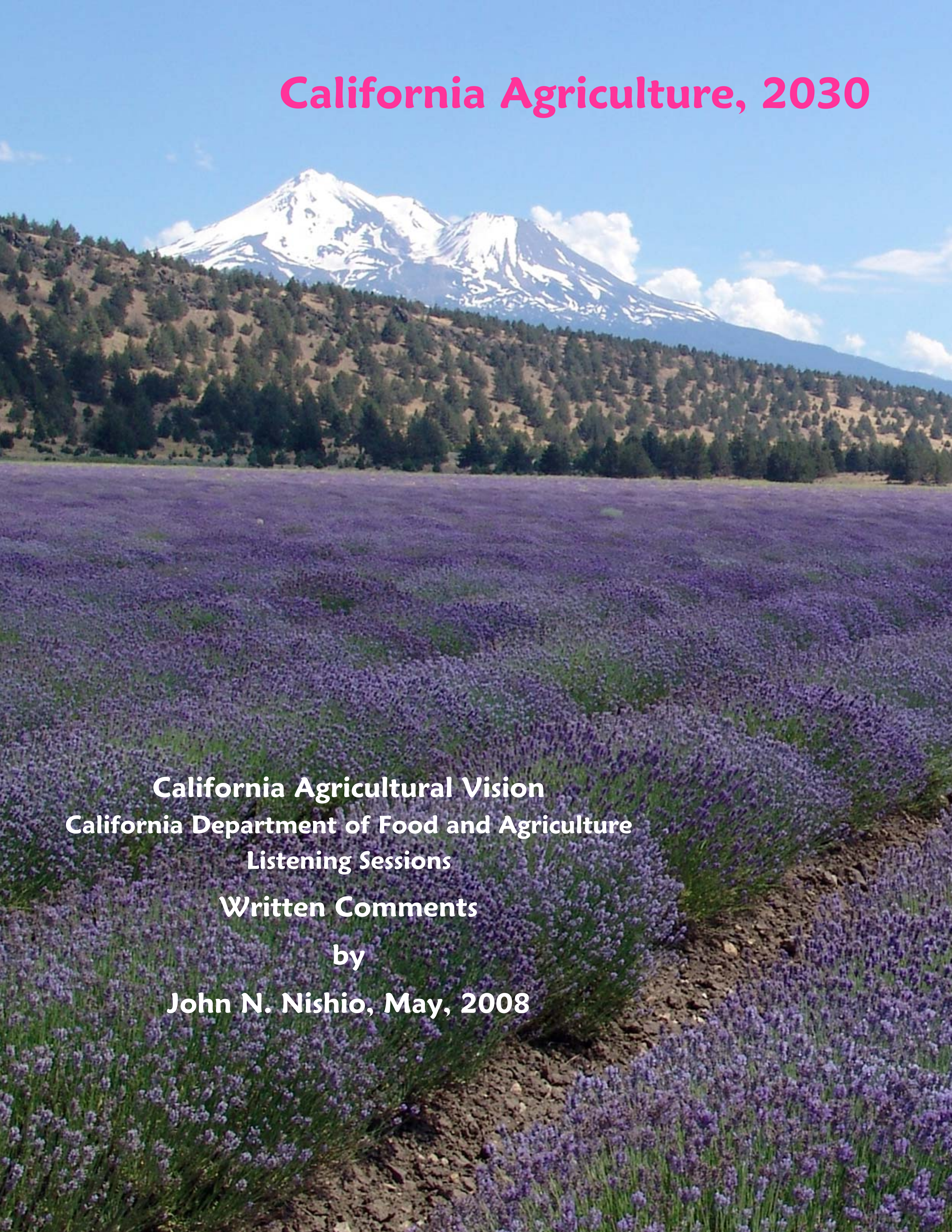
California Agriculture, 2030



California Agricultural Vision

California Department of Food and Agriculture

Listening Sessions

Written Comments

by

John N. Nishio, May, 2008

California Agriculture 2030 **John N. Nishio**

We <u>must have</u> solutions for feeding the planet. A vision will guide the development of solutions, and the vision ought to be dynamic, reflecting new knowledge and discoveries. A great deal can be accomplished in 20 years. We <u>must have</u> an educated workforce and innovation to ensure that the developed solutions are implemented. We <u>must have</u> significantly increased funding for creative, traditional and non-traditional agricultural research.

Unfortunately, the US is on the verge of losing its edge as the innovative and technological leader in the world, because it is not generating an adequate highly-trained workforce. The role of Sputnik in thrusting the US to its present technological and economic heights is well understood. For years we have discussed the need for a new "Sputnik" initiative to allow the US to continue to compete globally. The broader, national awareness of the problem was officially recognized by H.R. 2272, the America COMPETES (Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science) Act. Upon signing the act, President Bush stated, "*…it [the act] provides a comprehensive strategy to help keep America the most innovative Nation in the world by strengthening our scientific education and research, improving our technological enterprise, and providing 21st century job training.*"

Our planet is on the verge of a predicted, but avertable, collapse due to overuse of resources and population growth. Stuart Udall's *The Quiet Crisis* (1963) provided perspective to the environmental movement and warned us of our dangerous overuse of our limited natural resources. Almost 50 years later Udall's words remain relevant, and "The Quiet Crisis" is now being directed at the growing gap between our demand for Science, Technology, Engineering and Mathematics (STEM)-trained workers and the supply (Jackson, 2002). While we failed to heed the warning of Udall and many others, resulting in extreme global degradation and climate change, we can learn from such failures. The US can circumvent a melt-down of another kind, if we act now, and if we act quickly, to increase and improve our technological and agricultural work force.

We <u>must have</u> forethought today, to meet our needs tomorrow. Our present concern for STEM-education and the environment is commendable; however, a fundamental, and crucial, element is missing from STEM. Agriculture, often taken for granted, is the root and foundation of modern civilization. The altruistic, global imperative for populations living in temperate climates to feed those in other parts of the world must be met, but California and the US must also focus its attention to ensuring food for its own citizens. While food, fiber, and fuel have always been the major products of agriculture; in the future we will see more relative consumption obligated to the bioenergy segment.

Thus, **we <u>must have</u> the present STEM-education initiative expanded to include agriculture.** The "A" for agriculture powerfully converts "STEM" into "STEAM". Training and education focused on STEAM will provide power and energy to sustainably take California and the US to 2030 and beyond. **We <u>must have</u> STEAM-education implemented as an immediate priority.**

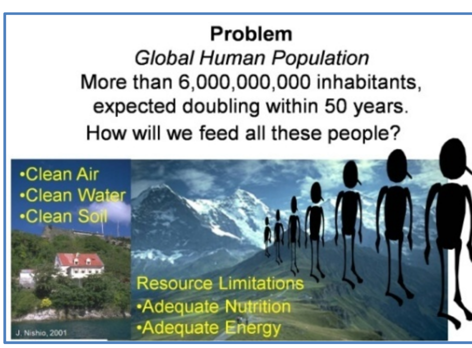
Cover — "Organic" Lavender, Finkbine Farms West, Montague, CA, photo by J. Nishio

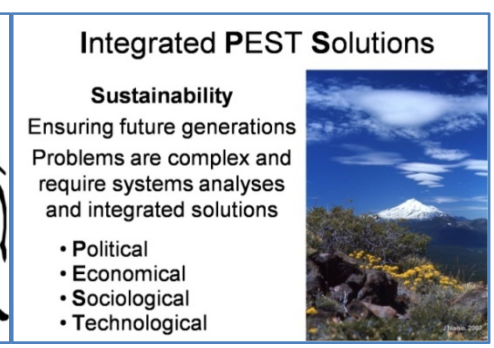
In the US, declining margins and expanding average farm size are intimately interlocked. Vertical integration on a small scale may be beneficial for the small farmer, when a dependable work force and local market are available, but large corporations have taken such integration to new heights. Indeed, vertical integration has been one of the major reasons for the decline in small farm operations in the US. Mechanization has led to decreased labor requirements, and such mechanization has also contributed to the consolidation of farms. Ironically, we have larger farms, but prime farm land is being converted to non-agricultural use at an alarming rate. *The Destruction of California* (Dasmann, 1965) alerted us to the detrimental consequences of the urbanization of California and the concomitant loss of class-1 agricultural land. **We <u>must have</u> policies and incentives to prevent the conversion of prime farm land to non-agricultural use.**

Before addressing how I envision agriculture in 2030, please allow me the opportunity to provide some personal background. I was born and raised in rural Fresno, and at the age of nine my family moved to Chowchilla. My first job (as a child) was doing piece work (6¢ per tray of grapes). I later worked in the packing sheds, distribution centers, and at a fruit stand. My grandparents were migrant laborers, and my father also labored in the productive fields of Fresno. My uncles were involved in agriculture as farmers, chick sexers (International Chick Sexing Association), and packers/distributers. I was the Madera County 4-H All-Star.

Besides being the director of the recently established Professional Science Master's Option in Environmental Sciences at CSU, Chico, I am the science advisor and research director for a large farming operation that runs both "organic" and "conventional" operations.

Finally, having been raised in the heart of California's agriculture in the San Joaquin Valley, I have seen how slowly, in general, we accept change, and how we resist new technologies. That said, there have always been innovators in farming. Economic pressures can partially explain both the need for innovation and the resistance to change. I hope that history does not repeat itself and that real action and positive outcomes will result from the 2030 listening and visioning sessions being conducted by the CDFA. CDFA is to be commended for its actions. **What will be our biggest challenge? We <u>must have</u> the political will and resources to institute change to reach our collective vision, whatever that may be.**



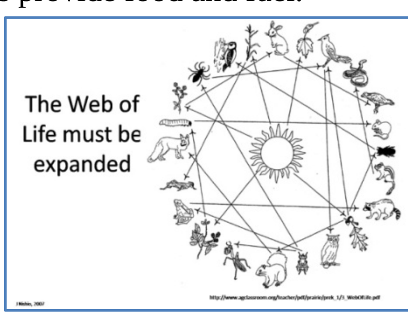


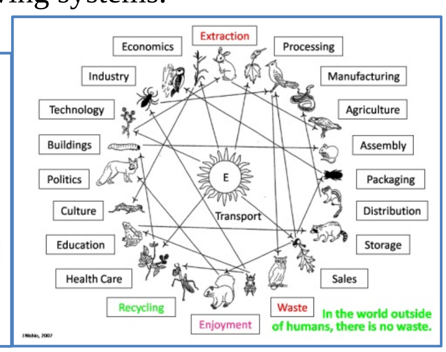
"I believe that education is the fundamental method of social progress and reform. All reforms which rest simply upon the law, or the threatening of certain penalties, or upon changes in mechanical or outward arrangements, are transitory and futile.... But through education society can formulate its own purposes, can organize its own means and resources, and thus shape itself with definiteness and economy in the direction in which it wishes to move.... Education thus conceived marks the most perfect and intimate union of science and art conceivable in human experience."
--John Dewey, *My Pedagogic Creed*, 1897

One vision of agriculture

- California and US Agriculture are self-sufficient. We have food security, because we have the appropriate domestic supply, independent of foreign supply.
- Fair trade exists, because the cost of production in the US is considered for imports (tariffs, subsidies, or other forms of incentive are in place to level the international playing field).
- Laborers are paid a fair wage, including some form of health benefit and sick leave.
- Producers are paid a fair price for all goods produced; including the cost of labor.
- If subsidies exist, they are specifically targeted to expense parameters to make all farms succeed, such as labor costs and infrastructural costs, such as equipment.
- Minimum water, nutrients, and other inputs are applied to fields for maximum yield.
- Yields per acre are significantly higher than in 2010, but sustainable practices are in place.
- Water rights are not linked to usage ("use it or lose it" does not apply). Growers retain rights to water in balance with protection of environment (wildlife habitat). Water for food remains a priority. (In the US today, a 10% reduction in agricultural water would provide enough water to more than double our domestic water usage. California would require a slightly higher reduction, simply because of our population density).
- Recombinant technology is an important tool for sustainable agriculture
- Crop varieties, many developed by recombinant technology, have the following traits.
  - ✓ Enhanced harvest yield (related to trait below)
  - ✓ "Improved" carbon partitioning, resulting in high oil content, high protein content, high sugar content, etc. in the desired organ.
  - ✓ Value added traits, like high nutritional value, uniformity, increased fiber strength, etc.
  - ✓ Abiotic stress tolerance (e.g., drought, salinity, temperature, etc.)
  - ✓ Biotic stress tolerance (e.g., pests and disease)
  - ✓ Allelopathic (decreases growth of competitors)
  - ✓ Enhanced nutrient uptake efficiency and utilization

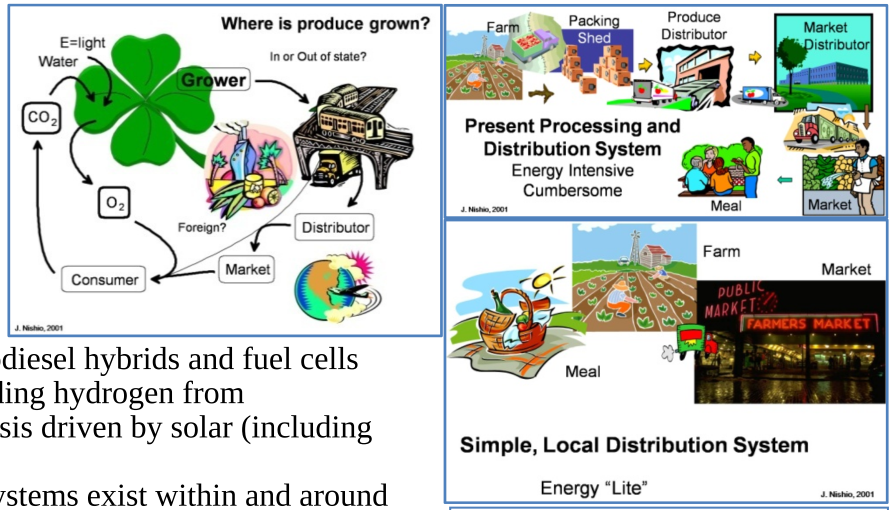
- Mechanized farming is improved and expanded, but the machinery is powered by renewable energy sources. Mechanized farming is accepted and sustainable.
- Canals have glass houses over them to provide new growth space and decrease evaporation. Floating glasshouses in reservoirs also decrease evaporation.
- Biocompatible agriculture based on thermodynamic analyses is incorporated into all agricultural systems. The marriage between conventional and "organic" is complete; with the best of both having been incorporated into all farms and growing systems.
- Efficient algal growth systems provide food and fuel.
- Small farms and large farms coexist peacefully and productively.
- Growers have sustainable programs in place. Sustainability is the norm.
- Farms are "integrated" with close looped systems in place (including natural or constructed wetlands and livestock for composting and food).





- Fields are fertilized by recycled phosphorus from waste water (otherwise we will run out of phosphorus).
- "Synthetic" foods made from vegetable products have long stability and superb nutrition.
- Farms grow their fuel, on their own ground or as co-ops, with fuels processed in local co-ops.

- Where wind and water power are available, they are providing electricity for the farm operation. Additionally, solar power and fuel cells powered by biofuels are integrated into farming operations. In combination with all forms of biofuel-powered and electrically-powered vehicles and equipment (including generators), the agricultural carbon footprint is zero or negative.
- Long-haul trucks are obsolete. Rail transport and cargo blimps make long hauls from rural to urban centers; return trips carry goods needed in the rural areas. Blimps are also used for local hauls. The trains and blimps are solar electric-powered/biodiesel hybrids and fuel cells powered by biogas, including hydrogen from photosynthesis or hydrolysis driven by solar (including wind and water) power.



In 2030 local systems are the norm.

- Local, intensive growth systems exist within and around urban centers.
- Year round, covered "farmer's" markets exist throughout the state (not just in LA and SF).
- Agro-tourism provides educational centers, quality agricultural goods, and entertainment—they are tourist destinations, like the "wine" country. Tourists are transported by mass transit (buses and the like) and bike and walking trails are incorporated.
- New high rise developments and subdivisions have integrated, local growth systems, including rooftop and basement agriculture, glasshouse agriculture, balcony/porch and house systems.
- Growth systems integrated into markets allow shoppers to have fresh produce available year round.
- Large farms in the path of development have integrated, sustainable high rise developments with maximal protected agricultural land that supply the community with food, fiber and fuel, as well as continuing to be a profit center for the owner. Growers profit as co-developers of their property. The developments have various themes or cultural specialties, including incorporation of retirement communities. The planned unit developments incorporate minimal transport schemes and appropriate transport systems are in place. Other businesses thrive in and around the community centers.

To be redundant, the biggest challenge will be generating the political will to actualize the resulting collective vision.

ADDITIONAL THOUGHTS

Homeland security is an issue, and as you generate the collective vision, a secure domestic food supply chain must be considered. Additionally, it is important that we have an available workforce and a mechanism for allowing young people to become farm owners. Using agriculture as a theme for education will assure awareness and respect for farming. For me a "must have" is to provide a mechanism for attaining the predicted outcomes. Below are a couple of ideas that move us in the direction of reaching a "sustainable" future.

Excerpt from CSUPERB preproposal, 1/2004, John Nishio

Protection of food and fiber resources is a homeland security issue. An energy supply chain for the US that minimizes or eliminates dependence upon foreign sources is desirable and in the national interest. If the foreign supply of oil were eliminated, the present US surplus would eventually be depleted, but conservation efforts, use of alternate energy sources, and new technology would insure sustainability. If the food and fiber supply chain were disrupted, however, there could be immediate disastrous repercussions. Therefore, a food and fiber supply chain that is reasonably safe and independent of foreign supply is strategically desirable. Fiber relates to construction materials, fuel, clothing, paper, and the like; and for the sake of space will not be further developed. Instead the food supply chain will be used to illustrate the importance of protecting domestic agriculture in the US.

The lack of control over the present food supply chain is illustrated by the early December, 2003 outbreak of hepatitis A in Pennsylvania that resulted in 3 deaths and at least 600 illnesses. The source of the illness was traced back to green onion fields in Mexico. Two months prior to the Pennsylvania incident, hepatitis A caused at least 300 illnesses in Tennessee, Georgia, and North Carolina, and the source was the same set of farms. That the same set of farms, within such a short time frame, was the inadvertent source raises important health and security issues. Purposeful contamination or disruption of the foreign or domestic food supply chain is certainly possible.

For the safety of US citizens, a well-monitored and "local" food production system seems to be a clear choice. Whether there is or is not a higher probability of food contamination with disease causing organisms or pesticide residues from foreign vs. domestic markets is debatable. However, because of present US regulatory and inspection practices, it seems that, in general, contamination of the food supply chain with residues from agricultural pesticides disease-causing organisms is more probable with foreign food than with domestically raised products. Increased inspection efforts would likely decrease the risk. Efforts to deal with local farming needs and establishment of methods for supplying efficiently raised crops and livestock is highly desirable, as regulation and monitoring of the global food supply chain is daunting.

Immediate elimination or lowering of our dependence upon foreign foods would increase the safety of our food and fiber supply chain. However, that is not possible, as we do not have the present technology, nor desire, to institute such efforts. Moreover, our dependence upon foreign food and fiber is increasing not decreasing. A wholly domestic and sustainable food supply chain policy would have a positive impact on rural US and the security of the US, as a whole.

The efforts of the California State University Agricultural and Environmental Biotechnology Consortium would focus on improved productivity. To many that may seem misdirected, as we presently seem to be awash in overproduction. The caloric intake of the average US citizen per capita is one of the highest on the planet. Yet, within our borders, people are malnourished and even starving. Globally, the human nutritional problem is verging on unconscionable. One of the present goals of the US agricultural system is to increase exportation of our products, and that is reasonable. However, importation of basic, necessary nutritional requirements is counter to US security.

The largest cause of decreased productivity on US farms is environmental stress due to abiotic factors (Boyer, 1982). Biotic (insects, fungi, bacteria, viruses, parasites and weeds) causes of decreased productivity are layered on the seemingly unavoidable environmental impacts, and biotic causes of lost productivity receive immediate media attention. "Healthy" plants and animals are less susceptible to biotic agents of disease, so efforts to improve stress tolerance will be one of the key research targets of the consortium. Additionally, improved efficiency of production through better understanding of nutritional and growth requirements is a desired outcome.

For example, understanding how plants cope with water stress may lead to improving water stress tolerance. Examining the nutritional requirements of plants for optimal growth can lead to prescribed watering and fertilizer practices that conserve important nutrients and decrease pollution. Incorporating water use efficient and nutrient use efficient plants into our agricultural system will further increase the efficiency of agriculture. The marriage of biotechnology and organic practices into a biocompatible agricultural system is a predicted result. By demonstrating the utility of such an approach, the implementation of the positive components of both approaches will be accelerated. The goals would be based on energy efficiency and profitability for the grower. It is important that strong public research and education programs focused on integrated processes of agriculture be continued and further developed.

Excerpt from an NSF Math Science Partnership proposal (not funded) I wrote in 2003 entitled, "**An agriculturally- and environmentally-based student and teacher continuum for integrated rural education."** One of the goals of the proposal was to use agriculture and the environment as the main theme for teaching all sciences. The thinking can be used in K-12.

Phase II. Curriculum Development. National and state subject standards have stimulated discussions and changes in the K-12 educational system. Standards-based education at the college level is also being discussed. Particularly germane to our proposal are standards for math and science educators, though an important underpinning of our approach is that science and math should be more integrated into other subjects, and *vice versa*.

Discovery and process-based learning have been shown to be effective approaches for teaching. Increased motivation, interest, and retention can result when real-life applications are involved in learning. The vehicle for learning math and science content standards will be integrated, real-life environmental and agricultural issues.

Agriculture is at the root of modern society. It represents the largest economic sector on the planet. The environment directly impacts all facets of our daily lives, and agriculture is completely dependent upon the environment. We have chosen agriculture and the environment as the core theme for integrating education because of their relevance to the rural environment. Within the context of state and national standards, we hope to address how might we better articulate science and mathematics curricula? How might we better articulate science and math curricula with art, humanities, and social sciences curricula? A guiding principle in our process is that through understanding comes learning and quantifiable improvement in test scores. In other words, there is no reason to short-change process-based learning to reach the "end" (better test scores).

As an example of an integrative approach, one can start with the goal of planting a garden. At the farm, the students would have to do a soil analysis. Based on that they would learn what type of plants might be suitable. They would have to look up historical rain and temperature patterns. They would learn about regulations for chemicals, even if they chose to grow the plants "organically". Dealing with pests, nutrition, irrigation (run-off and chemicals) provides opportunities for reading, writing, chemistry, life sciences, health, safety, and mathematics. Examining integrated pest management provides opportunities to examine the connections of life and the impacts of choices in crop management. Examining the inputs and outputs and the need for efficient practices for profitability is a lesson in thermodynamics and economics.

An example of directed curriculum integration would be the integration of science history into history. Besides studying wars, conflict, political scandal and imperialism, students could also learn what science was being discovered at particular times. The development of technology is something to which students can easily relate, and it leads directly into science discovery. Incorporating world art, music, and literature in a historical context would provide new meaning to history.

Ideally, we will have students conducting their own experiments. What type of feed provides maximum yield in various breeds? What variety of a certain crop is the most economical to produce? Why do we conduct agriculture in the way that we do? How can we improve the efficiency of agriculture? Is there a way to grow plants with less fertilizer and water? What is the difference between chickens given antibiotics and chickens raised “traditionally”?

Phase III. Module development. Content delivery system. Students have various learning methods, such as visual, verbal, and physical (action). Personal preference impacts the outcome of most courses, but often students are not provided choices suitable to their preferences. We appreciate that it is possible to develop delivery systems that can address some, but not all individual preferences. We propose to develop a delivery system that will allow the students some choice in the messenger and delivery style.

The ethnic and racial composition of the faculty of many schools across the country does not reflect the composition of the students; or the composition of the students and faculty do not reflect the local demographics. A recent study showed how prejudice can negatively influence executive function (Richeson, JA, Shelton JN 2003 When prejudice does not pay: Effects of Interracial Contact on Executive Function. *Psychological Science* 14: 287-290). Therefore, providing a racially balanced classroom may positively influence student performance. When one signs on to play a video game, one is often asked to select a character, with a particular look, speed, weapon set, and so forth. Such an activity allows the player to “relate” to the system. In much the same way, we would offer choice in who “delivers” the lecture “today”.

Broad knowledge of science is required for elementary teachers. Especially in smaller rural schools, common in northern California, a single teacher may be responsible for science education for several grades. In California, if that teacher is responsible for 6^{th}, 7^{th}, and 8^{th} grade, then he or she is responsible for earth sciences (6^{th}), life sciences (7^{th}), and physical sciences (8^{th}) in one teaching day. It is also possible that the teacher may be called upon to teach math classes, as well. The preparation and challenges are daunting. Additionally, the teacher would be required to have three degrees in science and one in math, if certain standards are put in place. At the high school level chemistry and physics are disciplines that also would require specific degrees. Besides preparing our present preservice teachers, our modular system could help present teachers deal with the broad array of science necessary to be a “qualified” teacher today. One of the key aims of the delivery system is the reduction of stress in learning and teaching science—which spills over to the fear of math phenomenon, as well.

Very importantly however, the methods being developed will be useful for all disciplines. The usefulness for individual subjects is obvious, but it is our intent that the modules will be used in a multidisciplinary way. Particularly for science related subjects, it is important to have prior knowledge of the scientific “facts” before cogent discussion of related topics can proceed. For example, if a social sciences or philosophy class wanted to have a discussion on the impact of genetic engineering on society, it would be helpful if some understanding of genetic engineering were at hand. Our modules will facilitate such cross disciplinary teaching and discussion.