

UNIVERSITY OF CALIFORNIA
DIVISION OF AGRICULTURE AND NATURAL RESOURCES

2014 Combined Research and Extension
Federal Annual Report

Agricultural Experiment Station
and Cooperative Extension

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**2014 University of California Combined Research and Extension
Annual Report of Accomplishments and Results**

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I. Report Overview

Executive Summary

The University of California Division of Agriculture and Natural Resources (UC ANR) is the major land grant arm for the university and the state, as part of the nationwide public university system "built on behalf of the people" (Abraham Lincoln). The Agricultural Experiment Station (AES) was established to develop cutting-edge research information that can be applied to solving real-world problems in agriculture and natural resources. Cooperative Extension (CE) was created as a cadre of academics located in local communities to translate and test research findings for practical, local solutions. UC ANR is unique in its three way partnership with federal, state and county governments to provide these local and statewide research and extension programs that address the critical issues of California. Through its partnerships and collaborations, UC ANR is able to leverage its resources to increase its ability to address these issues.

UC ANR's mission is to:

- Maintain and enhance connections that fully engage UC with the people of California
- Achieve innovation in fundamental and applied research and education that supports
 - sustainable, safe, nutritious food production and delivery systems
 - economic success in a global economy
 - a sustainable, healthy, productive environment
 - science literacy and youth development programs

Agricultural Experiment Station faculty members conduct research and teach in three colleges and one professional school on the Davis, Berkeley and Riverside campuses. The AES has over 650 academic researchers, most of whom also have professorial appointments representing dozens of scientific disciplines. Cooperative Extension, the principal outreach arm of UC, is comprised of academic appointees located in campus departments, UC Research and Extension Centers, and local offices as CE specialists or local offices as CE advisors. There are around 110 specialists and 175 advisors conducting research, outreach, and education across California's 58 counties. Nine research and extension centers (RECs), located in a variety of ecosystems across the state, provide a core research and extension base. Eight statewide programs and two UC systemwide institutes focus on specific issues that engage UC ANR academics and UC faculty from all the other campuses, allowing integrated teams to work on complex issues that need multidisciplinary approaches.

FY 2014

The Division continues an aggressive effort to hire new CE academics to vigorously rebuild Cooperative Extension. More than 60 CE Advisors and Specialist positions have been hired over the past several years, with additional recruitments underway. During FY 2014, a call for proposals for CE positions was released to identify strategic positions for strengthening the UC

ANR network to address programmatic gaps and emerging needs. The final approved positions for this call are announced in FY 2015.

In addition, UC ANR launched the Graduate Training in Cooperative Extension Pilot Program to train and recruit the next generation of Cooperative Extension (CE) specialists and advisors. This is a 3-year pilot program partnering the UC Berkeley College of Natural Resources students with UCCE specialists and advisors as mentors to carry out extension-based projects that link to CE research through a competitive process. Six students make up the inaugural Graduate Group in Cooperative Extension. They are working on individual projects, and also continue to connect other graduate students to CE by hosting training events. Another request for applications for Graduate Training in Cooperative Extension Pilot Program is released for FY 2015.

During FY 2014 UC ANR established two new, formal Statewide Programs. The California Naturalist Program provides hands-on instruction and exposure to real world environmental projects designed to inspire adults to become active citizen scientists and enhance their personal connection with the natural world. Participants become certified and are encouraged to complete 40 hours of volunteer service. The Master Food Preserver Program provides up-to-date information on food safety and preservation. The Master Food Preserver volunteers conduct monthly public workshops, speakers bureau presentations to community groups, and information booths at farmers' markets, community festivals, and other local events to demonstrate research-based methods for preserving food safely at home to prevent food borne illness. Both programs utilize the train-the-trainer model to enable volunteers to magnify UCCE's public service outreach.

UC ANR endures ongoing budget constraints and seeks alternative ways to support programs. Several years ago the Division began to develop the Cooperative Extension multi-county partnership model which aims to save multiple participating counties and the University funds (through administrative consolidation) while maintaining the strength of local programs. It is used, where appropriate, instead of the historic individual county-based administrative units. Significant input from internal and external stakeholders continues to guide this strategy to increase administrative efficiency. In particular, the County Directors Council participates in the ongoing evaluations and discussions with internal task forces formed to analyze the potential for multi-county partnerships around the state. There are now three established multi-county partnerships, with a fourth under development.

UC ANR continues to make significant progress toward its Strategic Vision 2025. The Vision identifies multidisciplinary, integrated Strategic Initiatives that represent the best opportunities for UC ANR's considerable infrastructure and talent to seek new resources and new ways of partnering within and outside the University to find solutions to the issues that will be facing California in 2025. During 2014 UC ANR continued work on the following five initiatives: 1) Healthy Families and Communities; 2) Sustainable Natural Ecosystems; 3) Endemic and Invasive Pests and Diseases; 4) Sustainable Food Systems; and 5) Water Quality, Quantity, and Quality.

During 2014, UC ANR completed the third round of the Division's internal competitive grants program. Of the 195 letters of intent 70 were invited to submit full proposals, and 65 full proposals were received. In February 2014, ANR's Vice President announced funding for 15 projects, for a total of approximately \$3.5 million over 5 years. UC ANR did not release a call for proposals in 2014 in order to conduct a formative assessment to determine if the program's

intended results are being reached or if the trajectory is on target to reach them. The program was found to be on track to reach its goals: to address high-priority issues that are consistent with the Strategic Vision; encourage collaboration among academics; strengthen the research-extension network; support short-term, high-impact projects; and contribute policy-relevant outcomes that address significant agricultural, economic, environmental and social issues in California. UC ANR will release a 2015 call.

For FY 2014, California reports on the following six Federal Planned Programs:

1. Healthy Families and Communities
2. Sustainable Food Systems
3. Endemic and Invasive Pests
4. Sustainable Natural Ecosystems
5. Water Quality, Quantity, and Security
6. Sustainable Energy

The following narratives describe the FY 2014 program highlights for these Federal Planned Programs.

Healthy Families and Communities

Childhood obesity, positive youth development, and science literacy, are key issues being addressed through Healthy Families and Communities' research, education and outreach programs. Sixty five Hatch and Multistate Research projects were conducted by investigators at UC Riverside, Davis, and Berkeley.

CE specialists worked on 20 research and extension projects. CE advisors worked on 272 extension projects, and led an additional 12 research projects under the Federal Planned Program Healthy Families and Communities. The following discussion illustrates significant work that was conducted by UC ANR in 2014.

Childhood Obesity

One-third of US adults and 17% of children are considered obese and there are numerous health consequences to obesity (cardiovascular disease, diabetes, and more). Obesity is expensive, costing taxpayers \$147 billion in 2008. In addressing obesity prevention and the relation of obesity to chronic disease, studies and projects include both causes and preventative issues ranging from biological to human behavior. Selected examples highlighting accomplishments in this area follow:

- Biological studies addressed: underlying cell metabolism factors which causes fat tissue after excessive caloric intake; how stress hormones affect metabolic syndrome leading to chronic health diseases (e.g., hypertension and obesity); the role of fatty acid regulation in the development of metabolic disorders; the role of gut microbes in obesity and potential therapies utilizing microbes; the best pattern for nutrient restriction vs. intake (fasting vs. eating) to produce the most beneficial health outcomes--and how cell communication and hormones levels are affected after fasting; and, the mechanisms that underlie the benefits of fruits, vegetables, and whole grains consumption such as how vegetables control

- inflammation and slow stress damage within body systems.
- Human behavior research included: intervention studies which showed that student knowledge about healthy foods increased significantly after participation in a school-based nutrition education intervention; and fruit and vegetable consumption in populations of low-income populations improved after participating in a community-based intervention program. In a youth day camp fitness study, the intervention group lost more weight and were more physically active than the control group. Parents of the intervention group reported more fruit and vegetable and less unhealthy food consumption. A workbook was developed with cooking plans for children. Outcomes were that families used the lessons with their kids, and reported success in decreasing their children's screen time. A longitudinal study's preliminary outcomes to test the efficacy of a 5-week nutrition, child feeding and guided goal setting intervention for low-income parents of young children suggest that the overweight/obesity rates were slowed. A website was developed for USDA program directors and educators to customize nutrition education through guided goal setting intervention for four cultural groups (African American, Asian, Caucasian, and Hispanic). "My Child At Mealtime," an assessment tool designed to measure parenting behaviors associated with childhood obesity, was validated and shown to be effective at motivating and guiding parents to change parenting behaviors that affect children's weight.

Human Nutrition and Health

Studies on health and diseases and the relationship of foods to nutrition and human behavior spanned both biological and behavioral levels. Selected examples highlighting accomplishments in this area follow:

- Biological studies addressed: the positive role of grape consumption in vascular health, which has implications for heart disease and stroke - a leading cause of death. The process by which lipids and other components in milk and plant compounds support health and improves immunity by stimulating the growth of beneficial intestinal bacteria, thereby protecting the intestine from pathogens and toxins, is a finding with implications for infectious disease, another leading cause of death. People older than 65 represent 13% of the population; a number expected to climb to 20% by 2030. In investigating "failure to thrive" syndrome in the elderly (under nutrition, weight loss, loss of physical and cognitive function, and depression) an important outcome included that maintaining food intake could halt or reverse metabolic and functional decline. A key outcome in prevention of birth defects was linked to the relationship between copper deficiency, developmental toxicity, and fetal iron deficiency.
- A behavioral study addressed how human senses influence food consumption and resulted in the development of scales to measure odor-related feelings which have become the gold standard in this area of consumer research and are used world-wide. Interview data from frontline service providers of a faith-based welfare to work program was assessed to determine the nature of their work that contributed to client outcomes; results were published in technical and peer-reviewed papers.

Nutrition Education

California's low-income population continues to struggle with body weight: 65% of adults at or below 199% of the federal poverty level are overweight or obese. California youth across all income levels need to improve their body weight composition, as 38% of 5th, 7th, and 9th

graders are not within the Health Fitness Zone for body weight; economically disadvantaged and minority youth have much higher rates. Nutrition education to address childhood obesity and chronic disease prevention in low-income populations is provided using individual, family, and community environmental change strategies based upon the 2010 Dietary Guidelines for Americans through the Expanded Food and Nutrition Education Program (EFNEP) and the Supplemental Nutrition Assistance Program-Education Connection (SNAP-Ed; CalFresh Nutrition Education in California) reaching 155,000 adults and youth. Selected examples highlighting accomplishments in this area follow:

- Outcome results show adults completing EFNEP lessons improved in nutrition practices (89%) and food budgeting and food security practices (86%). Youth outcome results include 88% improvement in nutrition knowledge and behavior and 46% improvement in selecting low-cost nutritious foods. Both programs work in the community to promote environmental changes with agency partners and schools.
- UC CalFresh outcomes show that teachers are reporting comparative changes in their own classroom behaviors between the beginning of the school year to the end: 49% encourage students to eat breakfast, 51% promote physical activity, 44% make healthier personal choices, and 41% remind families to bring health snacks. A SNAP-Ed evaluation project revealed that MyPlate adult education lessons showed greater change outcomes in fruit, vegetables, whole grain consumption, and using a grocery list as opposed to those who only received a USDA ChooseMyPlate handout or no instruction.

Youth Development

Costs associated with serious mental illness exceed \$300 billion per year. Debilitating mental health issues affect 6% of all adults; around 8% of teens 13-18 have an anxiety disorder; and 11% of adolescents will have a depressive disorder by age 18. Research and projects were aimed at promoting positive child, youth, and family social and emotional health outcomes. Selected examples highlighting accomplishments in this area follow:

- A taxonomy of teacher behaviors and environmental settings which promotes child engagement in different learning/skill development activities was developed as a result of a study of child care environments. Anxiety disorders and risk factors among youth were studied and findings were shared with public health educators and mental health clinicians to directly benefit to clients and students.
- There were 75,541 youth enrolled in the 4-H Youth Development Program engaging youth in more than 170 project categories in Science, Engineering, and Technology (SET), Healthy Living, and Citizenship. Positive youth development is the foundation for the following California 4-H initiatives.
- 4-H Thrive!: evaluated the effects of the positive youth development program to enable 4-H to reach their full potential to become successful, contributing members of their communities. These 4-H youth were found to have: increased ability to identify and pursue a keen interest (a "spark"); increased growth mindset and goal management skills; increased self-esteem; and decreased stress.
- 4-H Science, Engineering, and Technology: youth enrolled in 97,046 science projects increasing their likelihood to pursue careers in science.
- Healthy Living: youth enrolled in 9,860 Healthy Living projects to improve their ability to make healthier lifestyle choices. For example, 4-H clubs collaborated with Solano County's Department of Health on a youth advocacy project to address the importance of reducing

excess sugar-sweetened beverage consumption, resulting in two 4-H clubs decreasing their sweetened beverage consumption.

- 4-H Citizenship: aims to increase youth civic engagement to strengthen communities. Youth enrolled in 29,528 Citizenship projects, with over 85% of 4-H youth reporting being civically involved in their communities. Over the past two years, 4-H funded over 150 service learning grants totaling over \$145,000. Youth used these funds to benefit their communities including: planting trees, creating a mobile soup kitchen, helping special needs military youth, and holding a healthy living exposition for the elderly.

Healthy Communities

Agricultural economy and worker safety affect community health—locally, nationally, and internationally. Research and education on labor practices, immigration patterns, and market economies of regions in California and internationally may inform California's \$42.6 billion dollar agricultural industry and the world economy. These projects included study of labor migration movement between land and forested areas in Indonesia; the impact of agricultural and trade reforms to rural economies in Mexico; the dynamics and practical implications of paid domestic labor in the Greater Sacramento Region and how domestic labor work changes workers' household culture including personal health, and care of children and elderly; and, the organization and control of production networks for products manufactured in California, and how this cycle affects workers. A few more specific examples follow:

- An analyses on the food economy found that the California wine grape industry prices seldom fluctuate with supply and demand; information which is important for policy makers. Several viticulture and enology workshops were implemented to extend information about integrating food science, water management to maximize quality and taste, and decreasing plant virus, to the grape and wine industry, reaching more than 800 attendees.
- California's climate is important to agricultural economy: Cal-Adapt, a web portal for understanding California's climate future was developed to promote access to the wealth of information collected by state researchers. The California Energy commission will develop the Cal-Adapt website and encourage its use for policy makers. In 2014, there were 60,000 web "hits" showing the web portal is being used heavily and is successful.
- Recent global events have highlighted the importance of quality personal protective equipment (PPE) as a factor in personal and community health. New research addressing health and safety of workers focused on the role PPE including: barriers to using PPE; assessment of PPE performance; research-based guidelines for PPE; PPE resistance to bacteria and chemicals; and the interactions of PPE and protective clothing with the human body during intense movement. Promising discoveries regarding fumigant sensors for PPE have been made, industry sponsorships are being provided with researchers' goal to have their work supported by state EPA pesticide regulation.

Sustainable Food Systems

Projected population growth, widespread poverty, acute water issues, and declining agricultural productivity within the context of climate change create an urgency to increase food production in ways that are more efficient and sustainable in our nation, as well as across the world. California agriculture maintains a vital role in providing an abundant source of safe, nutritious, and remarkably inexpensive food for its residents, the nation, and the world.

California has been an innovative leader in food production for more than a century. California is a major producer of vegetables, fruits, nuts (nearly 50% of the nation's supply), and dairy products (more than 20% of the nation's supply). These are healthy and under-consumed sources of nutrition for Californians and people nationwide. More than 400 commodities are produced in the state. California agriculture faces unprecedented challenges to its sustainability, including climate change, water constraints (quantity and quality), regulation, labor, invasive species, urbanization, and other factors. Much of the impact of California agriculture upon the nation and the world has been due to the University of California's research and Extension efforts, which demonstrate breadth and depth of expertise and innovation.

In addition, UC ANR is leveraging significant resources around the areas of urban agriculture and local/regional food systems. This research and extension work includes production information, additional economic studies, small producer/beginning farmer training, food safety training for small-scale producers, the development of an urban agriculture portal, edible landscape guides, volunteer training, farm-to-school work (with schools, with districts and with producers seeking to access this model), and work in public policy on food councils.

One hundred and seventy nine Hatch and Multistate Research projects were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 64 research and extension projects. CE advisors worked on 558 extension projects, and led an additional 73 research projects under the Federal Planned Program: Sustainable Food Systems. The following projects illustrate the types and range of projects with important results being conducted by academic and non-academic personnel located in county extension offices, the three UC ANR campuses, several Research and Extension Centers, and occasionally on USDA facilities in collaborative efforts:

Food Access and Diversity in the Food System

Selected examples highlighting accomplishments in this area follow:

- Community Supported Agriculture (CSA) is a type of direct marketing relationship where consumers commit to support local producers, paying in advance to receive produce shares. More than 200,000 homes in California subscribe to community supported agriculture (CSA) programs. Research on expanding CSA sales and access in California is having positive impacts on producers, consumers, and public policy. Producers are gaining better information about the characteristics of their customers, adopting successful strategies to reach new customers, and learning how to improve the economics of this model. A focus is on helping CSA producers expand their membership to include historically under-represented groups, including residents engaged with the USDA's food entitlement programs; an expected outcome is increased food security and food access, as well as improved nutrition for at-risk populations.
- A UC researcher is co-leading a multi-state group on a project to increase the prosperity of small and medium-sized farms by identifying and facilitating their participation in regional specialty food markets, such as cheese, grain products, processed produce, and processed meats.

Specialty Crops

Selected examples highlighting accomplishments in this area follow:

- An ongoing strawberry breeding project has resulted in 20 strawberry cultivars in the last 22 years. These advances in breeding have made strawberries a year-round crop with high quality and reasonable prices. Strawberries represent approximately \$2.6B in revenue for California producers.
- Alternative weed control options for California strawberry and vegetable growers is helping producers cope with the loss of herbicides (through regulatory action), as well as labor shortages and increasing energy costs. These integrated weed management strategies may allow reduced pesticide inputs and ease regulatory concerns, as well as hold down production costs for this \$5B sector.
- A molecular genetic improvement project focusing on California's specialty crops has identified genetic regions in a wild tomato species linked to water stress tolerance. The genes conferring water stress tolerance in this wild species may be targets for marker-assisted breeding to improve stress tolerance of cultivated tomatoes. A set of
- sub-near-isogenic tomato breeding lines, produced by this project, may serve as a genetic resource for breeding water-stress tolerant tomato cultivars.
- A series of projects on precision technologies for specialty crop production - some using wireless sensor networks - has had positive economic and environmental impacts, through reduced water usage, and more precise application of inputs to enhance crop yields.
- Development of new cultivars can provide producers with additional market opportunities and consumers with better tasting, more attractive, fruits and vegetables. Two mandarin cultivars (Tango, 2006) were sold by 2012, making it one of the most successful citrus cultivars released in the U.S. Asparagus cultivar "DePaoli" (2006) has been planted in significant acreage in California, and is being tested in other countries.
- Research on pollination and pollen compatibility in olive orchards demonstrated a strong relationship between temperature during bloom and expression of incompatibility such that table olive cultivars behave as self-compatible in cooler areas but a self-incompatible in hotter regions. With expected temperature increases due to climate change, these temperature-dependent aspects of reproductive biology will become more important. Similar research in prunes has shown that temperature-dependent aspects of flower abortion and fruit set in prune orchards may require new, higher-temperature tolerant prune varieties if California growers are to remain competitive.

Food Safety

Selected examples highlighting accomplishments in this area follow:

- Applied studies are proving to be of direct relevance to successful pre- and post-processing handling of products by the fresh-cut industry, such as fresh-cut mangoes, melons, spinach, and potatoes.
- UC researchers seek to define factors that affect how foodborne pathogens survive in environments where they enter the food supply in order to have the greatest impact on increasing food safety.
- Approximately 79 individuals, who represent a large contingent of California-based fresh-cut processors, were trained in the 18th annual Fresh-Cut Products Workshop, a 3-day course offered by instructors from the UC Postharvest Technology Research and Information

Center.

- Over 200 beef producers were certified or recertified in quality assurance and the UC participated with the 13 Western States to develop a common Beef Safety and Quality Assurance manual, test, and recertification process.
- Research on lactic acid bacteria has established methods for examining the role of food matrices (plant-based and dairy-based) on probiotic *Lactobacillus* in the mammalian gut and identified novel attributes of food-associated lactic acid bacteria that will be of use in applied research and product development. Expected long-term impacts are the development of improved and optimized control measures for microbial safety and quality of foods.
- Over 230 Cottage Food producers attended daylong workshops to learn how to legally, safely, and profitable produce Cottage Foods.

Plant Production and Genetics

Selected examples highlighting accomplishments in this area follow:

- The potential benefits of conservation tillage and residue management are being explored in several projects. Repeated trials show that no-tillage plus high-residue preservation practices reduce soil water evaporation in summer. UC's Conservation Tillage workgroup (made up of 1,000 researchers, extension educators, farmers, USDA NRCS and private sector partners) investigates innovative conservation tillage practices in California.
- Seed formation is critical to the formation of most fruits. UC's work in genetic and molecular analysis provides new information on the critical process of ovule development and the regulation of plant development. This understanding translates into novel methods for engineered regulation of gene expression for crop improvement or biomedical applications.
- Multiple research projects were conducted on the genetic and biochemical response pathways to stresses in plants, such as heat, drought, pests, and air pollution. These studies characterized signal and response mechanisms and investigated genetic variation and crop germplasm for potential to mitigate various stresses. In one project, simple traits of cowpea that were genetically mapped included heat tolerance during reproductive development, delayed drought-induced senescence, and resistance to aphids, thrips, *Striga* and *Fusarium*. In many cases, this basic research may lead to marker-assisted breeding or other tools for new variety development.
- A series of studies have examined the genetic and biochemical pathways of photosynthesis in order to explore potential for increasing crop productivity.
- Deficit irrigation and efficient nitrogen fertilization combined with selective pruning techniques in almond orchards have demonstrated improvements in canopy management resulting in reduced input costs and pesticide applications with a potential for increased worker safety.
- The classical and molecular genetics of lettuce project has a goal to improve multiple types of lettuce resulting in the generation and release of advanced breeding lines, with particular emphasis on improving disease resistance. This program emphasizes backcrossing to move disease resistance genes as rapidly as possible into California lettuce types. As lines carrying individual new resistance genes approach horticulturally acceptable types, they are intercrossed to generate multi-disease resistance lines. Primary germplasm and advanced breeding lines are released to the seed industry, so that companies with both large and small breeding programs can utilize these materials. These activities have resulted in improved lettuce cultivars that in turn provide higher quality lettuce and less reliance on chemical protectants.

- The wheat breeding and genetics project released foundation seed of a low cadmium durum wheat variety, Miwok. In addition, common and durum wheat lines continue to be developed and evaluated through regional variety trials for agronomic traits, quality characteristics, and disease resistance. Introgression of stripe rust resistance genes into wheat varieties using molecular markers has effectively stopped the stripe rust epidemic that started in 2000 and resulted in large economic losses for California growers. UC has established collaborations with private breeding programs to help accelerate the introduction of resistance genes in commercially available varieties.

Animals and Their Systems

Selected examples highlighting accomplishments in this area follow:

- A series of applied animal behavior and welfare projects develop animal behavior measurement techniques to assess on-farm welfare challenges and evaluate alternative management strategies, with a focus on reducing injury, illness, and losses while improving animal welfare for a range of animals, including cows, pigs, and poultry..
- One poultry project improves energy and resource use efficiency through light management. Results showed that dimmer lighting might confer some welfare and production benefits in commercial settings.
- A project on the preparation of agricultural-by-products as feed ingredients resulted in the development of approved protocols for feeding many fruit and vegetable by-products to poultry.
- Commercial freshwater and marine aquaculture in California is a diverse industry producing dozens of species of finfish and shellfish. A series of projects examined aquatic animal systems to improve the production, quality, and welfare of aquatic animals. Findings resulted in knowledge gains that may improve production and quality of white sturgeon eggs used for caviar. Further results improve understandings needed by regulatory agencies to make scientifically sound decisions on the management of selenium and mercury in sturgeon species. Programs on aquatic animal welfare have changed the attitude of finfish producers and the shellfish industry towards the public's desire for animal welfare adoption in animal production, which in turn can improve industry sustainability.

Technological Innovation

Selected examples highlighting accomplishments in this area follow:

- Through the Informatics and Geographic Information Systems (IGIS) program, UC is making data from UC ANR's Research and Extension Center (REC) system broadly available via web-based applications in order to make meaningful predictions of the agricultural and ecosystem response to future change, and to increase our understanding of opportunities to enhance agricultural production. A network of flux towers arrayed across UC ANR's nine RECs have been installed, and include closed path infrared gas analyzers and 3-D sonic anemometers for measuring the net exchange of CO₂, H₂O and heat via the eddy covariance method. Each site also supports a suite of ecological sensors that measure air and soil temperature, relative humidity, soil moisture, solar radiation, soil heat flux, and soil CO₂ concentration.
- A research project focused on developing feasible mechanical harvesting and determining appropriate tree training methods is optimizing harvest efficiency in California black ripe

table olives. Two harvesting technologies have been developed to effectively remove fruit without fruit and tree damage. Trunk shaking is one harvesting technology that is being developed for use in commercial production and canopy contact technology. Research demonstrated that mechanically harvested trees resulted in Manzanillo olives harvested more efficiently than and as economically as hand harvested trees.

- A soilless plant growing systems research project resulted in findings that demonstrated the feasibility of plant production agriculture and solar photovoltaic co-existing simultaneously on the same land. Using solar photovoltaic panels which allow 30-35% light penetration to the plants, researchers were able to grow plants (e.g. citrus) without any loss of biomass. Many of the tested nursery plants did show a slight decline in biomass production but where plant production is already commonly done under shade, the use of photovoltaic technology may serve as an alternative that allows farmers to capture additional income from light energy.
- Research on precision irrigation, fertilization, and management of specialty crops by wireless sensor networks features wireless nodes and actuation hardware/software. Precision agriculture leads to economic and environmental benefits since it involves applying inputs such as chemicals and water on a site-specific or "prescription" basis to enhance crop yield, reduce inputs, and/or reduce environmental damage.

Economics, Markets, and Policy

Selected examples highlighting accomplishments in this area follow:

- The focus of an agricultural sustainability and food labeling policy project is to develop an understanding of what types of sustainability-related labeling standards are workable and which will improve consumer welfare, producer welfare, or sustainability of production. The research has gained traction through publications, and enabled the investigation of private benefits and the social costs of various forms of producer cooperation.
- A modeling workhorse to address agro-environmental problems arising from cropping systems was also produced. This study provides important insight into the likely effects of nitrogen taxes, a policy currently under consideration in California to mitigate nitrate pollution in water.
- An analysis of new challenges and opportunities for California's mandated marketing programs analyzed the effectiveness of various messages and specific promotional material. Results enabled producers and industry groups to fine-tune messages. Knowledge regarding the success of these programs contributed to them being renewed by vote of the producers operating under the programs. In addition, emerging areas of potential opportunity were identified in certification of food-safety related practices.
- An analysis was conducted to identify underlying causes of commodity price changes and the response of market participants, including the roles of government policy, storage, and financial speculation by entities, such as hedge funds. This research is providing new knowledge about commodity price volatility by modeling commodity price dynamics to decompose price variation into various components.
- While agricultural index insurance contracts promise a cost-effective way to remove risk from a variety of farming and livestock systems, uptake of these contracts has often been tepid and their beneficial economic impacts consequently muted. This international research focuses on more intelligently designed index insurance contracts. A major outreach publication, "Sharing the Risk and the Uncertainty," was prepared and was directed towards key decision makers in the US and other countries who are tasked with choosing the proper

course for public intervention in the agricultural insurance sphere.

- A project on Next Generation Unionism and Regional Equity in California explored innovative policies and strategies designed to improve working conditions and career outcomes for laborers.
- A project examining the impacts of immigration on the competitiveness of California and US agriculture considered the economic status of farm workers and their children, as well as the viability of agricultural communities with large farm worker populations. Researchers reported estimates of how many unauthorized workers would be legalized under various reform proposals and what wage tipping point would spur labor-saving mechanization.
- UC's work in agritourism enables small and mid-scale producers to diversify their operations. Producers were trained in agritourism challenges and opportunities, business planning, risk management, hospitality and effective marketing. The work also facilitated the development of new regional networks, and engagement with local planning and community development agencies to reduce permitting and regulatory barriers.

Endemic and Invasive Pests and Diseases

Pests and disease affect the viability and productivity of agriculture, natural resources, public health and the environment of Californians. The speed and frequency of international travel today, combined with the volume of imported food, commodities and materials have greatly increased the rate of establishment of invasive pests and diseases in California. As global climate patterns shift, the distribution of pests and diseases will change, and many habitats will become more susceptible to new threats. To ensure the sustainability of the state's food and agricultural production and its natural resources as well as the health of the economy, UC ANR developed the Endemic and Invasive Pests and Diseases Initiative (EIPD). This initiative's goals are to foster research and extension programs that 1) exclude pests and diseases through improved detection and diagnostics, 2) develop information that responds to emerging problems with pests and disease, and 3) provide long-term integrated pest management (IPM) solutions for established pests. The following sections provide research highlights within each of these EIPD initiative goals.

Exclusion of Pests and Diseases through Early Detection and Diagnostics

The first step in controlling the damage of any pest or disease, be it arthropods, vertebrates, weeds, or pathogens, is to prevent it from entering a new region. Exclusion includes diagnostics, detection and interception. Eradication of pests and diseases may be feasible if an early detection system is in place. Lack of early detection may result in expensive pest and disease management costs in the long-term, disruption in commerce and industry prosperity, and human and animal health impacts if diseases are involved. Selected examples highlighting accomplishments in this area follow:

- Molecular genetic tools, computational methods, and historical records, are being used by a number of research programs to determine the identity of insect pest species and their natural enemies.
- Collections-based research involves digitizing records to track data associated with specimens. This information will help to predict natural and artificial spread of invasive pests and disease and the impacts of climate change.
- Molecular identification of nematodes continues with the goal of identifying species, understanding diversity and developing diagnostic methods for plant parasitic, free-living

and vertebrate parasites. An intuitive online identification and self-training system for diagnosis of nematodes from California was developed using soil samples from coast, inland, mountain and desert areas. Correlations between different types of soil crusts and particular taxonomic groups of nematodes confirmed the relationship between species of nematodes and the types of algae they feed on.

- Modeling the spatial dynamics of indirect (human to vector to human) transmission of dengue virus by mosquitoes is providing insights into the early detection and best use of vector control and vaccine resources. Small seasonal changes in temperature and humidity regulated onset, peak, and decline of epidemics, likely by directly influencing mosquito life cycles, competence, and mosquito-human contact in specific ways. Larger epidemics begin earlier and develop faster in a local transmission season, a phenomenon likely driven by the local level of human immunity, and that large epidemics can likely be identified early allowing preventative measures to be strategically targeted, and therefore most effective.
- A number of research programs are sequencing genomes and studying methods of gene silencing and RNA interference, with the goal of transforming host plants so that they can withstand viral, fungal, and bacterial pathogens in crop plants. An understanding of how pathogens are transmitted and replicated at the molecular level provides a greater understanding of plant defense systems that can lead to new management tactics.
- Small RNAs uniquely induced by citrus pathogens (such as *Liberibacter* spp., *spiroplasma citri*, and citrus tristeza virus) that cause citrus diseases are being identified. They can potentially be used as early diagnostic markers for the diseases in the field. In addition, a real time multiplex assay for the simultaneous and rapid detection of three regulated citrus viruses (i.e. citrus tristeza virus, citrus psorosis virus, and citrus leaf blotch virus) was developed.
- A molecular genetic study was undertaken to broaden the available information on the phylogeny of the genus *Phytophthora*. A total of 166 isolates representing 90 recognized species and 17 provisional species were analyzed. The identification of species present in a sample can be determined without the need for culturing by sequencing the genus specific amplicon and comparing that with a reference sequence database of known *Phytophthora* species.

Emerging Problems with Pests and Diseases

When new pests and/or diseases emerge, they need to be addressed in order to protect animal health, plant health, public health, food security, food safety, and the environment. Often newly arrived pests and diseases are problems because they lack natural control agents, creating devastating problems as they spread. Endemic pests and diseases can also develop into more serious problems because of external factors such as changes in climate and plant/animal management practices. Selected examples highlighting accomplishments in this area follow:

- Spotted wing drosophila (*Drosophila suzukii*) is a major threat to specialty small fruit crop production. Combining circadian biology with pest management strategies, it was found that the SWD was more susceptible to insecticides at dawn.
- A number of studies on the ecology of invasive weeds such as barb goatgrass (*Aegilops triuncialis*), *Holcus lanatus*, and giant reed *Arundo donax* continued. Efforts are being made to manage invasive weeds with mechanical and chemical means and to determine if native species persist and re-establish.
- The invasive glassy-winged sharpshooter is the vector of the grape pathogen *Xylella fastidiosa*, the etiological agent of Pierce's disease. Research projects examined the impact

of grape variety on disease epidemics, the success of nursery treatments to prevent spread of the vector, identified microbes in the xylem that would act as natural enemies of *Xylella*, modeled the vector behavior and its implications for pathogen transmission, continued the development of transgenic plants that could resist the disease, and studied virulence genes to create strategies to reduce virulence gene expression of the pathogen.

- The American crow plays a role in the movement of pathogens of human health concern in urban and agricultural landscapes through its feces. A study described two antibiotic-resistant bacterial types in urban crow roosts and determined the role crows play in the transmission West of Nile virus.
- Fusarium dieback in avocado is caused by a new, yet unnamed *Fusarium* sp., that forms a symbiotic relationship with the Polyphagous shot hole borer. Surveys confirm the damaging impact on urban and commercial avocado trees as well as some ornamentals. Molecular identification revealed different isolates of *Fusarium* and of populations of the beetle from different counties. Fungicide treatments were screened in an effort to develop a management program for this disease.

Integrated Management

When pests and/or pathogens become established in California, integrated management tactics are needed to reduce their impact on agriculture, natural resources, communities, and human health. Selected examples highlighting accomplishments in this area follow:

- Studies of the etiology, epidemiology, biology and management of fungal and bacterial diseases important in fruit crop productions systems were continued. Focuses of research included studying *Xanthomonas* genetics with the goal of marker-assisted breeding of the common bean, the impact of antibiotics on bacterial pathogens of fruit trees, and investigating canker and dieback pathogens of citrus in the desert.
- Research continued on animal health issues. Projects included developing a vaccine for cattle that would prevent specific strains of infectious bovine keratoconjunctivitis (pinkeye). A program for IPM of house flies in confined animal facilities included use of barrier traps, pesticide resistance monitoring, and a web site to provide online identification and improved pesticide use. Studies of the northern fowl mite provided insights into how the mites impact hen metabolism and egg production.
- The detection of glyphosate herbicide resistance in junglerice in the Central Valley of California threatens the implementation of the glyphosate-based stale seedbed technique, which is one of the few tools available for controlling multiple-herbicide resistant weeds in rice. Faced with the ensuing reduced control options, rice growers in California have come to rely on the contact herbicide propanil. Studies of whole plants demonstrated resistance to this herbicide as well. This is the first case of propanil resistance outside the Poaceae family.
- A number research programs are identifying and studying the microbes in soil that can act to suppress pests and diseases. One project identified the fungi involved in suppressing sugarbeet cyst nematodes (*Dactylella oviparasitica* and *Fusarium oxysporum*) and root-knot nematodes (*Pochonia chlamydosporium* and a *Tetracladium* sp.). Another project identified a soil microbe (*Olpidium bornovanus*) that mediates germination of *Monosporascus cannonballus* and demonstrated that mediation is dependent upon saturated soil conditions occurring only during or immediately after an irrigation.
- Biological control is a cornerstone of sustainable management of insect pests of agricultural crops. Biological control agents were identified, reared, released and evaluated for a

number of pests (spotted wing drosophila, olive fruit fly, whiteflies, spider mites, mealybugs, grape leafhopper) in a number of crops (walnuts, grapes, citrus, ornamental floriculture).

- Integrated pest management programs manage pests with economic, environmental and sociological considerations. Advances in the integrated management of arthropod pests utilizing plant breeding, reduced risk insecticides, pheromone disruption, economic thresholds for treatment, sampling methods, biopesticides, managing insecticide resistance, and managing natural enemies, were demonstrated in rice, avocados, strawberries, almond, vegetables, caneberry, stone fruit, olive and citrus as well as urban settings.
- Ecoinformatics (big data sets) was used to analyze plant responses to pest pressures and management tactics using grower supplied data. The ecoinformatics dataset, primarily by virtue of its large size and associated higher level of statistical power, resolved effects that had been impossible to resolve in experimental studies. For example, a key pest of cotton, the herbivore *Lygus hesperus*, has strong effects on cotton yield during an early-season window (June) of heightened plant sensitivity to damage. In contrast, during the mid-season (July), when most growers currently apply pesticides to suppress *Lygus*, cotton plants can fully compensate for low to moderate levels of damage, and thus insecticide applications are not needed. *Lygus* generate hidden costs by changing the growth form of the cotton plant in ways that elicit increased use of plant growth regulators by farmers. Finally, the same dataset revealed that crops grown around a focal cotton field can have both positive and negative effects on cotton performance through their influence on *Lygus* colonization of the focal cotton field.

Sustainable Natural Ecosystems

The term "Sustainable" is often defined as the ability to continue a defined behavior indefinitely and most definitions include three pillars that support it. Those pillars are economic, social and environmental. The term "Natural Ecosystems" refers collectively to forests, rangelands, and wetlands. In California, these lands are typically upstream or downstream of intensively managed agricultural and residential lands. They provide valuable goods and services to society but their ecological diversity and mixed ownership increase the complexity in regards to ensuring their sustainability. A central theme of the SNE program is to better understand the ecological and physical process that control overall system productivity and thereby better understand how these processes are managed in our highly variable climate. Even the ecosystems in federal parks and wilderness areas have significant interactions via fires, atmospheric-land deposition and emissions, with the private and public landscapes that are valued for the goods and services that are consumed or managed by California's residents. Population growth, climate change, land use change and fragmentation, and limited science literacy about these ecosystems are adding to the challenges. The goal of the ANR Sustainable Natural Ecosystems Strategic Initiative and Federal Planned Program is to have a large positive impact on California's natural resource ecosystems and insure that the three pillars of sustainability are balanced.

One hundred and twenty six Hatch and Multistate research projects were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 25 research and extension projects. CE advisors worked on 130 extension projects, and led an additional 12 research projects under the Federal Planned Program Sustainable Natural Ecosystems. Projects are being conducted in several areas that are essential to sustaining California's natural resources. A few examples of the breadth of projects along with selected examples of

high impact programs follow:

Range Resources Management

Selected examples highlighting accomplishments in this area follow:

- Rangeland stewardship by California ranchers - showed through rancher decision making there is a better understanding that provides social and ecological insights for sustaining multifunctional working rangelands. Also showed that adaptive rangeland decision-making positively influences conservation program participation. Adaptive rangeland decision-making successfully helps California ranchers deal with drought.
- Restoration of degraded rangeland - showed that using a systems or quantitative approach vs. a qualitative approach to restoration projects will allow managers to forecast site-specific restoration outcomes and evaluate how various management tools and strategies will likely alter outcomes. Such forecasts will be essential if society is ultimately going to recover ecosystem services on degraded rangeland in an economically feasible manner.
- Environmental change and plant-soil feedbacks in the resilience of California grasslands - showed how understanding plant-soil feedbacks will help control Medusahead, Yellow Starthistle and Italian thistle. Medusahead invasion is characterized by an extended period of positive frequency dependence, where high population growth rates are associated with increased abundance and thus further high population growth. Positive growth rates occur until the population achieves relatively high levels of abundance. Soil from Medusahead patches reduce desirable annual species up to 20%. Medusahead does best in dense patches while Yellow Starthistle and Italian thistle do worse. These noxious weeds spread quickly within a pasture but dispersal and success at low population sizes is critical for larger scales across pastures. Positive plant-soil feedbacks may turn negative with time and with increased self-inhibition more control possibilities of these weeds become available.
- Conservation of California's Serpentine Flora - showed that enhanced spring rainfall alters the biomass, composition, and invasibility of grasslands. Also found these changes were weaker in endemic-rich serpentine grasslands than in grasslands on more fertile soils and that species composition varies less across climatic gradients on serpentine soil than those on more fertile soils.

Wildlife & Fisheries

Selected examples highlighting accomplishments in this area follow:

- Demographic, Environmental and Climatic Processes Affecting the Viability of California Wildlife - showed the negative effects of climate change on bird and mammal distribution in the Sierras. Also showed how aerial photography can be used to show land use change and the impacts on Black and Virginia Rails bird populations
- Conserving and Protecting Bee Pollinators in Disturbed and Managed Habitats of California - has created a wealth of new information on wildland bee communities including assessing diversity and abundance of bees in an area. This project has been successful in attracting significant numbers of native bees to lands where bee-plants were added.
- Understanding the interaction between artificial and natural selection in salmon with hatchery inputs - showed the efficacy of alternative management approaches on reducing the effects of aquaculture on wild populations.
- Impacts of reproductive stressors on fish from the Sacramento/San Joaquin Delta and SF

Bay - showed that the declines in the fish populations in the Sacramento-San Joaquin Delta may in part be due to endocrine disruption which has a population-level effect. Also showed that fish development in urbanized estuaries may be impacted even without a major oil spill.

Riparian Systems & Wetlands

A selected example highlighting accomplishment in this area follows:

- Water Reuse for Ecosystems - showed how to identify characteristics of sites that would benefit from managed streamflow augmentation in California and select biological metrics that can be used to evaluate success. Protocols will be developed that will allow water utilities to relieve stress on imperiled stream ecosystems. Showed the effects of floods and droughts on ecological processes.

Forestry

Selected examples highlighting accomplishments in this area follow:

- Ecosystems in a Changing Hydroclimate - showed that Douglas-firs maintain significant transpiration through the winter rainy season and transpire maximally in the spring, followed by a sharp decline in transpiration in the summer dry season. Pacific madrones and to a lesser extent other broadleaf evergreen species in contrast, transpire maximally in the summer dry season. This will assist forest owners and managers understand the impacts of climate change on these forests.
- Tree population dynamics methods - shows how to estimate models from intermittent tree size monitoring data including estimation of patterns of growth, survival and reproduction incorporating variation due to location, year, and individual tree as well as explanatory variables such as tree density and site and climate variables for white fir from Sierra Nevada forests using long-term monitoring data.
- Develop more effective equipment and methods for reducing the potential of wildfire in forest stands- showed the effects of the most common forest fuel reduction treatments on carbon pools composed of live and dead biomass as well as potential wildfire emissions from six different sites. Also showed most of the benefits of increased fire resistance can be achieved with relatively small reductions in current carbon stocks. Retaining or growing larger trees also reduced the vulnerability of carbon loss from wildfire.

Water Quality, Quantity, and Security

Water--essential to all life--can only be understood in the context of larger societal concerns such as food safety, climate change, land use, agricultural and ecosystem sustainability, global population growth, and urbanization. Reflecting its significance, water is an integral component of major governmental acts such as the federal Endangered Species Act, National Environmental Policy Act, Clean Water Act, and the state's Porter-Cologne Water Quality Control Act. In California, water is the life blood of the state's economy; its availability and quality is critical for the state's agricultural, urban, and environmental systems now and in perpetuity.

Several issues regarding California's water are paramount:

- The supply of water will be limited for all users.
- Competition for water will intensify among agricultural, urban, and environmental users, with water being transferred from agriculture to the latter two groups.
- Short- and long-term climate trends will exacerbate the problems associated with water availability.
- Degradation of water quality will become more important as a major public issue.
- Legal and regulatory decisions will have significant impacts on water use and quality among all sectors.

Sixteen Hatch and Multistate Research projects were awarded to investigators at UC Riverside, Davis, and Berkeley under the required Federal Planned Program: Water Quality, Quantity, and Security. CE specialists worked on 13 research and extension projects. CE advisors worked on 98 extension projects, and led an additional 5 research projects under the Federal Planned Program: Water Quality, Quantity, and Security.

Aquaculture

Aquaculture continues to be important in the state. Aquaculture facilities may produce products for human consumption or for ecosystem restoration or maintenance (breeding and stocking). A selected example highlighting accomplishments in this area follows:

- Research was performed to reduce water use and environmental impacts by converting from flow-through systems to recirculating systems. This requires filtration and other techniques to purify the wastewater before it is reintroduced into the system. The system built at UC Davis for this project has performed well and serves as a demonstration system for other aquaculture producers.

Groundwater Quantity and Quality

Management of groundwater recharge is important for both quantity and quality purposes. Increased irrigation efficiency can lead to increased concentrations of salts being leached to groundwater aquifers. The drought in California has increased attention on sustainable groundwater management throughout the state. A selected example highlighting accomplishments in this area follows:

- Work is being performed to assess the potential to use agricultural lands to increase groundwater recharge from storm events. This would increase the amount of freshwater recharge and reduce salinity concentrations. This work will be increasingly important as precipitation variability will increase with climate variability.

Water Use Efficiency

Increasing water use efficiency is critical to creating value from our water supplies. Selected examples highlighting accomplishments in this area follow:

- Work was performed on micro irrigation technologies to maximize potential water savings

and crop yields. Management of the technologies is critical to reach these goals.

- Work on canopy cover sensing is being performed to help us determine orchard water use and water needs. The research to date has led to increased yields and thus increases in water use efficiency.
- Work is also being done to increase performance of soil moisture probes and leaf pressure chambers to refine our water management recommendations. New tools have been developed to assist growers in managing irrigation to increase efficiency.

Ecosystem Conservation and Restoration

Modeling of sediment transport is critical to increasing fisheries productivity. Sediment control is important to maintaining gravel beds that are important to fish egg development. A selected example highlighting accomplishments in this area follows:

- Stream restoration modeling work is being performed to help improve stream ecosystems.

Water Quality and Nitrates

Nitrate pollution to groundwater sources is a major concern in California. Selected examples highlighting accomplishments in this area follow:

- Research to reduce nitrate pollution has focused on the main pathway, leaching. By increasing irrigation efficiency and optimizing nitrogen applications we can reduce leaching.
- Work on micro irrigation technologies has created several nutrient and irrigation relating applications that will reduce groundwater pollution and reduce leaching.
- New research and curriculum development is increasing capacity within the state to solve this problem.

Informatics and GIS

UC ANR has been using informatics and Geographic Information Systems (GIS) to track groundwater quality, manage forests and water resources, monitor land use and growth and relate to water supply and water demand. This information can feed into policy debates concerning optimal growth and water management in California.

Water Policy

The importance of water to California and its economy is evidenced by the intensity of its policy debates. UC continues to inform these debates with sound science and with scientific policy analysis. Selected examples highlighting accomplishments in this area follow:

- UC ANR has developed the state's only comprehensive water management model that incorporates both economic and engineering parameters. This model is used to estimate the impacts of changes in water supply on the water sector.
- Research and outreach evaluated policy options to manage nitrate pollution in our groundwater systems.
- Additional work was done on the impacts of a change in water supply on the agricultural economy of the San Joaquin Valley.

Sustainable Energy

The UC ANR 2025 Strategic Vision for sustainable energy production outlined initiatives to improve the energy security of California through innovative research on green technologies through science linking engineering, agricultural, biological and environmental research. Public demand for renewable sources of energy, coupled with the need for more energy-efficient agriculture and food production drives the need for agricultural research to meet these future renewable needs. California has some of the most active biomass power plants of any state, but the availability of alternative renewable fuels is somewhat limited in the state. Four ethanol plants produce approximately 180 million gallons of ethanol and eight biodiesel production plants are currently producing approximately 25.96 million gallons of biodiesel. Three of the four ethanol plants rely primarily on imported feedstocks for their ethanol production. UC ANR's role in improving energy security and green technologies include research and support of new production technologies that minimize fossil fuel energy consumption, develop through new technologies and marketing, genetic, genomic engineering, and agronomic research to produce sustainable feedstocks from forest, waste, agriculture production and waste, and develop science-based policies and information to guide policy makers on issues related to energy.

The UC Berkeley Energy Biosciences Institute (EBI) created in 2007 is a unique partnership with the Lawrence Berkeley National Laboratory, the University of Illinois at Urbana-Champaign, and British Petroleum (BP). It is supported by a \$500 million grant from BP. More than 300 researchers, including AES faculty, are researching the complete bioenergy life cycle from feedstock development through the fermentation process. At UC Davis, there is a Bioenergy Research Center with more than 100 hundred campus researchers with a wide range of disciplines working to advance the development and deployment of heat, power, and biofuels from biomass feedstocks. Davis is also the home of the California Biomass Collaborative, which is part of the statewide California Renewable Energy Collaborative and includes over 500 members from government, industry, academia, and environmental organizations.

Twelve Hatch and Multistate Research projects with a sustainable energy focus were conducted by investigators at UC Davis, Berkeley, and Riverside. There were also at least two projects conducted by CE specialists and advisors under the Federal Planned Program Sustainable Energy. Projects are being conducted in several areas that are essential to sustaining California's energy needs; a few illustrative examples follow.

Biofuel Crops

Biofuel feedstocks must be produced in a sustainable way in order to not compete with food crops on prime agricultural lands. These feedstocks are needed in order for California to meet the states requirements for low carbon intensity fuels as outlined under the Low Carbon Fuel Standard. Executive order S-0606 requires in-state production of biofuels to add to the state's economy and must meet its new greenhouse gas reduction goals. The UC system has also announced an aggressive policy to be carbon neutral by 2025 and research and deployment of renewables will be continue to be a major research focus for UC scientists. UC research is currently underway to evaluate the potential for various feedstocks that could play a role in California's agricultural diverse cropping systems and include crops such as sorghum, oilseeds, sugarbeets, and other potential crops. Selected examples highlighting accomplishments in this area follow:

- There are research projects working to provide valuable information on the potential of sorghum as a viable feedstock for renewable fuel production in California: to evaluate both grain and biomass production throughout the state and an ongoing program to evaluate these sorghums for their water use efficiency. Sorghum is an annual crop that could be both a short-term and long-term solution for California's need for a renewable, sustainable biomass feedstock. Sorghum is unique in that it can be used in all the various processes being discussed and debated for biofuel production. Furthermore, sorghum is drought tolerant and uses less fertilizer inputs than other crops.
- An oilseed project is investigating winter annual oilseeds as new crops for California. The research is conducting a multi-environmental trial to identify the best oilseed species and varieties for diverse locations in California, and is conducting experiments to understand management practices. The project will identify the best varieties of canola and camelina for California and their expected yields in diverse locations throughout the state, identify critical management practices for the successful production, and use the growth model APSIM and the economic model CBCAM to predict yield and likely locations throughout the state where crop adoption should be profitable.
- A project is underway to investigate mechanisms regulating photosynthate partitioning that could help meet global demands for energy and synthetic chemistry feedstock, but without contributing to climate change or other environmental degradation. This work is researching novel methods for the generation, sequestration and quantification of isoprene (C₅H₈) hydrocarbons in photosynthetic microorganisms. Isoprene, derived entirely via photosynthesis, could serve as a renewable biofuel or feedstock in the synthetic chemistry industry. Photosynthetic microorganisms can grow to high densities within fully enclosed photo-bioreactors. Such a system would enable oxygenic photosynthesis to convert solar energy and store it in the form of hydrocarbons, while permitting collection and sequestration of this volatile product. The work will further test suitability of this approach in industrial scale-up for the production of renewable photosynthetically-generated isoprene hydrocarbons.

Biofuel Production

Biofuel production from biomass feedstocks are costly due to the recalcitrant nature of cell walls. Cell walls can hinder the ability of conversion technologies to fully extract the full potential of fuel production. Several projects are looking at novel ways to either increase the efficiency of renewable fuel production, at other processes to generate fuels, and whether the state can meet its demands for renewable fuels. Selected examples highlighting accomplishments in this area follow:

- Research is underway to generate plants with "designer" wall structures representing novel biomaterials and feedstocks for biorefineries. Plant cell walls (lignocellulosics) are composed of complex networks of structurally diverse polymers. The precise effect of the heterogeneous substituents on the biophysical properties of the wall, their function during growth and development, and their evolution during plant speciation is not known.
- Research identified for the first time an arabinofuranosyl transferase in tomato. When expressed in the model plant *Arabidopsis*, the hemicellulose became arabinosylated generating a polysaccharide in the wall that the plant has not seen before. Thus through the help of numerous mutants the work was able to ascribe function to biosynthetic genes.
- Research into the production of clean power and fuels from biomass through thermochemical gasification and pyrolysis continues. The research also involves feedstock

modification to improve chemical properties for high temperature applications, more specifically the selective removal of inorganic constituents through solid-liquid extractions to elevate ash fusion temperatures and reduce corrosion and pollutant emissions.

- Estimates of gasoline fuel demand under several different scenarios were analyzed and the projected demand was used to estimate the required ethanol quantity needed for California under an E10 policy. Estimates on ethanol consumption were based on projections of fuel demand as a base case and these demands were used to evaluate the effects of an E10 policy on greenhouse gas emissions. The project analyzed the effects of an E10 ethanol-blend policy on ethanol consumption and greenhouse gas reduction in California and research was disseminated in a report to Chevron and two outreach publications.

Woody Biomass

Woody biomass is a broad category that encompasses all woody materials that could be used as feedstock for renewable fuels. This fuel type can be used directly through thermochemical processes or indirectly producing intermediary fuels such as alcohol, wood pellets, or syngas. A selected example of projects that explore the possibility of woody biomass feedstocks follows:

- Research focused on thermochemical biomass conversion of various feedstocks, including agricultural waste, forest, energy crops and urban feedstocks. Thermal properties associated with conversion through both oxidative and pyrolysis were investigated.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2014	Extension	Research
	1862	1862
Plan	300.8	366.3
Actual	264.6	417.4

II. Merit Review Process

The Merit Review Process that was Employed for this year included:

- Internal University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review

Brief Explanation

Scientific Peer Review

Each project funded under the Hatch Act is peer reviewed at the department level in the colleges/school at Berkeley, Davis, and Riverside. A peer review committee is appointed by the department chair. The committee evaluates the relevance, quality and scientific value of the proposed research. Upon completion of the peer review, the project is also reviewed at the dean's office for USDA compliance and forwarded to the Vice President's office for final review and submission to NIFA.

Merit Review

UC ANR's organizational structure emphasizes that resource allocation decisions will be driven by programmatic considerations and developed through a broad participatory process. This process includes review of the quality and relevance to program goals for all of the Division's programs.

At the statewide level, the UC ANR Program Council met almost monthly. It was chaired by the Associate Vice President, and included the four Executive Associate Deans, five strategic initiative leaders, and two county-based CE representatives, as well as other ex-officio administrative members. This group coordinates Divisionwide planning and delivery of programs and develops recommendations for allocation of Division resources. The Program Council reviewed all programmatic budget requests from a statewide perspective to make specific recommendations on budget expenditures and resource allocation principles. These recommendations were then considered by the Vice President for final allocation decisions.

UC ANR's strategic initiative leaders and advisory panels are key players in helping the Division meet its goals, by organizing division-wide conferences, developing five-year, statewide strategic plans, and coordinating the internal competitive grants program. During FY 2014, the five Strategic Initiatives held six panel meetings and close to 60 conferences calls. UC ANR's Program Teams provide an umbrella structure for the Division's many Workgroups to meet. These Program Teams carry out their essential leadership functions and enhance inter-Workgroup communication and collaboration. During 2014, 17 Program Teams met, with 21 Workgroups meeting in conjunction. These groups looked at the Division's program priorities and determined efforts that will best address these needs.

During 2014, UC ANR completed the 2013 internal, competitive grants cycle. During fall of 2013, the 2013 cycle proposals were reviewed by ad hoc, technical committees recruited by the strategic initiative leaders. The membership of these committees depended on the proposals

received and included external experts. By December 2013, after each proposal received at least two technical reviews by academics who had no conflict of interest with the proposal, the strategic initiative leaders recommended to Program Council a consensus slate of highly ranked proposals. Each of the recommended proposals was discussed in detail by Program Council in January 2014 to make final recommendations for funding. In February 2014, UC ANR's Vice President announced funding for 15 projects, for a total of approximately \$3.5 million over 5 years.

The Division actively engages stakeholders in a thorough process to determine the highest priority Cooperative Extension academic positions to rebuild and strengthen the UC ANR network, given the many retirements over the past few years and to address programmatic gaps and emerging needs. During FY 2014 a third call for CE positions was released. The online position proposal submittal process allows as much time as possible for consultation and discussions with internal UC ANR stakeholders in all program areas. UC ANR expects and strongly encourages engaging external stakeholders, including commodity groups, cooperating programs, agency partners, community groups, and others, to explicitly discuss the priority needs for these positions. In FY 2014, more than 120 CE positions proposals were developed in consultation with our stakeholders. Then the review process involved public comment (more than 900 individual comments from agricultural organizations, governmental agencies, youth and nutrition coalitions, individuals and many others), UC ANR Program Teams, Cooperative Extension County Directors and College and School leadership. All of the review information, along with information regarding current staffing and retirement projections, was considered by UC ANR Program Council in their deliberations to provide recommendations the Vice President, who then makes the final decision in FY 2015.

III. Stakeholder Input

Actions taken to seek stakeholder input that encouraged their participation included:

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals
- Survey of selected individuals from general public

Brief Explanation

UC ANR used a variety of mechanisms to seek stakeholder input on the development of Division program priorities and use of its research, extension and education funds. In addition, CE advisors delivering programs in 58 California counties received input on local needs from their local clientele on a daily basis. All of the input received from stakeholders was used by UC ANR members in program planning and implementation at the local, regional, and statewide level.

Research and Extension Center System Strategic Planning

During FY 2014, UC ANR's Research and Extension Center system, consisting of nine centers statewide, continued strategic planning focused on stakeholder guidance. Stakeholder input is sought both through the diverse committees, including CE advisors, CE specialists, and AES faculty and members from external stakeholder groups, as well through broad feedback loops conducted throughout the process, reaching additional stakeholder groups identified by the committee. During 2014, one center completed its strategic plan, and another center launched the rigorous strategic planning process. The strategic planning process is collaborative, future-oriented and utilization-focused. The process includes assessment, strategy formation, and implementation accountability. Situational and stakeholder analysis identifies key strengths and opportunities, as well as challenges to inform the development of the strategic directions, each with specific goals, intended outcomes, and key actions that include identified implementation responsibility and anticipated deliverables.

Strategic Initiative, Program Team, and Workgroup Meetings

The Strategic Initiative, Program Team, and Workgroup Meetings are the primary mechanism for accomplishing UC ANR's high priority research and extension goals through grassroots leadership. During FY 2014, the five Strategic Initiatives held six panel meetings and close to 60 conferences calls, and 17 Program Teams met with 21 Workgroups meeting in conjunction. These meetings brought together AES and CE personnel and non-ANR partners to work on emerging and continuing priority issues in Division program areas.

Workgroups involve external stakeholders in their program planning process and Workgroup activities and projects. The involvement of external stakeholders in the Workgroups ensures that real world needs are brought to the attention of the Division as programs are planned and implemented. External stakeholders on the workgroups include individual producers, representatives from local community groups, state and federal agencies, industry groups, consumer groups, and colleagues from other higher education institutions.

Statewide Program Reviews & Strategic Planning

Each of the Division's eight statewide programs undergoes a routine program review with significant input from key stakeholder groups. The review committees include members from across the UC ANR network and external stakeholder representatives. As part of the review process, the committee also solicits input from additional stakeholders through interviews and web-based surveys. During FY 2014, no such reviews were conducted.

During FY 2014, the UC Statewide Integrated Pest Management Program launched a rigorous, strategic planning process designed to actively engage stakeholders throughout the process.

From May through September 2014 eight stakeholder focus groups were conducted throughout the state to inform the development of the program's strategic plan for the next five to ten years. This stakeholder input was designed to provide assessment information to compile stakeholder insights on significant topics relevant to developing future program strategy; and a list of stakeholder identified program strengths, challenges, and future opportunities. Overall 46 people external to the UC Statewide IPM program, as well as the program's internal academics and staff participated in the eight focus groups.

Formal advisory groups

The President's Advisory Commission on Agriculture and Natural Resources meets twice annually to advise and assist UC in identifying the educational needs of the state's agricultural, natural and human resources communities and ways to meet them through science-based research, educational outreach and classroom instruction. The members represent close to 30 different business, consumer, youth and government leaders from throughout California and meet twice a year to provide input. The UC ANR Vice President participates as a member of this Commission and brings the Commission's advice to the UC ANR Executive Council, which includes the four Deans from the UC ANR affiliated colleges/school. This leadership council then provides strategic guidance in the articulation of long-term programmatic directions Divisionwide, the allocation of resources across units, and the development of UC ANR policies.

Each of the three colleges at Berkeley, Davis and Riverside and the School of Veterinary Medicine at Davis, have external stakeholder advisory councils that met at least annually to provide feedback on their research, extension, and teaching programs. In addition, departments may have advisory boards. The Statewide Programs also have advisory groups, some mostly composed of external members, which meet regularly to review progress and offer recommendations for future program direction.

Commodity Organizations/Marketing Order Boards

Members of these organizations provided their annual input on research and extension needs for their commodities to UC ANR members through regular meetings and discussion of funding for research projects. In addition, during FY 2014 members from the California Commodity Committee met individually and in small groups with the Vice President to discuss their future work, including the most effective process and next steps to provide recommendations on program planning and funding issues.

Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys

Methods for collecting Stakeholder Input

- Meeting with traditional stakeholder groups
- Survey of traditional stakeholder groups
- Meeting with traditional stakeholder individuals
- Survey of traditional stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

A statement of how the input was considered

- In the budget process
- To identify emerging issues
- Redirect extension programs
- Redirect research programs
- In the action plans
- To set priorities

IV. Expenditure Summary

1. Total Actual Formula dollars allocated (prepopulated from C-REEMS)	
Extension	Research
Smith-Lever 3b & 3c	Hatch
7,940,241	6,999,429

2. Total Actual Dollars Planned Programs Inputs		
	Extension	Research
	Smith-Lever 3b & 3c	Hatch
Actual Formula	5,006,148	5,290,619
Actual Matching	5,006,148	5,290,619
Actual All Other	100,150,962	292,216,558
Total Actual Expended	110,163,258	302,797,796

3. Amount of above actual formula dollars expended which comes from carryover funds from previous years		
	Extension	Research
	Smith-Lever 3b & 3c	Hatch
Carryover	0	0

V. Planned Programs

- A. Healthy families and Communities**
- B. Sustainable Food Systems**
- C. Sustainable Natural Ecosystems**
- D. Endemic and Invasive Pests**
- E. Sustainable Energy**
- F. Water Quality, Quantity and Security**

A) Healthy Families and Communities

1) Healthy Families and Communities Planned Program Knowledge Areas

KA Code	Knowledge Area	Extension	Research
121	Management of Range Resources	0%	2%
133	Pollution Prevention and Mitigation	0%	2%
305	Animal Physiological Processes	0%	8%
502	New and Improved Food Products	0%	2%
601	Economics of Agricultural Production and Farm Management	0%	2%
604	Marketing and Distribution Practices	0%	2%
606	International Trade and Development	0%	1%
608	Community Resource Planning and Development	1%	4%
610	Domestic Policy Analysis	0%	2%
701	Nutrient Composition of Food	0%	2%
702	Requirements and Function of Nutrients and Other Food Components	1%	45%
703	Nutrition Education and Behavior	29%	7%
704	Nutrition and Hunger in the Population	1%	1%
723	Hazards to Human Health and Safety	0%	3%
724	Healthy Lifestyle	8%	3%
802	Human Development and Family Well-Being	8%	7%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	3%	3%
805	Community Institutions, Health, and Social Services	4%	1%
806	Youth Development	39%	3%
903	Communication, Education, and Information Delivery	6%	0%
	Total	100%	100%

2) Healthy Families and Communities Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2014	Extension	Research
Plan	47.0	46.3
Actual Paid Professional	7.8	17.4
Actual Volunteer	690.0	0.0

Actual dollars expended in this program (includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c 1,681,514	Hatch 776,563
1862 Matching 1,681,514	1862 Matching 776,563
1862 All other 14,972,055	1862 All other 39,975,001

3) Healthy Families and Communities Planned Program Activity

Brief description of the Activity

UC ANR's integrated research and extension activities conducted research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Adults, children, youth and families in general
- Children in general
- Low and moderate income adults, children, youth and families
- Adults and children at-risk for nutrition-related health problems, including individuals living in poverty, recent immigrants, and African-American, Native American, and Hispanic populations
- Nutrition and healthcare professionals
- Preschool, primary and secondary school teachers and administrators
- Professional childcare providers
- Public agencies and private organizations concerned with food, nutrition and health

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes. The Division looks forward to the re-invention into a system of greater value to California Extension.

4) Healthy Families and Communities NIFA Defined Standard Output Measures

FY 2014	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	126,703	545,650	2	22	117	139

Patents Listed:

1. A METHOD FOR HIGH-THROUGHPUT SCREENING OF CHEMICAL ENTITIES FOR UNANTICIPATED ACTIONS IN BIOLOGICAL SYSTEMS
2. A METHOD FOR HIGH-THROUGHPUT SCREENING OF CHEMICAL ENTITIES FOR UNANTICIPATED ACTIONS IN BIOLOGICAL SYSTEMS

5) Healthy Families and Communities State Defined Outputs

FY 2014	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	News-letters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	495	112	190	6	2	77	2	5

6) Healthy Families and Communities State Defined Outcomes

a) Knowledge Outcomes

- 997 children and youth, participating in 4H club, community, in-school and afterschool educational programs, increased their level of science, agricultural and environmental literacy.

Knowledge Area: 806 Youth Development

- 236 youth educators and child resource specialists, participating in youth development education programs, gained knowledge of youth development practices.

Knowledge Area: 806 Youth Development

- 300 community garden managers, non-profit agency personnel, small business owners, and low-income members of the public, participating in Master Gardener Programs, gained knowledge about home horticulture and pest management.

Knowledge Area: 805 Community Institutions and Social Services

- 120 adults, participating in food safety and food preservation programs, gained knowledge of safe food handling, preparation and preservation techniques.

Knowledge Area: 703 Nutrition Education and Behavior

b) Attitude Changes

- 8291 adults and families with children, participating in CalFresh and other obesity prevention programs, increased readiness to adopt healthier dietary practices.

Knowledge Area: 703 Nutrition Education and Behavior

c) Skills Acquired

- Youth developed important skills to help them thrive and direct them on a pathway toward successful adult development through participation in 4-H Thrive!

Issue (Who cares and Why)

Far too many youth currently fail to reach their full potential. For example, one out of five adolescents in California are at risk for depression; national costs for treating youth with mental health issues is estimated to be \$12 billion. Strategies are needed to promote attributes in youth that lead to successful adult development and prevent these negative outcomes. To address this issue, the UC ANR 4-H Youth Development Program (YDP) partnered with the Thrive Foundation for Youth to deliver a new program for increasing the number of thriving youth in California who reach their full potential and become successful, contributing members of their communities.

What has been done

UC ANR and UC Cooperative Extension personnel developed a curriculum called 4-H Thrive!, which was designed to help youth identify and develop inner sources of motivation, develop learning and growth mindsets, self-reflect on the indicators of thriving, and improve their goal management skills.

Research indicates that youth who possess these skills are more likely to thrive and less likely to engage in risky behaviors. The program, being delivered across California, includes the 4-H Thrive! curriculum and professional development for those implementing the curriculum. Program staff trained 490 volunteer 4-H master trainers, who in turn trained 529 volunteers who lead projects in local 4-H clubs. 4-H Thrive! has been delivered to 3,516 youth in 35 California counties. ANR provided knowledge, staff, and volunteer resources in the development, delivery and evaluation of 4-H Thrive!

Results

Results show that 4-H Thrive! youth have more positive outcomes than youth not involved in 4-H. Also, based on pre- and post-program measures, the more youth felt that 4-H helped them get better at their "spark," the more they thrived. Other

ways youth thrived was through increasing their growth mindset and goal management skills. Thriving youth were also better adjusted: the more youth thrived, the more their stress decreased and their self-esteem increased. Findings will be used to establish effective youth development practices and to inform both policy and program implementation.

Knowledge Area: 806 Youth Development

d) Behavior Changes

- 6867 low-moderate income individuals and families, participating in nutrition and consumer education programs, adopted recommended food resource management techniques.

Knowledge Area: 704 Nutrition and Hunger in the Population

- 7577 adults, participating in nutrition education programs, adopted recommended dietary practices.

Knowledge Area: 703 Nutrition Education and Behavior

- 5370 low-income adults, participating in nutrition education programs, adopted safe food handling and preparation techniques.

Knowledge Area: 724 Healthy Lifestyle

- 4-H clubs pass new healthy beverage policy.

Issue (Who cares and Why)

Children who are overweight can experience negative physical, emotional, social, intellectual and financial outcomes. And because research shows overweight children are less likely to go to college, their weight impacts intellectual and financial futures. With 30.5 percent of California children classified as overweight or obese, this public health issue a priority. UCCE has identified 12 major risk factors for weight gain; one is consumption of sugar-sweetened beverages. The average American consumes about half a pound of sugar a day, and more than 30 percent of calories from added sugars are from sweetened beverages.

What has been done

The Solano County Department of Health contacted 4-H to partner on a youth advocacy project to address this issue. 4-H youth members were trained about excess sugar-sweetened beverage consumption. The 10 middle school and high school 4-Hers created a plan, which included educational and policy components. The project started with building awareness in the 4-H community. They developed interactive educational activities to help participants calculate how much sugar was in their favorite beverages. In addition, the 4-Hers presented a skit to emphasize the importance of exercise and hydrating properly. At later meetings, they presented a sample healthy drink policy that said water is the best option for hydration and water must be provided as an option at all club meetings.

Results

As a result of this youth-led advocacy effort, two 4-H clubs in Solano County passed a new healthy beverage policy. These 107 4-H members must now have access to water at meetings, providing a sugar- and calorie-free option. This work was shared with the 4-H Statewide Healthy Living Leadership Team and a statewide water 4-H policy was adopted as a result of their workgroup efforts. 4-H is committed to the health of its youth, and continued application of the latest research to the program benefits all members.

Knowledge Area: 806 Youth Development

- Children eat more fruit.

Issue (Who cares and Why)

Combating childhood obesity and malnutrition are a priority for UCCE. Children who are healthy do better academically, socially and economically, and this benefits all of society. A cornerstone of good health is diet, and a cornerstone of a healthful diet is adequate intakes of fruits and vegetables. Research shows that children do not meet the recommendations for fruit intake daily (averaging just 1.3 of the 2 fruit servings recommended per day). Studies have shown an inverse relationship with fruit consumption and weight status. Fruit is well liked by children, but access and perceptions of peer acceptance can be a hurdle.

What has been done

A UCCE 4-H youth development and nutrition program helped a team of four boys develop and ultimately be awarded two grants for a total of \$2,000. As a result, weekly deliveries of local fruit were made to the school. The boys delivered the fruit to the classrooms for students to snack on throughout the week. Presentations were given to teach their classmates how to wash fruit and prepare it using a variety of utensils. A culminating Youth Service Day activity included reading storybooks about fruit to preschoolers and elementary students, leading a fun fruit activity for preschoolers, and helping classmates prepare fruit smoothies on a smoothie bike.

Results

Fruit deliveries began in February and continued through May. The youth grantees developed and conducted evaluations. The 65 students served in first through sixth grade reported that they liked having the fruit in the classroom during the previous four months, and that they thought it increased how much fruit they ate. The evaluations (completed by 53 of the students) show that the number of students snacking on fruit during the school day increased from eight students before the intervention to 26 two months into the intervention and 23 during the last week, a 186 percent increase.

*Knowledge Areas: 703 Nutrition Education and Behavior,
806 Youth Development*

- New knowledge applied to policy making for high school voter registration education.

Issue (Who cares and Why)

It is unclear how youth learn to participate in civic and political activities in high school. While high schools follow education codes, and social science frameworks and standards, there is a gap between what the research on youth civic engagement states are effective practices and how high schools are teaching youth the skills necessary to participate in a democratic society.

What has been done

A UCCE advisor worked with the California Civic Engagement Project, at the UC Davis Center for Regional Change, and provided research based information. The UCCE advisor's research paper on high school voter registration education is currently the only one that describes what is/is not happening in high schools on this topic.

Results

The Director of the California Civic Engagement Project was invited to offer testimony for AB 1817 Voter registration: high school pupils. The UCCE research-based information, as well as other information was shared during that testimony. AB 1817 was signed by Governor Brown on July 16, 2014. This is the first bill on the topic of high school voter registration education that incorporates identical language for an electoral and an educational code.

Knowledge Area: 806 Youth Development

- A new tool to support youth well-being is utilized.

Issue (Who cares and Why)

A key step in fostering healthy families and communities is presenting accurate, compelling and actionable community-scale data about the condition of youth. California wants and needs for its youth to thrive, not merely to survive or face fewer problems. But how do we know whether our young people are doing well?

What has been done

UCCE joined together with the UC Davis Center for Regional Change and UC Cooperative Extension to develop an interactive website, Putting Youth on the Map (PYOM), that presents two georeferenced youth indices plus 46 additional data layers. The data on these interactive maps allow users to identify areas where youth are becoming vulnerable to making unhealthy transitions to adulthood at relatively high rates, identify areas with relatively strong composite pictures of adolescent well-being, and provide baseline data for

tracking change in the conditions of youth. Over 130 youth, family or community development professionals participated in two introductory webinars.
(See <http://interact.regionalchange.ucdavis.edu/youth/>)

Results

Several non-profit youth-serving organizations have used the site to inform their grant development. Youth advocates have used the site as part of leadership training for young people. The Yolo County collaborative is using site data to inform action to support youth well-being. 4-H Youth Development Advisors are using the site for their county needs assessments.

Knowledge Area: 703 Nutrition Education and Behavior

e) Social/Health Condition Changes

- Low-income Californians increase food security.

Issue (Who cares and Why)

A 2012 UCLA Health Policy Brief reported that 3.8 million low-income adults in California were food insecure. Food insecurity affects academic achievement, increases the risk of obesity and chronic disease and impairs mental health. Providing low-income families with food education along with resource management skills can help improve the overall health and food security of the household.

What has been done

In 2011, UCCE nutrition advisors responded to the need for food resource management education by developing a four-lesson series called Plan, Shop, Save, and Cook (PSSC). UCCE CalFresh Nutrition Program educators began teaching the PSSC series statewide in 2011. During each one-hour lesson, participants learned and practiced skills to help them eat healthier on their limited budgets. Skill building activities included planning healthy meals based on the 2010 Dietary Guidelines for Americans, writing a shopping list for their menus, using food labels to select healthy foods and beverages, identifying the lowest cost product option by using unit pricing, and tasting easy to prepare, low-cost healthy recipes. Participants also learned about cooking and storage techniques to save time and avoid food waste.

Results

UCCE statewide evaluation data collected from 3,744 individuals from 2011-2013 indicated that participant improvement in food resource management skills ranged from 53 percent in reading food labels to 38 percent in comparing prices. The participants not only improved their resource management skills to eat healthier, but also improved

their food security by 37 percent (as measured by not running out of food). Specifically, participants who received federal food assistance through the SNAP program and made greater improvements in their resource skills reported the greatest improvement in food security.

Knowledge Area: 704 Nutrition and Hunger in the Population

- School communities are healthier.

Issue (Who cares and Why)

The prevalence of childhood obesity leads to negative health consequences, including Type 2 adult diabetes, high blood pressure, heart and vascular disease, and others, which contribute to a shortened life span. During the early years of life children form eating habits for a lifetime, learn healthy food options essential for normal/optimal growth and development, and should be engaging in daily physical activities. Federal law requires every school district to have local wellness policies to address nutrition education, physical activity, schools meals, and other foods and beverages available at school.

What has been done

Twenty five early childhood teachers and directors from 14 sites representing over 600 children, in the Fremont and Hayward Unified School Districts, State preschools, and YMCA Head Starts, were trained on the Let's Move early care and education curriculum. In addition, nutrition and physical activity guidelines were drafted and expected to be approved and adopted during the 2014/15 school year.

Results

Individual teachers have already begun making healthy displays and changes in their classrooms and play areas. Teachers have adopted the practices learned, including incorporate gardening, taste tests of fruits or vegetables the students have never had before, dancing three times a week, etc. Students have started bringing water to school, and are telling their parents to drink water rather than soda. The parents have tried the healthy recipes at home and are asking for more recipes. The school administration increased purchasing fruits and vegetables from once per month to weekly; bread and crackers are whole grain; and they are buying less sugary cereals.

Knowledge Areas: 703 Nutrition Education and Behavior, 724 Healthy Lifestyle, 806 Youth Development

7) Healthy Families and Communities Planned Program External Factors

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government regulations
- Competing public priorities
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

During FY 2014, California continued to face its worst drought in decades. Water supply and quality for agricultural, urban, and environmental systems has become one of the state's biggest challenges. UC ANR has focused efforts to serve as a resource both in offering everything from near-term management advice to farmers and ranchers to the innovative work being carried out by researchers on a vast array of issues from drought resistant crops to snow sensors to climate change.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights UC ANR's most significant work during FY 2014, especially the research developments. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.

B) Sustainable Food Systems

1) Sustainable Food Systems Planned Program Knowledge Areas

KA Code	Knowledge Area	%1862 Extension	%1862 Research
102	Soil, Plant, Water, Nutrient Relationships	14%	5%
111	Conservation and Efficient Use of Water	2%	2%
201	Plant Genome, Genetics, and Genetic Mechanisms	1%	18%
202	Plant Genetic Resources	3%	5%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	4%	9%
204	Plant Product Quality and Utility (Preharvest)	7%	5%
205	Plant Management Systems	31%	5%
206	Basic Plant Biology	1%	15%
211	Insects, Mites, and Other Arthropods Affecting Plants	2%	2%
212	Pathogens and Nematodes Affecting Plants	1%	4%
302	Nutrient Utilization in Animals	4%	4%
307	Animal Management Systems	11%	1%
502	New and Improved Food Products	2%	4%
503	Quality Maintenance in Storing and Marketing Food Products	2%	3%
601	Economics of Agricultural Production and Farm Management	6%	3%
702	Requirements and Function of Nutrients and Other Food Components	0%	7%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	4%	2%
723	Hazards to Human Health and Safety	1%	2%
	Total	100%	100%

2) Sustainable Food Systems Planned Program Inputs

Actual amount of professional FTE/Sys expended this program

Year: 2014	Extension	Research
Plan	122.8	132.0
Actual Paid Professional	7.5	17.5
Actual Volunteer	0.0	0.0

Actual dollars expended in this program (includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c	Hatch
1,007,462	1,947,597
matching	matching
1,007,462	1,947,597
all other	all other
39,549,983	97,102,148

3) Sustainable Food Systems Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities will conduct research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Food producers (e.g. farmers/ranchers and rangeland owners/operators/managers, including conventional organic, small and large producers)
- Agricultural advising professionals (e.g. Pest Control Advisors, crop advisors, landscape professionals)
- Allied industry companies including seed and supply companies
- Food processors, handlers, retailers, and suppliers
- Public regulatory agencies and private non-profit advocacy groups
- Food consumers, members of the general public

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to many Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes.

4) Sustainable Food Systems NIFA Defined Standard Output Measures

FY 2014	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	380,245	0	7	88	336	424

Patents listed:

1. DNA DEMETHYLATION IN THE ARABIDOPSIS GENOME
2. SNP DISCOVERY IN CANDIDATE GENES FOR CATTLE LIPID COMPOSITION
3. HARD WHITE SPRING WHEAT VARIETY "PATWIN-515"
4. DURUM WHEAT VARIETY MIWOK
5. STAYGREEN MAIZE: ENGINEERING SINGLE-GENE-CONTROLLED STAYGREEN POTENTIAL INTO PLANTS
6. STAYGREEN MAIZE: GENES WHICH PRODUCE STAYGREEN CHARACTERISTICS IN MAIZE AND THEIR USES
7. USE OF A NATURAL METABOLITE (ADENOSINE) TO INCREASE FRUIT SIZE AND YIELD

5) Sustainable Food Systems State Defined Outputs

FY 2014	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	News-letters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	926	90	126	28	38	252	10	22

6) Sustainable Food Systems State Defined Outcomes

a) Knowledge Changes

- 157 farm and ranch owners/managers and allied industry professionals, participating in the programs, gained knowledge of crop and varietal selection factors and research-based performance data.
Knowledge Areas: 202 Plant Genetic Resources, 204 Plant Product Quality and Utility (Preharvest)
- 1289 farm, ranch, landscaping owners/managers and allied industry professionals, participating in the programs, gained knowledge of aspects of comprehensive management systems for plant and animal production.
Knowledge Areas: 102 Soil, Plant, Water, Nutrient Relationships, 204 Plant Product Quality and Utility (Preharvest), 205 Plant Management Systems, 206 Basic Plant Biology, 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Diseases and Nematodes Affecting Plants, 302 Nutrient Utilization in Animals, 307 Animal Management Systems, 601 Economics of Agricultural Production and Farm Management
- 222 farm and ranch owners/managers, participating in the programs, gained knowledge of business management practices and marketing strategies, including the costs and risks associated with producing specialty crops.
Knowledge Areas: 601 Economics of Agricultural Production and farm management, 604 Marketing and Distribution Practices

b) Attitude Changes

- 51 farm and ranch owners/managers and allied industry professionals, participating in the programs, were more likely to try out or adopt recommended cultural practices, pest and disease management, or other aspects of comprehensive management systems for animal and plant production.
Knowledge Areas: 102 Soil, Plant, Water, Nutrient Relationships, 203 Plant Biological Efficiency and Abiotic Stresses Affecting Plants, 204 Plant Product Quality and Utility (Preharvest), 205 Plant Management Systems, 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Diseases and Nematodes Affecting Plants, 307 Animal Management Systems

c) Skill Changes

None reported

d) Behavior Changes

- 504 participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources. (National Outcome Indicator)

e) Social/Health Condition Changes

None reported

f) Environmental Changes

None reported

g) Economic Changes

- Economic study helped determine winegrape growers' compensation of \$5.6 million for vineyard losses.

Issue (Who cares and Why)

From 1998 to about 2000, more than 40 percent of the Temecula Valley vineyards were removed due to Pierce's disease, which is spread by the glassy-winged sharpshooter. In 2000, the California Department of Food and Agriculture received money from the federal government to provide compensation to growers and alleviate the impact of their losses caused by this disease. In order to process the amount of compensation, both the growers and CDFA required current information on production practices and costs of establishment for winegrape production in the impacted areas.

What has been done

An economic study analyzing the costs of establishment and production was developed for wine grapes in Temecula, Riverside County. This study detailed production practices, and estimated and analyzed the capital needed to establish vineyards and produce winegrapes in the area. The study was developed in cooperation with growers using the practices and costs of their vineyard establishment and production.

Results

Winegrape growers in Temecula received \$5.6 million in compensation from CDFA for their vineyard losses due to Pierce's disease. The amount of the compensation was determined using the values and analysis presented in the UC economic study. The costs of establishment and production provided both growers and CDFA the detailed cultural practices and economic basis for discussion and determination of a fair compensation. This compensation enabled many of the growers to replant their vineyards and stay in the business of winegrape production. The Temecula wine grape industry has recovered many of its losses and continues to build the economy of the community. In 2005, the industry contributed about \$4 million in crop value to the economy. The revival of the industry also restored employment in agriculture and service industries. It enabled the wine industry to stabilize and continue generating income to the community through tourism.

Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants

- Precedence set for grower gains to increased market opportunity overseas and greater economic competitiveness.

Issue (Who cares and Why)

Off shore markets can be difficult to acquire especially when Pest Risk Assessments (PRA) are needed. PRAs are reviewed by the local agricultural commissioner, the United States Department of Agriculture Animal Plant Health Inspection Service and the receiving country. The process can halt at any level. Many growers find it daunting to write a technical PRA.

What has been done

UCCE provides the needed expertise to help growers write the technical Pest Risk Assessments(PRA).

Results

Through UCCE assistance, one ornamental plant grower successfully completed the PRA opening the market opportunity with Guatemala. A template was developed for other growers to use in acquiring markets in Guatemala and other countries.

Knowledge Areas: 604 Marketing and Distribution Practices

7) Sustainable Food System Planned Program External Factors

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public policy changes
- Government regulations
- Competing public priorities
- Populations Changes (immigration, new cultural groupings, etc.)

8) Sustainable Food Systems Planned Program Evaluation Studies

Evaluation Results

UC ANR's quantitative and qualitative outcomes recorded from the evaluation studies are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights UC ANR's most significant work during FY 2014, especially the research developments. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.

C) Sustainable Natural Ecosystems

1) Sustainable Natural Ecosystems Planned Program Knowledge Areas

KA Code	Knowledge Area	%1862 Extension	%1862 Research
101	Appraisal of Soil Resources	3%	3%
102	Soil, Plant, Water, Nutrient Relationships	3%	13%
111	Conservation and Efficient Use of Water	6%	4%
112	Watershed Protection and Management	3%	3%
121	Management of Range Resources	18%	4%
122	Management and Control of Forest and Range Fires	6%	1%
123	Management and Sustainability of Forest Resources	20%	1%
131	Alternative Uses of Land	4%	2%
132	Weather and Climate	2%	8%
133	Pollution Prevention and Mitigation	2%	8%
135	Aquatic and Terrestrial Wildlife	10%	4%
136	Conservation of Biological Diversity	10%	13%
141	Air Resource Protection and Management	7%	8%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	1%	3%
212	Pathogens and Nematodes Affecting Plants	0%	3%
305	Animal Physiological Processes	0%	3%
311	Animal Diseases	0%	3%
605	Natural Resource and Environmental Economics	4%	8%
610	Domestic Policy Analysis	1%	5%
702	Requirements and Function of Nutrients and Other Food Components	0%	3%
	Total	100%	100%

2) Sustainable Natural Ecosystems Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2014	Extension	Research
Plan	31.4	70.4
Actual Paid	6.2	9.1
Actual Volunteer	0.0	0.0

Actual dollars expended in this program (includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c	Hatch
977,267	958,247
matching	matching
977,267	958,247
all other	all other
11,199,343	60,557,576

3) Sustainable Natural Ecosystems Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities conducted research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Farmers
- Ranchers
- Inland fishery owners/operators
- Governmental agencies
- Agricultural and fishing organizations
- Owners/managers of private and public rangeland, forest and wildlands
- Community organizations
- Resource managers

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes. The Division looks forward to the re-invention into a system of greater value to California Extension

4) Sustainable Natural Ecosystems NIFA Defined Standard Output Measures

FY 2014	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	43,882	0	5	65	336	401

Patents Listed

1. Engineering Isoprene (C₅H₈) Hydrocarbons in Cyanobacteria
2. BIOLOGICAL ACTIVITY OF YX ALLELES OF PHYTOCHROME EXPRESSED IN TRANSGENIC PLANT
3. A RECOMBINANT ENDO-BETA-1,2-XYLANASE FROM THE THERMOPHILIC ACIDOPHILIC CELLULOLYTIC BACTERIUM ACIDOTHERMUS CELLULOLYTICUS WITH ACTIVITY FROM
4. PRODUCTION OF CELLULASE ENZYMES IN PLANT HOSTS USING TRANSIENT AGROINFILTRATION
5. A NOVEL APPROACH TO FUNCTIONAL GENOMIC STUDIES OF THE SUPERFAMILY OF RECEPTOR-LIKE PROTEIN KINASE-RLK's) IN PLANTS

5) Sustainable Natural Ecosystems State Defined Outputs

FY 2014	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	New s-letters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	56	54	15	5	8	138	1	2

6) Sustainable Natural Ecosystems State Defined Outcomes

a) Knowledge Changes

None Reported

b) Attitude Changes

None Reported

c) Skill Changes

None Reported

d) Behavior Changes

- e) New knowledge on ecosystem services is applied to conservation decision making.

Issue (Who cares and Why)

Land managers have restored river and stream banks using revegetation technologies with native plant material for over four decades in coastal California, achieving multiple ecosystem functions and natural resource management objectives. The number of river and stream restoration projects in the United States has steadily increased since the 1980s, with over \$2 billion spent on river restoration in California. There is a need for new knowledge to understand long term carbon sequestration potential within coastal California streams to maximize these ecosystem services. More science-based information is needed to inform policies and programs to mitigate greenhouse gas emissions and develop market driven incentives for carbon sequestration.

What has been done

The UC ANR watershed team is completing a novel pilot study of carbon sequestration and nutrient cycling resulting from watershed restoration and riparian revegetation. The researchers collaborated with Natural Resource Conservation Service, Resource Conservation Districts and restoration consultants to locate revegetation sites. Landowners and land managers provided permission to access property and information about previous stewardship projects, grazing management and ranch history. 42 sites were sampled ranging from 0 to 45 years in time since restoration (i.e. project age) documenting carbon. In addition to wildlife habitat and water quality, watershed restoration appears to have also improved air quality. Total and labile carbon increase over time as project age increases. Multivariate analysis is in progress to ascertain if keystone species or certain functional groups maximize long-term carbon storage. Research findings are being disseminated on multiple levels to local partners, regional programs and international disciplines.

Results

The conservation partnership, including, most importantly, its farmers and ranchers have a fuller appreciation for what they have accomplished, and are applying the results towards options to improve long-term agricultural viability.

Landowners are prioritizing new sites for conservation and restoration projects, in addition to organizing old ranch photos that document pre-project conditions of previously restored sites. Local Resource Conservation Districts are implementing water quality trading credits, and grant funds are being leveraged to install new stream restoration projects. Policies encouraging ecosystem services have also utilized the results to validate how conservation practices have improved numerous ecological attributes and functions.

Knowledge Area: 112 Watershed Protection and Management, 132 Weather and Climate

- County urban plan made more sustainable.

Issue (Who cares and Why)

Conservation is a highly important issue to urban communities. Science-based information is needed on landscape water management, hazard tree assessment and management, pest management, and sustainable tree care. There is interest to minimize the use of pesticides in urban areas through using pest resistant varieties. Each year, structural failures in urban trees cause property damage and/or personal injury, and cities spend thousands of dollars each year repairing damage to sidewalks, curbs, and gutters caused by tree roots.

What has been done

UCCE provides educational programs and research in urban forestry, to support city and county parks, green space managers, street tree programs, commercial tree and landscape professionals, schools, and nonprofit environmental groups. Working with the California Department of Water Resources, UCCE developed a method of determining water needs of urban landscapes, and over 1,500 species of landscape plants have been assessed. Information on key risk factors in standing trees in order to assess the potential for failure, and strategies to reduce damage has been collected and shared. During 2014, UCCE provided two head planners for Santa Clara County working on a tree species selection with information on the pest vulnerability of their tree palette.

Results

Decision-makers were informed on tree species selection for Santa Clara County's 2050 Urban Greening plan, which greatly enhanced the sustainability of the tree planting plan. The resilience to pests and diseases of the county's future urban forest will be improved.

Knowledge Area: 123 Management and Sustainability of Forest Resources

- Cattlemen Association formally adopted a new tool to help ranchers show they are good stewards.

Issue (Who cares and Why)

There is increasing pressure on ranchers to show their stewardship of the land and natural resources. The laws or regulations covering water quality, endangered species, air quality, and food safety are increasing. Citizens have a

great interest in having clean water, safe food and a healthy ecosystem. At the same time private land owners are feeling that these outside regulations are suppressing their private property rights. It is important for ranchers to show they are good stewards and yet be able to earn a living from the land they own.

What has been done

A UCCE project was designed to help ranchers show they are managing properly, by creating and implementing a voluntary self-assessment program to evaluate all aspects of ranching operations to ensure the sustainability of production, lands, and families. UCCE held several planning meetings including CE advisors and specialists, the Ranch Committee, members of the National Grazing Lands Coalition and the Natural Resources Conservation Service (NRCS). UCCE organized workshops to "Beta Test" the Ranching Sustainability Analysis (RSA) system for its clarity and usefulness. In addition, through three other workshops and a ranch water quality short course portions of the RSA were discussed.

Results

Implementation of the Ranching Sustainable Analysis (RSA) program has been slow, but it is starting to take off. The San Luis Obispo Cattlemen Association has formally adopted the RSA. In addition, the National Grazing Lands Coalition is now on board.

Knowledge Area: 121 Management of Range Resources

e) Social/Health Condition Changes

None reported

f) Environmental Condition Changes

- Native bee habitat and populations increase on agricultural land.

Issue (Who cares and Why)

Although some agricultural activity has a negative impact and is partially responsible for decline of wild native and honey bees, agricultural land has the potential to provide habitat for local wild native and honey bees. There is a need to identify appropriate "best practices" for habitat management by farmers, that won't overburden their already busy daily routines even if it produces clear benefits to crop production.

What has been done

UC ANR researchers have worked together to survey and evaluate ecological relationships of native California bee species and their flowers in selected agro and urban ecosystems. They have installed native bee plants and artificial nests, conducted bee monitoring to identify key bee species, and led many outreach and education workshops, presentations, and tours. Topics covered: the basics of bee-plant relationships, host plant selection, habitat installation and maintenance, native bee ecology, basic identification, and monitoring. In addition, scientific papers have been published and posters presented at major conferences. A new book is also now available: *California Bees and Blooms: A Guide for Gardeners and Naturalists*. Lastly, a

website is maintained with up-to-date information (www.helpabee.org).

Results

There have also been significant changes in perceived value of native bees. Farmers are now paying attention to how their actions may impact native bees. The farmers and farmworkers now look for and identify native bees on the planted habitats. In addition, farmworkers learned to identify California annuals and avoid them when weeding. There are 18 newly established acres of native bee habitat on the treatment farms. While more study is required, it appears these habitats are working to increase native bee populations on the treatment farms, and may be supporting increased populations of native bees overall. Some farmers have recognized the marketing value of their new habitats, particularly as the media continues to focus on honey bee decline.

Knowledge Area: 136 Conservation of Biological Diversity

g) Economic Changes

- Dairy producers meet regulatory compliance and receive savings.

Issue (Who cares and Why)

Dairy operators have identified the need for education and assistance to understand what is necessary for environmental compliance related to Waste Discharge Requirements and Air District requirements.

What has been done

UCCE continued work on the California Dairy Quality Assurance Program (CDQAP), collaborating with all pertinent regional regulatory agencies. Previously successful outreach methods, including workshops, fact-sheets and industry newsletters, continued to be used to provide up-to-date information and compliance assistance to dairy operators and their consultants. Classes were offered to provide updates on regulatory requirements and support producers in meeting the program's educational requirements for certification (6 hours of water quality and 2 hours of air quality). Classes were attended by producers who did not yet have the minimum education requirements. Forty one producers completed education requirements for certification.

Results

Third-party evaluation and certification continued to be successful, allowing participating producers to confirm regulatory compliance and enjoy 50% reduced water permit fees. 78 facilities were evaluated with 27 first-time certifications and 45 re-certifications in 2013-2014. The fee discount is valued at approximately \$300 to \$5,000 per facility per year, depending on dairy size. A total of 668 facilities were eligible for fee discounts. Based on the 2014-2015 state water board fee schedules this has an estimated savings for producers of between \$1.1 and \$1.6 million.

Knowledge Area: 133 Pollution Prevention and Mitigation

7) Sustainable Natural Ecosystems Planned Program External Factors

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public policy changes
- Government regulations
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)

8) Sustainable Natural Ecosystems Planned Program Evaluation Studies

Evaluation Results

UC ANR's quantitative and qualitative outcomes recorded from the evaluation studies are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights UC ANR's most significant work during FY 2014, especially the research developments. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.

D) Endemic and Invasive Pests and Diseases

1) Endemic and Invasive Pests and Diseases Planned Program Knowledge Areas

KA Code	Knowledge Area	Extension	Research
102	Soil, Plant, Water, Nutrient Relationships	1%	0%
111	Conservation and Efficient Use of Water	0%	1%
133	Pollution Prevention and Mitigation	0%	2%
135	Aquatic and Terrestrial Wildlife	2%	3%
136	Conservation of Biological Diversity	1%	3%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	2%
206	Basic Plant Biology	1%	2%
211	Insects, Mites, and Other Arthropods Affecting Plants	13%	13%
212	Diseases and Nematodes Affecting Plants	20%	35%
213	Weeds Affecting Plants	13%	3%
214	Vertebrates, Mollusks, and Other Pests Affecting Plants	1%	0%
215	Biological Control of Pests Affecting Plants	3%	11%
216	Integrated Pest Management Systems	41%	8%
305	Animal Physiological Processes	0%	4%
311	Animal Diseases	1%	3%
312	External Parasites and Pests of Animals	1%	2%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%	1%
721	Insects and Other Pests Affecting Humans	2%	2%
722	Zoonotic Diseases and Parasites Affecting Humans	0%	3%
723	Hazards to Human Health and Safety	0%	2%
	Total	100%	100%

2) Endemic and Invasive Pests and Diseases Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2014	Extension	Research
Plan	73.9	89.0
Actual Paid Professional	6.6	9.7
Actual Volunteer	0.0	0.0

Actual dollars expended in this program (includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c 938,924	Hatch 1,125,479
matching 938,924	matching 1,125,479
all other 25,651,165	all other 76,099,521

3) Endemic and Invasive Pests and Diseases Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities conducted research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Farmers
- Ranchers
- Rangeland owners/managers
- Landscaping professionals
- Owners/operators of allied agricultural industries
- General public
- Crop and pest consultants

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes. The Division looks forward to the re-invention into a system of greater value to California Extension.

4) Endemic and Invasive Pests and Diseases NIFA Defined Standard Output Measures

FY 2014	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	105,114	0	5	208	273	481

Patents Listed

1. USE OF CMQ, A SYNTHETIC PLANT DEFENSE ELICITOR, FOR THE DEVELOPMENT OF PESTICIDES
2. AVOCADO ROOTROT RESISTANT ROOTSTOCKS-PP4: AVOCADO ROOTSTOCK NAMED 'ZENTMYER'
3. AVOCADO ROOTROT RESISTANT ROOTSTOCKS-PP14: AVOCADO VARIETY NAMED 'UZI'
4. AVOCADO ROOTROT RESISTANT ROOTSTOCKS-PP27: AVOCADO VARIETY NAMED 'STEDDOM'
5. A MOLECULAR METHOD FOR UNIVERSAL DETECTION OF CITRUS VIROIDS

5) Endemic and Invasive Pests and Diseases State Defined Outputs

FY 2014	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	News-letters	Web Sites	Research projects
Actual	46	34	19	19	18	217

6) Endemic and Invasive Pests and Diseases State Defined Outcomes

a) Knowledge Changes

- 852 farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, gained knowledge of integrated pest management strategies and techniques.

Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Diseases and Nematodes Affecting Plants,

213 Weeds Affecting Plants, 216 Integrated Pest Management Systems, 312 External Parasites and Pests of Animals

- 614 farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, gained knowledge of pesticide and pharmaceutical efficacy and optimal use.

Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Diseases and Nematodes Affecting Plants, 213 Weeds Affecting Plants

- 234 farm, ranch, rangeland, landscaping, and boat owner/operators and managers, allied industry professionals, and members of the public participating in the programs, gained knowledge of prevention, detection, and treatment strategies and techniques for management of invasive species.

Knowledge Areas: 135 Aquatic and terrestrial Wildlife, 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Diseases and Nematodes Affecting Plants, 213 Weeds Affecting Plants, 216 Integrated Pest Management Systems, 312 External Parasites and Pests of Animals

b) Attitude Changes

- 115 farm, ranch, rangeland, and boat owner/operators, pest control advisers, and other allied industry professionals, participating in the pest and disease management programs, were more willing to adopt recommended strategies and techniques to control endemic and invasive pests and diseases.

Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Diseases and Nematodes Affecting Plants, 213 Weeds Affecting Plants, 214 Vertebrates, Mollusks, and Other Pests Affecting Plants, 216 Integrated Pest Management Systems, 311 Animal Diseases, 312 External Parasites and Pests of Animals

c) Skills Changes

None reported

d) Behavior Changes

- 125 farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, adopted recommended prevention, detection and monitoring, and treatment practices for integrated pest management.

Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Diseases and Nematodes Affecting Plants,

213 Weeds Affecting Plants, 216 Integrated Pest Management Systems, 312 External Parasites and Pests of Animals

- Public workers adopt practices that improve detection and prevention of aquatic pests.

Issue (Who cares and Why)

Aquatic invasive species cause significant economic and ecological problems. Quagga and zebra mussels clog water supply systems and deplete plankton. Tiny New Zealand mudsnails displace native snails. Invasive bullfrogs and clawed frogs voraciously consume native species and carry a disease that has decimated native frog populations. Dense mats of invasive waterweeds slow water flow in streams and irrigation channels, block boats, and kill native species by blocking out sunlight and causing oxygen levels to fall. However, much of the damage can be reduced if people who work in aquatic habitats are trained. They can help lower the risks of spreading invasive species to new areas and serve as eyes and ears for resource agencies with a mission to manage and control these pests.

What has been done

In spring 2013, UCCE advisors in Southern California conducted six workshops for 181 staff members of local public works, parks, watersheds and flood control agencies as well as for staff members of a UC Research and Extension Center. The participants learned how to recognize 25 aquatic invasive species, decontaminate their field gear, plan their work to reduce risks of spreading these pests, and report sightings to resource agencies. Forty-nine percent of the participants were minorities and 29 percent were women. Through hands-on exercises, they practiced identifying species, detecting them in mud, inspecting boats and decontaminating boots. The advisors distributed decks of laminated reference cards (with photographs and information), which they created, at workshops. More than 14,000 people learned about aquatic invasive pests from the advisors' blog articles that were based on their workshops.

Results

The participants significantly increased their ability to identify aquatic invasive species and their environmental impacts, their knowledge of how to report sightings, and their skills on how to decontaminate their gear and avoid spreading these pests. According to survey results, 80 to 90 percent of participants reported learning this information for the first time at one of the workshops. Within the first few following months, agencies reported having made changes. Two agencies implemented new or improved their existing decontamination protocols for field gear and planned their work accordingly to prevent the spread of aquatic pests. Two agencies educated the public on how to prevent the spread of pests by posting signs and talking to visitors at lakes. Five aquatic pest sightings were reported to field supervisors and a New Zealand mudsnail infestation was reported to three natural resources agencies. Altogether, these actions will help to prevent the spread of pests in areas where the workshops were conducted - all 2.5 million acres.

Knowledge Areas: 216 Integrated Pest Management Systems

- Policy makers apply new knowledge and designate additional pests and disease as significant threats to the California grape industry.

Issue (Who cares and Why)

Vineyard managers, owners, viticulturists and pest control advisors in California have a commitment to agricultural sustainability in the face of three new significant pest management challenges: vine mealybug and brown marmorated stink bug and red blotch disease. More information is needed to learn to manage these.

What has been done

During 2014, UCCE provided guidance and input into revamping the process by which the California Department of Food and Agriculture's Pierce's Disease/Glassy-winged Sharpshooter (PD/GWSS) Board evaluates and designates pests and diseases as important.

Results

The UCCE input was critical in securing the PD/GWSS Board designating these two additional pests and one disease as significant threats to the California grape industry. State and federal funds, as well as grower assessments, fund PD/GWSS Board research projects. This funding can now be leveraged to develop management practices and to conduct outreach and education for these additional two pests and one disease.

Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Diseases and Nematodes Affecting Plants

- Strawberry growers adopt pest management practice that reduces the environmental impact of fumigants.

Issue (Who cares and Why)

California produces 90% of the strawberries in the United States. Since the 1960s growers have relied on the soil fumigant methyl bromide. In 2005 under the Montreal Protocol, developed countries banned methyl bromide to protect the stratospheric ozone layer, except for "critical use" exemptions. California strawberry growers have been operating under these exemptions, given the lack of alternatives that are both effective and affordable. In 2013 California strawberries alone accounted for 73% of the total exemptions nationwide. The exemptions continue to shrink. Soil-borne pest control in strawberries is increasingly difficult without methyl bromide and is a priority issue in non-fumigated production.

What has been done

UC ANR academics have developed strong external stakeholder engagement with commercial strawberry growers and the California Strawberry Commission. UC research is critical to finding cost effective and environmentally sustainable alternatives to methyl bromide. UCCE evaluates chemical and non-chemical tools for soil borne pest control in strawberries. UCCE provides outreach on this

topic in 15 counties, including all those with strawberries as a leading commodity: Monterey, Ventura, Santa Barbara, San Luis Obispo and Santa Cruz.

Results

Fifty eight growers have adopted the practice of using impermeable films to retain fumigants to control soil-borne diseases in strawberries, which has greater efficacy and minimizes emissions, thus reducing environmental impact.

Knowledge Areas: 212 Diseases and Nematodes Affecting Plants

e) Social/Health Condition Changes

None reported

f) Environmental Changes

- Decreased prevalence of European Grapevine Moth (EGVM) in California.

Issue (Who cares and Why)

The European Grapevine Moth (EGVM) is a recently introduced pest to Napa County, the state of California, and North America. The 2010 growing season was the first time that vineyard owners, managers, and pest control advisors in Napa County were tasked with managing this insect. In 2010, 50% of the vineyard acreage in Napa County was treated with insecticides targeting this insect. Management efforts continue as the regulatory program attempts to eradicate this insect from California. There is an abundance of information in the literature about EGVM but all of this has to be verified for California.

What has been done

UCCE launched several applied research efforts as well as a strong outreach component. UCCE is studying the life cycle and host range of this insect in Napa, verifying the degree-day model, trapping and reporting trap catches and monitoring eggs to time insecticide sprays, and determining the efficacy of various combinations of insecticides. UCCE programs provide information on insect identification, biology, life cycle, and appropriate treatments in a timely fashion to growers, managers, and advisers. UC Advisors were a critical resource for scientific expertise and information during the course of the ongoing EGVM program, and continue to educate regulators, growers, and the general public about best management practices for management of EGVM in California.

Results

UCCE research, education and outreach have contributed to the following environmental improvements: 150,760 California vineyard acres were affected by EGVM regulatory program in 2010; by the fall of 2014, that number had been reduced to 49,312 acres. At the peak of the EGVM regulatory program, it affected growers in 10 California counties; as of 2014, that number has been reduced to two counties. In 2010, a total of 100,959 moths were captured in traps across California; in 2014, only one moth was caught in traps across California.

Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants

g) Economic Changes

- Growers reduce fungicide sprays, saving time and money and helping improve air quality.

Issue (Who cares and Why)

Powdery mildew is the number one grapevine disease in California, and sulfur is the most common fungicide used to manage it. Growers like sulfur because of its low cost and ease of application, and because it doesn't promote powdery mildew resistance. Used alone, sulfur requires frequent application, and can cause phytotoxicity and health concerns. Other fungicides, when combined with sulfur, can promote fungicide resistance. Growers can reduce these problems by implementing the UC Powdery Mildew Risk Index (PMI), which helps pinpoint the best times to apply fungicides.

What has been done

A UCCE viticulture advisor met regularly with San Joaquin Valley grape growers, focusing on powdery mildew disease. Using local weather data from the Fresno-Madera Weather Network, the advisor has shown growers how to implement and organize the PMI to develop spray programs using fungicides of their choice.

Results

Once growers see the exceptional results enabled by the PMI, they often commit entire vineyards to the new program. On 40-acre plots, growers can reduce costs, per eliminated application, of \$149 when using dusting sulfur, \$282 when using wettable sulfur, and \$689 when using a sterol inhibitor such as fenarimol. Many growers have eliminated three sprays when conditions were right.

Knowledge Areas: 212 Diseases and Nematodes Affecting Plants

- Growers cease unnecessary sprays, saving time and money.

Issue (Who cares and Why)

California is well known for producing a wide range of specialty vegetable crops that contribute to agricultural diversity, including parsley. Parsley is widely used in dried spice mixes, soups and other prepared foods. Significant acreage in parsley is also dedicated to fresh-market uses in salads and other recipes. In the past few years, growers began to observe unfamiliar disease issues in their parsley fields, contributing to loss of quality and reduced yields. Because parsley growers do not have an industry research board to address such concerns, a formal and organized grant program was not available to address these issues.

What has been done

UCCE stepped in to initiate investigations into these new parsley problems, collaborating with farmers and pest control advisers to understand the extent of the problems and to obtain samples of the diseased crops. UCCE was successful in isolating and identifying several pathogens those were responsible for causing the disease symptoms. Working with USDA researchers, they found

that three new diseases were present in California parsley crops: bacterial leaf spot, *Stemphylium* leaf spot, and *Apium* virus Y disease. The team subsequently studied these three pathogens to determine the range of susceptible crops and the possible source of the pathogens.

Results

Key research findings will enable growers to manage the problems. Previous to this research, some growers were spraying symptomatic fields because they believed that a disease called late blight was responsible. Based on UCCE findings, growers now know that late blight was not involved and that these applications are not useful for the new problems. Growers have ceased making these sprays, eliminating the use of unnecessary chemicals and saving costs. This research helped resolve a significant growing problem for this \$18 million California crop.

7) Endemic and Invasive Pests and Diseases Planned Program External Factors

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public policy changes
- Government regulations
- Competing Public priorities
- Population changes (immigration, new cultural groupings, etc.)

8) Endemic and Invasive Pests and Diseases Planned program Evaluation Studies

Evaluation Results

UC ANR's quantitative and qualitative outcomes recorded from the evaluation studies are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights UC ANR's most significant work during FY 2014, especially the research developments. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section

E) Sustainable Energy

1) Sustainable Energy Planned Program Knowledge Areas

KA Code	Knowledge Area	Extension	Research
102	Soil, Plant, Water, Nutrient Relationships	0%	2%
111	Conservation and Efficient Use of Water	0%	1%
123	Management and Sustainability of Forest Resources	22%	0%
133	Pollution Prevention and Mitigation	0%	1%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	10%
202	Plant Genetic Resources	0%	5%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	17%
204	Plant Product Quality and Utility (Preharvest)	0%	6%
205	Plant Management Systems	0%	3%
206	Basic Plant Biology	0%	24%
212	Pathogens and Nematodes Affecting Plants	0%	2%
402	Engineering Systems and Equipment	22%	1%
403	Waste Disposal, Recycling, and Reuse	0%	1%
503	Quality Maintenance in Storing and Marketing Food Products	0%	1%
511	New and Improved Non-Food Products and Processes	0%	16%
605	Natural Resource and Environmental Economics	22%	7%
608	Community Resource Planning and Development	34%	0%
609	Economic Theory and Methods	0%	1%
610	Domestic Policy Analysis	0%	1%
611	Foreign Policy and Programs	0%	1%
	Total	100%	100%

2) Sustainable Energy Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2014	Extension	Research
Plan	0.5	9.7
Actual Paid Professional	0.3	2.0
Actual Volunteer	0.0	0.0

Actual dollars expended in this program (includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c 37,471	Hatch 325,233
1862 matching 37,471	1862 matching 325,233
1862 all other 184,334	1862 all other 8,331,042

3) Sustainable Energy Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities will conduct research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Relevant agency and private-sector partners
- Lawmakers working on issues related to energy
- Members of the public in general
- Agricultural producers of crops for use as biofuels

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes. The Division looks forward to the re-invention into a system of greater value to California Extension.

4) Sustainable Energy Defined Standard Output Measures

FY 2014	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	0	0	0	0	29	29

Patents Listed:

1. A Colorimetric Bioessay for Perchlorate
2. Identification of New Genes and Proteins Associated With Plant Cell Wall Deconstruction in the Filamentous Fungus, Neurospora Crassa
3. Maize Mutant Variety with High Glucan Content

5) Sustainable Energy State Defined Outputs

FY 2014	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	News-letters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	0	0	0	0	0	12	0	0

6) Sustainable Energy State Defined Outcomes

a) Knowledge Changes

None reported

b) Attitude Changes

None reported

c) Skill Changes

None reported

d) Behavior Changes

- New sustainable management method adopted by one solar power company.

Issue (Who cares and Why)

A new solar farm covering 4,200 acres, formerly dry land farmed was being installed, and it was important to identify which species would provide the appropriate vegetative ground cover within the project site to prevent erosion and provide habitat for endangered species like the kit fox, kangaroo rat and burrowing owl. In addition, long term vegetation management is needed to prevent shading of solar panels and reduce fire risks.

What has been done

UCCE developed a re-vegetation study for the solar farm, working with scientists from Cal Poly and a consulting firm. UCCE helped to set up a grazing trial to

determine if sheep could be used to control vegetation instead of mowing or use of chemicals.

Results

The trial was successful and sheep are now used to control the vegetation around the panels. This allows for multi-purpose use including solar energy generation, grazing and wildlife habitat.

Knowledge Area: 605 Natural Resource and Environmental Economics

e) Social/Health Condition Changes

None reported

f) Environmental Condition Changes

None reported

g) Economic Condition Changes

None reported

7) Sustainable Energy Planned Program External Factors

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public Priorities
- Populations changes (immigration, new cultural groupings, etc.)

8) Sustainable Energy Planned Program Evaluation Studies

Evaluation Results

UC ANR's quantitative and qualitative outcomes recorded from the evaluation studies are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights UC ANR's most significant work during FY 2014, especially the research developments. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.

F) Water Quality, Quantity and Security

1) Water Quality, Quantity and Security Planned Program Knowledge Areas

KA Code	Knowledge Area	Extension	Research
102	Soil, Plant, Water, Nutrient Relationships	6%	26%
103	Management of Saline and Sodic Soils and Salinity	6%	1%
111	Conservation and Efficient Use of Water	34%	15%
112	Watershed Protection and Management	29%	11%
123	Management and Sustainability of Forest Resources	0%	2%
124	Urban Forestry	1%	0%
131	Alternative Uses of Land	0%	2%
132	Weather and Climate	2%	5%
133	Pollution Prevention and Mitigation	17%	6%
135	Aquatic and Terrestrial Wildlife	0%	4%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	2%
205	Plant Management Systems	1%	6%
206	Basic Plant Biology	0%	4%
311	Animal Diseases	0%	1%
403	Waste Disposal, Recycling, and Reuse	3%	1%
404	Instrumentation and Control Systems	0%	2%
405	Drainage and Irrigation Systems and Facilities	1%	1%
501	New and Improved Food Processing Technologies	0%	4%
605	Natural Resource and Environmental Economics	0%	5%
723	Hazards to Human Health and Safety	0%	2%
	Total	100%	100%

2) Water Quality, Quantity and Security Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2014	Extension	Research
Plan	24.2	11.7
Actual	2.0	1.0

Actual dollars expended in this program (includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c 363,510	Hatch 157,500
matching 363,510	matching 157,500
all other 8,594,082	all other 10,151,270

3) Water Quality, Quantity and Security Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities conducted research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Governmental agencies
- Water managers
- UC campus-based water centers
- The general public
- Farmers
- Ranchers
- Agricultural organizations
- Owners/managers of private and public rangeland, forest and wildlands

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to Communities for Practice, to answer "Ask an Expert" questions, and for other networking purposes. The Division looks forward to the re-invention into a system of greater value to California Extension.

4) Water Quality, Quantity and Security NIFA Defined Standard Output Measures

FY 2014	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	54,843	0	0	14	40	54

5) Water Quality, Quantity and Security State Defined Outputs

FY 2014	Classes/ Short Courses	Workshops	Demonstrations/ Field Days	Newsletters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	8	11	7	2	3	21	0	0

6) Water Quality, Quantity and Security State Defined Outcomes

a) Knowledge Changes

- 168 farm, ranch, and rangeland owners/managers and allied industry professionals, participating in water quality education programs, gained knowledge of best management practices for improving water quality.
Knowledge Areas: 111 Conservation and Efficient Use of Water, 112 Watershed Protection and Management, 133 Pollution Prevention and Mitigation
- 108 farm owner/operators and managers, and allied industry professionals, participating in agriculture education programs, gained knowledge of irrigation and water management practices.
Knowledge Areas: 102 Soil, Plant, Water, Nutrient Relationships, 103 Management of Saline and Sodic Soils and Salinity

b) Attitude Changes

None reported

c) Skill Changes

- 725 farm, ranch and landscape owner/operators and managers, and allied industry professionals, participating in agriculture education programs, gained skills in recommended irrigation or other water and soil management practices.

*Knowledge Areas: 102 Soil, Plant, Water, Nutrient Relationships,
103 Management of Saline and Sodic Soils and Salinity*

d) Behavior Changes

- 59 farm, ranch and nursery owner/operator and managers, and allied industry professionals, participating in agriculture education programs, adopted recommended irrigation or other water and soil management practices.

*Knowledge Areas: 102 Soil, Plant, Water, Nutrient Relationships,
103 Management of Saline and Sodic Soils and Salinity*

e) Social/Health Condition Changes

None reported

h) Environmental Condition Changes

None reported

g) Economic Condition Changes

None reported

7) Water Quality, Quantity and Security Planned Program External Factors

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public policy changes
- Government regulations
- Competing public priorities
- Populations changes (immigration, new cultural groupings, etc.)

8) Water Quality, Quantity and Security Planned Program Evaluation Studies

Evaluation Results

UC ANR's quantitative and qualitative outcomes recorded from the evaluation studies are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights UC ANR's most significant work during FY 2014, especially the research developments. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.