ATCC 23280				Unknown	Lab collection
Listeria grayi		ATCC 19120				Animal	Lab collection
Listeria innocua		ATCC 33090				Animal (cow)	Lab collection
Listeria ivanovii		ATCC 19119				Animal (sheep)	Lab collection
Listeria monocytogenes		ATCC 15313				Animal (rabbit)	Lab collection
Listeria seeligeri		UMD 489				Unknown	Lab collection
Listeria welshimeri		ATCC 35897				Plant	Lab collection
Salmonella enterica serovar Braenderup		FDA71				Unknown	FDA, CFSAN
S. enterica serovar Enteritidis		SE 9				Unknown	FDA, CFSAN
S. enterica serovar Heidelberg		63B2				Unknown	FDA, CFSAN
S. enterica serovar Javiana		7 N				Unknown	FDA, CFSAN
S. enterica serovar Mbandaka		37 N				Food (candy)	FDA, CFSAN
S. enterica serovar Montevideo		1 H				Food (whole eggs)	FDA, CFSAN
S. enterica serovar Muenchen		1501 H				Feed (feather meal)	FDA, CFSAN
S. enterica serovar Newport		FDA197				Unknown	FDA, CFSAN
S. enterica serovar Oranienburg		1410 H				Feed (feather meal)	FDA, CFSAN
S. enterica serovar Poona		2861 H				Animal (turtle)	FDA, CFSAN
S. enterica serovar Stanley		1243 H				Feed (bonemeal)	FDA, CFSAN
S. enterica serovar Typhimurium		ATCC 43971				Unknown	FDA, CFSAN
Shigella boydii		RH12-23-11				Unknown	Lab collection
Shigella dysenteriae		RH12-25-9				Unknown	Lab collection
Shigella flexneri		G45				Unknown	Lab collection
Vibrio aestuarianus		ATCC 35048				Animal (oyster)	Lab collection
Vibrio cholerae		15937-E6				Unknown	Lab collection
Vibrio harveyi		ATCC 35084				Animal (shark)	Lab collection
Vibrio mimicus		ATCC 33655				Human	Lab collection
Vibrio parahaemolyticus		ATCC 27969				Animal (crab)	Lab collection
Vibrio vulnificus		515-4C2				Animal (oyster)	Lab collection

[a] The seven underlined strains were used for the evaluation of specificity and sensitivity and spiked-produce experiments, while the others were used only for the specificity testing.
[b] CDC, Centers for Disease Control and Prevention; FDA, CFSAN, U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition; FDA, CVM, U.S. Food and Drug Administration, Center for Veterinary Medicine; Lab collection, the strain collection maintained at the University of Maryland, College Park, MD.
[c] A total of 156 strains were tested.

duce items described above were used and similar inoculation, processing, and testing procedures were followed, with three major exceptions: inoculation level, enrichment, and replication scheme. The inoculation level applied was 10^0 CFU/25 g, with two additional ones (10^2 and 10^3 CFU/25 g) being used for sprouts only. After surface inoculation and cold storage, the samples were first incubated at 42°C for up to 24 h, and aliquots (1 ml) were removed at 6, 8, 10, and 24 h for processing by use of the PrepMan Ultra reagent and testing by LAMP and qPCR as described above. The experiments were independently repeated three times with different produce samples. In total, there were 21 inoculated samples (one sample per strain [$n = 7$] in three repeats [$n = 3$]) and 3 uninoculated controls tested per produce item. The number of inoculated samples was tripled for the sprouts varieties, i.e., 63 samples were tested, due to the two additional inoculation levels tested.

Comparison of DNA extraction methods. Six DNA extraction methods were evaluated using the same eight produce items described above spiked with 1.2 to 1.8 CFU/25 g (or 1.2×10^2 to 1.8×10^2 CFU/25 g for sprouts varieties) of *E. coli* O157:H7 strain MDL 3562 and enriched for various periods (6, 8, 10, 24 h). For each produce item, experiments were independently repeated three times with different samples. These methods were (i) testing of raw enrichment broth, i.e., direct testing without any DNA preparation step; (ii) boiling preparation at 95°C for 10 min; (iii) two-step centrifugation by first centrifuging at 500 × *g* for 1 min to remove produce tissues and then centrifuging again at 16,000 × *g* for 5 min to pellet bacterial cells and resuspending the pellet in 100 μl of TE (Tris-EDTA) buffer; (iv) two-step centrifugation followed by boiling, i.e., heating the bacterial suspension in TE buffer prepared by the two-step centrifugation method at 95°C for 10 min; (v) the method with the PrepMan Ultra reagent, as describe above; and (vi) the FTA Elute method, which, briefly, consisted of adding 65 μl of enrichment broths onto an FTA card (Whatman Inc., Florham Park, NJ), punching out two 2-mm disks after absorption, allowing the disks to dry, washing the disks with

TABLE 2 Sensitivity of the LAMP suite and qPCR assays in pure culture and with spiked produce[k]

Assay target	Target gene and subtype	Strain	Detection limit (CFU/reaction in pure culture or CFU/25 g in spiked produce)							
			Pure culture		Lettuce		Spinach		Sprouts	
			LAMP	qPCR	LAMP	qPCR	LAMP	qPCR	LAMP	qPCR
Stx1	*stx*$_{1a}$	SJ9	10	10	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5-10^6[g]	1.4×10^5
Stx2	*stx*$_{2a}$	SJ9	1–10[b]	10	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5
Stx2	*stx*$_{2c}$	CVM 9790	1×10^3	1–10[b]	1.7×10^7	1.7×10^5	1.7×10^7	1.7×10^5	1.7×10^7	1.7×10^5
Stx2	*stx*$_{2d}$	CVM 9322	14	14	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5-10^6[h]	1.5×10^5-10^6[g]
Intimin	*eae*-β	SJ9	1×10^2	10	1.4×10^6-10^7[c]	1.4×10^5	1.4×10^7	1.4×10^5-10^6[e]	1.4×10^7	1.4×10^5-10^6[i]
Intimin	*eae*-γ1	CVM 9790	10	1–10[b]	1.7×10^5	1.7×10^5	1.7×10^5	1.7×10^5	1.7×10^5	1.7×10^5
Intimin	*eae*-ε	CVM 9322	14	14	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5
Intimin	*eae*-θ	SJ13	2×10^2	2–20[a]	1.4×10^8	1.4×10^5	1.4×10^8	1.4×10^5-10^6[f]	1.4×10^8	1.4×10^5-10^6[j]
O26	*wzy* (O26)	SJ3	12	1.2–12[a]	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5
O45	*wzy* (O45)	SJ9	1–10[a]	1–10[b]	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5
O103	*wzx* (O103)	CVM 9322	14	14	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5
O111	*wzy* (O111)	SJ13	20	2	1.4×10^5	1.4×10^5	1.4×10^5-10^6[d]	1.4×10^5	1.4×10^5-10^6[g]	1.4×10^5
O121	*wzy* (O121)	ESC0601	20	20	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5
O145	*wzx* (O145)	CVM 9790	10	10	1.7×10^5	1.7×10^5	1.7×10^5	1.7×10^5	1.7×10^5-10^6[g]	1.7×10^5
O157	*wzy* (O157)	MDL 3562	12	1.2–12[a]	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5	1.4×10^5

[a] One out of three repeats was positive for the lower detection limit.
[b] Two out of three repeats were positive for the lower detection limit.
[c] Iceberg lettuce had the lower detection limit.
[d] Baby and savoy spinach had the lower detection limit.
[e] Baby spinach had the lower detection limit.
[f] Savoy and semisavoy spinach had the lower detection limit.
[g] Clover and mung bean sprouts had the lower detection limit.
[h] Clover sprouts had the lower detection limit.
[i] Alfalfa and clover sprouts had the lower detection limit.
[j] Alfalfa and mung bean sprouts had the lower detection limit.
[k] In produce testing, 1.5 ml of 10-fold serially diluted overnight STEC cultures (prepared at different times from those used in the pure culture testing) was added to each 25-g produce sample.

sterile water, and then heating with water at 95°C for 30 min. Aliquots (2 μl) of DNA templates prepared by all six methods were tested by *eae* LAMP and *eae* qPCR.

Data analysis. Means and standard deviations of T_t values for LAMP and C_T values for qPCR were calculated by use of the Microsoft Excel program (Seattle, WA). The T_t and C_T values sorted by assay target, gene subtype, produce type, enrichment time, and DNA extraction method were compared by using analysis of variance (SAS for Windows, version 9.2; SAS Institute, Cary, NC). Differences between the mean values were considered significant when P was <0.05.

RESULTS

Assay specificity. Among 156 bacterial strains (Table 1) tested by the STEC LAMP suite, false-positive or false-negative results were not observed; i.e., LAMP results matched 100% with known strain characteristics for all of the target genes. The overall mean T_t values ranged from 16.1 min for *eae* LAMP to 24.3 min for *stx*$_2$ LAMP (data not shown). Among the three assays targeting STEC virulence genes, *stx*$_1$ and *eae* LAMPs yielded significantly lower T_t values than *stx*$_2$ LAMP, while O26 and O121 LAMPs had the lowest T_t values among the seven serogroup-specific assays ($P < 0.05$) (data not shown). The T_t values also differed among strains carrying various *stx*$_2$ and *eae* subtypes. Notably, the *stx*$_2$ LAMP proceeded the slowest in strains harboring *stx*$_{2g}$ (mean T_t, 30.6 min), followed by LAMPs with *stx*$_{2c}$ (24.7 min), *stx*$_{2d}$ (24.4 min), and *stx*$_{2a}$ (23.7 min), while by the *eae* LAMP, strains containing *eae*-γ1 had T_t values (11.6 min) significantly shorter than those for strains containing *eae*-β (16.9 min), *eae*-ε (17 min), or *eae*-θ (18.4 min) ($P < 0.05$).

For qPCR, the vast majority of specificity tests accurately detected the 156 strains, with the overall mean C_T values ranging from 12.8 cycles for the *eae* qPCR to 20 cycles for the O103 qPCR (data not shown). However, false-negative results were consistently generated by the *stx*$_2$ qPCR for two strains (ESC0603 and N5789) carrying the *stx*$_{2g}$ gene. In contrast, the C_T values did not vary significantly among strains possessing different *stx*$_2$ or *eae* subtypes ($P > 0.05$; data not shown).

Assay sensitivity. Table 2 summarizes LAMP and qPCR sensitivity when testing 10-fold serial dilutions of STEC strains belonging to the seven adulterant serogroups. In pure culture testing, the LAMP suite consistently detected 10 to 20 CFU/reaction of target STEC strains. In one or two out of three repeats, *stx*$_2$ and O45 LAMPs were capable of detecting the respective STEC strains at an even lower concentration, i.e., 1 CFU per reaction. However, the *stx*$_2$ and *eae* LAMP assays were less sensitive (up to 100-fold) for strains carrying certain target gene subtypes, e.g., *stx*$_{2c}$, *eae*-β, and *eae*-θ. The detection limits for qPCR assays consistently fell between 1 and 20 CFU per reaction for all assay targets and their subtypes (Table 2).

Assay sensitivity in spiked produce is also summarized in Table 2. For the uninoculated controls, aerobic plate counts averaged 10^4 to 10^5 CFU/g in lettuce and spinach varieties and 10^6 to 10^8 CFU/g in sprouts varieties, and all target genes tested negative by LAMP and qPCR (data not shown). In lettuce and spinach varieties, the LAMP suite detected down to 10^5 CFU per 25 g produce (approximately 10^3 CFU/g, equivalent to 2 CFU per reaction). In alfalfa (but not clover and mung bean) sprouts, 10-fold higher cell concentrations (10^6 CFU/25 g) were needed for accurate detection by the *stx*$_1$, O111, and O145 LAMPs. Regardless of produce type or

TABLE 3 Effect of six DNA extraction methods on *eae* LAMP and *eae* qPCR detection of STEC in baby spinach samples spiked with 1.2 to 1.8 CFU/25 g of *Escherichia coli* O157:H7 strain MDL 3562 (*eae*-γ1) and tested after cold storage and various enrichment periods[c]

	Avg LAMP T_t (min) after enrichment for:				Avg qPCR C_T (no. of cycles) after enrichment for:			
Method	6 h	8 h	10 h	24 h	6 h	8 h	10 h	24 h
Raw enrichment broth			18.4 ± 1.9^{AB}	14.7 ± 0.2^{A}		29.1 ± 0.8^{B}	25.0 ± 0.4^{C}	23.6 ± 0.2^{B}
Boiling preparation	24.5[a]	16.4 ± 0.6^{BC}	13.0 ± 0.3^{C}	13.0 ± 0.4^{B}	32.5 ± 0.9	27.1 ± 0.4^{C}	25.0 ± 0.8^{C}	19.2 ± 0.6^{D}
Two-step centrifugation	22.2[a]	18.7 ± 1.0^{B}	18.2 ± 0.4^{B}	13.5 ± 0.2^{B}			30.5 ± 0.1^{B}	21.4 ± 0.6^{C}
Two-step centrifugation followed by boiling	20.6 ± 1.2[b]	14.8 ± 0.7^{C}	12.5 ± 0.5^{C}	12.2 ± 0.5^{C}		27.9 ± 0.2^{BC}	21.1 ± 0.4^{D}	19.4 ± 0.3^{D}
PrepMan Ultra reagent	21.7 ± 1.9	15.6 ± 1.0^{C}	13.0 ± 0.3^{C}	13.0 ± 0.2^{B}	33.47[a]	27.1 ± 1.1^{C}	20.5 ± 1.3^{D}	19.6 ± 0.3^{D}
FTA Elute		21.6 ± 3.3^{A}	19.7 ± 0.4^{A}	13.1 ± 0.7^{B}		35.7 ± 0.7^{A}	34.1 ± 0.6^{A}	24.6 ± 0.1^{A}

[a] One out of three repeats was detected by LAMP or qPCR.
[b] Two out of three repeats were detected by LAMP.
[c] In each column within the data for LAMP or qPCR, T_t or C_T values followed by different uppercase letters are significantly different ($P < 0.05$).

variety, the stx_2 and *eae* LAMPs were less sensitive (up to 1,000-fold) for strains containing stx_{2c}, *eae*-β, and *eae*-θ subtypes. In comparison, all of the qPCR assays detected down to 10^5 CFU/25 g in lettuce, spinach, and sprouts varieties. Small variations in detection limit (10-fold) among varieties of the same produce type were observed by either LAMP or qPCR (Table 2).

Effect of DNA extraction methods. Table 3 compares the effects of six DNA extraction methods on detection of *E. coli* O157:H7 by *eae* LAMP and *eae* qPCR in baby spinach samples spiked with 1.2 to 1.8 CFU/25 g of *E. coli* O157:H7 strain MDL 3562 (*eae*-γ1). Positive LAMP results were obtained by all six methods but at different enrichment times. For samples enriched for 6 h, the method with the PrepMan Ultra sample preparation reagent was the only one that consistently gave positive LAMP results. The methods with FTA Elute and raw enrichment broth required 8 and 10 h of enrichment, respectively, to generate positive LAMP results. For qPCR, 8 h of enrichment was needed for the majority of methods and 10 h was needed for the two-step centrifugation method. Boiling facilitated LAMP and qPCR detection, as evidenced by lower T_t and C_T values in boiled samples and/or the shorter enrichment time needed for detection. Among all six methods, the method with FTA Elute tended to generate the highest T_t or C_T values at each enrichment period in baby spinach (Table 3).

In other spinach varieties, the minimum enrichment time required for LAMP detection was 6 h (8 h for qPCR) when the method with two-step centrifugation followed by boiling or the PrepMan Ultra sample preparation reagent was used (data not shown). However, at least 10 h of enrichment was required for both LAMP and qPCR when using FTA Elute and at least 24 h of enrichment was required for the other three methods (raw enrichment broth, boiling preparation, and two-step centrifugation). In two lettuce varieties, regardless of the DNA extraction method, samples enriched for 6 to 8 h were accurately detected by LAMP and qPCR (data not shown). In three sprouts varieties spiked with 1.2×10^2 to 1.8×10^2 CFU/25 g of STEC cells, 6 to 8 h of enrichment was sufficient for LAMP and qPCR detection, except for alfalfa and clover sprouts by FTA Elute, which needed 10 h (data not shown).

Rapid detection of low levels of STEC in spiked produce. Table 4 summarizes the LAMP and qPCR results in baby spinach samples spiked with 1.2 to 1.8 CFU/25 g of STEC strains and tested after

TABLE 4 Comparison of the LAMP suite and qPCR assays with baby spinach samples spiked with 1.2 to 1.8 CFU/25 g of STEC strains and tested after cold storage and various enrichment periods[c]

			Avg LAMP T_t (min) after enrichment for:				Avg qPCR C_T (no. of cycles) after enrichment for:			
Assay target	Target gene and subtype	Strain	6 h	8 h	10 h	24 h	6 h	8 h	10 h	24 h
Stx1	stx_{1a}	SJ9		24.6 ± 2.3^{A}	19.9 ± 1.0^{B}	17.1 ± 0.6^{B}	33.9 ± 0.7^{A}	29.8 ± 0.5^{B}	25.8 ± 0.9^{C}	19.1 ± 0.9^{D}
Stx2	stx_{2a}	SJ9	39.3[a]	33.4 ± 0.8^{A}	28.7 ± 0.6^{B}	26.0 ± 1.0^{C}	34.47[a]	30.8 ± 0.4^{A}	26.4 ± 0.4^{B}	18.9 ± 0.4^{C}
Stx2	stx_{2c}	CVM 9790		34 ± 0.6[b]	31.0 ± 1.3^{A}	29.0 ± 1.6^{A}		28.8 ± 0.3^{A}	23.8 ± 1.0^{B}	21.1 ± 0.6^{C}
Stx2	stx_{2d}	CVM 9322	34.0 ± 1.2^{A}	30.5 ± 0.6^{B}	27.9 ± 0.6^{C}	27.0 ± 0.8^{C}	32.8 ± 0.5^{A}	29.1 ± 0.4^{B}	24.3 ± 0.6^{C}	22.7 ± 0.4^{D}
Intimin	*eae*-β	SJ9		27.4 ± 1.1^{A}	23.1 ± 0.8^{B}	19.4 ± 0.3^{C}		30.8 ± 0.5^{A}	26.6 ± 0.9^{B}	19.6 ± 0.4^{C}
Intimin	*eae*-γ1	CVM 9790	16.7 ± 0.2^{A}	14.1 ± 0.8^{B}	12.5 ± 0.3^{C}	12.0 ± 0.3^{C}	31.9 ± 0.4^{A}	27.8 ± 0.6^{B}	23.7 ± 1.1^{C}	21.6 ± 0.6^{D}
Intimin	*eae*-ε	CVM 9322	25.4 ± 0.5^{A}	20.6 ± 0.3^{B}	17.2 ± 0.6^{C}	15.7 ± 0.4^{D}	32.4 ± 0.6^{A}	28.3 ± 0.4^{B}	23.7 ± 0.8^{C}	22.0 ± 0.6^{D}
Intimin	*eae*-θ	SJ13	25.8 ± 1.4^{A}	23.3 ± 0.3^{B}	21.8 ± 0.4^{B}	22.0 ± 1.4^{B}	29.4 ± 0.5^{A}	26.7 ± 0.9^{B}	25.1 ± 0.8^{C}	25.0 ± 0.1^{C}
O26	*wzy* (O26)	SJ3	28.6 ± 1.7^{A}	22.0 ± 1.1^{B}	19.8 ± 0.7^{C}	18.5 ± 0.5^{C}	31.1 ± 0.4^{A}	24.6 ± 0.1^{B}	20.6 ± 0.3^{C}	17.0 ± 0.8^{D}
O45	*wzy* (O45)	SJ9	28.4 ± 2.6^{A}	22.9 ± 2.6^{B}	20.3 ± 1.7^{B}	18.8 ± 1.4^{C}		30.5 ± 0.7^{A}	25.9 ± 0.5^{B}	19.0 ± 0.3^{C}
O103	*wzx* (O103)	CVM 9322	37.0 ± 3.9^{A}	30.6 ± 2.5^{B}	26.5 ± 1.8^{B}	25.5 ± 0.8^{C}	32.3 ± 0.7^{A}	28.0 ± 0.6^{B}	23.3 ± 0.4^{C}	21.9 ± 0.4^{D}
O111	*wzy* (O111)	SJ13	28.3 ± 1.2^{A}	24.7 ± 0.4^{B}	24.2 ± 1.0^{B}	24.2 ± 1.8^{B}	29.8 ± 0.8^{A}	26.7 ± 1.1^{B}	24.7 ± 1.1^{C}	24.4 ± 0.2^{C}
O121	*wzy* (O121)	ESC0601	25.5 ± 1.0^{A}	21.8 ± 0.8^{B}	19.7 ± 0.7^{C}	19.6 ± 0.7^{C}	32.5 ± 0.5^{A}	28.1 ± 0.9^{B}	25.5 ± 0.1^{C}	24.5 ± 0.7^{C}
O145	*wzx* (O145)	CVM 9790	35.5 ± 2.8^{A}	28.8 ± 1.5^{B}	24.0 ± 1.2^{C}	22.5 ± 1.9^{C}	31.8 ± 0.8^{A}	27.5 ± 1.9^{B}	21.8 ± 1.9^{C}	18.7 ± 0.8^{D}
O157	*wzy* (O157)	MDL 3562		31.9 ± 3.0^{A}	25.9 ± 5.3^{B}	25.1 ± 3.3^{B}		28.4 ± 0.9^{A}	20.4 ± 1.9^{B}	19.2 ± 1.6^{C}

[a] One out of three repeats was detected by LAMP or qPCR.
[b] Two out of three repeats were detected by LAMP.
[c] In each row within the data for LAMP or qPCR, T_t or C_T values followed by different uppercase letters are significantly different ($P < 0.05$).

cold storage and various enrichment periods. After 6 h of enrichment, all LAMP assays in the suite successfully detected such low levels of STEC in baby spinach, except for the stx_1 and O157 LAMPs and the stx_2 and *eae* LAMPs in strains carrying stx_{2c} and *eae*-β, respectively. Significantly higher T_t values were observed for samples enriched for 6 or 8 h than those enriched for longer periods ($P < 0.05$). A similar trend of detection was observed for qPCR, although the O45 qPCR rather than the stx_1 qPCR failed to detect STEC with the 6-h enrichment period (Table 4).

In other spinach and lettuce varieties, both LAMP and qPCR achieved accurate detection after 6 to 8 h of enrichment, except for stx_2 LAMP in savoy spinach spiked with CVM 9790 (stx_{2c}), which required 10 h of enrichment (data not shown). In contrast, neither LAMP nor qPCR detected such low levels (1.2 to 1.8 CFU/25 g) of STEC strains in sprouts varieties even after 24 h of enrichment (data not shown). The 10^2-CFU/25 g inoculum resulted in positive LAMP and qPCR results in sprouts after 6 to 8 h of enrichment for 10 target gene and subtype combinations (stx_{1a}, stx_{2a}, stx_{2c}, stx_{2d}, *eae*-β, *eae*-γ1, O26, O45, O103, and O145). All 15 targets/subtypes were detected in sprouts samples spiked with 10^3 CFU/25 g after 6 to 8 h of enrichment (data not shown).

DISCUSSION

Upon comprehensive evaluation using 156 bacterial strains and eight produce items, the STEC LAMP suite was demonstrated to be rapid (10 to 45 min), reliable (no false-positive or false-negative results), and robust (under conditions mimicking real-world contamination events, e.g., surface contamination, cold storage). Coupled with an effective DNA extraction method, the assays accurately detected low levels (1.2 to 1.8 CFU/25 g) of STEC in lettuce and spinach varieties (but not sprouts) after 6 to 8 h of enrichment. A similar trend of detection was observed for qPCR. This is the first study comparing LAMP and qPCR for detecting STEC strains with various *stx* and *eae* subtypes in multiple types of high-risk produce using conditions close to those from real-world applications.

Few studies have closely examined the ability of PCR and qPCR to detect STEC *stx* or *eae* subtypes (39–41), and to our knowledge, only one recent study explored the ability of LAMP to detect *eae* variants (42). There are currently 3 stx_1 subtypes (stx_{1a}, stx_{1c}, and stx_{1d}), 7 stx_2 subtypes (a through g), and about 30 *eae* subtypes (α, β, γ, ε, etc.) (37, 43). The presence of *eae* subtypes (primarily β, γ, and θ) and certain closely related stx_2 subtypes (stx_{2a}, stx_{2c}, and stx_{2d}) is strongly associated with severe human illness, such as HUS (36, 43). In a recent produce survey of STEC, the stx_{1a} and stx_{2a} subtypes were the most common, followed by stx_{2d} and stx_{2c}, and only 2 to 3% of strains had the stx_{2e} and stx_{2g} subtypes, while the *eae* subtypes present were β, γ, and ε (43). The LAMP suite was capable of detecting all of the major target gene subtypes evaluated in this study, consisting of two stx_1 subtypes (stx_{1a} and stx_{1c}), four stx_2 subtypes (stx_{2a}, stx_{2c}, stx_{2d}, and stx_{2g}), and four *eae* subtypes (β, γ, ε, and θ). The ability to detect all 27 *eae* variants tested was also reported in a recent *eae* LAMP study (42). Such broad specificity is not unexpected, since both *eae* LAMP assays employed primers in the highly conserved N-terminal region (670 amino acids) of all intimin subtypes (36). In contrast, the *eae* qPCR primers were located outside this region, increasing the assay's vulnerability for false-negative results. Due to the inability of their qPCR assays to detect some *eae* and *stx* subtypes (stx_{1d}, stx_{2e}, stx_{2f}, and stx_{2g}), the current USDA *Microbiology Laboratory Guidebook 5B* has adopted *eae* and *stx* primers/probes developed elsewhere, modified the O145 probe, and included a commercially available qPCR (BAX system; Dupont Qualicon) as an alternative method (44). Other studies also reported the failure of some PCR/qPCR assays to detect genetically distant *stx* subtypes, e.g., stx_{2b}, stx_{2f}, and stx_{2g} (40, 45). A recent evaluation of seven commercially available qPCR systems for *stx* subtypes also returned variable results (41). Therefore, careful selection and evaluation of primers/probes are critical in developing these NAATs.

Besides the inability of the stx_2 qPCR to detect two strains containing stx_{2g}, the specificities of LAMP and qPCR did not obviously differ for the 156 strains tested. Upon initial development, LAMP assays targeting STEC virulence genes (32) and seven O serogroups (33) were shown to be 100% specific by testing 90 and 120 strains, respectively. However, the specificity of qPCR assays evaluated in this study was not reported when initially developed (35), except that the O157 qPCR targeting the *wzy* gene was reported to be 100% specific (34). Such high specificity also agreed with that for other LAMP assays for STEC and *E. coli* O157 (20, 24, 29, 30). Interestingly, significant differences in LAMP T_t values among virulence gene-based assays or serogroup-specific assays or among strains possessing different stx_2 or *eae* subtypes were observed in this study, suggesting variations in assay amplification efficiency. Despite this, all T_t values observed in positive LAMP assays were below 31 min, indicating robust detection (46).

An entirely new set of seven STEC strains was selected to evaluate assay sensitivity. The detection limits of the LAMP suite (1 to 20 CFU per reaction in pure culture) closely mimicked those in previous studies (32, 33) and also fell within the range (0.7 to 100 CFU per reaction) reported for other STEC LAMP assays (20–24, 29–31). One important finding in the present study is that the stx_2 and *eae* LAMPs were less sensitive (up to 100-fold) in strains containing stx_{2c}, *eae*-β, and *eae*-θ subtypes, likely due to mismatches on LAMP primer sequences between these subtypes and those used as prototypes for primer design, i.e., sequences with GenBank accession numbers X07865 (stx_{2a}) and Z11541 (*eae*-γ1) (32). Previously, *eae* LAMP showed inferior sensitivity in STEC strains 97-3250 and 3215-99 (32), which have now been confirmed by PCR-RFLP, similar to other strains used in this study, to harbor the *eae*-β and *eae*-θ subtypes, respectively (data not shown). Conversely, qPCR assays were capable of detecting various stx_2 and *eae* subtypes without compromised sensitivity, possibly due to the use of fewer pairs of primers in qPCR.

Lettuce, spinach, and sprouts were tested since they have historically been involved in STEC outbreaks (10–13). The recent produce survey also identified spinach, lettuce, and cilantro (not sprouts) to be most problematic in STEC contamination (43). The seven serogroup-specific LAMP assays have been evaluated in baby spinach and romaine lettuce (33) but not virulence-based assays (32). In previous studies, inoculation usually occurred in produce homogenates rather than on the surface of intact produce, and samples were tested directly without cold storage (33). In the present study, with surface inoculation and aging treatment, the LAMP suite achieved robust and accurate detection of 10^5 to 10^6 CFU/25 g (i.e., 10^3 to 10^4 CFU/g, equivalent to 2 to 20 CFU per reaction) of STEC in all produce varieties without enrichment, which was comparable to the detection limits reported previously (33). Consistent with pure culture sensitivity data, inferior sensitivity was also observed when testing strains with certain target gene subtypes (stx_{2c}, *eae*-β, and *eae*-θ) in produce. The small variations (10-fold) observed among varieties of the same produce type indicated the effect of produce variety on sample processing and downstream assay, underscoring the need for commodity-specific evaluation.

With 6 to 8 h of enrichment, the LAMP suite detected 1.2 to 1.8 CFU/25 g of STEC in lettuce and spinach varieties, even among strains containing target gene subtypes (*stx*$_{2c}$, *eae*-β, and *eae*-θ) for which assay sensitivity was inferior. Similar detection capabilities using PCR or qPCR for STEC in leafy greens were obtained, usually with 24 h of enrichment (47, 48). In the present study, for samples enriched for longer than 8 h, more stable (i.e., statistically insignificant) and shorter T_t values were observed. In contrast, enrichment periods longer than 6 h were found to be disadvantageous for the recovery of STEC from salad samples with low levels of contamination (49). The temperature difference used for enrichment (37°C versus 42°C) may account for the discrepancy. In sprouts varieties, both LAMP and qPCR failed to detect this low level (1.2 to 1.8 CFU/25 g) of STEC with up to 24 h of enrichment. Previous studies in Japan applying LAMP in alfalfa and radish sprouts reported 90 to 100% detection rates in samples contaminated with 1 to 20.8 CFU/25 g of STEC after overnight enrichment (20, 25, 28). A multiplex PCR was also recently shown to detect 7 to 58 CFU/25 g of STEC in alfalfa, leek, and soy sprouts (50). It is noteworthy that sprouts samples had rather abundant natural flora, which was at levels 2 to 3 log units higher than those in leafy greens. Further studies are needed to examine whether this normal flora in sprouts or natural compounds released from sprouts during processing may affect STEC survival during enrichment. If necessary, procedures such as acid treatment or immunomagnetic separation may be incorporated to enhance STEC detection in sprouts (51).

DNA extraction is a critical step in molecular-based NAATs. The PrepMan Ultra sample preparation reagent yielded the best results, but the other five methods also generated satisfactory results for LAMP and qPCR with samples enriched for up to 24 h. Previously, the PrepMan Ultra reagent has been widely used to extract STEC DNA from a wide range of food samples, including fresh produce (52). FTA Elute had the advantage of preserving sample DNAs for up to 2 years and without centrifugation steps; however, the final DNA amount extracted was approximately 100-fold less concentrated than that obtained by the other methods, thus requiring more cells in the enrichment broth or a prolonged enrichment time.

In conclusion, the LAMP suite was demonstrated to be a rapid, reliable, and robust method for detecting STEC in produce during routine sampling and testing, providing a valuable tool for the produce industry and regulatory agencies to better identify contamination risks and ensure produce safety, therefore reducing produce-related STEC outbreaks and illnesses.

ACKNOWLEDGMENTS

We thank Baoguang Li and Narjol Gonzalez-Escalona from the U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition (FDA/CFSAN), for providing some of the STEC strains and the LA-320C real-time turbidimeter, respectively.

This work was supported in part by a research grant (SCB11064) from the Center for Produce Safety at the University of California, Davis.

REFERENCES

1. **Karmali MA, Gannon V, Sargeant JM.** 2010. Verocytotoxin-producing *Escherichia coli* (VTEC). Vet. Microbiol. **140:**360–370. http://dx.doi.org/10.1016/j.vetmic.2009.04.011.
2. **CDC.** 2013. Surveillance for foodborne disease outbreaks—United States, 2009-2010. MMWR Morb. Mortal. Wkly. Rep. **62:**41–47. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6203a1.htm.
3. **Gould LH, Walsh KA, Vieira AR, Herman K, Williams IT, Hall AJ, Cole D.** 2013. Surveillance for foodborne disease outbreaks—United States, 1998–2008. MMWR Surveill. Summ. **62**(SS-2)**:**1–34. http://www.cdc.gov/mmwr/preview/mmwrhtml/ss6202a1.htm.
4. **Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson MA, Roy SL, Jones JL, Griffin PM.** 2011. Foodborne illness acquired in the United States—major pathogens. Emerg. Infect. Dis. **17:**7–15. http://dx.doi.org/10.3201/eid1701.P11101.
5. **Johnson KE, Thorpe CM, Sears CL.** 2006. The emerging clinical importance of non-O157 Shiga toxin-producing *Escherichia coli*. Clin. Infect. Dis. **43:**1587–1595. http://dx.doi.org/10.1086/509573.
6. **CDC.** 2011. Vital signs: incidence and trends of infection with pathogens transmitted commonly through food—foodborne diseases active surveillance network, 10 U.S. sites, 1996–2010. MMWR Morb. Mortal. Wkly. Rep. **60:**749–755. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6022a5.htm.
7. **CDC.** 2012. FoodNet 2011 surveillance report. CDC, Atlanta, GA. http://www.cdc.gov/foodnet/PDFs/2011_annual_report_508c.pdf. Accessed 1 December 2013.
8. **CDC.** 2013. Incidence and trends of infection with pathogens transmitted commonly through food—foodborne diseases active surveillance network, 10 U.S. sites, 1996–2012. MMWR Morb. Mortal. Wkly. Rep. **62:**283–287. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6215a2.htm.
9. **USDA.** 2012. Shiga toxin-producing *Escherichia coli* in certain raw beef products. Fed. Regist. **77:**31975–31981. http://www.fsis.usda.gov/OPPDE/rdad/FRPubs/2010-0023FRN.pdf.
10. **FDA.** 2007. FDA finalizes report on 2006 spinach outbreak. FDA, Rockville, MD. http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2007/ucm108873.htm. Accessed 1 December 2013.
11. **CDC.** 2010. Investigation update: multistate outbreak of human *E. coli* O145 infections linked to shredded romaine lettuce from a single processing facility. CDC, Atlanta, GA. http://www.cdc.gov/ecoli/2010/ecoli_o145/index.html. Accessed 1 December 2013.
12. **Buchholz U, Bernard H, Werber D, Bohmer MM, Remschmidt C, Wilking H, Delere Y, an der Heiden M, Adlhoch C, Dreesman J, Ehlers J, Ethelberg S, Faber M, Frank C, Fricke G, Greiner M, Hohle M, Ivarsson S, Jark U, Kirchner M, Koch J, Krause G, Luber P, Rosner B, Stark K, Kuhne M.** 2011. German outbreak of *Escherichia coli* O104:H4 associated with sprouts. N. Engl. J. Med. **365:**1763–1770. http://dx.doi.org/10.1056/NEJMoa1106482.
13. **CDC.** 2013. Reports of selected *E. coli* outbreak investigations. CDC, Atlanta, GA. http://www.cdc.gov/ecoli/outbreaks.html. Accessed 1 December 2013.
14. **Daniels W.** 2012. Nationwide produce outbreak: a moment you never forget. Food Saf. Mag. **17:**40–45. http://www.foodsafetymagazine.com/magazine-archive1/december-2011january-2012/nationwide-produce-outbreak-a-moment-you-never-forget/.
15. **Ge B, Meng J.** 2009. Advanced technologies for pathogen and toxin detection in foods: current applications and future directions. J. Lab. Autom. **14:**235–241. http://dx.doi.org/10.1016/j.jala.2008.12.012.
16. **Whitaker RJ.** 2011. Product testing: considering the issues. Produce Marketing Association, Newark, DE.
17. **Wang F, Yang Q, Kase JA, Meng J, Clotilde LM, Lin A, Ge B.** 2013. Current trends in detecting non-O157 Shiga toxin-producing *Escherichia coli* in food. Foodborne Pathog. Dis. **10:**665–677. http://dx.doi.org/10.1089/fpd.2012.1448.
18. **Mori Y, Notomi T.** 2009. Loop-mediated isothermal amplification (LAMP): a rapid, accurate, and cost-effective diagnostic method for infectious diseases. J. Infect. Chemother. **15:**62–69. http://dx.doi.org/10.1007/s10156-009-0669-9.
19. **Notomi T, Okayama H, Masubuchi H, Yonekawa T, Watanabe K, Amino N, Hase T.** 2000. Loop-mediated isothermal amplification of DNA. Nucleic Acids Res. **28:**E63. http://dx.doi.org/10.1093/nar/28.12.e63.
20. **Hara-Kudo Y, Nemoto J, Ohtsuka K, Segawa Y, Takatori K, Kojima T, Ikedo M.** 2007. Sensitive and rapid detection of Vero toxin-producing *Escherichia coli* using loop-mediated isothermal amplification. J. Med. Microbiol. **56:**398–406. http://dx.doi.org/10.1099/jmm.0.46819-0.
21. **Kouguchi Y, Fujiwara T, Teramoto M, Kuramoto M.** 2010. Homogenous, real-time duplex loop-mediated isothermal amplification using a

single fluorophore-labeled primer and an intercalator dye: its application to the simultaneous detection of Shiga toxin genes 1 and 2 in Shiga toxigenic *Escherichia coli* isolates. Mol. Cell. Probes **24:**190–195. http://dx.doi.org/10.1016/j.mcp.2010.03.001.
22. **Maruyama F, Kenzaka T, Yamaguchi N, Tani K, Nasu M.** 2003. Detection of bacteria carrying the stx_2 gene by in situ loop-mediated isothermal amplification. Appl. Environ. Microbiol. **69:**5023–5028. http://dx.doi.org/10.1128/AEM.69.8.5023-5028.2003.
23. **Zhu SR, Chen Y, Wang ZG, Jin DZ, Lu QY, Yao PP.** 2009. Detection of enterohemorrhagic *Escherichia coli* O157:H7 by loop-mediated isothermal amplification. Zhonghua Yu Fang Yi Xue Za Zhi **43:**803–808. (In Chinese.)
24. **Zhao X, Li Y, Wang L, You L, Xu Z, Li L, He X, Liu Y, Wang J, Yang L.** 2010. Development and application of a loop-mediated isothermal amplification method on rapid detection *Escherichia coli* O157 strains from food samples. Mol. Biol. Rep. **37:**2183–2188. http://dx.doi.org/10.1007/s11033-009-9700-6.
25. **Hara-Kudo Y, Konishi N, Ohtsuka K, Hiramatsu R, Tanaka H, Konuma H, Takatori K.** 2008. Detection of Verotoxigenic *Escherichia coli* O157 and O26 in food by plating methods and LAMP method: a collaborative study. Int. J. Food Microbiol. **122:**156–161. http://dx.doi.org/10.1016/j.ijfoodmicro.2007.11.078.
26. **Hara-Kudo Y, Niizuma J, Goto I, Iizuka S, Kaji Y, Kamakura K, Suzuki S, Takatori K.** 2008. Surveillance of Shiga toxin-producing *Escherichia coli* in beef with effective procedures, independent of serotype. Foodborne Pathog. Dis. **5:**97–103. http://dx.doi.org/10.1089/fpd.2007.0031.
27. **Ohtsuka K, Tanaka M, Ohtsuka T, Takatori K, Hara-Kudo Y.** 2010. Comparison of detection methods for *Escherichia coli* O157 in beef livers and carcasses. Foodborne Pathog. Dis. **7:**1563–1567. http://dx.doi.org/10.1089/fpd.2010.0585.
28. **Kanki M, Seto K, Harada T, Yonogi S, Kumeda Y.** 2011. Comparison of four enrichment broths for the detection of non-O157 Shiga-toxin-producing *Escherichia coli* O91, O103, O111, O119, O121, O145 and O165 from pure culture and food samples. Lett. Appl. Microbiol. **53:**167–173. http://dx.doi.org/10.1111/j.1472-765X.2011.03085.x.
29. **Wang D, Liu F, Huo G, Ren D, Li Y.** 2009. Development and evaluation of a loop-mediated isothermal amplification method for detecting *Escherichia coli* O157 in raw milk. J. Rapid Methods Autom. Microbiol. **17:**55–66. http://dx.doi.org/10.1111/j.1745-4581.2008.00151.x.
30. **Jiang R, Long B, Zeng G, Wang D, Fan H, Wu X.** 2012. Loop-mediated isothermal amplification for detecting enterohemorrhagic *Escherichia coli* O157:H7: a comparison with PCR. Nan Fang Yi Ke Da Xue Xue Bao **32:**1026–1030. (In Chinese.)
31. **Zhao X, Wang J, Forghani F, Park JH, Park MS, Seo KH, Oh DH.** 2013. Rapid detection of viable *Escherichia coli* O157 by coupling propidium monoazide with loop-mediated isothermal amplification. J. Microbiol. Biotechnol. **23:**1708–1716. http://dx.doi.org/10.4014/jmb.1306.06003.
32. **Wang F, Jiang L, Ge B.** 2012. Loop-mediated isothermal amplification assays for detecting Shiga toxin-producing *Escherichia coli* in ground beef and human stools. J. Clin. Microbiol. **50:**91–97. http://dx.doi.org/10.1128/JCM.05612-11.
33. **Wang F, Jiang L, Yang Q, Prinyawiwatkul W, Ge B.** 2012. Rapid and specific detection of *Escherichia coli* serogroups O26, O45, O103, O111, O121, O145, and O157 in ground beef, beef trim, and produce by loop-mediated isothermal amplification. Appl. Environ. Microbiol. **78:**2727–2736. http://dx.doi.org/10.1128/AEM.07975-11.
34. **Fratamico PM, Bagi LK, Cray WC, Jr, Narang N, Yan X, Medina M, Liu Y.** 2011. Detection by multiplex real-time polymerase chain reaction assays and isolation of Shiga toxin-producing *Escherichia coli* serogroups O26, O45, O103, O111, O121, and O145 in ground beef. Foodborne Pathog. Dis. **8:**601–607. http://dx.doi.org/10.1089/fpd.2010.0773.
35. **Fratamico PM, Debroy C.** 2010. Detection of *Escherichia coli* O157:H7 in food using real-time multiplex PCR assays targeting the stx_1, stx_2, wzy_{O157}, and the $fliC_{h7}$ or *eae* genes. Food Anal. Methods **3:**330–337. http://dx.doi.org/10.1007/s12161-010-9140-x.
36. **Ramachandran V, Brett K, Hornitzky MA, Dowton M, Bettelheim KA, Walker MJ, Djordjevic SP.** 2003. Distribution of intimin subtypes among *Escherichia coli* isolates from ruminant and human sources. J. Clin. Microbiol. **41:**5022–5032. http://dx.doi.org/10.1128/JCM.41.11.5022-5032.2003.
37. **Scheutz F, Teel LD, Beutin L, Pierard D, Buvens G, Karch H, Mellmann A, Caprioli A, Tozzoli R, Morabito S, Strockbine NA, Melton-Celsa AR, Sanchez M, Persson S, O'Brien AD.** 2012. Multicenter evaluation of a sequence-based protocol for subtyping Shiga toxins and standardizing Stx nomenclature. J. Clin. Microbiol. **50:**2951–2963. http://dx.doi.org/10.1128/JCM.00860-12.
38. **Lang MM, Harris LJ, Beuchat LR.** 2004. Survival and recovery of *Escherichia coli* O157:H7, *Salmonella*, and *Listeria monocytogenes* on lettuce and parsley as affected by method of inoculation, time between inoculation and analysis, and treatment with chlorinated water. J. Food Prot. **67:**1092–1103.
39. **Wasilenko JL, Fratamico PM, Narang N, Tillman GE, Ladely S, Simmons M, Cray WC, Jr.** 2012. Influence of primer sequences and DNA extraction method on detection of non-O157 Shiga toxin-producing *Escherichia coli* in ground beef by real-time PCR targeting the *eae*, *stx*, and serogroup-specific genes. J. Food Prot. **75:**1939–1950. http://dx.doi.org/10.4315/0362-028X.JFP-12-087.
40. **Feng PC, Jinneman K, Scheutz F, Monday SR.** 2011. Specificity of PCR and serological assays in the detection of *Escherichia coli* Shiga toxin subtypes. Appl. Environ. Microbiol. **77:**6699–6702. http://dx.doi.org/10.1128/AEM.00370-11.
41. **Margot H, Cernela N, Iversen C, Zweifel C, Stephan R.** 2013. Evaluation of seven different commercially available real-time PCR assays for detection of Shiga toxin 1 and 2 gene subtypes. J. Food Prot. **76:**871–873. http://dx.doi.org/10.4315/0362-028X.JFP-12-365.
42. **Zhang X, Ye Q, Liu Y, Li B, Ivanek R, He K.** 2013. Development of a LAMP assay for rapid detection of different intimin variants of attaching and effacing microbial pathogens. J. Med. Microbiol. **62:**1665–1672. http://dx.doi.org/10.1099/jmm.0.054551-0.
43. **Feng PC, Reddy S.** 2013. Prevalences of Shiga toxin subtypes and selected other virulence factors among Shiga-toxigenic *Escherichia coli* strains isolated from fresh produce. Appl. Environ. Microbiol. **79:**6917–6923. http://dx.doi.org/10.1128/AEM.02455-13.
44. **USDA.** 2013. Microbiology laboratory guidebook 5B.04: detection and isolation of non-O157 Shiga toxin-producing *Escherichia coli* (STEC) from meat products and carcass and environmental sponges. USDA, Washington, DC. http://www.fsis.usda.gov/wps/wcm/connect/7ffc02b5-3d33-4a79-b50c-81f208893204/MLG-5B.pdf?MOD=AJPERES. Accessed 1 December 2013.
45. **Beutin L, Jahn S, Fach P.** 2009. Evaluation of the 'GeneDisc' real-time PCR system for detection of enterohaemorrhagic *Escherichia coli* (EHEC) O26, O103, O111, O145 and O157 strains according to their virulence markers and their O- and H-antigen-associated genes. J. Appl. Microbiol. **106:**1122–1132. http://dx.doi.org/10.1111/j.1365-2672.2008.04076.x.
46. **Yang Q, Wang F, Prinyawiwatkul W, Ge B.** 2014. Robustness of *Salmonella* loop-mediated isothermal amplification assays for food applications. J. Appl. Microbiol. **116:**81–88. http://dx.doi.org/10.1111/jam.12340.
47. **Kase JA, Maounounen-Laasri A, Son I, Deer DM, Borenstein S, Prezioso S, Hammack TS.** 2012. Comparison of different sample preparation procedures for the detection and isolation of *Escherichia coli* O157:H7 and non-O157 STECs from leafy greens and cilantro. Food Microbiol. **32:**423–426. http://dx.doi.org/10.1016/j.fm.2012.08.006.
48. **Gill A, Martinez-Perez A, McIlwham S, Blais B.** 2012. Development of a method for the detection of verotoxin-producing *Escherichia coli* in food. J. Food Prot. **75:**827–837. http://dx.doi.org/10.4315/0362-028X.JFP-11-395.
49. **Tzschoppe M, Martin A, Beutin L.** 2012. A rapid procedure for the detection and isolation of enterohaemorrhagic *Escherichia coli* (EHEC) serogroup O26, O103, O111, O118, O121, O145 and O157 strains and the aggregative EHEC O104:H4 strain from ready-to-eat vegetables. Int. J. Food Microbiol. **152:**19–30. http://dx.doi.org/10.1016/j.ijfoodmicro.2011.10.009.
50. **Verstraete K, Robyn J, Del-Favero J, De Rijk P, Joris M-A, Herman L, Heyndrickx M, De Zutter L, De Reu K.** 2012. Evaluation of a multiplex-PCR detection in combination with an isolation method for STEC O26, O103, O111, O145 and sorbitol fermenting O157 in food. Food Microbiol. **29:**49–55. http://dx.doi.org/10.1016/j.fm.2011.08.017.
51. **Fedio WM, Jinneman KC, Yoshitomi KJ, Zapata R, Weagant SD.** 2012. Efficacy of a post enrichment acid treatment for isolation of *Escherichia coli* O157:H7 from alfalfa sprouts. Food Microbiol. **30:**83–90. http://dx.doi.org/10.1016/j.fm.2011.12.003.
52. **Elizaquivel P, Aznar R.** 2008. Comparison of four commercial DNA extraction kits for PCR detection of *Listeria monocytogenes*, *Salmonella*, *Escherichia coli* O157:H7, and *Staphylococcus aureus* in fresh, minimally processed vegetables. J. Food Prot. **71:**2110–2114.

CPS CENTER *for* PRODUCE SAFETY

CPS 2011 RFP
FINAL PROJECT REPORT

Project Title

Distribution of *Salmonella* in pistachios and development of effective sampling strategies

Project Period

January 1, 2013 – December 31, 2013

Principal Investigator

Linda J. Harris
Department of Food Science and Technology
University of California, Davis
530-754-9485, ljharris@ucdavis.edu

Co-Principal Investigator

Robert Atwill
Western Institute for Food Safety and Security
University of California, Davis
ratwill@ucdavis.edu

Objectives

1. To determine the prevalence, concentration and distribution of *Salmonella* in U.S. pistachios for 2 crop years.
2. To develop cost-effective sampling strategies that could be used by the pistachio industry to evaluate the microbial status of raw pistachios.

Funding for this project provided by the Center for Produce Safety through:

CDFA SCBGP grant #SCB11066, California Pistachio Research Board, and CPS Campaign for Research

Linda Harris, UC Davis
Distribution of Salmonella in pistachios and development of effective sampling strategies

FINAL REPORT

Abstract

Nuts and other low-moisture foods have generally been considered low-risks for foodborne illness because they are consumed in a dry state where water activity (available moisture) is too low to support microbial growth. Over the past 14 years outbreaks associated with consumption of raw almonds, hazelnuts, pine nuts, and peanut butter have been documented in the U.S. and elsewhere. In 2009 and 2013 there were recalls of pistachios after *Salmonella* was isolated from U.S. product. These recalls lead to an increased interest in identifying sources and routes of contamination of this organism in pistachios. Immediately after hulling, pistachios are passed through a float tank containing water that separates nuts on the basis of density. About 85% of pistachios are fully formed with nuts that fill the shell; these nuts sink and are called "sinkers." The remaining 15% include pistachios that are smaller, less developed nuts and those with insect damage or adhering hull; these nuts float and are called "floaters." Raw inshell floater and sinker pistachios from the 2010, 2011, and 2012 harvests were collected within 2 months of harvest from seven collaborating pistachio processors representing 98% of California pistachio production. Twelve approximately 1-kg samples were collected from each storage silo holding between 1 to 1.5 million pounds of pistachios; 3,968 samples were collected over the 3 years. The overall prevalence of *Salmonella* in 100-g subsamples was 2% for floaters and 0.4% for sinkers, with an overall combined weighted prevalence of 0.6%. Levels of *Salmonella* in positive samples were low; an average of 1 MPN (or cells)/100 g was detected in floater samples (range 0.1 to 8 MPN/100 g) and 0.2 MPN/100 g was detected in sinker samples (range 0.1 to 0.6 MPN/100 g). In 2012, samples were further categorized into those that were harvested in the "first shake," "second shake", or were "mixed" (combination of first and second shake). All of the positive samples collected in 2012 came from silos containing "second shake" or "mixed" pistachios. At the prevalence and levels of *Salmonella* found in this study, processors can increase the probability of detecting *Salmonella* in pistachio floater samples by enriching 250 to 375 g of sample that has been collected from throughout a silo. In contrast three to four 375 g enrichments would be needed to reliably detect *Salmonella* in positive sinker samples. A relatively narrow range of *Salmonella* serovars (nine total) were isolated from pistachios over the 3 years of this study; several serovars were isolated in more than 1 year and often across multiple samples within a year. These findings suggests that contamination of pistachios may occur during postharvest handling, and that some strains of *Salmonella* may be resident in the environment in and around some pistachio hulling and storage facilities. The data generated by this research are being used to update and improve a Quantitative Microbial Risk Assessment (QMRA) for pistachios. We are also working with the pistachio industry to identify opportunities to reduce prevalence and levels of *Salmonella* in pistachios particularly in the floater stream.

Background

Nuts and other low-moisture foods are generally considered low-risks for foodborne illness because they are consumed in a dry state where water activity (available moisture) is too low to support microbial growth. However, it is increasingly recognized that many foodborne pathogens can cause illness at very low concentrations, such that microbial growth is not required. In the past decade, foodborne illness outbreaks associated with consumption of raw almonds, pine nuts, hazelnuts, and peanut butter have been documented in the U.S. In 2009 there was a large recall of pistachios after *Salmonella* Montevideo was isolated from commercial products, and in 2013 a smaller recall was also triggered by isolation of *Salmonella* Senftenberg from pistachios that was also epidemiologically linked to several illnesses across the U.S. However, with the exception of almonds, very little is known about the prevalence, levels, and distribution of *Salmonella* in nut production and processing environments; these data are important to develop robust quantitative microbial risk assessment (QMRA) and for developing scientifically-sound product sampling schemes for verification of food safety plans.

One objective of this research was to determine the prevalence (in 100-g samples), levels, and distribution of *Salmonella* in U.S. pistachios over a 2-year period. *Salmonella* isolates were characterized as a means of providing insight into potential routes of contamination, with the long-term goal of identifying appropriate mitigation strategies. A second objective was to use these data to evaluate cost-effective sampling strategies that could be applied by the pistachio industry to evaluate the microbial status of raw pistachios.

Research Methods and Results

Prevalence of *Salmonella* in California pistachios

Raw inshell pistachio samples from the 2011 and 2012 harvests were collected within 2 months of harvest and stored at 4°C. Previous studies have demonstrated that *Salmonella* does not decrease on inshell pistachios stored under these conditions (Kimber et al., 2012). Seven collaborating pistachio processors representing the majority of California pistachio production (about 98%) participated in the survey. The number of samples collected from each collaborator roughly corresponded to their proportion of the approximate crop volume. Pistachios were coded to blind the samples, and then stored and processed for *Salmonella* by the American Council for Food Safety and Quality (ACFSQ) (Fresno, Calif.).

During the harvest process, pistachios are removed from the tree, transported to a hulling facility where the hulls are removed and the nuts are then dried and stored. Immediately after hulling but before drying, pistachios pass through a float tank that separates nuts on the basis of density – nuts that fill the shell are heavier and sink while smaller nuts and those with insect damage or adhering hull float. Nuts that sink are called "sinkers" (~85% of the typical crop) and nuts that float are called "floaters" (~15% of the typical crop). Sinker and floater nuts are handled independently after initial separation and are dried and stored separately. An evaluation of data from a 2010 survey (generated prior to receiving the current grant funding) indicated a potentially higher prevalence of *Salmonella* in floater samples. Therefore, we chose to analyze a disproportionate number of floaters in 2011 and 2012 (35% and 27% of samples, respectively). Pistachios are stored in silos that hold 1 to 1.5 million pounds of product and have from three to 10 sampling ports (88% have five to eight sampling ports). With a couple of exceptions, a total of 12 samples of ~1 kg each were taken from each silo. For two silos in 2012 a total of 24 samples were collected and from one silo a total of 28 samples were collected.

A total of 2,816 pistachio samples were collected and analyzed in 2011 and 2012. Because the data from 2010 (1,152 samples) were important to the overall evaluation of the survey data they are included throughout the results and discussion. Thus a total of 3,968 samples were analyzed and a total of 32 positive samples (21 floaters and 11 sinkers) were identified over the 3-year survey. The average prevalence of *Salmonella* in 100-g samples of pistachios was 0.62% based on a weighted average in relative proportion to the amount of floaters and sinkers produced each year (Table 1). The prevalence of *Salmonella* was significantly higher in floater pistachios (average 2%) than sinker pistachios (average 0.4%).

Levels of *Salmonella* in positive pistachio samples

Each positive pistachio sample was evaluated using a three-tube MPN technique (3 X 50 g, 3 X 5 g, and 3 X 0.25 g). The average level of *Salmonella* in the 21 positive floater samples was 3.8 MPN/100 g with a range of 0.47 MPN/100 g (nine samples) to 48 MPN/100 g (one sample). None of the MPN tubes were positive for *Salmonella* in any of the sinker samples; the MPN for all 11 of the sinker samples was 0.47 MPN/100 g.

Distribution of *Salmonella* in positive pistachio samples

The remaining pistachios from the positive samples were subsampled in 50-g portions (from four to 15 portions in 2010 or 10 portions in 2011 and 2012) and each subsample was separately enriched for *Salmonella*. The majority of initially-positive sinker samples were negative upon retesting (9 of 11; Table 2); two sinker samples had four additional positive subsamples (4 of 17 and 4 of 14) in 2010. The number of additional *Salmonella*-positive subsamples for initially-positive floater samples ranged from 0 (2 of 21) to 7 (1 of 21). These additional samples were used to recalculate MPN values. In almost all cases the calculated MPN decreased with subsequent retesting. The average level of *Salmonella* in the 11 positive sinker samples was 0.23 ± 0.18 MPN/100 g, with a range of 0.10 MPN/100 g (one sample) to 0.62 MPN/100 g (one sample). The average level of *Salmonella* in the 21 positive floater samples was 1.1 ± 1.7 MPN/100 g, with a range of 0.14 MPN/100 g (two samples) to 8 MPN/100 g (one sample).

In 2012, on the recommendation of one of our industry partners, we also made note of whether or not the pistachios were harvested from the first or second shake of the tree. Pistachio trees are not always shaken twice during harvest, but "second shake" nuts often have softer hulls because it is later in the season and the fruit is more mature. A silo was considered positive if any of the initial 12 samples collected from that silo were positive. One of 84 (~1%) sinker silos evaluated yielded a positive sample; 31% (10 of 32) of the floater silos yielded one or more positive samples. All the positive floater samples came from silos that held second shake or mixed (first and second shake) nuts, and the single positive sinker sample also came from a second shake silo. First shake sinker and floater silos made up 46% and 25%, respectively of the total sampled.

Distribution of *Salmonella* in initially-negative pistachio samples

Initially-negative pistachio samples were also retested in 50-g portions. In 2010, the decision to retest samples was made at the end of the survey after most of the samples had been discarded. Ten sinker samples were each retested by enrichment of 10 50-g portions. Of the 10 sinker samples retested, nine were negative for all 10 subsamples, and one yielded a single positive.

A random number generator was used to select 10 or 20 initially-negative samples for retesting in 2011 and 2012, respectively. A total of 10 subsamples were enriched for *Salmonella* from each of these samples. In 2011, four of these samples were floaters and six were sinkers. Of the 40 floater subsamples tested, one was positive; none of the 60 sinker subsamples was positive on retesting. In 2012, four of the initially-negative samples were floaters and 16 were sinkers. Of the 40 floater subsamples tested, one was positive; none of the 160 sinker subsamples was positive on retesting.

***Salmonella* serovars isolated from pistachios**

Three isolated colonies from each initially-positive enrichment were purified and serotyped. All initial three isolates from a sample were the same serotype, with the exception of one sinker sample in which a second serovar was identified. Isolates from each positive MPN tube were also serotyped as well as any isolates from secondary 50-g subsample enrichments. The serovars isolated from MPN subsamples were often, but not always, the same as the initial isolate. More than one serovar of *Salmonella* was isolated from 14 of the 32 positive samples; three or four different serovars of *Salmonella* were isolated from eight different pistachio samples. All isolates over the three years were one of nine different serovars (Table 3). *Salmonella* Montevideo was isolated from 66% of the samples (45%, 50%, and 87% of samples in 2010, 2011, and 2012).

Pulsed Field Gel Elecrophoresis (PFGE) patterns (fingerprints) for *Salmonella* isolates

PFGE patterns were determined to provide further information on the diversity of the *Salmonella* isolates. There were two PFGE patterns of *Salmonella* Montevideo isolated in each of the 3 years (of 11 isolates evaluated) and two PFGE patterns of *Salmonella* Worthington (of 10 isolates evaluated) over 2 years. *Salmonella* Enteritidis PFGE patterns were the same within each of the three phage types identified (PT9c, PT37, and RDNC). Three different *Salmonella* Liverpool PFGE patterns were noted for the eight isolates. Two PFGE patterns differing by a single band were noted for the eight *Salmonella* Senftenberg isolates.

Cost-effective sampling strategies for testing raw floater pistachios

To evaluate sampling strategies for testing raw pistachios some assumptions needed to be made. Specifically it was assumed that the specificity of the analytical method for detecting *Salmonella* in 100 g of pistachios is 99.9% accurate due to culture confirmation, hence, the probability of a false positive is only 0.1%. It was also assumed that the analytical methods used are capable of reliably detecting one or more cells of *Salmonella*, that the *Salmonella* are Poisson distributed throughout the samples, and that the overall MPN values estimated represent the mean of this Poisson distribution. Based on these assumptions, the sensitivity of detecting *Salmonella* contamination in 100 grams of pistachios is 56% when an unweighted arithmetic mean of all samples of 0.82 MPN/100 g was used (floaters and sinkers combined), and 36% when an unweighted median of all samples of 0.45 MPN/100 g was used (floaters and sinkers combined) for the average concentration of *Salmonella* contamination. Based on these numbers the sensitivity of detecting *Salmonella* would be over 90% if 300 g were analyzed (0.82 MPN/100 g) or 600 g were analyzed (0.45 MPN/100 g) (Table 4).

A second approach to determining appropriate sample size was also taken. The International Commission on the Microbiological Criteria for Foods has an online spreadsheet that can be used for such purposes (http://www.icmsf.org/main/software_downloads.html). The data generated here for levels of *Salmonella* in positive floater and sinker samples were used to evaluate an appropriate sample size based on the desired probability of finding *Salmonella* should the organism be present. They assume that any positive sample would be contaminated at the levels found in this study.

Both the initial MPN/g calculated (see Levels of *Salmonella* in Positive Samples above) as well as the MPN calculated using all samples (see Distribution of *Salmonella* in Positive Samples above) were used. It is usually recommended that a sampling plan achieve at least a 95% probability of detecting a positive in a positive lot (5% or lower values in the Table 5). For floater silos contaminated at levels reported here, a 250 g or greater subsample would provide an estimated 97% likelihood of detecting a positive. For sinker samples, three 375 g samples would be needed to provide a 95% assurance of finding *Salmonella* in a positive lot.

Outcomes and Accomplishments
The data generated by this project are being used to complete a QMRA for pistachios that was initiated in a previously funded CPS project. In addition, on July 17, 2013, the Food and Drug Administration posted a formal request for raw data that will be used to develop a tree nut risk assessment (risk of salmonellosis associated with eating tree nuts) over the next 1 to 2 years. We worked closely with the pistachio industry to organize the data generated from this grant to include in their formal data submission to the docket that was due December 16, 2013 ((Docket No. FDA-2013-N-0747) Assessment of the Risk of Human Salmonellosis Associated with the Consumption of Tree Nuts; Request for Comments, Scientific Data and Information).

Summary of Findings and Recommendations
The overall weighted prevalence of *Salmonella* in raw California inshell pistachios in 100-g samples determined for nearly 4,000 samples collected over three harvests (2010, 2011, and 2012) was 0.6%. This finding is similar to the prevalence of *Salmonella* observed for other tree nuts: e.g. almonds at 1% prevalence (Lambertini et al., 2012), and inshell pecans at 0.8% prevalence (Danyluk personal communication). The overall levels of *Salmonella* determined for positive samples (average 0.8 MPN/100 g or 0.008 MPN/g) were also similar to those reported in other nuts and other low moisture foods.

However, there was a significant difference in the overall prevalence of *Salmonella* in sinker (0.4%) and floater pistachios (2%). The average level of *Salmonella* in sinkers (0.2 MPN/100 g) was also significantly lower than that of floaters (1 MPN/100 g). In addition, more than one positive sample was not typically identified from the 12 samples collected from a single sinker silo. The sinker stream makes up roughly 85% of the total volume by weight of the annual crop (Figure 1). The majority of sinkers (90%) are inshell product with small amounts of kernel (3%), shell (5%), and inedible kernel (2%). In contrast, the 15% floater stream is largely inedible kernel (50%) with relatively small amounts of inshell (10%) and kernel (15%).

The data suggest that the higher prevalence and levels of *Salmonella* in floater pistachios is driven by a subset of silos that are much more contaminated than the rest. Data from 2012 suggest that this contamination is strongly associated with pistachios that are "second shake." For these floater silos the prevalence of *Salmonella* among the samples analyzed ranged from 14 to 100% (average 48% positive 100-g samples from 11 silos). The level of *Salmonella* in these silos was the same as the calculated overall average (0.008 MPN/g). These silos each contain 1 to 1.5 million pounds of pistachios and even though only 25% of the weight is edible product, the amounts are significant. It is not known if the prevalence of *Salmonella* from these silos would be similar after the product was sorted and shelled. While most pistachios are treated by one or more processes that have been validated to reduce *Salmonella*, large volumes of pistachios, even when contaminated at low levels, pose a risk of contaminating the both the equipment and facility in which they are handled. This increases the risk of a post-processing recontamination event.

To maintain optimum quality, pistachio processors target short times between shaking nuts from the tree to the time the hull is removed. Based on data from our earlier CPS-funded study *Salmonella* can grow on harvested pistachios under temperatures and humidities that can be achieved in harvest trailers that are held for several hours. Increases in levels of *Salmonella* are significant after 6 hours. *Salmonella* can also multiply in hulled pistachios when there are delays between hulling and drying. Because the prevalence of *Salmonella* was lower in sinker pistachios it is likely that the cause of the higher prevalence in a number of floater silos occurred after the float tank. The association with second shake pistachios may be related to the condition of the hulls that adhere to ~~a greater portion of hulled floaters but also suggests the possibility of delays between hulling and drying.~~

The isolation of a narrow range of *Salmonella* serovars and PFGE patterns over the 3 years of this study suggests that several strains of *Salmonella* may have established resident and persistent populations at one or more of the pistachio handlers that participated in this study. It is possible that several silos are contaminated with these *Salmonella*. Cleaning and sanitizing silos is challenging and it is possible that the reoccurring contamination of floaters is due to an introduction of *Salmonella* after the pistachios are dried and as they are loaded into these silos. However, this explanation does not explain the strong association of positive samples with second shake pistachios and especially with floaters.

Pistachios were sampled through silo sample ports using a sample trier. The sampling was not supervised by UC Davis but was undertaken by a contract laboratory. Although the triers are sprayed with a 70% ethanol solution between each sample, the construction of each triers are complex making sanitation a challenge. It is possible that the sanitation step was inadequate and resulted in some cross-contamination among samples. This might explain why some of the floater silos had a higher prevalence of *Salmonella* but would not fully explain why the positives were consistently associated with floater samples in each of the 3 years since the same triers were used to collect both floater and sinker samples.

Although all of the pistachios from this survey have already been processed and distributed, it is strongly recommended that the participants in this study closely evaluate their floater stream for future crops. Particular attention should be given to those silos that contain second shake or mixed pistachios. Analyzing a single 250 to 375-g sample of pistachios per silo by enrichment (assuming subsamples are taken from throughout the silo and well mixed) should give a reasonable likelihood of finding *Salmonella* if present at the levels observed in 2012. If positives are found, these facilities should handle pistachios from these silos with caution and they should consider performing a root cause analysis with the goal of developing an action plan to 1) reduce prevalence of *Salmonella* in floater pistachios and 2) eradicate potentially resident populations of *Salmonella*.

The overall results from sinker pistachios provide substantial data demonstrating that production of pistachios with low prevalence and levels of *Salmonella* is possible. By focusing on identifying the root cases for contamination of second shake floater pistachios the U.S. pistachio industry should be able to implement targeted mitigation strategies that will further reduce the overall prevalence of *Salmonella* in this commodity.

Cited References

Kimber, M. A., H. Kaur, L. Wang, M. D. Danyluk, and L. J. Harris. 2012. Survival of *Salmonella*, *Escherichia coli* O157:H7, and *Listeria monocytogenes* on inoculated almonds and pistachios stored at –19, 4, and 24°C. J. Food Prot. 75:1394–1403.

Lambertini, E., M. D. Danyluk, D. W. Schaffner, C. K. Winter, and L. J. Harris. 2012. Risk of salmonellosis from consumption of almonds in the North American market. Food Res. Int. 45:1166–1174

APPENDICES

Publications and Presentations (required)

No publications to report.

No presentations specific to these data to report.

Budget Summary (required)

The funds were spent as outlined in the original budget. A significant amount of the funds were used to process the initial samples for *Salmonella*. UC Davis staff determined the levels and distribution of *Salmonella* in initially-positive and in initially-negative samples. Staff at UC Davis processed all of the *Salmonella* isolates including adding them to the culture collection, ensuring they were serotyped, phage typed when necessary, and that PFGE patterns were determined.

The funds were sufficient to implement the project as proposed.

Tables and Figures (optional)

Table 1. Prevalence of *Salmonella* 2010-2012

Year	No. samples (sinkers/floaters)	No. positive samples (sinkers/floaters)	% positive sinkers/floaters	Total % positive proportionate to crop volume[1]
2010	1152 (984/168)	11 (7/4)	0.71/2.38	0.96
2011	1380 (900/480)	6 (3/3)	0.33/0.63	0.38
2012	1436 (1052/384)	15 (1/14)	0.1/3.64	0.63
Total/Average	3968 (2935/1033)	32 (11/21)	0.37/2.03	0.62

[1]Assumes 85% sinkers and 15% floaters.

Table 2. Additional positive 50-g subsamples identified in initially-positive pistachio samples in 2011 and 2012 (30 samples total)

Number of additional positive samples	Sinker	Floater	Total
0	9	2	11
1	0	6	6
2	0	5	5
3	0	3	3
4	2	2	4
5	0	1	1
6	0	1	1
7	0	1	1

Table 3. *Salmonella* serotypes isolated from positive pistachio samples (2010 through 2012).

Salmonella serotype	Number of the 32 samples with serotype (% of total samples with serotype)	Year when serotype isolated (no. of samples with serovar)
Agona	2 (6)	2010 (1), 2012 (1)
Enteritidis Phage Type: RDNC	3 (9)	2010 (1), 2011 (1), 2012 (1)
Enteritidis Phage Type: 9c	2 (6)	2010 (1), 2011 (1)
Enteritidis Phage Type: 37	1 (3)	2010 (1)
Liverpool	8 (25)	2011(1), 2012(7)
Montevideo	21 (66)	2010 (5), 2011 (3), 2012 (13)
Senftenberg	8 (25)	2010 (2), 2012 (6)
Tennessee	1 (3)	2010 (1)
Worthington	12 (38)	2010 (4), 2012 (8)
Total	57 isolates	

Table 4: Sensitivity to detect *Salmonella* contamination in samples of floater pistachios as a function of the number of replicate 100-g aliquots that are tested per batch

No. of 100-g aliquots	Sensitivity (arithmetic mean)[1]	Sensitivity (median)[1]
1	56%	36%
2	81%	59%
3	91%	74%
4	96%	83%
5	98%	89%
6	99%	93%

[1] Calculations of sensitivity based on using either the arithmetic mean of 1.1 MPN/100 g or the median of 0.63 MPN/100 g for the typical concentration of *Salmonella* contamination.

Table 5: Probability of a negative *Salmonella* test result when the sample is actually positive.

						375 g			
Pistachio	Mean	Sigma	100 g	200 g	250 g	1	2	3	4
Floater	-1.42[1]	0.52	2.56%	0.07%	0.01%	0.00	ND	ND	ND
	-1.94[2]	0.42	23.17%	5.37%	2.58%	0.42%	0.00	ND	ND
Sinker	-2.33[1]	0.05	62.47%	39.03%	30.85%	17.13%	2.93%	0.50%	0.09%
	-2.64[2]	0.26	76.33%	58.26%	50.90%	36.31%	13.19%	4.79%	1.74%

[1] Mean and Sigma from initial MPN calculations
[2] Mean and Sigma from MPN calculated using all samples tested

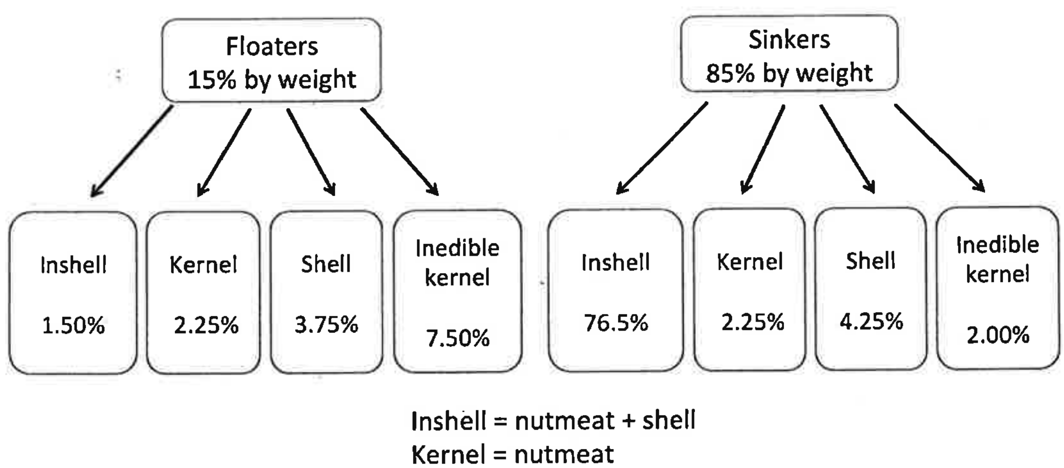


Figure 1. Proportion of edible product in sinker and floater streams of pistachios.

Suggestions to CPS (optional)
None.

Linda Harris, UC Davis

Distribution of Salmonella in pistachios and development of effective sampling strategies

Project 73




SHELTER + MOBILITY

Recommendations for California's Specialty Crop Ag Workforce

Ag Innovations Network

APRIL 2014

ABOUT AIN Ag Innovations Network (AIN) is a nonprofit, nonpartisan organization dedicated to helping stakeholders solve problems in the food system through effective collaboration. Since 1999, AIN has been designing, organizing, facilitating, and managing multi-stakeholder efforts to improve the performance of the food system for producers, consumers, and participants in local, regional, and global food supply chains. These efforts focus on both policy changes and direct improvements on farms, processing sites, and food outlets. AIN combines deep expertise in the challenges of the global food system, from production through food access, with an approach to problem solving that gives groups the tools they need to deliver outcomes in meetings, conferences, and multi-stakeholder collaborations.

CALIFORNIA AGRICULTURAL WORKFORCE HOUSING & TRANSPORTATION PROJECT

The Workforce Housing and Transportation Project (WHTP) was initiated in response to an ongoing need to address agricultural labor shortages experienced by California's specialty crop producers. This report and its recommendations were developed by agricultural, labor, housing, and transportation organizations and individuals from across the state. A full list of project participants can be found in Appendix E.

Dan Schurman, Serena Coltrane-Briscoe, and Joseph McIntyre of Ag Innovations Network coordinated the production of this publication.

Design was provided by notion:creative | www.notioncreative.com

We are grateful for project funding from a United States Department of Agriculture (USDA) Agricultural Marketing Service Specialty Crop* Block Grant, administered by the California Department of Food and Agriculture.

**Specialty crops are fruits and vegetables, tree nuts, dried fruits, horticulture, and nursery crops (including floriculture).*

EXECUTIVE SUMMARY

This report details the findings and recommendations of the California Agricultural Workforce Housing and Transportation Project, a yearlong multi-stakeholder investigation into the community, political, and industry challenges and barriers to the provision of adequate and affordable housing and transportation to the state's specialty crop workforce and their families.

The key recommendations from the report include the following:

- Improve existing and develop new affordable and decent housing for specialty crop farmworkers and their families by establishing new, dedicated state funding sources, and by reducing costs and barriers to such improvements.
- Conduct needed studies on current farmworker housing and transportation conditions and needs, and create a central, online repository to house information related to farmworker housing and transportation as a resource for housing providers, local governments, planning agencies, and advocates.
- Increase effective incorporation of farmworker housing and transportation needs in federal, state, regional, and local planning and funding policies and priorities through the development of formal, regional advisory councils and a statewide council.
- Maintain the newly revised definition of "rural" under federal law beyond the next census and create a recognized and accepted rural-specific definition of "smart growth" consistent with the aims and terms of AB 32.
- Increase farmworker transportation options, both public and private.
- Increase farmworker driver safety awareness and practice through the establishment of a consistent program for driver education and safety training for farmworkers and their families.

The stakeholders involved in this project offer these recommendations in the hope of ensuring that resources and systems are in place that will result in all of California's specialty crop agricultural workers and their families having safe, reliable, and affordable transportation to their places of employment, and a home that reflects their dignity and importance.

PROJECT BACKGROUND

From left: Hired agricultural workers in a vanpool; CalVans vanpool. Photo courtesy of CalVans.

California's specialty crop producers rely heavily on the availability of farm labor in their operations. Over the past several years, these producers have reported a decreasing supply of available labor. In response to these reports, the California State Board of Food and Agriculture (State Board) convened a panel of agricultural producers and employers, and affordable housing experts in August 2012 to investigate the housing and transportation issues faced by the state's agricultural producers and workforce, with the assumption that these issues present access barriers to workers and contribute to labor shortages. This was followed in early 2013 by the California Department of Food and Agriculture (CDFA) engaging Ag Innovations Network (AIN) in organizing a longer-term initiative to bring together the state's agricultural, labor, housing, and transportation leaders to develop a set of recommendations for addressing these issues. AIN is a California nonprofit organization that specializes in helping stakeholders solve problems in the food system through effective collaboration.

The lack of safe and affordable housing and transportation for hired farmworkers is a problem shared by California's farmworkers and its specialty crop agricultural industry.

Methodology

Working with a steering committee of representatives from CDFA, the State Board, and the Governor's office, Ag Innovations Network identified more than one hundred potential stakeholders from throughout the state representing the following interest groups:

- Farmers and ranchers
- Farmworkers
- Labor unions
- Labor advocacy organizations
- Farm labor contractors
- Production agriculture companies
- Agricultural support and management companies
- Agricultural trade organizations
- Agricultural supply chain partners
- Farmworker and affordable housing developers
- Housing, transportation, and social service providers
- Civic organizations
- Federal, state, and local government
- Consumers
- Research and academia

From the identified stakeholders, fifty individuals were successfully recruited to participate in the California Agricultural Workforce Housing and Transportation Project. Of these, approximately forty were interviewed extensively by Ag Innovations Network staff to develop a broad understanding of the stakeholders' perspectives on a) the nature and extent of the housing and transportation challenges and barriers experienced by farmworkers and growers, b) the community and political issues contributing to these challenges, and c) the opportunities and possibilities for addressing them. The data collected in these interviews were summarized and reported back to the stakeholders at an initial meeting held in May 2013 in Sacramento at which 49 of the 50 stakeholders were present. During this meeting, the stakeholders further discussed their perspectives and decided upon a course of action for developing a set of recommendations. Following the meeting, two working groups were formed to focus on housing and transportation issues, respectively. These working groups met face-to-face and virtually during the next six months, with the guidance and facilitation of Ag Innovations Network. Discussions were robust, frank, and focused on the top issues and opportunities for change identified by participants.

A subsequent outreach and implementation phase of the project is currently being contemplated to engage and encourage leaders and decision-makers across the state to act on the recommendations.

Context

The lack of safe and affordable housing and transportation for hired farmworkers is a problem shared by California's farmworkers and its specialty crop agricultural industry. Not only is the existence of affordable housing and transportation a key factor in the quality of life for workers, it also contributes to labor force stability for employers. |The shortage of affordable housing and transportation in key growing regions can exacerbate local farm labor shortages and create unneeded hardship for workers. These hardships can translate directly into damage to the economic health and sustainability of growers, workers, and the specialty crop industry.

While there was disagreement among stakeholders about the relative contributions of various factors causing these problems, there was broad consensus on the severity of the challenge, its impact on the lives and economic well being of workers and growers alike, the need for a systemic response, and the recommendations described in this report. The contributing causal factors cited by stakeholders are shown in Appendix A.

Unlike the situation 30 years ago, today's average California specialty crop farm offers farmworker employment throughout most of the year. Changes in the types of crops and the diversity of specialty crops being grown in California, as well as other factors, including the dramatic increase in the use of farm labor contractors as employers who transport their workers to job sites from a fixed location, mean that the majority of hired workers are "settled" not "seasonal." Settled workers live permanently in the state with their families, in private market housing in cities and rural towns, and in some instances travel up to 100 miles per day to reach their job site. In general, these local jurisdictions have not adequately planned for nor fostered the development of affordable housing for agricultural workers and their families, either seasonal or year-round. Strained resources, community opposition to affordable housing projects (especially those for farmworkers and their families), and aging and inadequate infrastructure common to many of these jurisdictions often prevent them from meeting affordable housing needs.

Existing farmworker housing in need of repair. Photo courtesy of Cabrillo Economic Development Corporation.

The vast majority of California's hired specialty crop agricultural workers rely on private vehicles to get themselves to and from work, often relying on ride sharing arrangements with co-workers and/or supervisors, and frequently paying a significant portion of their day's wages for transportation. Employers wishing to provide a legal means of transport to agricultural workers find it challenging to afford and/or comply with insurance requirements and conflicting state and federal regulations. While the California Vanpool Authority program (CalVans), has grown in the past decade to serve 2,700 workers in 17 California counties, it is not a state-run program and is limited in its ability to serve other regions.

Most specialty crop agricultural jobs are located in resource-scarce rural counties with public transportation systems that are inadequate to serve the nontraditional schedules of hired specialty crop workers, who may also need to work at multiple locations in one day. The transportation needs of the specialty crop sector in particular, and unincorporated rural communities in general, are often overlooked and/or not prioritized in regional transportation planning processes.

RECOMMENDATIONS

The following recommendations focus on the housing and transportation issues related to the specialty crop sector in California and the workers it employs.

1. Improve existing and develop new affordable and decent housing for specialty crop farmworkers and their families by reducing costs and barriers.

» CONTEXT

There is a shortage in the amount of suitable, affordable housing for specialty crop farmworkers and their families throughout California. Much of the housing currently used by the state's farmworkers and their families is in serious need of replacement, upgrades, and/or repairs, and there are an inadequate number of new units being created.

High land values and construction costs, as well as often costly and restrictive local requirements, make it particularly difficult to create low-cost housing in California. Additionally, there is a lack of adequate infrastructure in many farmworker communities to support needed development. Making matters worse, existing housing is often either poorly maintained, due to lax code enforcement, or cost-prohibitive to rehabilitate due to over-zealous code enforcement, which can lead to closure and subsequent displacement. Farmworkers can also face discrimination in access to decent, affordable housing and their communities often suffer from unequal municipal services.

» STRATEGIES

a. Improve the condition of existing housing stock and infrastructure

Improving current conditions can be easier and less expensive than developing new farmworker housing.

- Building upon recent changes made to state policies on migrant centers in response to the drought, allow migrant centers to be open year-round and serve both families and unaccompanied workers.
- Prioritize improvements to farmworker housing that address health and safety endangering conditions.
- Promote smart and effective code enforcement that encourages compliance and repair, and discourages displacement.
    - Study the effect of variations in code enforcement practices and their impact on housing availability as a way to ensure both safety and adequate supply of housing.
- Enforce existing requirements for the condition of housing. Make rehabilitation funds available to people who own and operate farmworker housing to improve it and keep it affordable. Ensure such funds are balanced in simultaneously providing flexibility for housing owners while improving the quality and safety of such housing.
- Strengthen health and safety codes to require repairs if possible, prevent displacement, and require relocation assistance and replacement housing if repairs cannot be accomplished.
- Strengthen requirements in housing elements, and zoning and planning laws so as to prevent closure of

and displacement from mobile home parks and farmworker housing units, and to ensure that jurisdictions pursue funding for infrastructure improvements.

b. Reduce the cost and barriers to developing new affordable housing for specialty crop farmworkers, their families, and other members of rural communities in California

In addition to improving existing stock, new affordable housing is needed both in traditional rural and agricultural regions, and also in California's cities, towns, and municipal areas where many farmworkers and their families live and from which they commute to their jobs at nearby farms and processing sites.

- Encourage cities and counties to conduct farmworker needs surveys and incorporate information collected into city and county housing plans.
- Reduce local restrictions to developing farmworker housing such as zoning and land use requirements, hearing and design review processes, and the imposition of project conditions such as street widths, setbacks, certain building standards, covered parking, etc.
- Provide relief to low-income housing developers in the form of reductions or waivers of local permit application fees, project review fees, and building permits.
- Strengthen existing by-right farmworker housing development provisions to require a certain number of sites, and allow farmworker housing by right in zones where other housing might need a use permit.
- Encourage LAFCO policies to favor expansion of services to farmworker housing, reduce restrictions or impediments to acquiring those services, and encourage annexations that serve farmworker needs.
- Adjust state laws to better accommodate farmworker housing.
    - Strengthen existing state law (Government Code Section 65589.7) that gives preference for water and sewer hook-ups to affordable housing by ensuring that the law is clear and that hook-ups are available and not cost prohibitive.
    - Incorporate set asides and incentives into housing programs to develop decent, affordable farmworker housing.
    - Strengthen state requirements for housing elements in local general plans so as to effectively identify farmworker housing conditions and needs in local communities, adequately plan to build sufficient

In addition to improving existing stock, new affordable housing is needed both in traditional rural and agricultural regions, and also in California's cities, towns, and municipal jobs at nearby farms and processing sites.

Existing farmworker housing in need of repair. Photo courtesy of Cabrillo Economic Development Corporation.

Newer farmworker housing. Photo courtesy of Cabrillo Economic Development Corporation.

farmworker housing to meet those needs, assure that impediments to fair housing for farmworkers are overcome, require programs to fund the development of farmworker housing, and annex or provide municipal services to farmworker communities.

  - Consider relief from CEQA review for farmworker housing projects.

- Expand tax credits and monetary incentives for affordable housing, such as a subvention payment program for tax abatement (welfare tax exemption) specifically for farmworker housing.

- Encourage jurisdictions to expand the allowable number of farmworker housing units on land zoned for agriculture beyond the 36 beds or 12 units permitted by state law (California Health and Safety Code section 17021.6), provided that land is able to access municipal services and that mitigation measures are included to address potential conflicts arising from adjacent agricultural use. (The proposed Employee Housing Act, AB 1037, which would increase the 12-unit limit to 48 units if operated by a governmental or nonprofit agency, is an example of a current effort to add farmworker housing on agricultural land.)

2. Improve existing and develop new farmworker housing by establishing new, dedicated state funding sources.

» CONTEXT

The expiration of state housing bonds, the termination of redevelopment funds, and dwindling federal funds have left few affordable housing funding resources in the state, requiring alternative sources to both maintain existing and develop sufficient new farmworker housing.

» STRATEGIES

Create permanent, dedicated funding sources for farmworker housing

- Support consistent and adequate funding for the Joe Serna, Jr. Farmworker Housing Grant Program, which finances the new construction, rehabilitation, and acquisition of owner-occupied and rental units for agricultural workers.

- Raise the maximum percentage of USDA Farm Labor Housing Loans and Grants (Sections 514/516) program funding to any one state above the current limit of 30%.

    - The vast majority of applications (80% in 2012) come from California, where most of the need and opportunities exist.

- Strengthen housing element requirements in city and county general plans to ensure that adequate planning is implemented and funding provided and sought by local jurisdictions to address the need for housing for farmworkers and their families.

- Create incentives for local housing development interests and farming organizations to work with farmers to share costs in the development of affordable housing for farmworkers and their families.

- Establish both a statewide affordable housing trust fund that includes a farmworker housing set aside, and regional/local trust funds dedicated to addressing needs identified in the farmworker housing needs assessments called for in Recommendation #1b. (Possible sources for funding of these trust funds, as well as other recommendations in this report, are suggested in Appendix B.)

3. Collect, consolidate, and make accessible needed data and information on farmworker housing and transportation needs and solutions.

» CONTEXT

Due to incomplete and inaccurate data on farmworker populations and their needs, it is challenging to convince municipalities of the importance of improving and expanding farmworker housing and transportation.

» STRATEGY

Create funding sources for and conduct needed studies on current conditions and needs, and create a central, online repository to house information related to farmworker housing and transportation as a resource for housing providers, local governments, and advocates.

Subjects, components, and characteristics of such studies and the databank website should include:

- Existing studies, where available, demonstrating farmworker housing and transportation needs and conditions.

- Results from needed new studies on where farmworkers live, their housing conditions, scarcity of resources, and the effects of substandard housing on farmworker and public health.

New farmworker housing in Ventura County. Photo courtesy of Stephen Schafer, Schaf Photo Architectural Photography.

- Case studies and models highlighting successes in both housing and transportation.
- Needs assessment template that is easy to use and localized.
- Farmworker housing affordability index.
- Links to other resources.
- Multilingual resources.
- User-friendly search capacity.
- Mechanism for regular updates.
- Hosted by an organization or collaboration of organizations such as the California Institute for Rural Studies or the California Coalition for Rural Housing.
- Involvement from willing and interested collaborating entities such as government agencies, universities, research institutions, individual researchers, real estate interests, and affordable housing developers.

4. Increase effective incorporation of farmworker housing and transportation needs in federal, state, regional, and local planning and funding policies and priorities.

» CONTEXT

The housing and transportation needs of rural areas, and specifically the needs of agricultural workers and their families, are often not coordinated or addressed at the federal, state, regional, and local levels. While these needs are recognized by some agencies and jurisdictions, they are not adequately represented in various planning processes. In addition, growing regions vary dramatically in their farmworker populations and needs, rendering statewide policies less effective.

On the housing side, there is frequently organized local opposition to farmworker housing in general or

The housing and transportation needs of rural areas, and specifically the needs of agricultural workers and their families, are often not coordinated or addressed at the federal, state, regional, and local levels.

to specific farmworker housing project proposals. When transportation issues are considered, often there is an overemphasis on farm-to-market rather than worker-to-field, and agencies lack convincing or informative data on farmworkers' commute needs. In general, there is a lack of understanding among elected officials of agricultural worker housing and transportation needs.

Although diverse sectors of regional communities are currently working on and interested in providing more farmworker housing and increasing transportation options, they are currently not coordinated, nor in communication with one another, which prevents them from leveraging their collective influence.

Prior to the latest Farm Bill, the federal definition of "rural" potentially excluded dozens of California rural areas from eligibility for funding and research programs aimed at improving conditions in rural areas, such as USDA Rural Development Programs and others that prioritize "smart growth" principles and projects. The reality of farming in California is different from other parts of the country in that many of the state's most productive agricultural regions are not isolated and rural in the traditional sense of the term, but closely adjacent to urban and suburban areas that have grown ever closer to agricultural areas during the past several decades. In addition, "smart growth" requirements of the Sustainable Communities and Climate Protection Act of 2008 (SB 375) do not adequately distinguish between rural and urban communities, leaving rural communities at a competitive disadvantage for housing and transportation funding programs. See Appendix C for further information on these problems.

» STRATEGIES

a. Coordinate farmworker housing advocacy and development efforts through formal, regional advisory councils and a statewide council.

- Organize Regional Farmworker Housing Advisory Councils in these growing regions:
  - Imperial (including Coachella Valley, San Diego and Riverside)
  - Central Coast (Ventura to Santa Cruz)
  - San Joaquin Valley (Bakersfield to Stockton)
  - Sacramento Valley (Stockton to Redding)
  - North Coast
- Charge the Regional Councils to act as advisory and advocacy bodies to their respective local Councils of Governments, Boards of Supervisors, City Councils, and other political bodies that make decisions about low-income housing.

- Compose the Regional Councils with representatives from a diverse cross-sector of interests.
- Create a statewide California Farmworker Housing Advisory Council, with representation from the Regional Councils, to advise the California Department of Housing & Community Development, the Legislature, and the Governor.
- In addition to their advisory and advocacy roles, task both the Regional and Statewide Councils with coordinating and conducting research on conditions, needs assessments, policy and program solution options and models, etc.
- Provide adequate resources and staff to the Regional and Statewide Councils to perform their functions.

b. Include rural and agricultural worker transportation needs in state and regional land use and transportation planning.

- Gather useful information on farmworker commute data to make better planning decisions.
- Document the needs of agricultural workers and their families and address these transportation needs within the Circulation Elements of the General Plans of cities and counties through involvement and engagement with the General Plan update process of the Governor's Office of Planning and Research.
- Explicitly connect transportation and housing needs in state, regional, and local planning efforts.
- Represent and advocate for the needs of farmworkers and their households in state, regional, and local transportation and land use planning forums.
- Educate and bring awareness to elected officials and agency staff about farmworker transportation needs and the overall importance of farmworkers to communities and to the California agricultural economy.
- Conduct targeted outreach to agricultural employers to share information about worker transportation needs, to demonstrate how meeting these needs directly benefits their businesses, and to garner their support for this agenda.
- Establish an ongoing multi-stakeholder, cross-sector, cross-regional coalition for organizing, outreach, fundraising, and advocacy on agricultural transportation needs and issues, including the driver safety training recommendation #6 below.

c. Maintain the newly revised definition of "rural" under federal law beyond the next census and create a recognized and accepted rural-specific definition of "smart growth".

- Advocate for maintenance of the recent change in the definition of "rural" under federal law that reflects the nature of rurality, i.e., farming regions, in California where these regions may abut urbanizing areas and/or in largely agricultural counties that may have a large city as their defining "anchor" for determining eligibility for USDA Rural Development programs.
- Create a rural-specific definition of smart growth, consistent with the aims and terms of AB 32, and have it recognized and implemented in all funding programs and policies related to AB 32 and SB 375.

Farmworker cars at edge of field. Photo courtesy of Sergio Sanchez.

5. Increase farmworker transportation options.

» CONTEXT

The majority of California's farmworkers does not own their own vehicle and depends on co-workers, employers or public transportation to get to and from the fields and packinghouses where they work, all of which can be unreliable or unaffordable. While public and private transportation options exist, such as the California Vanpool Authority (CalVans), these are under-utilized, not widely available, or inconveniently scheduled or located.

» STRATEGY

Increase availability of affordable public and private transportation options for workers and employers.

- Promote or expand CalVans for use in other farm labor regions beyond those where it is presently providing services.
- Investigate options for funding CalVans expansion: identify existing untapped sources (if any), assess potential new funds and applicability of existing funds for CalVans, and project impacts and increases in ridership that would result from investment in CalVans' expansion.
- Conduct outreach to private operators of vanpools to educate them about Federal Department of Labor regulations and how to document their operating costs more accurately to comply.
- Encourage the development or expansion of regulated private taxi service in rural communities where the commuting distance to agricultural jobs is relatively short.
- Increase use and awareness of the federal voucher program for public transportation.

6. Increase farmworker driver safety awareness and practice.

» CONTEXT

Many of California's farmworkers rely on private vehicles as their primary means of transportation to and from the fields and packinghouses where they work. Many of those who drive do so without a legal driver's license, and many are unaware of even the most basic traffic safety laws and rules of the road. There have been many documented instances of traffic fatalities involving farmworkers that were caused by this lack of safety awareness. The recent passage of AB 60, making it possible for undocumented residents to acquire a legal driver's license, was a milestone accomplishment for workers and their advocates and supporters. There is now a corresponding need for driver education and safety training, both to enable them to pass the driver's license tests and also to increase the overall safety of California's roads and highways.

The majority of California's farmworkers does not own their own vehicle and depends on co-workers, employers or public transportation to get to and from the fields and packinghouses where they work, all of which can be unreliable or unaffordable.

» STRATEGY

Establish a consistent program for driver education and safety training, and enable willing entities to offer the program.

- Assign or enable an appropriate entity (such as California Highway Patrol, in partnership with Department of Motor Vehicles (DMV) and nonprofit organizations) to act as a clearinghouse for information regarding driver safety training programs, to develop consistency among programs, and to disseminate information and guidelines about programs.
- Include information about driving options, privileges, and requirements in California.
- Utilize DMV's efforts to identify existing driver safety training programs and use existing models to establish a single approved training program or standards for an acceptable program.
- Encourage entities (such as California Association of Agricultural Labor (CAAL), CalVans, Ag Safe, California Farm Labor Contractor Association (CFLCA), or Proteus) to become licensed by DMV to conduct driver's training programs.
- Assist interested and qualified entities to access existing grant funding sources to support the development of safety training programs and offset or subsidize the cost to individuals and employers to provide the trainings.
- Work with insurance companies and state agencies to create incentives for employers, individuals, and others to utilize driver safety training programs.
- Create an outreach program to disseminate information about the program to employers, workers, and the public.
- Include involvement from affected and relevant agencies and organizations (see Appendix C for possible participating entities).

CONCLUSION

From left: Villa Cesar Chavez, newer farmworker housing in Ventura County; a shed that was inhabited by farm workers. Photos courtesy of House Farm Workers!

The stakeholders involved in this project represented a broad spectrum of interests and viewpoints, some of which have historically been in conflict on issues relating to farm labor in California. While expecting complete agreement across such a diverse group is unrealistic, the group was able to find common ground and agreement on the critical importance of addressing these issues for the benefit of employers, workers, their families, and their communities. The ultimate goal of this project is to ensure that resources and systems are in place that will result in all of California's specialty crop agricultural workers and their families having safe, reliable, and affordable transportation to their places of employment, and a home that reflects their dignity and importance. The recommendations contained in this report represent the stakeholders' commitment to achieving that goal.

APPENDICES

Appendix A: *Causal Factors Cited by Project Stakeholders*

Over the past 30 years, there has been a steady decline in the amount of "farmworker housing," both on and near farms and ranches. As workers have increasingly been forced to find their own housing (and, by extension, their own transportation) in the face of this reduction in employer-provided housing, there has not been a corresponding increase in the availability of affordable housing for farmworkers throughout rural farming regions in California.

Contributing factors to these situations cited by stakeholders (but not necessarily agreed to by all) include the following:

- Zoning policies limiting housing on agricultural properties, and limiting agricultural housing off farms.
- The impact of stronger public health standards for housing that limit the willingness and ability of housing providers, including growers, to house farmworkers.
- Increased costs of land, construction, maintenance, and insurance.
- Decline in housing conditions and subsequent litigation against housing providers.
- A shift away from the use of farm labor camps.
- A reduction in funding for the construction and provision of affordable housing in general and farmworker housing in particular.
- The dramatic increase in California home prices and overall shortage in affordable housing throughout the state.
- The relatively low wages paid to agricultural workers that severely limit their housing and transportation options. It was noted by some that this is a primary cause of the labor shortages experienced by the industry.
- The failure and inability of rural jurisdictions to adequately plan and provide housing and public transportation options for agricultural workers.
- Community opposition to farmworker housing projects in cities and towns adjacent to agricultural areas.
- Housing discrimination and exploitation experienced by farmworkers, particularly those without documented legal immigration status.

Appendix B: *Possible Funding Sources for Project Recommendations*

The strategies recommended throughout this report will require additional funding to execute. Perhaps the most obvious of these is the call for a statewide affordable housing trust fund and regional/local trust funds. There is, in fact, current legislation under consideration by the State Legislature to create and fund such a statewide affordable housing trust fund. The California Homes and Jobs Act of 2013 (SB 391) would create a California Affordable Housing Trust Fund financed through a real estate transaction fee. The endorsement of this legislation represented the primary point of disagreement among this project's stakeholders. While most stakeholders support the legislation and wanted to include it in the project recommendations put forth in this report, the stakeholders were not able to reach complete consensus on this issue primarily based on the objections of a few stakeholders to the imposition of an additional fee to finance the Trust Fund.

Another potential funding source that was discussed but not agreed upon by the stakeholders would result from a change in federal policy on the use of USDA loan and grant program funds. These programs currently prohibit loans or grants to construct housing for undocumented workers, including those participating in the H2A program. It was felt by some participants that this policy unfairly excludes those employers who are trying to legally employ foreign workers through the H2A program, and that a change in this policy is warranted to correct this unfairness and to make available additional funds for constructing housing for H2A workers.

Other possible sources cited for funding of state and local housing trust funds include other real estate transaction fees, mitigation requirements, in-lieu fees, Transient Occupancy Taxes (TOTs), and inclusionary housing fees. The stakeholders in this process did not reach consensus on recommending any of these as specific sources, only to identify them as possible sources to be considered.

Other recommendations requiring funding include the creation of the farmworker housing databank website, statewide and regional Farmworker Housing Advisory Councils, and driver safety training programs. Possible sources of funding for these activities identified by the stakeholders include the following:

- USDA Rural Development funds
- USDA Specialty Crop Block Grants
- CA Department of Housing and Community Development funds
- CA Department of Transportation
- Agricultural industry contributions
- Financial industry contributions
- Housing developers
- Charitable foundations
- Membership assessments (in the case of the Councils)
- Fundraising events/activities
- Other private sources
- Combinations or joint funding from some or all of these

Appendix C: *Resources & References*

STUDIES AND REPORTS ON FARMWORKER HOUSING AND TRANSPORTATION CONDITIONS IN CALIFORNIA

2012 Napa County Farmworker Housing Needs Assessment, prepared for Napa County Housing and Intergovernmental Affairs (2013):
http://aginnovations.org/images/uploads/Napa_Farmworker_Housing_Needs_Assessment.pdf

California Vanpool Authority Progress Report (2013):
http://aginnovations.org/images/uploads/CalVans_Report_042013.pdf

California Department of Public Health "The Overlapping Issues of Health and Housing: A Report on California Statewide Data and Healthy Housing Indicators" (2013):
http://californiabreathing.org/images/pdfs/HealthyHousingIndicators_1-27-14W.pdf

California Institute for Rural Studies (CIRS) Policy Brief on Public Transportation in the East Coachella Valley (2013):
http://aginnovations.org/images/uploads/CIRS_Policy_brief_Coachella_transportation.pdf

California Rural Legal Assistance, Inc. (CRLA) Report "Blueprint for Change: Solving Housing Problems in Farmworker Communities" (2011):
http://aginnovations.org/images/uploads/crla_HousingRpt.pdf

AMBAG Agricultural Workers Vanpool Program Study Report (2010):
http://aginnovations.org/images/uploads/AMBAG_Vanpool_Study_Final_Report.pdf

CalTrans Agricultural Worker Transportation Program Report (2010):
http://aginnovations.org/images/uploads/State_Ag_Worker_Transportation_Program_Report_to_Legislature_2010.pdf

CRLA Report "The Health Consequences of Sub-standard Farm Labor Housing" (2010):
http://aginnovations.org/images/uploads/CRLA-UnSafeAtHome052610.pdf

An Assessment of the Demand for Farmworker Housing and Transportation in Mendocino County conducted by CIRS (2007):
http://aginnovations.org/images/uploads/CIRS_Mendo_housing_and_transportation_study_2008.pdf

CalTrans Agricultural Worker Transportation Needs Assessment (2003):
http://aginnovations.org/images/uploads/State_AITS_Ag_Worker_Transportation_Needs_Assessment_2003.pdf

County of Ventura Farmworker Housing Study (2002):
http://aginnovations.org/images/uploads/fwh_study.pdf

Ventura County Ag Futures Alliance report "Farm Worker Housing: A Crisis Calling for Community Action" (2002):
http://aginnovations.org/images/uploads/FWH_Report_FINAL.pdf

Other resources and articles available at:
http://aginnovations.org/workforce/whtp_resources

EXAMPLES OF REGIONAL AND STATEWIDE AFFORDABLE HOUSING AND TRANSPORTATION COUNCILS

California Employer Advisory Council:
http://ceac.org/about/ceac_history

House Farm Workers! Program, Ventura:
http://housefarmworkers.org/HFW!/Home.html

Social Services Transportation Advisory Councils:
http://www.tamcmonterey.org/information/resource/guide_pdf/TAMCResourceGuide_All-in-one.pdf

»continued on next page

Appendix C: *Resources & References, continued*

SOURCES FOR DATA ON HOUSING STOCK, COST OF HOUSING, AND FARMWORKER WAGES IN APPLICABLE REGIONS

California Department of Housing and Community Development:
http://www.hcd.ca.gov/hpd

California Farm Bureau Federation and Farm Employers Labor Service (FELS) annual wage survey:
http://www.vineyardteam.org/files/resources/Wage-Benefit-Package.pdf

US Department of Labor Employment & Training Administration's National Ag Worker Survey:
http://www.doleta.gov/agworker/naws.cfm

INFORMATION ON AND EXAMPLES OF LOCAL HOUSING ELEMENTS

California Department of Housing and Community Development: "Building Blocks for Effective Housing Elements":
http://www.hcd.ca.gov/hpd/housing_element2/index.php

Ventura County housing element:
http://www.ventura.org/rma/planning/pdf/plans/Final-HsgEl-GPP.pdf

INFORMATION ON PERTINENT LEGISLATION CITED IN THE REPORT

AB 60: http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB60

AB 1037: http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1037

SB 375 & AB 32: http://www.ca-ilg.org/post/basics-sb-375

SB 391: http://www.californiahomesandjobsact.org/wp-content/uploads/2013/02/CHJA-Fact-Sheet.pdf

RESOURCES ON CHANGING DEFINITION OF RURAL IN FEDERAL FUNDING CONTEXT

CIRS: "Changing Rural Definition Threatens Loss of Millions of Dollars of Federal Housing Assistance in California":
http://www.cirsinc.org/index.php/rural-california-report/entry/changing-rural-definition-threatens-loss-of-millions-of-dollars-of-federal-housing-assistance-in-california.html

CRLA Report "Toward a New Definition of Rurality in 21st Century California": http://aginnovations.org/images/uploads/crla_Rurality_Report-062013.pdf

Leadership Counsel for Justice and Accountability report "Smart Growth in Rural California: A Land Use and Investment Plan for California":
http://aginnovations.org/images/uploads/Smart_Growth_in_Rural_California_a_working_paper.pdf

INFORMATION ON THE CALIFORNIA AGRICULTURAL WORKFORCE HOUSING & TRANSPORTATION PROJECT PROCESS

Overview of the Project:
http://aginnovations.org/workforce

Synopsis, presentations, and the full report from the stakeholder summit held on May 8, 2013:
http://aginnovations.org/workforce/whtp_summit

Appendix D: *Potential Collaborators*

In addition to the stakeholder groups that participated in this project, a number of additional collaborating organizations and agencies could potentially be needed to implement the recommendations included in this report. Among these are the following:

- Agricultural employer organizations
- Agricultural labor organizations
- California Highway Patrol
- California Department of Motor Vehicles
- California Department of Transportation
- California Labor & Workforce Development Agency
- California Department of Insurance
- California State Compensation Insurance Fund
- California Office of Planning and Research
- California Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA)
- Local Agency Formation Commissions (LAFCOs)
- Insurance industry groups
- Regional and local planning departments
- Regional and local public transportation agencies
- Social service nonprofit organizations

Appendix E: *Project Stakeholder Participants*

All stakeholders listed here have engaged in some or all of the process leading to the findings and recommendations presented within this report. Participants' inclusion in this list does not necessarily indicate full support of all recommendations presented, although full consensus was sought whenever possible.

Isabel Arrollo *El Quinto Sol de America, Tulare County*

José Baer *Rancho la Viña, Buellton, Santa Barbara County**

Dewey Bandy *California Coalition for Rural Housing*

Lisa Bates *CA Dept. of Housing & Community Development (HCD)*

Barry Broad *Teamsters Union*

Ellen Brokaw *Brokaw Ranch Co. and House Farm Workers!, Ventura County**

Carol Chandler *Chandler Farms, Selma**

Tom Collishaw *Self-Help Enterprises, Visalia*

Manuel Cunha *Nisei Farmers League, Fresno**

Alfred Diaz-Infante *Community Housing Improvement Systems and Planning Association, Monterey County*

Sandy Elles *Napa County Farm Bureau**

Karen Flock *Cabrillo Economic Development Corporation, Ventura County*

Luawanna Hallstrom *Collaborative Communications, San Diego*

Kevin Herman *The Specialty Crop Company, Madera**

Cesar Hernandez *Reiter Affiliated Companies, Oxnard**

Ismael Herrera *San Joaquin Valley Partnership*

Chuck Herrin *Sunrise Farm Labor, Coalinga*

Jim Houston *CDFA*

Tom Huffman *Driscoll's**

Ronald Hughes *CalVans*

Ilene Jacobs *California Rural Legal Assistance*

Cesar Lara *Teamsters & Monterey Bay Central Labor Council*

Bryan Little *California Farm Bureau Federation*

Olga Marquez *El Quinto Sol de America, Tulare County*

Gil Molina *California Association of Agricultural Labor*

Paul Muller *Full Belly Farm, Capay Valley, Yolo County**

Chris Paige *California Human Development*

Jila Priebe *California Department of Transportation*

Dave Puglia *Western Growers Association**

Susan Quale *Sierra Cascade Nursery, Susanville**

Craig Regelbrugge *American Nursery & Landscape Association**

Heriberto Rosales *CA Dept. of Housing & Community Development (HCD)*

Simón Salinas *Monterey County Board of Supervisors*

Sergio Sanchez *California Strawberry Commission**

Guadalupe Sandoval *California Farm Labor Contractors Association*

Rosaura Segura *Napa Valley Migrant Farmworker Housing Committee*

Antonio Silva *California Human Development*

Sharon Sprowls *Sacramento Area Council of Governments (SACOG)*

Juan Uranga *Center for Community Advocacy, Salinas*

Chris Valadez *California Grape and Tree Fruit League**

Don Villarejo *Retired Farm Labor Researcher and Advocate*

Gail Wadsworth *California Institute for Rural Studies*

Amy Wolfe *AgSafe*

** Indicates individual specialty crop grower or association of specialty crop growers.*

Ag Innovations Network is a nonprofit, nonpartisan organization dedicated to helping stakeholders solve problems in the food system through effective collaboration.

aginnovations.org | 707.823.6111 | info@aginnovations.org

Cover Photos from Left: Stephen Schafer, Schaf Photo Architectural Photography; CalVans; CalVans; Ron Ross.

CA Agricultural Workforce Housing and Transportation Project

Project Evaluation: Synthesis
Based on 6 phone interviews, 1 paper survey, and 4 online evaluations
June 2014

How well did we achieve the following project goals?
Convene a balanced, diverse group of stakeholders to talk about workforce housing and transportation issues
Interviewees expressed general sentiment that this goal was achieved. Missing stakeholders included:
- Farmworkers themselves or their children (the inherent challenges of scheduling, language barriers, etc. were acknowledged).
- The transportation planning industry/network

Other comments:
- Consider starting with specific geographic areas to engage more progressive ag leaders that we can work with.
- Ensure that people at the table are able to engage in a consensus process.

Establish an accessible way for participants to interact
In-person meetings:
- Best, most productive format.
- Glad the first and last meetings were in person.

Conference calls:
- General understanding that this was necessary given geography and schedules, but no one really liked them.
- Often hard to know who is talking, know when you can talk, and read body language.
- Suggest web meetings, such as WebEx or Citrix Go To Meeting, which are more encouraging to participants and allow you can see participants' faces if webcams are enabled. Participants can also send a private message, raise their hand virtually, or raise their hand physically.

Emails:
- Email is challenging due to time constraints, especially with a lot of documents involved.

Overall participation:
- After the initial summit, which was wonderful, there was a lack of follow-up participation, particularly by ag representatives.
- Participants weren't invested enough. They weren't sure how their contribution would lead to a difference. They need to feel they have a job to do or a clear contribution to make.

Other:
- As a participant in both working groups, I got confused about which subcommittees were doing what, which drafts were which, etc.

Convey meeting results and project updates accurately
- Good job of capturing conversations.
- When points were missed, comments were incorporated afterwards.
- We were kept well informed with updates, drafts, and comments. If anything, it was hard to keep up with it all.

Design a process (initial stakeholder meeting followed by working group meetings and phone calls) to help develop meaningful and appropriate recommendations for reducing housing and transportation barriers for specialty crop workers that have a high likelihood of implementation and success

- It's a huge challenge to get consensus on recommendations when dealing with a large group. The problem with demanding consensus is that the most important recommendations of one group might not be agreed upon by the whole group. As a result, the recommendations are less urgent to act on. We all had to make compromises, but not everyone was willing to. You did a good job in the final paper of conveying differences among stakeholder groups. Considering those challenges, the recommendations did express the goals of the majority of people who were in the conversations.
- The nature of achieving consensus on what we could achieve consensus on, limits the level of satisfaction that any faction will have. It was frustrating at times. Ultimately, I felt like we had strong statements, even though I was hopeful for a higher level of consensus.
- The process worked. We did better on reaching consensus goals with transportation than housing. Even without as much consensus as I would have liked, it was still worthwhile. It reflects the reality of our diverse state and diverse sectors.
- Yes, the process did result in meaningful and appropriate recommendations. You can see pieces of everyone's input in the report.
- Sadly, these are the same kinds of recommendations that have been pushed around for 30 years – there are strategies, but we need political will and funding to support change.
- The recommendations came out in the report as strategies. We didn't get to the level that I think we need to. We need more specific recommendations about how to proceed and actions to follow – an ask. The report is pretty dry.

Facilitation

- AIN did a good job of not getting frustrated, listening to everyone, checking back with people frequently and responding to what people said.
- It was a good process. Everyone had an opportunity to speak their mind. AIN did a good job of managing the process, capturing different opinions and negotiating different recommendations that would work for both ends of the spectrum.

What was your experience as a participant in the project like?

- During conference calls there were times I felt like I wasn't being listened to, but when the notes came out, I could tell I had been listened to. A little better acknowledgement of participants' comments during the calls would be good.
- At first, I was surprised by the inclusion of transportation because my work is very focused on housing and I did not see the connection. The project shed some light on the importance of transportation. In the end, I appreciated the diversity.
- I appreciated interacting with people I don't always get a chance to interact with, particularly on the ag side of world. Much of our work is focused on ag interests and industry, but we don't always get to interact. That's useful and I appreciated that opportunity.
- I felt positive, particularly about the in-person meetings. I was not able to put as much time and energy into the project as I would have liked. It's promising that CDFA supported this work.

How engaged did you feel you were in the project? If you were not particularly engaged, what factors contributed to this, and is there anything we could have done to better facilitate your participation?

- I was pretty overwhelmed with other stuff, but you were patient enough to follow up. This was one of the most productive task forces I've participated in despite the wide differences of opinion. I was impressed with the way things were and the way I was treated. Even with emotion and passion, you were able to keep people focused. I get uncomfortable when people are allowed to engage in a negative way – that didn't happen. You redirected respectfully. It was one of my best experiences with facilitators and task forces. I'd like to send a personal thank you to the full team. You made it easy to participate - great facilitation and style.

How might we take the recommendations from the project a step further? What opportunities are you (or should we be) paying attention to right now?

- *Recommendation 2: Improve existing and develop new farmworker housing by establishing new, dedicated state funding resources.*
    - We need to think about options we have because there is no money in existing funds. Our best hope is carbon credit funding within Sustainable Communities Plans. Some money has been set aside for this, but not nearly enough.
    - There is a budget surplus that could go to housing – keep farmworker housing in that conversation. Consider reinstating General Fund funding for affordable housing and farmworker housing.
    - The Assembly budget has $200 million for affordable multifamily housing. We may be able to include farmworker housing, but that's not on the table at this point. There is some discussion about it at the CA Coalition for Rural Housing level.
- *Recommendation 3: Collect, consolidate, and make accessible needed date and information on farmworker housing and transportation needs and solutions.*
    - One of CIRS's goals is to become a go to organization for information on rural communities and farmworker communities specifically. They have been seeking funding to set up a portal similar to http://www.cirsinc.org/index.php/projects/environmental-justice-resources-for-the-eastern-coachella-valley/information-resource-guide.html.
    - Conducting and/or updating needs assessments will help make the case for farmworker housing.
- *Recommendation 4: Increase effective incorporation of farmworker housing and transportation needs in federal, state, regional, and local planning and funding policies and priorities.*
    - Start the statewide and regional councils with a state group and hire a staff person once we've defined what we're going to do. Have the staff person raise funds. If it's well defined and there is a good solid product, it could be fundable. Start with the Central Coast region as a pilot project. We have evidence in Ventura that it could make difference and Ellen Brokaw knows someone who might be a good candidate for the staff position.
    - Focus on the definition of smart growth for rural areas (e.g., paper written by Leadership Counsel for Justice & Accountability).
- *Recommendation 5: Increase farmworker transportation options.*
    - Examine which options are affordable and feasible for isolated communities (e.g., CalVans, car shares, buses). A current pilot project in Coachella has been successful is extending the bus line and increasing frequency, resulting in increased ridership.

- Consider both SB 375 GHG reduction goals and cap and trade opportunities. The parts of the state with the most ag are also the worst from an air pollution standpoint. You can't have a GHG discussion and ignore SJV.
- Counties are putting together 20-year housing and transportation needs as we speak. Now is a good time to get some of the recommendations implemented at some level, especially in farmworker communities. We should present the report to those bodies.

Report Outreach

- We need a good powerpoint presentation conveying why people would want to know about this and including a specific ask.
- I shared the report with my colleagues, who felt the statements and outcome were strong.
- I distributed the report to several groups from cities and schools and colleges where they are talking about this – they have found the report to be interesting and it has opened their mind even more. It's a good tool. As I encounter people and tell about it, they want to engage.

Do you have any additional feedback, either for this project or future projects?

- Great job overall. I'm happy with the final product and I hope we can continue to work together.
- I was very frustrated toward the end because it looked like we had produced another report that would be shelved. I was relieved to hear about final meeting and potential next steps – however, unless there is funding to go forward, it will still be shelved.
- It would be great to keep the momentum going, and not just have the report collect dust on a shelf somewhere.
- I hope that out of the June 4 meeting will come a clearer picture of what we're wanting/asking, which will help raise funds for what's next.
- Does CDFA or the State Board of Food and Agriculture have subcommittees? Maybe they could establish a housing and transportation subcommittee with access to staffing. It would be a good way to get started and stay connected with CDFA.

	Respondents	% of total Respondents
Total Respondents	87	
Registration type:		
a small-scale farmer or rancher	0	0%
a student or apprentice	4	5%
a farmers' market manager or employee	25	29%
government staff or official	8	9%
beginning farmer or rancher (10 yrs or less)	32	37%
farmer/rancher (more than 10 yrs)	11	13%
non-profit or community organization representative	11	34%
media, press or communications professional	2	2%
advisor or other agricultural professional	6	7%

Other (please specify)

- former market manager, food writer
- educator
- land owner
- new farmer
- psycholgist - day program on a Ranch
- Buyer

	Respondents	% of Respondents
Farmers/Ranchers	43	
What are your crops or products?		
Fruits	29	67%
Meat	9	21%
Vegetables	30	70%
dairy/cheese	1	2%
herbs	17	40%
eggs	11	26%
cut flowers/plants	9	21%
grains	4	9%

Other (please specify)

- homestead production
- We help market small farms
- books

	Respondents	% of Respondents
Farmers/Ranchers	43	
How would you describe the scale of your operations?		
Responses	42	98%
small scale	38	90%
medium scale	4	10%
large scale	0	0%

	Total Respondents	% of Respondents
Overall, how would you rate this conference?	87	
Responses	85	98%
Excellent	39	46%
Good	31	36%
Satisfactory	12	14%
Poor	3	4%

	Total Respondents	% of Total Respondents
Did this conference meet your expectations?	87	
Responses	80	92%
Yes	73	91%

No	7	9%

Why?

- good speakers, timely topics, good participation in workshops and staying in the workshops indicates high interest.
- It appears that the Farmer Market representatives have taken control of the small farm conference and the conferences are no longer relevant to the small farmer but to the needs of the middle man and others. The issues of a small farmer is have gone by the way side.
- This was my first visit to the California Small Farm Conference. I had a wonderful visit.
- The conference was poorly advertised and organized.
- For the most part yes, especially with workshop content and field experiences, but the chairs were very uncomfortable for long hours. Also, networking opportunities to be better facilitated.
- Too few farmers on the panels.
- Sort of
- Good speakers in workshops
- In some areas yes, others no
- Absolutely!
- Sort of
- Too few details in most (not all) seminars, food!!!

		% of Total Respondents
Total Respondents	87	
Responses	80	92%

Based on your experience at this conference, would you consider attending a future conference?

Yes	60	75%
Maybe	17	21%
No	3	4%

		% of Respondents
Total Respondents	87	
Responses	82	94%
Speaker, Deborah Madison - Excellent	39	48%
Speaker, Deborah Madison - Good	28	34%
Speaker, Deborah Madison - Satisfactory	6	7%
Speaker, Deborah Madison - Poor	1	1%
Speaker, Deborah Madison - didn't attend	8	10%

		% of Respondents
Total Respondents	87	
Responses	79	91%
Speaker, Leonard Diggs - Excellent	19	24%
Speaker, Leonard Diggs - Good	24	30%
Speaker, Leonard Diggs - Satisfactory	13	16%
Speaker, Leonard Diggs - Poor	4	5%
Speaker, Leonard Diggs - didn't attend	19	24%

		% of Respondents
Total Respondents	87	
Responses	70	80%
Speaker, Sandra Schubert - Excellent	11	16%
Speaker, Sandra Schubert - Good	15	21%
Speaker, Sandra Schubert - Satisfactory	18	26%
Speaker, Sandra Schubert - Poor	3	4%
Speaker, Sandra Schubert - didn't attend	23	26%

% of Respondents

Total Respondents	87	
Responses	84	97%
Workshops - Excellent	38	45%
Workshops - Good	34	40%
Workshops - Satisfactory	7	8%
Workshops - Poor	2	2%
Workshops - didn't attend	3	3%

		% of Respondents
Total Respondents	87	
Respondents	81	93%
Monday Tasting Reception - Excellent	31	38%
Monday Tasting Reception - Good	19	23%
Monday Tasting Reception - Satisfactory	14	17%
Monday Tasting Reception - Poor	4	5%
Monday Tasting Reception - didn't attend	13	15%

		% of Respondents
Total Respondents	87	
Responses	78	90%
Exhibitors - Excellent	24	31%
Exhibitors - Good	40	51%
Exhibitors - Satisfactory	12	15%
Exhibitors - Poor	0	0%
Exhibitors - didn't attend	2	2%

		% of Respondents
Total Respondents	87	
Responses	84	97%
Networking Opportunities - Excellent	49	58%
Networking Opportunities - Good	23	27%
Networking Opportunities - Satisfactory	9	11%
Networking Opportunities - Poor	2	2%
Networking Opportunities - didn't attend	1	1%
		% of Respondents
Total Respondents	87	
Responses	80	92%
Affordability of the Conference - Excellent	25	31%
Affordability of the Conference - Good	27	34%
Affordability of the Conference - Satisfactory	21	26%
Affordability of the Conference - Poor	7	9%
Affordability of the Conference - didn't attend	0	0%

		% of Respondents
Total Respondents	87	
Responses	83	95%
Yes, I learned one new skill	23	28%
Yes, I learned two or more new skills	55	66%
No	5	6%

		% of Respondents
Total Respondents	87	
Responses	50	57%

Please estimate annual business income/savings you anticipate receiving based on this/these new skill(s)

$1-$500	7	14%
$501-$1,000	11	22%
$1,001-$5,000	25	50%
$5,001-$10,000	7	14%
More than $10,000	0	0%

Other comments or suggestions for subject matter at future conferences:

- Water use efficiency and building resilience to changes in climate from drought to storage on farm.
- I would suggest renaming the conference to something that would apply to like Urban farming or something that would apply to the new direction of the small farm conference
- Social Media for marketing; added value; agritourism.
- Invite more farmers to participate on the planning committee and on the workshop panels.
- Great conference! Could use more time as an exhibitor.
- I was surprised that all the food was not sourced locally nor in season, seems hypocritical. On another note, I really enjoyed the "Raising the Bar; Integrity @CFM" talk.
- More local sourcing of food, more support of local community (facilities other than a hotel?) Heard great things about the field courses, very much wish my schedule had allowed me to attend!
- Great Job!
- Tasting reception a little crowded. Really enjoyed the Rural Chicks workshops, cooling strategies - excellent workshops.
- Business Planning - "Starting to the Consumer" and What is the Funding Requirement for a New Farm?
- Loved the farmers' market field course! Food was below par, not a great use of local ingredients. Timing between workshops/meals/speakers was behind schedule. Participants who requested specific meal options were not given those options. Food was overpriced. Registration process hard to navigate - and didn't make it clear about what meals were or were not included. Tasting options were too limited. Poor choice for keynote on Tuesday. It was unfortunate that Deborah Madison was cut short, as she is such an honored guest. Great networking opportunity, lots of important people were in attendance, and we made great connections. Too much focus on large/corporate farmers' markets and LA. Would have really appreciated more emphasis on No. Cal.
- The choice of the Tues. breakfast speaker was very poor. Let's get off the "feel good rock & roll" and find speakers with something to offer!
- Wonderful Conference! Thank you!
- Better WiFi. Segment tracks into advanced and beginner.
- Can we discuss integrating cannabis as a crop? Many, many farmers use this cash crop for economic sustainability. Plus it is a wonderful food, compost, fiber, & medical crop. It's not illegal to talk about marijuana.
- Great hotel, good services & food.
- Would like to see more sessions on legislation pending ie. AB1871 - other laws that affect CFMs. Would also like to see sessions on how to increase restaurant sales for market sellers and also how market managers can tell their farmers' stories to increase sales at CFMs. Focus the roundtable session so it breaks out into regional groups. 2 social media tracks for beginning and advanced. Thank you to you all for all the ward work you put into the sessions and the conference!
- Would like to see the conference implement principles touted at the conference - host at places where local, small farm products are actually served at meals (hotel catering was a great disappointment) Exhaust all possible ways to utilize small, local businesses to host & supply the whole event.
- Farming to food to nutrition to health.
- Highly disappointed in the meals given. Most fruits & veggies were non-local & out of season. Furthermore, it was outrageously overpriced for only a few meals. I will not buy this offer again. I also found Leonard Diggs' presentation to be extremely poor & unprofessional. For the price of this conference, I expect the quality & reflection of the values of small, local farms to be better represented at future events. And additional suggestion, as a farmer & market manager in way northern California, I would appreciate a future conference being located north of Sonoma Co. There is a significant agricultural population (that come w/rural issues & needs) that contribute in a meaningful way to CA and this region is currently underserved. The farm tour on Sunday was by far the highlight of my conference experience. I would love to see more farmer led, hands on workshops in the future.
- More on the future of farmers markets from a regional or state level, focusing on policy

- Thank you! I look forward to coming back, I'd be interested in seeing some info on alternative farm models ie. urban farms, HA crop farms. Thank you thank you thank you!
- I thought the emerging issues farm tour shouldn't have been such large farms.
- Compliments on an amazing conference. Thanks for all of your hard work!
- More persons of color, speakers, vendors, visits
- Get more tech help - Leonard Diggs did not get to finish his excellent presentation & in several workshops there were light & computer problems with no resolution.**
- I am very disappointed by the meal package. We had to go out every day in order to be fed properly.
- Not sure about savings. Still in exploratory stages.
- Hotel wonderful - great value. Schubert tables near back could not hear. As a result, everyone ignored speaker and carried on with personal conversations. Audio could have been louder to help. I am a first time attendee. You should include this question. Networking was difficult because of this. Leonard is brilliant. Loved his theme. It's unfortunate he had an IT problem. We all understand.**
- Establishing micro-workshops to address smaller-specialized interests. Possibilities: beginning market manager & established managers. A workshop exploring new ideas & the next generation.
- At least one brick and mortar food retailer focused on section w/an emphasis on sourcing from small and/or local farms.
- Market mgr roundtable could have benefited from more of a "round" set-up. Theater seating didn't facilitate the feeling of collaboration. As an exhibitor, I would have liked to not be in the separate room. It felt a little isolating & didn't feel like it was conducive to walk throughs. During Ms. Schubert's talk @ Monday lunch I felt the talking at tables was very disrespectful & took away from her message. Would have been great to have someone ask those folks to keep it down :) thanks for all your hard work.
- More blocks of rooms available at the conference rate!
- It would be great if the smaller workshops were in the round so you can see who is talking
- I hope we all band together to affect the future of small farms positively, in addition to sharing ideas combining effort to support certain bills in favor of agriculture
- Please treat your speakers and volunteers better. Feed them for one. I didn't do either of those things but I certainly heard about it.
- For a farmers conference the food should be higher quality and more locally sourced. Work with hotels that will accommodate this and make menus around farmers attending on the table. Go the extra step.
- I would expect a conference centered around supporting small farms would take the time and care to serve their guests something that comes from the local small farms. A salad of not good looking greens and a couple of lentils and terrible looking vegetables is not appropriate and especially for vegans - you don't serve raw tofu - and is certainly not worth $40 a plate. Highly disappointing and doesn't make me want to network.
- Most of the workshops seemed more like sales pitches then providing informative details. How can you serve such terrible, big farm food to small farmers?! And the price (both food & overall)
- More technical integration such as irrigation, butchering, sheering, building a CSA.
- Agritourism first two stops - excellent. Crowd sourcing & community, drought workshops all excellent
- Great Conference. Lots of topics and speakers relevant to a small farmer.
- Awesome first visit for me!
- More on biodiversity- more about predator habitat, IFM for mammal pests (gopher, grounds squirrel) & insect pests. Completion at CFMs - is it always a good thing? Too many CFMs in some places. New models for CFMs. Should have given Deborah Madison the whole 1 1/2 hour time allotted. I really think she was just getting started. Sonoma City politicians have other soapboxes, and I came from out of the area. Politically he seems like a good guy, but I came to hear Ms. Madison, not a pro-ag stump speech. Workshop seemed all well run and pull selected, except the computer - almost everyone had trouble. Maybe the moderators all need a 30 min. training.**
- More concentration on farming techniques, standard equipment etc.
- It was a great disappointment when Deborah M only got a very shortened time. Re-evaluate the length of everything to go into that time slot for more satisfaction. Why do I have to pay to listen to a key speaker? I would prefer an option for 1) people who want to buy a meal and 2) people who want to listen to the speaker. Did you actually pay Leonard to speak? Tasting was not 2 all representative of the many wineries and farms of your area. The program was great though & the rabbit. More beers - ciders - seasonal fruits & local veggies (I know they are here.) I'm just saying - it could have been fabulous. Thanks to everyone for their work efforts.

- Would like to see more exhibitors for farmer's markets tools/supplies like bags/packaging that are California based. Also, are any workshop materials available online there were some I wanted to go to but conflicted with one another.
- Preferred that the tasting night is on Sunday or first night and hearing keynote dinner the second night. Also would like tours on weekday because I can never make them on Sunday
- Please give more time between workshops & lunch & workshops 30 min is better. The biodiversity tour was amazing. I learned so much about farming.

**Spoke with AV101 regarding the comments related to technical difficulties. Leonard Diggs brought the wrong PowerPoint and showed up to his presentation late. AV101 met with him the previous day and requested that he come 30 minutes early on Tuesday to set-up his presentation and that did not happen. Other technical difficulties were the result of speakers unplugging the existing laptops to use their own and not knowing how to integrate the projector. In the future, I suggest we request copies of their presentation prior to arriving onsite.