2018 FULL PROPOSAL
Fertilizer Research and Education Program, California Department of Food and Agriculture

**Understanding Influences on Grower Decision Making and Adoption of Nitrogen Management Practices in the Southern San Joaquin Valley**

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Executive Summary
Adoption of improved nitrogen (N) management practices is paramount to meeting the requirement of reducing N loading to groundwater of California. However, there is inadequate information on linking adoption rates with barriers to adoption. This project aims 1) to quantify the current use of improved practices and characterize drivers of grower behavior in order to enhance future research, education and outreach programs, and tailor policy recommendations and 2) to expand our previous work (See FREP Project 16-0621-SA) conducted in the Sacramento and North San Joaquin Valleys to the Southern San Joaquin Valley (SSJV). The findings will help guide practice, policy, investment and incentives necessary to meet agricultural and environmental challenges in California.

Our objectives are as follows:
1) To develop an understanding of links between adoption rates and barriers to adoption of N management practices in the coalitions of the SSJV Management Practices Evaluation Program (MPEP)
2) To distribute, collect and aggregate survey data from growers and certified crop advisors (CCAs)
3) To analyze data to determine key motivations and barriers to grower adoption and CCA recommendation of N management practices
4) To communicate these findings directly with the grower and CCA communities in which we work, as well as academic and regulatory body audiences
5) To outline key variables on linking adoption rates with barriers to adoption of N management practices within grower and CCA populations to tailor outreach, education and incentive programs

We will collaborate with all the member water quality coalitions of the SSJV MPEP on this project. The SSJV MPEP Committee will provide input and outreach resources to ensure our project activities will have local buy-in. We will also work closely with the California Institute for Water Resources (CIWR) and the Western Regional Certified Crop Advisor Program (WRCCAP) who will provide input and outreach resources to ensure our project is relevant to the CCA population.

Our team brings superb capabilities in the required research methodologies, extensive understanding of agricultural N management strategies, and an excellent reputation among growers and stakeholders. Collaborating with the SSJV MPEP and CIWR will greatly promote grower and CCA participation and enhance our ability to interpret results. All results will remain anonymous and provide multiple avenues for participation to maximize participation. Our approach includes both online and mail surveys and will yield results with high degree of site, crop and grower specificity.

Quantifying current practices provides a baseline for measuring progress. Identifying barriers to adoption provides a framework for outreach, more focused research and innovation and guidance for policy development. Outlining and recommending potential incentive mechanisms targeted at different segments of the grower population suggests paths forward to work toward reducing and overcoming current barriers to adoption. This information is critical for both producers and regulators in order to meet the challenges of reducing N loading to groundwater while sustaining California agriculture.

Justification
Problem
Adoption of nitrogen (N) management practices by California growers is a required step to reduce N loading to groundwater, to maintain economically viable cropping systems, while satisfying the Irrigated Lands Regulatory Program (ILRP) requirements. However, there is inadequate information on linking adoption rates with barriers to adoption. Research over the past decade identified many promising practices that can improve N management and maintain economically viable cropping systems. Practices
include the use of N budgets to balance N inputs and outputs for individual field units; implementation of the “4R’s” (right rate, time, place, and source) to guide fertilization strategy; the use of leaf and soil N sampling to verify of crop nutrient status and monitor residual soil N; split application of fertilizers with irrigation; enhancing soil health to improve soil N retention; and careful deployment and management of microirrigation systems. Despite progress in the development of N management practices, there is insufficient understanding regarding the current rate and barriers to practice adoption. This project aims to quantify the current use of N management practices and characterize barrier to adoption in order to enhance future research, education and outreach programs and to tailor policy recommendations specific to the SSJV. Our research findings will help guide practice, policy, investment and incentives necessary to meet agricultural and environmental challenges in California.

Recent research suggests grower perceptions of risk, economic and labor constraints, social norms, sources of trusted information, social capital and networks, farm characteristics including size and income, and participation in local policy forums influence grower decision making. However, we do not currently have a robust understanding how these factors relate to adoption of N management practices across the diverse geography and grower demographics of the SSJV. Furthermore, room for improvement exists to target outreach and education strategies to grower and CCA populations.

The general order for the ILRP requires development of Management Practices Evaluation Program (MPEP) to measure progress toward adoption of practices that reduce N loading to groundwater. Inherent in a MPEP is the requirement to identify beneficial practices, to adapt these practices to specific site/crop/grower conditions and to provide a strategy to measure progress. Research and extension personnel at the University of California, the CSU system, USDA-NRCS, commodity groups and industry funded programs achieved much progress identifying technical solutions. However, currently we lack good strategies to determine adoption rates of N management practices and knowledge of the general or specific constraints to adapt specific practices to specific site/crop/grower conditions.

This project aims 1) to develop an understanding of the status of grower adoption of improved N management practices in the SSJV; 2) to determine the key influences on grower decision making including the role of CCAs; and 3) to identify the key incentives and barriers to enhanced adoption of N management practices. The information developed will inform stakeholder groups including regional Water Quality Coalitions, UC Extension, private consultants, State Water Boards, commodity groups and others to inform policy-making, improve N management and to reduce N loading to groundwater.

**FREP Mission and Research Priorities**

This project addresses the research priority area of “Addressing Challenges and Barriers to Improving Management Practices”. Our work will evaluate the factors influencing grower decision making and adoption of N management practices. While practices such as N budgeting, the 4R’s, leaf sampling and improved fertigation have contributed greatly to improved N management, widespread adoption of these practices across irrigated agriculture cannot be realized without understanding the barriers that influence grower decision making. Filling this knowledge gap will help develop and implement effective incentive programs that will encourage growers and CCAs to explore new approaches.

**Impact**

Progress toward meeting water quality mandates in California, as defined in the ILRP, is fundamental to protecting of groundwater and sustaining agriculture in California. Thus, by understanding barriers to adoption of N management practices, this project will have substantial impact in California.
Waste discharge requirements require agricultural producers to develop practices that protect groundwater. The Central Valley Regional Water Quality Control Board (RWQCB) requires water quality coalitions, hereafter referred to as ‘coalitions’, to conduct a MPEP that identifies N management practices protective of groundwater. Additionally, coalitions administer regional water quality management and monitoring plans and report results to the RWQCB. All growers submit a farm evaluation of practices in use and a CCA-certified N management plan consisting of crop N outputs, applied N fertilizers, applied organic N materials and adjustments for N credits to their coalition.

This project addresses coalition needs by linking grower adoption rates with barriers to more complete adoption as well as characterizing the roles of CCAs. We will collaborate with SSJV MPEP made up of Buena Vista Coalition, Cawelo Water District Coalition, Kaweah Basin Water Quality Association, Kern River Watershed Coalition Authority, Kings River Water Quality Coalition, Tule Basin Water Quality Coalition and Westside Water Quality Coalition. These coalitions represent diverse Central Valley agricultural communities in terms of farm size and crop type as well as remain vulnerable to N loading to groundwater. We will also collaborate with CIWR as a trusted organization with a track record of educating CCAs. Throughout this project, we will leverage our experiences from our current project (FREP Project 16-0621-SA) to utilize methodologies, technologies and results so that our work with SSJV growers and CCAs utilizes the most effective approaches. Together these projects will allow us to survey the majority of irrigated lands in the San Joaquin Valley. All data collection and analysis tools developed will be available to facilitate future efforts across the state. This project provides critical baseline information for the SSJV MPEP against which we can measure progress toward meeting regulatory mandates. Furthermore, this project improves our understanding of linking adoption rates with barriers to adoption and will guide research, outreach, and policy and incentive programs.

Long-Term Solutions
Currently, tools exist to support N management practices for a majority of crops in California. However, limited knowledge of barriers that influence grower decision making constrains adoption of these practices. We aim to demonstrate progress toward meeting water quality regulations and targeting outreach and education programs by using the San Joaquin County and Delta and the East San Joaquin Valley coalitions as well as the SSJV MPEP as case studies. Furthermore, this project develops synergies between N management, soil health, and efficient water use by agriculture. Growers are more likely to adopt practices that provide both economic and environmental benefits over the long term.

Related Research
Many research studies and outreach efforts over the past decade aim to optimize N management practices by our research group and others. Understanding N use by crops, developing practices and tools to optimize N application, and monitoring practices to measure results is the focus of a majority of our research. Additionally, our team developed an early understandings of grower behavior and decision making utilizing survey and interview methodologies (Lubell et al., 2014; Niles et al., 2013; Niles et al., 2015; Niles et al., 2016). Furthermore, our team in partnership with CIWR successfully executed the CCA N management training project and published multiple ANR extension articles (Khalsa et al., 2018a; Khalsa et al., 2018b; Muhammad et al., 2018a; Muhammad et al., 2018b). Nevertheless, there has been no research linking adoption rates with barriers to adoption in the important agricultural region of SSJV.

Multiple studies, many of them funded by FREP, explored N management practices in annual and permanent cropping systems. Muhammad et al. (2015) identified in-season patterns of N accumulation in fruit and optimum N rates to match almond fruit N demand. Saa et al. (2014) modelled almond leaf N from early season samples to facilitate in-season N management decisions. Alsina et al. (2013) reported
significantly greater N\textsubscript{2}O emissions in almond from drip irrigation compared to microsprinklers. Schellenberg et al. (2012) demonstrated significantly greater peak N\textsubscript{2}O emissions from different N fertilizer sources during summer fertigation. Baram et al. (2016) conducted a study to explore current and alternative irrigation and fertigation practices and found that reduction of N losses to groundwater would require better control of fertigation amounts and irrigation duration. Khalsa et al. (2016) demonstrated the role of leaf litter as an organic matter input in orchards and its effect on N cycling. Improvements in N management practices also occurred in annual crops like tomato, lettuce and strawberry. Hartz and Bottoms (2009) developed growth-response curves that show the accumulation of tomato N biomass during the growing season to aid timing N fertilizer application. Researchers developed similar advances in monitoring N biomass accumulation in lettuce using leaf N tissue analysis to help time fertilizer applications (Bottoms et al., 2012). Bottoms et al. (2013) also identified effective rotations from vegetables into strawberry and showed residual soil N can satisfy the strawberry crop demand during winter. Many row crops including cotton have adopted conservation tillage, which can improve soil organic carbon and internal N cycling of soil (Mitchell et al., 2007).

Barriers to adoption of N management practices may be variable based on region and crop type, and some examples include; problems of trust in information sources, perceived added costs or increased risks, lack of technology or training, constraints on water delivery or distribution and lack of time or resources. A recent USDA study, “Conservation Practice Adoption Rates Vary Widely by Crop and Region”, brought federal attention to these phenomena and expressed need for further research on barriers of adoption of best management practices. The study investigated financial and demographic influences on adoption of cover crops, conservation tillage and N fertilizer management. The report emphasized economic factors are not the only influences driving farmer decision making, even when practices produce cost-reduction benefits. Rather, adoption rates vary dramatically by crop type, field characteristics and location. This study argues for further research to determine factors influencing “sustained and combined” adoption of best management practices (Wade et al., 2015).

Niles et al. (2015) discovered personal experiences by Yolo County farmers with environmental risk (i.e. drought) led to increased adoption of adaptation practices (i.e. drip irrigation, water conservation, and planting of drought tolerant varieties). Lubell et al. (2014) and Shaw and Lubell (2011) showed social networks and shared group memberships that facilitate social learning increase adoption rates of best management practices by Lodi winegrape growers in San Joaquin County. These studies build on a large body of scholarly work addressing diffusion of innovation and farmer decision making.

**Contribution to Knowledge Base**
This project contributes to the knowledge base by generating specific new information about linking adoption rates with barriers to adoption N management practices by growers in the SSJV. This knowledge provides a basis for outreach and education as well as incentive programs. Understanding how grower decision making varies across a region like the SSJV facilitates program development that addresses different barriers experienced by subsets of the grower population. A host of predictor variables may explain adoption rates and barriers to adoption including 1) social factors like demographics, education, farming history and traditions, perceptions of environmental and economic risks, information sources and social networks; 2) political factors like attitudes toward government programs and regulations, involvement in local resources governance and historic water rights; 3) economic factors like farm input costs, crop profitability, farm size and income, practice costs, land ownership, accrued debt and access to capital; and 4) local soil, climate and environmental factors. Assessment of a wide range of influences contributes profoundly to our knowledge base.
Specific Hypotheses

(H1) Growers with poorer access to information through peer-to-peer relationships, farm advisors, CCAs, industry groups, and/or scientists are less likely to adopt N management practices, participate in N management discussions and workshops, and use of incentive programs.

(H2) The primary information source influences grower engagement and adoption of improved N management practices. We predict this information source will be the PCA or CCA. Growers who do not regularly work with UC Extension, NRCS, Resources Conservation Districts, or industry groups, nor are active participants in coalitions, will be less likely to adopt N management practices.

(H3) Access to resources and power, including finances, labor, and land ownership, will be a driving factor in adoption of N management practices. We predict growers with lower financial and human capital and those who rent the land on which they grow will be show lower adoption and engagement with other stakeholders through forums like the coalition meetings and N management workshops.

(H4) Framing N management practices as direct benefits to growers such as N fertilizer savings, cost savings, reduced inputs and delivering practical information through a variety of trusted sources leads to more widespread support among current non-adopters.

(H5) Smaller or less profitable farms and farmers growing on leased lands have lower capacity to experiment with new N management practices and to complete various policy requirements and will be less likely to adopt N management practices.

(H6) CCAs recommend N management practices based on tenure of a working relationship with a grower, perceptions of a grower willingness to adopt and their affiliation with product sales.

Measuring these complex factors will contribute to our understanding of grower decision making and practice adoption. We specify various levels of adoption from adopters to non-adopters as well as full, sustained, partial, or temporary adopters. Furthermore, our work will inform design and implementation of FREP outreach and education programs related to N management.

Grower Use
This project enhances the relevance, applicability of N management practices and allows research, outreach and education programs to be better tailored to diverse grower populations. Understanding barriers to adoption helps with mandatory efforts to reduce N loading to groundwater and may potentially increase economic returns. We will deliver our results to grower and CCA populations at relevant venues due to our partnerships with SSJV MPEP and CIWR throughout the project.

Objectives
Objective 1: Develop an understanding of links between adoption rates and barriers to adoption of N management practices in the coalitions of the SSJV MPEP. Specific practices include: use of N budgets, adaptive N fertilizer application rates, sources, timing and placement (4R’s), use of leaf and soil sampling, split N applications with irrigation, use of cover crops and organic matter amendments, and a host of irrigation practices related to N management, specially fertigation.

Objective 2: Distribute, collect and aggregate survey data from grower members in the coalitions of the SSJV MPEP as well as CCAs. Quantify current practice adoption (full/partial, permanent/temporary) and
Objective 3: Analyze responses to determine key motivations and barriers to grower adoption of N management practices. Validate survey responses by crosschecking with the SSJV MPEP reports. Use results to test our hypotheses with a variety of multivariate statistical models.

Objectives 4: Communicate findings directly to grower and CCA populations, as well as to academic and regulatory bodies, independent crop advisor associations and industry groups to inform improved outreach and education for all stakeholder groups.

Objective 5: Use results from multivariate statistical analyses to identify key variables on linking adoption rates with barriers to adoption of N management practices within grower and CCA populations to tailor outreach, education and incentive programs.

Work Plans and Methods

Objective 1: To develop an understanding of links between adoption rates and barriers to adoption of N management practices in the coalitions of the SSJV

Task 1.1: Identify relevant practices and barriers to test for the grower mail survey. This task will be informed by our work in the San Joaquin Delta and County and the East Joaquin from 2017. Furthermore, under a contract with SSJV MPEP, we completed grower meeting surveys in 2018 (See Donald Ikemiya Support Letter). (Winter 2019)

Task 1.2: Identify relevant practices and barriers to test for the CCA online survey. This task will be informed by partnership with the CIWR. (Winter 2019)

Objective 2: To distribute, collect and aggregate survey data from growers and CCAs

Task 2.1: Design survey instrument based on experience drawn from FREP Project 16-0621-SA, to assess social, political and economic factors influencing decision making and adoption of N management practices. The survey will include questions regarding different levels of N management practice implementation, participation in available outreach/extension programs, communication with agricultural stakeholders, attitudes towards N management regulations, and basic operator/operation characteristics. Assemble survey advisory committees (SAC) from project supporters and representatives of key stakeholder groups. (Winter 2019)

Task 2.2: Design online survey instrument, based on results drawn from a CCA pilot survey (conducted by CIWR in Spring 2018) to assess social, political and economic factors influencing CCA recommendations and perceived grower adoption of N management practices. The survey will include questions regarding recommendations of N management practices based on crop choice and grower demographics, participation in education programs, communication with agricultural stakeholders, attitudes towards N management issues, and basic demographic and employment characteristics. Assemble separate SAC in partnership with CIWR, CCAs surveyed in the pilot study and members of the WRCCAP. (Winter 2019)
Task 2.3: Survey Review: SACs review first draft of surveys; revise according to reviews. Researchers pilot second draft of survey instrument with a small group of growers and CCAs in order to test the efficacy of the question design to elicit desired information. Revise again if needed. (Spring 2019)

Task 2.4: Develop strategy for identifying appropriate grower sample, finalize mail grower survey and CCA online survey and outreach activities by SSJV MPEP, CIWR and WRCCAP. (Spring 2019)

Task 2.5: Deliver survey to all growers and CCAs using available membership lists. (Summer 2019)

Objective 3: To analyze data to determine key motivations and barriers to N management practices

Task 3.1: Develop descriptive analysis of compiled results and emerging trends from survey response data, leading to at least one peer-reviewed paper. (Spring 2020)

Task 3.2: Use multi-level hierarchical modeling with random effects and factor analysis on survey response data to determine key variables influencing grower decision making and adoption of N management practices in each the SSJV, leading to at least one peer-reviewed paper. (Summer 2020)

Task 3.3: Develop a report for FREP and policy briefs that address key social, economic, and political factors influencing grower adoption and CCA recommendation of N management practices and advise actions to overcome barriers to adoption. Distribute reports to project collaborators and supporters. (Fall 2020)

Objective 4: To communicate these findings directly with stakeholder groups

Task 4.1: Organize and conduct outreach activities, including workshops to present trends of adoption of N management practices in each region, comparison of perceived costs/benefits of practices, and introduce resources (i.e. technical advisory services and financial incentive programs) to assist in adapting management practices. Workshops hosted in collaboration with coalitions and UC Extension. (Throughout 2019, continue in appropriate venues through 2020)

Objective 5: To outline key variables populations to tailor outreach, education and incentive programs

Task 5.1: Outline and recommend programs and policy incentives that address unique barriers experienced by different subsets of the grower population

We will use the results of multivariate analysis of practice adoption behavior to identify key variables that could be targeted by different types of outreach programs and policy incentives (See Task 3.1). These may include building financial and technical assistance programs, improving access to educational tools, developing low interest loans and cost share programs, and providing tailored technical workshops for growers and operators and sustainability training workshops for crop advisors, each of which specifically address unique needs of different segments of the agricultural community.

Methods
Our project will consist of three distinct phases – 1) mail and online surveys; 2) analysis; and 3) outreach:

Mail Survey: In early 2019, a mail survey will be designed based on the contextual understandings reached through meetings with the SSJV MPEP Committee. We will use a customized version of the
A survey instrument developed by Dr. Mark Lubell and colleagues that has been tested in the North San Joaquin and Sacramento Valleys (See FREP Project 16-0621-SA). The survey will also consider results gather from SSJV grower meeting surveys conducted by Dr. Khalsa under contract with SSJV MPEP in early 2018. A SAC will be assembled from project collaborators, supporters and other key stakeholders in the SSJV region. After integrating feedback, the survey will be distributed by mail after Memorial Day 2019. We will follow the Dillman (2008) method, of introductory and reminder postcards for mail-out surveys, with extensive outreach to our partners in each region to improve our response rates. Principal investigator Dr. Patrick Brown, Co-PIs Dr. Mark Lubell Dr. Sat Darshan Khalsa have extensive experience surveying grower in California, including work with agricultural networks (Lubell et al., 2011), rangelands (Lubell et al., 2013), organic matter amendments (Khalsa and Brown, 2017) and other projects.

CCA Online Survey: In summer 2019, an online survey will be designed based on the preliminary results of a CCA N training feedback survey conducted in spring 2018 by CIWR. We will design this survey to be synchronized with of the questions in the grower mail survey. A SAC, consisting of CCAs, WRCCAP members, CIWR, and other stakeholders will evaluate the survey for revisions and clarity. After the revision process, the online survey will be distributed to CCAs after making their preliminary 2019 N management recommendations. We will rely on our project collaborators to help boost response rates.

Analysis: Survey data and response rates will be assessed for accuracy and analyzed using R Statistical Software. We will identify key predictor variables influencing practice adoption (response variables) and use factor analysis to construct hierarchical multi-level random effect models to run comparisons that control for regional differences. This approach allows us to estimate the magnitude of influence of each key predictor variable. Finally, we will correlate our survey responses with public information from each region to both validate the survey data and understand differences between intended and actual actions. This step will both address survey validation needs and help to understand discrepancies between suggested and actually adopted changes to N management.

Outreach: We will interpret and present these results back to the SSJV MPEP Committee and the growers during annual coalition meetings, CCAs during education workshops and other events organized by WRCCAP, and to the FREP in 2019 and 2020. Additionally, we will write a summary report for FREP and policy briefs to be distributed through grower networks. We will also develop extension articles for UC Extension and other peer-reviewed publications.

Experimental Site
This project focuses on the regions covered by the SSJV MPEP, which represents over 340,000 irrigated acres and 2,441 grower members (Figure 1). Furthermore, we will target the nearly 1,200 CCAs statewide with our online survey including the 950 CCAs who participated in the educational N training workshops organized by CIWR from 2014 through 2018.

Significant biophysical challenges face agricultural production in the SSJV including high soil salinity, groundwater depletion, and erosion and sediment control. Factors hypothesized to influence grower adoption of N management practices remain unknown and unstudied in the SSJV. The region encompasses a broad diversity of grower demographics and production practices, which helps make results relevant to the many diverse agricultural regions across California. The region features a complex mix of agriculture, urban development, and natural environment land uses. The most profitable crops in the region include grapes, walnuts, almonds, alfalfa, and processing tomatoes. While baseline rates of adoption of N and soil management practices have not yet been assessed, we completed over 500 grower meeting surveys in 2018 at a 40% response rate during 2018 under a contract with the SSJV
MPEP (See Donald Ikemiya Support Letter). The SSJV MPEP has a high participation rates in the Central Valley, perhaps because of its substantial efforts to keep membership costs very low; however, growers continue to express concern over the challenges of meeting the new regulations due to additional imposed paperwork and overhead costs.

The diversity of these coalitions makes the SSJV MPEP ideal cases to compare. The SSJV MPEP agreed to support this project by actively integrating our project activities into their ongoing meetings and communications with growers in their coalitions. This integration of activities provides for great efficiency and increased the participation rate as evidenced by our 2018 grower meeting activities.
Project Management, Evaluation, and Outreach

Management
Project leaders Dr. Patrick Brown and Dr. Mark Lubell will manage the project with Dr. Sat Darshan Khalsa, Assistant Project Scientist. Dr. Khalsa will be responsible for the experimental design, designing the survey instrument while a to-be-named Junior Specialist will be responsible data collection, organization, and analysis support. Dr. Khalsa will also be responsible for coordinating with the supporters, conducting outreach events on schedule and with appropriate stakeholder audience groups, data collection and analysis and report writing. Dr. Lubell offers his expertise in survey design and implementation. Dr. Brown offers his expertise in development of N management practices, outreach and education. Dr. Parker offers his expertise working with CCAs and the N training program as well as connecting researchers with WRCCAP board members and decision makers.

Donald Ikemiya supports the project by connecting the researchers with members of the SSJV MPEP. SSJV MPEP member coalitions including David de Groot, Nicole Bell, and technical program manager John Dickey will support the program by participating in project development and implementation stages and provision of SSJV MPEP data for comparative analysis and interpretation. The SSJV MPEP Committee also offers expertise in understanding regional differences among grower populations and helping to distribute the surveys to their membership.

Evaluation
We will analyze grower response rates to our initial exploratory work funded by SSJV MPEP. After our initial exploratory work, we will proceed with our survey approach and will consider success on the project to be a 30% survey response rate. We will use our validation approach to correlate survey responses with farm N management plans and regional MPEPs to understand how much variation exists between intended and actual adoption of practices. We will also interface with CIWR to evaluate the responses to their CCA N training feedback survey conducted in spring 2018. We will be able to use this information to validate identified barriers to adoption.

We will assess the value of our educational tools and outreach efforts by attendance at workshops, spread and readership of our distributed report materials, and engagement and response to work toward overcoming identified barriers to adoption. Our project supporters will facilitate broad engagement and effective outreach of our findings. Finally, our data collection on current adoption of practices will provide a baseline for the SSJV to compare future adoption rates after implementation of outreach, education and incentive programs.

Outreach
Grower communication occurs in a number of venues in each region, including annual coalition meetings, Farm Bureau meetings, N management workshops and certifications, NRCS RCD best management practice open-houses, and UC Extension workshops and focus groups. We will develop presentations and policy reports to present in as many of these venues as possible. One strong communications outlet is through the coalitions, who have identified a number of meetings that are mandatory for their grower members to attend. Each coalition will hold three general overview meetings each during both 2019 and 2020. We will attend 2019 meetings to share the results of our exploratory grower surveys and also to bring awareness to the mail survey from this project. SSJV MPEP has agreed that our team can use these meetings to conduct outreach activities.

Additionally, we will share results with CCAs as a part of our ongoing trainings with CIWR and the California Association of Pest Control Advisors (CAPCA) and through a wide variety of commodity
groups, WRCCAP, UCANR, FREP and other organizations. Furthermore, we will publish and distribute policy briefs through our project supporters’ networks and publish peer-reviewed articles in focused journals like California Agriculture, as well as Agriculture, Ecosystems & Environment.

**Budget Narrative**

**Personnel Expenses**

Principal Investigator, Dr. Patrick Brown commits 2% of his annual effort to the project for the full duration of the project. No funds are requested to support his effort. Advise on specific N management practices that should be focus of survey. Coordinate with commodity groups, coalitions, extension specialists and others on project execution. Participate in focus group and interview activities. Help write-up survey results.

Co-Principal Investigator, Dr. Mark Lubell commits 2% of his annual effort to the project for the full duration of the project. No funds are requested to support his effort. Advise on research design, including survey design and delivery. Help analyze and write-up survey results for policy reports, outreach presentations, and publications.

Project Scientist, Sat Darshan Khalsa: Funds are requested to support the Project Scientist at 33% effort for the full duration of the project. Advise on specific N management practices that should be focus of survey. Coordinate with commodity groups, coalitions, extension specialists and others on project execution. The total funds requested $67,495.50 including $47,700 in salary and $15,625.92 in benefits (rate = 40.1% for 6 months, 41.3% for 12 months and 42.5% for 6 months).

Junior Specialist: Funds are requested to support to be named Junior Specialist. This researcher will be appointment for 9 months in 2019 and 3 months in 2020 at 100% time. Advise on research design, including survey design and delivery. Help analyze and write-up survey results for policy reports, outreach presentations, and academic publications. The total funds requested $53,737.92 including $38,112 in salary and $15,625.92 in benefits (rate = 40.1% for 3 months and 41.3% for 9 months).

**Operating Costs**

Supplies: A total of $12,200 requested for materials and supplies such as mailing supplies for survey. Travel: Funds requested to cover in-state travel expenses associated with site/field visits. We are estimating that we will need to complete about 5 trips per year (10 total) to our field sites. The costs are estimated based on round-trip mileage from Sacramento/Davis area to Fresno/Bakersfield Area, an average of 500 miles roundtrip at $0.545 per mile = $272.50 per trip with one overnight stay per trip (~$100) and two day per diem (~$67.50). Depending on the task at the hand, the PI, Co-PI, or Project Scientist will be making site visits. The total funds requested $4,400.00

**Other Expenses**

Indirect Costs: An indirect rate of 20% is applied to a base of Modified Total Direct Costs. The rate is in accordance with California Education Code 67327 and is part of the MOU between UCOP and the State. Total funds requested $27,566.68

**Prior Year Projects**

This project builds off of efforts conducted by Lubell, Brown and Khalsa in the SJCD and ESJ coalitions during 2017 and 2018 under FREP Project 16-0621-SA.
References
Khalsa S.D.S., Muhammad S., Brown P.H. (2018b) Nitrogen management in deciduous fruit and grapes, University of California Agriculture and Natural Resources, Oakland.

