2015 University of California Combined Research and Extension Annual Report of Accomplishments and Results

Status: Accepted
Date Accepted: 06/24/2016

I. Report Overview

1. 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 is the principal outreach arm of the Division with academic appointees located across the state on campuses, Research and Extension Centers (RECs), and in counties. There are around 115 CE specialists and 175 CE advisors conducting research, outreach, and education. The CE specialists are located in departments on the Berkeley, Davis, Riverside, and, more recently, Merced campuses, as well as on RECs. The CE advisors are located in county-based offices and on RECs. The nine RECs, located in a variety of ecosystems across the state, provide a core research and extension base. In addition, eight statewide programs 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 2015
During FY2015 the UC Regents appointed new UC ANR Vice President Glenda Humiston. She has been working on funds development and finding new resources for UC ANR, not just money but also new partners and opportunities for collaboration. She continues the Division's aggressive effort to hire new CE academics to vigorously rebuild Cooperative Extension. Over the past several years more than 90 CE advisors and CE specialists have been hired. During FY2015 seven CE specialists and 15 CE advisors were hired, with 45 additional recruitments approved.

UC ANR completed the fourth round of the Division's internal competitive grants program, and will fund 17 projects for a total of $3.7 million over 5 years. This program continues to invest in short-term, high-impact research, education and outreach projects that address high-priority issues that are consistent with the Strategic Vision; encourage collaboration among academics; strengthen the research-extension network; and demonstrate relevance and likelihood of impact on significant agricultural, economic, environmental and social issues in California.

UC ANR continued to strive for increased administrative efficiency through reviewing county partnerships to help counties operate more efficiently. UC Cooperative Extension has three multi-county partnerships, which aim to save funds for the multiple participating counties and the University through administrative consolidation, while maintaining the strength of local programs.

UC ANR completed the second year of the 3-year pilot program for Graduate Training in Cooperative Extension, designed to train and recruit the next generation of CE specialists and CE advisors. This program partners UC Berkeley College of Natural Resources students with CE specialists and CE advisors as mentors to carry out extension-based projects that link to CE research through a competitive process. Five students made up the second Graduate Group in Cooperative Extension. They work on individual projects, and also continue to connect other graduate students to CE by hosting training events.

UC ANR continued 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 2015 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.

For FY 2015, 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 2015 program highlights for these Federal Planned Programs.

Healthy Families and Communities

The current generation of children may be the first to have shorter life spans than their parents. Nearly one-third of California's school children are classified as overweight/obese. The science achievement in the United States among K-12 youth has lagged behind many of their grade level peers from other countries for many years, prompting much concern, and putting nation's economic and national security at risk. K-12 students who score below basic levels will lack the foundational knowledge and skills necessary for scientific careers and full participation in today's knowledge society. Far too many California youth currently fail to reach their full potential. Each year, approximately 80,000 California youth do not graduate high school and approximately one of every six 16-24 year olds in the state is out of school and out of work.

The Healthy Families and Communities Initiative addresses the critical issues of childhood obesity,

positive youth development, and science literacy through of research, education and outreach. This year 57 Hatch and Multistate Research projects were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 18 research and extension projects. CE advisors worked on 247 extension projects, and led an additional 11 research projects. The following illustrates the breadth of work and includes selected examples of high impact projects and programs:

Childhood Obesity
In the U.S., 32 percent of children are overweight or obese. Campus-based researchers on UC Berkeley and UC Davis campuses have joined with county-based CE advisors to investigate and evaluate a range of childhood obesity issues, in a variety of settings including childcare, school, after-school, community, worksite, and health care venues. Intervention and prevention efforts point to the importance of multifaceted approaches to this complex issue that include both children and parents. Five components help to address these concerns: 1) Nutrition education and promotion, 2) family and community partnerships, 3) integration of regional agriculture, 4) foods available on the school campus and 5) school wellness policies. A few highlights follow:

- Shaping Healthy Choices Program (SHCP): created family partnerships through parent newsletters. The newsletters combined school-to-home lesson connections for the classroom-based nutrition, garden and physical activity curriculum and the information on parenting practices relevant to healthy diet and physical activity. The result was positive changes in parenting behavior linked to poor dietary quality and overweight children.
- Cooperative Extension and a County Health Department drafted policies for 14 sites that are being implemented during the 2015/16 school year. Preliminary outcomes during the policy development phase are positive, as evidenced by the actions taken by administrators, teachers, parents, and students. Administrators have increased the purchasing of fresh fruits and vegetables from monthly to weekly; all teachers promote healthy eating and physical activity in the classroom and the playground; parents promote healthy food at home; and children encourage parents to reduce the intake of sugary drinks.
- Forty-four youth completed the youth-only series and 38 youth completed the same series along with an adult member of their families. Participation in project influenced nutrition and physical activity knowledge, attitudes and behaviors. Compared with the youth-only group, parents who participated in the youth-adult series were more likely to express confidence in modifying recipes to reduce fat and sugar, while still maintaining acceptability with their families. Among the youth, there was an overall trend towards nutrition behavior change, with significant change observed in reduced soda and sports drink consumption. In addition, youth were better able to identify whole grains.

Human Nutrition and Health
In California, poor diet and a lack of physical activity are second only to tobacco use as the leading cause of chronic disease and death. The percentage of deaths attributable to poor diet and physical inactivity is on the rise and expected to surpass tobacco in the near future. Almost 25% of California adults report that they do not engage in any physical activity and 20% of 2 to 11 year olds report watching more than the recommended maximum of television or video games in a typical weekday. A couple of highlights follow:

- One nutrition study provided insight into the metabolic functions and the molecular mechanisms mediating actions. One important finding demonstrated that the effects of leptin treatment normalized fasting glucose levels in obese type 2 diabetes. Taken together, the findings suggest that PTPs helps in the regulation of glucose homeostasis and energy balance in vivo and further establish this signaling mechanism as potential therapeutic target for metabolic regulation.
- Another study was designed to understand that commensal microbes play in defining health and what changes can happen with disease or invasion of pathogens. The research findings reveal that infant feeding practices influence infant metabolism and succession of the microbiome and thus early infant nutrition is important for setting proper metabolic stage later in life.

Nutrition Education
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), the Supplemental Nutrition Assistance Program-Education Connection (SNAP-Ed; CalFresh Nutrition Education in California), and other locally based nutrition education activities. Communities develop knowledge, skills, attitudes, and behaviors to tackle social and health disparities associated with hunger, malnutrition, poverty, and obesity. Families change the way their families eat, practice food safety and food budgeting, and become more physically activity. A couple highlights follow:

- Educators reported that EFNEP and UC CalFresh low income, low-literate audiences found the text alone Food Behavior Checklist (FBC) traditionally used to evaluate series-based nutrition education difficult to understand. CE specialist and CEadvisors sought input from stakeholder participants to develop visually-enhanced versions of the EFNEP Checklist, based on the earlier work.
- The UC ANR Nutrition Policy Institute (NPI) published a study that helped the state of California regulators develop regulations for the beverages that can be served in childcare centers and homes that are more comprehensive than those in any other state. In addition, the NPI developed resources to help food banks and those that work with them improve the nutrition quality of the foods they distribute.

Youth Development
Estimates suggest that 10-12% of youth are disconnected from formal employment or educational systems and this could double in 25 years. 4-H's unique role in addressing these youth development challenges is based upon scientifically valid research. Non-formal education strategies and approaches, especially the 4-H Youth Development Program and its 4-H SET Initiative, provide innovative out-of-school models, curricula, deliveries, and professional development for effectively engaging youth in self-directed learning and discovery. There were more than 300,000 youth participating in 4-H programs in California across all delivery methods (i.e., club, school enrichment, camp, special interest). Of these, 98,000 youth engaged in Science, Engineering and Technology efforts; nearly 26,000 in citizenship projects and 239,500 in healthy lifestyle related projects. These experiences led to the following outcomes:

- 92% liked experimenting in testing ideas and 90% got excited from learning about new discoveries
- 86% enjoyed exploring other cultures; 100% respect people from other cultures; 97% gained skills through community service that will help them in the future; only 45% want to work in government
- 78% drink less soda; 97% can make healthier food choices; 69% reported being more physical active for 60 minutes/day; 95% avoid using a substance that can harm them (i.e, tobacco, alcohol).

Healthy Communities
Key to UC ANR fulfilling its Healthy Families and Communities vision are ongoing efforts to conduct applied research and extension activities that target the various dimensions of a community. A few highlights of community work follow:

- In two California Counties, there are nearly 2100 farms with 32% of them farmed by beginning farmers. The response, a Farm Business Planning program was developed to improve farm practices and profit margins while reducing risk and losses.

- As government policymakers determine how to allocate precious tax resources, there is one big question we must be able to answer: "Do community gardens actually improve access to fresh produce in low-income communities?" One project is working to develop a reliable method for documenting vegetable output and associated cost savings from community gardens. This will provide decision makers valuable data as they determine whether to support the increase in number and/or size of community gardens.
- The hazards in air, water, food, home environments are exacerbated in areas because of concentrated poverty and racial/ethnic segregation. One project involved the development, implementation

and impact assessment of environmental justice methodologies to improve the health and well-being of the most vulnerable, disadvantaged and under-served communities in rural areas of California.

• One research study focused on determining factors that shape consumer decision - making and sustainability. The study focused on factors which constrain and shape people's choices to buy green/healthier, more responsible products. The analysis from this project will help to inform decision-makers, companies, consumers and the general public information that shapes their decision making (i.e., environmental, company reputation, price) and facilitate the development of information systems across different issue areas.

• Another study analyzed contemporary issues in regional planning, community and urban design. This effort developed case studies of multi-sector partnerships, coalitions and citizen-led initiatives and new immigrant communities to document policies, practices and processes in the planning design and management and use of public spaces and community landscapes. This work seeks to shed light on a number of urban design issues concerning immigrant communities, refugee and minority communities.

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). 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.

The Sustainable Food Systems Initiative focuses on four broad areas: improving the competitiveness and productivity of agriculture; water; food safety; and supporting the sustainability of small farms, local and regional food systems, and urban agriculture. This year 213 Hatch and Multistate Research projects were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 69 research and extension projects. CE advisors worked on 501 extension projects, and led an additional 69 research projects. The following illustrates the breadth of work and includes selected examples of high impact projects and programs:

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. CSA surveys and 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.

• One project supports farm-to-school programs with evaluation research in seven Northern California school districts and provided results to school districts, community partners, and public policy makers. Work was also conducted in collaboration with other UC scientists on a multi-component farm-to-school to prevent obesity. Preliminary results show that children classified as overweight or obese dropped from 56% to 38% during the one year the Shaping healthy choices Program was implanted in Sacramento

County.

• In partnership with the Parks, Recreation and Neighborhood Services Department of the City of San Jose, California, researchers developed an easily reproduced method for weighing the vegetable output of community gardens. Ten community gardeners in San Jose used portable electronic scales to weigh vegetable output from their garden plots over a four-month, Spring-Summer growing season. Results indicate that community garden practices are similar to those of biointensive, high-production farming, a sustainable, small-scale farming system that focuses on soil quality without using nonrenewable resources. Based on retail prices for produce, each plot produced $435 worth of food for the season. Documenting the harvests of urban community gardens helps to define their role in the local food economy, particularly if crop yields are monetized, since most of the production and consumption takes place in an informal economy where dollar values are not otherwise tracked.

Specialty Crops

Selected examples highlighting accomplishments in this area follow:

• Some newer blackberry cultivars offer a different growth habit that includes primocane fruiting, meaning they bear fruit in the first year rather than the traditional second year. This challenges growers with new alternative management options, including pruning and thinning practices that would best optimize production. Researchers conducted field trials with primocane fruiting cultivars in San Luis Obispo, Santa Barbara, Ventura and Santa Cruz counties that generated critical, region-specific information to enhance management practices for primocane fruiting blackberries. This multi-year project, spread across three growing districts, identified management practices, including a mow-down in January, early pruning, and "tipping" to delay production. Because of these efforts, Coastal California berry growers have new tools to efficiently manage primocane fruiting blackberry cultivars efficiently and productively in order to target profitable market windows.

• A molecular genetic improvement project focusing on California's specialty crops has identified genetic regions in a wild tomato species conferring resistance to rapid-onset water stress caused by root chilling. The basis of this response is the ability to rapidly respond to water stress via root signaling to the leaves to close their stomata, thereby preventing wilting. Marker-assisted selection was used to obtain a set of sub-near-isogenic lines for this region that may be used as advanced generation tomato breeding lines as a genetic resource for breeding water-stress tolerant tomato cultivars.

• Because of the requirements for longer orchard productivity and production efficiency for processed compared to fresh-market fruit, new varieties need to be thoroughly tested in the different production regions and under the range of environment/cultural conditions anticipated for commercial production. During the last several years, over 5,500 trees of UC processing peach selections have been planted in regional evaluation blocks to accelerate the evaluation and release of improved varieties to the California industry. Regional variety testing expedited the 2014 release of the variety Kader, which provides California growers with a productive, high processing-quality and improved brown rot resistant variety with the desired harvest time between Carson and Andross varieties. Genetically novel selections developed to facilitate mechanical harvest and selections with a genetically controlled more compact tree architecture for facilitating mechanical orchard management (thin/prune/harvest) are currently being evaluated.

• 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. Developments included a hand-held sensor suite (HHSS) to measure leaf temperature, air temperature, relative humidity, photosynthetically active radiation (PAR), and wind speed in tree crops. The HHSS was very convenient to use in field conditions and was successfully evaluated in commercial almond and walnut orchards. Stepwise multiple linear regression models were produced to relate leaf temperature with plant water status and micro-climatic data. These models were validated to classify the trees into water stressed and not-stressed categories in almond and walnut crops, respectively. Development of these methods is critical in providing producers with tools that allow them to make informed irrigation decisions for greatest water use efficiency and 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.

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 64 individuals, who represent a large contingent of California-based fresh-cut processors, suppliers, researchers and quality control personnel were trained in the 19th annual Fresh-Cut Products Workshop, a 3-day course offered by instructors from the UC Postharvest Technology Research and Information Center.

Plant Production and Genetics
Selected examples highlighting accomplishments in this area follow:

• One project focuses on the conservation of tomato germplasm, including mutants, wild relatives, and other miscellaneous stocks, maintained by the C.M. Rick Tomato Genetics Resource Center. The Center acquired three new accessions of the wild species S. habrochaites from previously unrepresented geographic regions of Ecuador. They also regenerated more wild species accessions that we formerly considered inactive; and had never been grown. The current total of number of active accessions is 3,829. A total of 5,497 seed samples representing 2,046 unique accessions were distributed in response to 319 requests from 231 researchers and breeders in 33 countries. Feedback provided by recipients indicates the stocks continue to be used to support a wide variety of research and breeding projects.
• 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 many cases, this basic research may lead to marker-assisted breeding or other tools for new variety development.
• 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 investigates innovative conservation tillage practices in California.
• A series of projects have examined the genetic and biochemical pathways of photosynthesis in order to explore potential for increasing crop productivity.
• 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.
• In an effort to develop new salt-tolerant grain and forage crops for agriculture on saline soils in California and other western states, researchers have hybridized wheat and wheatgrass (tritipyrum). A total 970 backcross lines were self-pollinated for one generation. Self-pollination of this material is planned for another three more generations before the material is assessed for salt tolerance and perennial growth habit in the resulting backcross recombinant inbred lines.

Animals and Their Systems
Selected examples highlighting accomplishments in this area follow:

• A new scoring system was developed for field identification of bovine respiratory disease (BRD) in calves. The new system requires assessment of clinical signs in a dichotomous manner (presence or absence of clinical signs) which may make it more feasible for on-farm use than a previous system (Wisconsin respiratory scoring system in calves). An ongoing study is comparing the reliability of both scoring systems during field use by different personnel. In addition, researchers are developing management practices, including rationally applied therapeutic and preventative interventions, which minimize the impact of BRD on cattle health, welfare and productivity.
• A series of applied animal behavior and welfare projects developed 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 resulted in increased knowledge about chromosome 16 that encodes the immunity-related genes involved in resistance and susceptible to poultry diseases as well as new information regarding the evolution of this chromosome and linked complexes in a closely related poultry species (Japanese quail). In another study, researchers mapped a new set of genes to chromosome 16.
• One ongoing project seeks to improve production and quality of the white sturgeon eggs used for caviar. World production of caviar from farmed sturgeon has recently exceeded production of capture fisheries. The roe yield in farmed white sturgeon is currently highly variable and this variability is associated with a high fat content of sturgeon ovaries. Researchers tested effects of high energy and low energy diets on the production and quality of eggs harvested as caviar in two farms of California and one farm in Idaho. Data collected from 7 year old production fish showed a significant effect of diet on the egg and caviar yields in gravid females, as well as a significant accumulation of the ovarian fat and lower caviar yield in the high energy diet fish. Study on deposition of fat in pubertal 1-3 year old fish is being analyzed but the preliminary data suggests that the high energy diets, and possibly genotype, affect ovarian adiposity in pubertal sturgeon. While the study of the energy partitioning in pubertal sturgeon is still in progress, the preliminary data suggests that the fish fed high energy diet have significantly heavier ovaries due to accumulation of fat in the ovaries.

Technological Innovation
Selected examples highlighting accomplishments in this area follow:

• Researchers created two tools that have great potential to help farmers conserve water and make better use of nitrogen fertilizer while maintaining crop productivity and quality: weather-based irrigation scheduling and the soil nitrate quick test. The soil nitrate quick test is an in-field test that lets growers quickly determine whether their soil has adequate nitrogen. Weather-based irrigation scheduling uses weather station data to determine actual crop water needs. Both tools use information about the specific crops to determine how much fertilizer and water each will need from the soil. CropManage (ucanr.edu/cropmanage) is an online application that makes both tools easy and accessible for growers to use in the field. Commercial-scale trials in lettuce demonstrated that growers using CropManage can reduce nitrogen and water without compromising quality or yield. The nitrogen rate recommended by CropManage generated yields similar to those of the growers' standard practice, but with an average reduction of 32% in nitrogen fertilizer. Commercial-scale CropManage trials with broccoli used 48% less water than is used for conventional plantings, with no reductions in yield or crop quality.
• 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.

• 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.

• Researchers continued to distribute vectors and methods for marker-free plant transformation which overcome the major intellectual property barriers that have slowed applications of plant genetic engineering. Ongoing evaluation of transgenic alfalfa plants generated using this transformation technology has demonstrated 40% yield increases. These alfalfa lines have been shown to retain the same nutritional quality as control alfalfa lines. This work has also been extended to generate transgenic alfalfa plants that express high level of proteins that are predicted to increase the feed value of alfalfa for both cattle and potentially for pet food as well.

Economics, Markets, and Policy

Selected examples highlighting accomplishments in this area follow:

• Researchers conducted a project to better understand the determinants of adoption of technological and institutional innovations and to measure the impact these innovations have on agricultural production and farmer welfare. Flood-tolerant seed Swarna-Sub1, a promising new rice seed that sharply reduces the susceptibility of the crop to flood damage, has been shown to perform just as well under normal non-flood conditions. Researchers focused on the effect of this reduction in production risk on economic behavior. Access to this new technology was shown to lead to an increases in area cultivated, fertilizer use, and the likelihood of using more modern planting methods. Also, the technology reduces precautionary savings of grain for consumption and increases the use of agricultural credit. By inducing increased investments in fertilizer, more planting-stage investments, and increased uptake of credit, this form of technological progress leads to substantial productivity gains even when floods do not occur. Estimates indicate that the productivity gains due to the decreased need to self-insure are around 41% of the size of the agronomic effects that arise solely due to improved plant breeding. Not accounting for this re-optimization as a result of technological change leads to a large under-estimation of the return from investing in research and development.

• An analysis of new challenges and opportunities for California's mandated marketing programs analyzed the effectiveness of various messages and specific promotional material within the framework of modern agricultural markets. In addition to traditional characteristics such as taste, current consumers of food products are increasingly differentiating products based upon characteristics of their production process (e.g. usage of chemicals, biotechnology, sustainability, location, or confinement conditions of animals), treatment of farm labor, or "fairness" of their marketing arrangements, and implications of production and consumption of the product for the environment. Specific work was directed towards identifying optimal regulatory structures and new opportunities for collective action created in quality-differentiated markets, including certification of these credence properties of agricultural products. Results will enabled producers and industry groups to fine-tune messages to meet consumer demands.

• An analysis was conducted to identify underlying causes of commodity price changes and volatility 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. Researchers addressed a recent apparent failure in the operation of grain futures markets. In a well-functioning futures market, the futures price at expiration equals the price of the underlying asset. This condition failed to hold in grain markets for most of 2005-10, when futures contracts expired up to 35% above the cash grain price. Researchers showed that this non-convergence phenomenon is an unintended consequence of market design. This finding contradicts claims that speculative trading was the underlying cause.

• A continuing 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. Results highlighted the uneven increase in wages in response to fewer newly arrived workers from Mexico, labor-saving changes and rising imports in some commodities, and more efficient use of available workers. Researchers also reported estimates of how many unauthorized workers would be legalized under various reform proposals, how farm employer usage of the H-2A guest worker program could change under various reform suggestions, and what wage tipping point would spur labor-saving mechanization.

Endemic and Invasive Pests and Diseases

Pests threaten California's resources within natural, agricultural, and animal systems. These pests run the gamut from arthropods, other invertebrates, weeds, diseases, vertebrates and other taxa. Many of the damaging pests are exotic/invasive species to California; it is estimated that 2/3 of all insecticides and acaricides applied to California crops target exotic pests. A similar level of concern exists for other taxa as well as for pests of natural systems. These exotic pests enter the state in spite of effective state and federal regulatory programs, commodity inspections, border stations, etc. However, the high levels of domestic and international travel as well as transportation of goods and commodities facilitate this entry of unwanted pests. New pathways for introduction are frequently identified such as the aquarium trade for aquatic pests and movement of beehives for certain hitchhiking pests. Natural dispersal and adaptation of pests also leads to new pest management challenges in California and this is enhanced by changes in global climate patterns.

The Endemic and Invasive Pests and Diseases (EIPD) Initiative provides a framework to coordinate and engage the resources of UC ANR to meet significant pest challenges. The EIPD initiative 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. This year 145 Hatch and Multistate Research projects were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 47 research and extension projects. CE advisors worked on 310 extension projects, and led an additional 74 research projects. The following illustrates the breadth of work and includes selected examples of high impact projects and programs:

Detection and Diagnostics

Early detection of pests, especially new invasive species, and proper diagnosis, i.e., identification, are critical steps for optimizing the chances of limiting establishment. If the detection can be made when the pest distribution is still limited, eradication or methods to limit spread can be enacted. Communication is often the key and UC-ANR, besides having "boots on the ground" and "ears and eyes" to interact with clientele statewide, has the expertise to develop these detection techniques. Identification of insects, disease organisms, and the like through microscopic examination is important but increasingly pest detection depends on the development and use of advanced molecular techniques. The following are examples of UC ANR projects addressing the areas of detection of invasive pests and diseases.

• Enhancing pest identification using molecular methods is ongoing for several taxa including the use of DNA sequences for nematode identification. New information on the biodiversity, species richness, and evolutionary relationships of nematodes, particularly those impacting on agriculture, is being developed. Simple molecular methods of diagnosis (e.g., PCR/RFLP) are being used as well as real-time PCR approaches for certain plant parasites. Methods are being developed to capture high quality images such as 4K-capable camera technology from specimens prior to destructive sampling for DNA extraction. The goal is to have an online identification and self-training system for diagnosis of parasitic and freeliving nematodes.

• Research is ongoing on developing molecular techniques to quickly ID the tomato leafminer, Tuta

absoluta. This is a pest that is spreading world-wide and is predicted to reach California. Ambrosia beetles have increased significantly in importance in the U.S. during the 2000's. Die-back of urban forestry trees in the Los Angeles Basin in 2011 prompted research and a new species of Ambrosia beetle was found. This was initially thought to be the Tea Shot Hole Borer found in Asia, Australia, and Florida but based on DNA sequences the beetle invading California is a different species, Euwallacea fornicates, the Polyphagous Shot Hole Borer. This species has a fungal symbiont, also new to science. The fungus destroys the vascular system of hosts, including boxelder, California coast live oak, and big leaf maple and agricultural species such as Avocado. Interestedly, samples from San Diego County revealed a different species of ambrosia beetle, also thought to be a recent invader, filling the same niche and causing similar damage.

• Various ANR researchers are studying the role of effectors for mediating the interactions between stressors and plants. Effectors are small highly diverse proteins secreted by plant pathogens and insects to mediate plant responses by suppressing the host immune system. Research is ongoing on stressors such as Ascomycete fungi, aphids, nematodes, the bacterium pathogen of citrus (Candidatus Liberibacter asiaticus), and Oomycetes. Development of serological detection methods based on antibodies generated against effectors could provide insights into pathogenesis and may aid with disease diagnosis.

• Weed scientists have developed a risk assessment tool for evaluating the potential invasiveness of ornamental plants before their introduction through the nursery supply chain. The invasive history, climate match, difficulty of control, environmental impacts, reproductive and dispersal strategies, and growth rate were rated with 56 questions.

Emerging Problems with Pests and Disease

It is estimated that a new invasive species establishes in California every 60 days; this rate is exceeded only by that occurring in Hawaii and Florida. Many of these invasive pests are not problematic in their country of origin but often flourish in new areas without their natural enemies. This can result in severe crop losses, damage to infrastructure, clogging of waterways, harm to environmental areas, infection of animals and humans, increased fire hazard from dying trees and other consequences. Environmental conditions in California are dominated by a Mediterranean climate but also range from the extremes of deserts to cool, moist coastal areas to temperate climates with severe winters in the northern part of the state. Therefore, climate matching for other potential invasive species shows a broad list of other highly damaging taxa that could flourish.

• Efforts are ongoing to develop sustainable approaches to managing two serious insect: disease scenarios. Pierce's Disease of grapes and the invasive glassy-winged sharpshooter, and Huanglongbing of citrus and the invasive Asian citrus psyllid are serious pests world-wide. A statewide regulatory, management, and research programs against these key pests have been in place for ~15 and 5 years, for the grape and citrus systems, respectively. State governmental officials have been coordinating area-wide monitoring and treatments and facilitated by UC-ANR scientists spearheading the research and extension efforts. Education and stakeholder involvement have been a key approach for both systems. For Pierce's Disease, research advances have included the evaluation of biological control organisms for the sharpshooter, development of a new culture medium for growing the Xylella bacterium, and efforts to develop resistant rootstocks through traditional plant breeding and by disrupting the actions of enzymes which damage the plant xylem elements. Biological control of the psyllid has been expedited; Tamarixia radiata was approved and >1 million parasitoids have been released. Studies are progressing on possible molecular approaches to management, i.e., the use of interference RNA (RNAi) to manage Asian citrus psyllid populations or interfere with the ability of the psyllid to acquire and/or transmit Candidatus Liberibacter asiaticus, and an understanding of molecular targets of contact chemosensory behavior and possible inhibitors.

• Stink bugs are another group that are flourishing in the U.S. as invasive pests. In California, the bagrada bug and brown marmorated stink bug are recent invaders adapting to the state's agricultural systems. UC-ANR has responded to these challenges by monitoring spread of these pests, developing short-term management tactics in key agricultural production areas, extending results to clientele, and

responding as these species evolve to our conditions. More sustainable management approaches are underway including importation and evaluation of biological control organisms.

• Additional insect vector: disease concerns have also developed in California. Either the insect, the disease organism, or both are new to the state or have adapted to create a damaging situation. Thousand cankers disease, caused by the fungus Geosmithia morbida, is killing walnut trees in California and threatens wildland and landscape trees and commercial walnuts. The fungus is spread by the walnut twig beetle, Pityophthorus juglandis. This species is believed to be native to the SW U.S., although the apparent new association with the fungus, now makes it a pest of significant concern. Juglans species susceptibility, a better understanding of the pathogenicity, disease distribution, and sampling methods for the beetle are among the areas being examined. Grapevine red blotch-associated virus is a new (since 2011) disease of grapes. Studies are underway to determine the insect vectors of this virus and to develop management programs.

• Invasive mosquitoes are another challenge for UC-ANR researchers. Two invasive mosquito species, the yellow fever mosquito and the Asian tiger mosquito, have recently been found in several California cities. These species are major vectors of Dengue and Chikungunya viruses, which have spread dramatically worldwide in recent years; the Zika virus is also vectored by these Aedes mosquitoes. Research has concentrated on mosquito management and distribution with educational efforts also being stressed.

• Research efforts are expanding on the emerging and increasing problems with herbicide-resistant weeds: Italian ryegrass, horseweed, hairy fleabane, junglerice, threespike goosegrass (glyphosate), fleabane, horseweed, and ryegrass (paraquat), and ryegrass (glufosinate). This includes an integrated approach to the research including alternative control strategies, weed biology and ecology, and basic research on the genomics and physiological factors underlying resistance.

Pest Management of Established Pests

Pest management programs for existing, established pests require frequent refinement to stay relevant. These pests are frequently fully entrenched in our crop and natural systems and therefore a challenge to manage. Changes in efficacy of current management tactics, adjustments in production strategies, revisions in crop landscapes, unusual environmental conditions, and other modifications allow these pests to increase in numbers. The following are examples of UC ANR projects addressing integrated management of pests and diseases.

• Several arthropod pests, under long-term, stable management programs, have reached damaging levels in recent years. These include blue alfalfa aphid on alfalfa, spider mites, leaffooted bug, and navel orangeworm on almonds, various armyworm species on tomatoes, rice, and cotton (early-season), consperse stink bug on tomatoes, and western tarnished plant bug on strawberries and lettuce. In many cases, the high populations can be correlated with California's 4-year drought which has resulted in significant environmental impacts.

• California has a long history of successful biological control programs. Biocontrol programs are ongoing on navel orangeworm, spider mites, fungus gnats, Erythroneura spp. leafhoppers, spotted wing Drosophila, olive fruit fly, and western tarnished plant bug; many of these programs are long-term efforts. Loss of flowering plant diversity in vineyards and the use of reduced risk insecticides and fungicides in walnuts were examined as possible impediments biological control services but not shown to be factors.

• Soils are challenging ecosystems for research as well as pest management tactics. Studies on the suppressive effects to root-knot nematodes of entomopathogenic nematodes (EPN) compared different species and spent bacterial symbionts culture medium. Several species of scavengers (ants, cockroaches, soil mites, and earwigs) consumed EPN-killed cadavers whereas springtails consumed significant numbers of the EPNs in the soil. The suppressive effects of soils on plant pathogens and nematodes were studied. New "strains" of the nematophagous fungus Dactylella oviparasitica were identified and this fungus was able to be established in naive soils.

• Research and extension programs were conducted on several escalating plant disease systems

including Prunus replant, tomato spotted wilt virus, Verticillium wilt of lettuce and other leafy greens, cucurbit yellow stunting disorder virus, and curly top of tomatoes as well as new diseases including tomato yellow leaf curl, squash vein yellowing virus and cucumber green mottle mosaic virus.

Sustainable Natural Ecosystems

"Sustainable" refers to the ability to continue a practice indefinitely, supported by three pillars: economic, social and environmental. "Natural Ecosystems" is the umbrella term for forests, rangelands and wetlands. These lands typically, in California, are upstream or downstream from intensively managed agricultural and residential lands. Natural ecosystems are valuable to society for the goods and services they provide. Their sustainability is complex due to ecological diversity and mixed ownership. Private and public landscapes, for example federal parks and wilderness areas dealing with fires, also influence the balance of natural processes within the context of population growth, climate changes, land use and fragmentation and, significantly, limited scientific literacy about these ecosystems.

The Sustainable Natural Ecosystems Initiative seeks to better understand the challenges of the ecological and physical processes that control the overall system so that natural ecosystems can remain highly productive in our highly variable climate. This year 127 Hatch and Multistate research projects were conducted by investigators at UC Berkeley, Davis, and Riverside. CE specialists worked on 22 research and extension projects. CE advisors worked on 126 extension projects, and led an additional eight research projects. Projects are being conducted in several areas that are essential to sustaining California's natural resources. The following illustrates the breadth of work and includes selected examples of high impact projects and programs:

Range Resources Management

- A study discovered that plants use volatile cues to protect other cohorts of the same species from grazing by making those cohorts more resistant to herbivores. This has significant impact in grazing management strategies, especially targeted grazing to remove brush or weedy invasive plants.
- Studies on the effects of climate change show impact on the dynamics of range weeds. It was discovered that lack of grazing on grasses tended to increase the population of filaree (Erodium species) in drought stricken areas.
- A study that evaluated elevated atmospheric carbon dioxide (CO2) on weed species showed that it rapidly affects plant physiology and ecosystem productivity in desert systems. The invasive grass, red brome, apparently evolves and increases under high CO2 levels, spreading into and dominating desert rangelands. In another grassland weed study with barbed goatgrass (Aegliops triuncialis) it was discovered that goatgrass interacts with climate changes like varying rainfall by changing its seeding pattern and density, resulting in increased seed output under dry conditions. Understanding how drought increases invasive encroachment on rangeland prepares California ranchers for better management and protection of the range.
- An ongoing study on how plant species, plant density and range management practices influence ecosystems services like production, erosion control, soil fertility, water quality, water storage, invasion control and soil carbon storage has discovered that drought conditions increase the prevalence of native grasses, decrease the noxious weeds (e.g. goatgrass and Medusahead) and have varied effects on the prevalence of the dominant naturalized species (e.g. wild oats and bromes). Spring grazing during these dry seasons greatly decreases the noxious invaders. Wetter conditions enhance noxious weeds and have varied effects on native grasses. Spring grazing under higher precipitation greatly enhances the invasion of noxious weeds. Fall grazing has no effect on the prevalence of native grasses or naturalized species, but greatly enhances the invasive species.

These findings will have significant impact on grazing management decisions in response to climate change.

Wildlife & Fisheries

• A study on the impacts of grazing on mountain meadows in the Sierra Nevada tested both grazing and meadow wetness (an impact of climate change) and their influence on plant communities and the Yosemite Toad populations. Results showed that light grazing had no impact on either the plant communities or the toad populations. Meadow wetness, however, did impact both with dryer conditions negatively impacting the communities and populations. This has a major impact on grazing policy on these public lands.

• Research on the ecology and conservation of inland fishes of California and the development of a flow regime resulted in the successful return and record salmon run this year in Putah Creek.

• Ongoing studies about conserving and protecting bee pollinators in disturbed and managed habitats of California have expanded statewide to over 15 cities. Results show more than 400 different species of native bees that depend on nearly 500 flower types. In addition, the research suggest that urban areas have great potential for conserving bee diversity and abundance. Designs of 10 bee/pollinator gardens have helped to increase bee populations. The impacts from this will help improve the population of native bees.

Forestry

• A study on climate change effects in California dealing with fire regimes showed that fuels management when done properly can reduce fire intensity and substantially increase tree survival. It also showed that fuels reduction treatment and wildfire both have strong effects on forest characteristics. Those treated forests had greater resilience: higher litter cover, lower recruitment of shrubs and greater recruitment of trees.

• Research on the genomics of California conifers aims to measure and monitor the adaptive genetic potential of California forest tree species against man-caused threats such as fire, land-use impacts, introduced pathogens and climate change that threaten the health and sustainability of California's forest ecosystems. Genomic based tools that forest managers can use in reforestation, conservation and restoration programs is the major goal of this research. This year the first draft of a reference genome sequence for sugar pine (Pinus lambertiana), a major California white pine species, was released.

Air Quality & Tax on Water Bottles

• An economic model developed by UC ANR researchers on the cost of greenhouse gas reduction is used by the California Air Resources Board to evaluate the costs of potential greenhouse gas reducing measures.

• A study on estimating the impacts of a tax on purchased water bottles among consumers showed that it significantly reduces the purchase of plastic water bottles.

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.

The Water Quality, Quantity, and Security (Water) Initiative has three goals: 1) to increase system understanding and characterization of water quality and quantity conditions; 2) to develop and implement management practices to achieve water quality and quantity objectives; and 3) facilitate integrative research and extension program delivery. This year 27 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 95 extension projects, and led an additional nine research projects Selected examples of projects are being performed in a number of areas that will directly impact California watersheds and California's water security follow:

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).

- 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.
- Additional research on temperature controls and the impacts on seaweed production is providing important information for future operations of these systems.

Groundwater Quantity and Quality
Management of groundwater recharge is important for both quantity and quality purposes. Increased in irrigation efficiency can lead to increased concentrations of salts being leached to groundwater aquifers. The drought has increased attention on sustainable groundwater management throughout the state.

- Work is being performed to assess the potential to use flood waters and natural basins as well as agricultural lands to increase groundwater recharge from storm events. This would increase the amount of freshwater recharge and reduce salinity concentrations in the root zone. 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 water supplies.

- 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. This work involves in-field data collection as well as aerial and space remote sensing. 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.
- Work is proceeding on the use of plant genetics for breeding drought tolerant varieties of several field crops. This involves identification of pathways and methodologies for testing drought tolerance.

• Additional work on orchard systems seeks to understand relationships between temperature (freezing), salinity and drought on crop production. Irrigation and fertilization management play an important role in much of this research.

• Work has focused on coupling advanced sustainability technologies, such as precision overhead and subsurface drip irrigation systems, with strip-till and no-till planting to achieve cheaper and more sustainable systems. The use of overhead irrigation is the most widely used irrigation system in the U.S., but it is not widely used in California. The study found that irrigation water application uniformity for the overhead system is 93 percent, which allows for less water use to meet irrigation demand than systems that are less uniform, such as surface or gravity flow furrow irrigation. The study also showed that 13 percent (4 inches) of soil water evaporation can be saved in the soil during a typical summer season when a thick matte of residues is on the soil surface. This research shows the potential for California farmers to reduce water use and evaporation by combining overhead irrigation and no-till practices.

Ecosystem Conservation and Restoration

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

• Work has begun to relate some of these stream parameters to climate events such as ENSO.

Water Quality and Nitrates

Nitrate pollution to groundwater sources is a major concern in California. Research to reduce nitrate pollution has focused on the main pathway, leaching. Increasing irrigation efficiency and optimizing nitrogen applications can reduce leaching.

• Work on micro irrigation technologies has created several nutrient and irrigation relating applications that will reduce groundwater pollution and leaching.

• Research on the use of bioreactors to clean up nitrogen laden groundwater and surface water flows is finding promising techniques to increase their efficiency.

• 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 Quality and Reuse

Agricultural production with recycled, reused or otherwise lower quality waters is of increasing importance in regions that face chronic water shortages.

• Research into water recirculation and use of treated wastewater in horticultural systems is being undertaken to understand the potential impacts of these lower quality waters, often with increased salinity, on crop production and product quality.

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.

• UC 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.

• The importance of the urban sector to water conservation has received increased attention in the drought as the Governor has called for a 25% mandatory conservation target for urban agencies. Work is underway to understand residential responses to conservation oriented programs. The role of water pricing in promoting conservation is receiving increased attention.

Water and Wine

There is considerable research focus on the impacts of wine production on water supplies and water quality.

• Work was initiated to compare changes in water yields in watersheds that are converted from native oak savannah landscapes to vineyards.

• Additional work is looking at reuse of winery wastewater on vineyards.

Sustainable Energy

Despite recent drops in oil prices, the public is still pursuing renewable sources of energy. Agricultural production and by-products are in need of research to ensure meeting these demands for greater future renewable needs. California has 96 biomass power plants of which only 32 are active. Eight ethanol plants produce approximately 255.1 million gallons of ethanol and six biodiesel production plants are currently producing approximately 50.5 million gallons of biodiesel. Five of the eight 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 ANR 2025 Strategic Vision outlines a sustainable energy initiative to improve the energy security of California through innovative research on green technologies through science linking engineering, agricultural, biological and environmental research. This year 22 Hatch and Multistate Research projects with a sustainable energy focus were conducted by investigators at UC Davis, Berkeley, and Riverside. A CE specialist worked on one research and extension project and a CE advisor worked on one extension project. Projects are being conducted in several areas that are essential to sustaining California's energy needs; selected 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. The UC system has 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. A few examples from 2014 follow:

• 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. Replicated field trials continue to evaluate both grain and biomass production throughout the state and there is an ongoing program to evaluate these sorghums for their water use efficiency. These research projects will provide valuable information on the potential of sorghum as a viable feedstock for renewable fuel production in the state. Grants have been awarded to

understand the genetic mechanisms involved in drought tolerance and their impact on biomass production using sorghum a model crop.

• A project to identify the best varieties of canola and camelina for California and their expected yields in diverse locations throughout the state is finishing up. The researchers are identifying critical management practices for the successful production of canola and camelina, and are using the growth model APSIM and the economic model CBCAM to predict yield and likely locations throughout the state where crop adoption should be profitable.

• Several projects are currently studying the physiology of plants and how they might relate to more efficient uses of nitrogen and water to further enhance biomass yields under limited nutrient and water scenarios. One project is investigating mechanisms regulating photosynthate partitioning that could help in developing renewable fuels and chemicals that will help meet global demands for energy and synthetic chemistry feedstock, but without contributing to climate change or other environmental degradation. Photosynthetic microorganisms, such as cyanobacteria or unicellular microalgae, 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. Under conditions of low oxygen partial pressure, or anoxia, accumulation of CrCpADH1 in cells and ethanol in the growth medium were observed. A metabolic pathway for ethanol production is being evaluated in Chlamydomonas, mediated by the chloroplast localized CrCpADH1 transgenic enzyme. The work will further test suitability of this approach in industrial scale-up for the production of renewable photosynthetically-generated isoprene hydrocarbons.

Conversion to Biofuels

Biofuel production from all types of feedstocks are difficult and costly. This may be 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 by efficient breakdown of cell walls or by generating new renewable products from biomass feedstock. A few projects are focused on addressing this issue:

• Research is underway to generate plants with "designer" cell wall structures representing novel biomaterials and feedstocks for biorefineries. Plant cell walls (lignocellulosics) are composed of complex networks of structurally divers polymers, most of which contain glycosyl-substituents and other non-carbohydrate such as O-acetyl-moieties. The precise effect of these heterogeneous substituents on the biophysical properties of the wall, their function during growth and development and or their evolution during plant speciation is not known. Research identified for the first time a 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. In addition, a protein that is involved in the O-acetylation of pectic polysaccharides was characterized.

• Research is underway to elucidate microalgae cell wall structure and starch accumulation so that microalgal polysaccharides can be utilized for biofules. Research is focusing on the liberation of fermentable sugars from cells walls of selected microalgae.

• A set of plant-derived genes is being engineered to convert starch in the leaf and stalks of biomass into tracylglycerol oils. This will be introduced into forage sorghum lines with enhanced yields of biomass.

Policy and Economics

• A project quantified how short-run volatility in renewable electricity (i.e. intermittency) affects the amount of air pollution emitted by interconnected fossil fuel generating units in the California electricity market. Recommend improvements in renewable energy policies and renewable siting processes that will mitigate the potential environmental impacts of renewable intermittency.

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 few examples of projects that explore the possibility of woody biomass feedstocks follow:

• Work continued on the development of an integrated geospatial optimization model to evaluate hybrid poplar feedstock production across the Pacific Northwest. The model is used to assess sustainability metrics on both a site-specific and system-wide basis and is spatially explicit and flexible to the desired resolution. The integration framework includes poplar growth models (3PG-Coppice, EPIC), bioenergy crop adoption (BCAM), and statewide agricultural production (SWAP) models to examine crop substitution effects, and a geospatial bioenergy systems model (GBSM) to determine optimal siting for biorefineries based on the desired regional outcomes. Environmental lifecycle assessment and socioeconomic impacts have also been modeled.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	278.2	0.0	399.9	0.0
Actual	279.8	0.0	348.9	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

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

2. 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 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 2015, the five Strategic Initiatives held eight panel meetings and 36 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 2015, there were 13 Program Teams meetings and 18 Workgroups meeting in conjunction, with 372 total participants. These groups looked at the Division's program priorities and determine efforts that will best address these needs.
During 2015, UC ANR released a request for proposals for the Division's competitive grants program. 117 letters of intent were received and 45 full proposals were invited for review, 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. 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. Then during FY 2016, each of the recommended proposals was discussed in detail by Program Council to make final recommendations for funding. In December 2015, UC ANR's Vice President announced funding for 17 projects, for a total of approximately $3.7 million over 5 years. The awards range from approximately $50,000 to $450,000.
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. 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 encourage engaging external stakeholders, including commodity groups, cooperating programs, agency partners, community groups, and others, to explicitly discuss the priority needs for these positions. The CE positions proposals are developed in consultation with our stakeholders. The review process involves public comment. All of the review information, along with information regarding current staffing and retirement projections, is considered by UC ANR Program Council in their deliberations to provide recommendations the Vice President, who then makes the final decision. The call for CE positions is released every other year, and thus during 2015 there was no call.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- 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 the 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
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 2015, one center completed its strategic plan, and two other 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 2015, the five Strategic Initiatives held eight panel meetings and 36 conference calls, and 13 Program Teams met with 18 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 2015, no such reviews were conducted. In addition, these statewide programs engage in regular strategic planning activities involving high levels of participation from both internal and external stakeholder 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, UC ANR leadership plans to meet with the Executive Committee of the California Commodities Committee to chart a path to reinvigorate the Committee during FY 2016.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

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

Brief explanation.

Please see previous Actions to Seek discussion.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. 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

Brief explanation.

Please see previous Actions to Seek discussion.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Action Plans
- To Set Priorities

Brief explanation.

Please see previous Actions to Seek discussion.

Brief Explanation of what you learned from your Stakeholders

Please see previous Actions to Seek discussion.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
7979466	0	6935147	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	5873093	0	5791578	0
Actual Matching	5873093	0	5791578	0
Actual All Other	102795953	0	282798002	0
Total Actual Expended	114542139	0	294381158	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Healthy Families and Communities

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation	0%		2%	
305	Animal Physiological Processes	0%		7%	
501	New and Improved Food Processing Technologies	0%		2%	
604	Marketing and Distribution Practices	0%		4%	
606	International Trade and Development	0%		4%	
607	Consumer Economics	0%		2%	
608	Community Resource Planning and Development	1%		6%	
610	Domestic Policy Analysis	0%		3%	
611	Foreign Policy and Programs	0%		1%	
701	Nutrient Composition of Food	0%		4%	
702	Requirements and Function of Nutrients and Other Food Components	1%		29%	
703	Nutrition Education and Behavior	27%		12%	
723	Hazards to Human Health and Safety	0%		3%	
724	Healthy Lifestyle	9%		3%	
801	Individual and Family Resource Management	1%		0%	
802	Human Development and Family Well-Being	7%		9%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	3%		4%	
805	Community Institutions, Health, and Social Services	4%		1%	
806	Youth Development	43%		4%	
903	Communication, Education, and Information Delivery	4%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	43.8	0.0	50.9	0.0
Actual Paid	11.8	0.0	4.4	0.0
Actual Volunteer	690.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1905442	0	753799	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1905442	0	753799	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
15734738	0	27105240	0

V(D). Planned Program (Activity)

1. 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.

2. 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

3. 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.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	182634	0	411258	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2015

Actual: 7

Patents listed

1. A METHOD FOR AUTOMATED, LARGE-SCALE MEASUREMENT OF THE SYNTHESIS AND BREAKDOWN RATES OF THE PROTEOME OR THE ORGANEOME.
2. Molecular Flux Rates Through Critical Pathways Measured by Stable Isotope Labeling In Vivo,as Targets and Biomarkers of Drug Action and ... (case # 2008-639-2)
3. Molecular Flux Rates Through Critical Pathways Measured by Stable Isotope Labeling In Vivo,as Targets and Biomarkers of Drug Action and ... (case # 2008-639-3)
4. A SOD2 Antioxidant Derivative
5.Virtual Biopsy for Measurement of Intracellular Protein Dynamics in a Tissue of Origin by Sampling Escaped Proteins in an Accessible Body Fl
6. PLATFORM DESIGN OF MULTVALENT IMMUNOGENS OR DELIVERY SYSTEMS WITH HEPATITIS E VIRAL CAPSID STRUCTURE OF DOMAIN MODULARITY (case # 2004-023-7)
7. PLATFORM DESIGN OF MULTVALENT IMMUNOGENS OR DELIVERY SYSTEMS WITH HEPATITIS E VIRAL CAPSID STRUCTURE OF DOMAIN MODULARITY (case # 2004-023-9)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	40	104	144

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2015	422

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2015	109

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual
2015	126

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2015	11

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2015	12

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2015	68

Output #7

Output Measure

- Videos, Slide Sets, and other AV or Digital Media Educational Products Created

Year	Actual
2015	1

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2015	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Low-income individuals and families, participating in nutrition and consumer education programs, gain knowledge of food resource management techniques.
2	Youth, participating in 4H clubs, acquire leadership and civic skills.
3	Youth, participating in 4H club, community, in-school and afterschool educational programs, acquire planning, problem solving, teamwork and other life skills.
4	Low-moderate income individuals and families, participating in nutrition and consumer education programs, adopt recommended food resource management techniques.
5	Children and youth, participating in 4H club, community, in-school and afterschool educational programs, increase their level of science, agricultural and environmental literacy.
6	Youth educators and child resource specialists, participating in youth development education programs, gain knowledge of youth development practices.
7	Individuals, including youth, participating in family and consumer well-being programs, gain knowledge about money management.
8	Children and youth, participating in nutrition education programs, gain knowledge of nutrition.
9	Adults, participating in nutrition education programs, adopt recommended dietary practices.
10	Individuals, participating in nutrition education programs, adopt safe food handling and preparation techniques.
11	Youth educators and child resource specialists, participating in youth development education programs, adopt recommended youth development practices.
12	Individuals, including youth, participating in resource management education programs, adopt financial management techniques.
13	Youth, participating in 4-H clubs, assume leadership roles in organizations or taking part in community affairs.
14	Youth educators and program extenders, participating in the programs, including 4-H and SET, gain knowledge of best practices to extend science, engineering, and technology education and opportunities.
15	Teachers, participating in health and nutrition programs, adopt recommended practices to prevent childhood obesity and foster a school environment that reinforces nutrition education.
16	Community garden managers, non-profit agency personnel, small business owners, and low-income members of the public, participating in Master Gardener and other urban horticultrure programs, gain knowledge about sustainable gardening practices.
17	Youth, participating in youth development programs, increase interest in science.

18	Families/caregivers, participating in nutrition education programs, gain knowledge of nutrition.
19	Individuals participating in food safety education, gain knowledge of safe food handling and preparation techniques.
20	Children and youth, including those "at-risk," participating in 4-H and other the youth develoment programs, increase confidence in their leadership abilities.
21	Families/caregivers, participating in nutrition education, adopt recommended dietary practices.
22	Children and youth, participating in nutrition education programs, adopt recommended dietary and healthier lifestyle practices.
23	Individuals, families, children and youth, will experience increased access to healthy food and greater food security.
24	Percentage of 4-H youth (4th- 12th graders) who make positive choices.
25	Percentage of 4-H youth (4th- 12th graders) who effectively communicate.
26	Percentage of 4-H youth (4th- 12th graders) who build connections.
27	Percentage of 4-H youth (4th- 12th graders) who apply content knowledge and skills in health, citizenship and science to contribute to the health, growth, and well-being of self, family, community, nation, and the world.
28	Percentage of of 4-H youth (4th- 12th graders) who express interest and engage in science.
29	Percentage of 4-H youth (4th- 12th graders) who express positive attitudes and aspirations toward science.
30	Percentage of 4-H youth (4th- 12th graders) who develop science skills and abilities.
31	Percentage of 4-H youth (8th-12th graders)who apply learning, and make a contribution through science.
32	Percentage of 4-H youth (4th- 12th graders) appreciate cultural diversity.
33	Percentage of 4-H youth (4th- 12th graders) who engage in community and community issues.
34	Percentage of 4-H youth (4th- 12th graders) who have understanding of the democratic process.
35	Percentage of 4-H youth (8th-12th graders) who have awareness of community and community issues.
36	Percentage of 4-H youth (4th- 12th graders) who choose food consistent with Dietary Guidelines.

37	Percentage of 4-H youth (4th- 12th graders) who improve physical activity practices.
38	Percentage of 4-H youth (4th- 12th graders) who avoid and prevent negative risk behaviors.
39	Preschools adopt childhood obesity prevention policies.
40	Research on childcare nutrition practices changes food environments for California preschoolers through multiple California state laws.
41	Research informs policy to limit these kinds of unhealthy foods and beverages sold in K-12 schools.
42	School lunchrooms doubled milk sales, improved atmosphere, and increased student involvement.
43	Garden-based nutrition education improves student learning.
44	4-H youth improve their technological literacy by producing films showcasing 4-H impacts on communities.
45	UC Cooperative Extension worked with UC Master Gardener volunteers to develop a therapeutic horticulture program, improving the school environment.
46	Improved parenting behaviors result from school-based nutrition education program.
47	Shaping Healthy Choices Program improves children's health.
48	Students eat healthy foods through the Healthy Shasta FARM (Fun at Redding Market) Club pilot.

Outcome #1

1. **Outcome Measures**

Low-income individuals and families, participating in nutrition and consumer education programs, gain knowledge of food resource management techniques.

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Youth, participating in 4H clubs, acquire leadership and civic skills.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Youth, participating in 4H club, community, in-school and afterschool educational programs, acquire planning, problem solving, teamwork and other life skills.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Low-moderate income individuals and families, participating in nutrition and consumer education programs, adopt recommended food resource management techniques.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	7949

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
801	Individual and Family Resource Management

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2212

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #6

1. Outcome Measures

Youth educators and child resource specialists, participating in youth development education programs, gain knowledge of youth development practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	90

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #7

1. Outcome Measures

Individuals, including youth, participating in family and consumer well-being programs, gain knowledge about money management.

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Children and youth, participating in nutrition education programs, gain knowledge of nutrition.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	4756

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #9

1. Outcome Measures

Adults, participating in nutrition education programs, adopt recommended dietary practices.

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Individuals, participating in nutrition education programs, adopt safe food handling and preparation techniques.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	5643

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #11

1. Outcome Measures

Youth educators and child resource specialists, participating in youth development education programs, adopt recommended youth development practices.

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

Individuals, including youth, participating in resource management education programs, adopt financial management techniques.

Not Reporting on this Outcome Measure

Outcome #13

1. Outcome Measures

Youth, participating in 4-H clubs, assume leadership roles in organizations or taking part in community affairs.

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

Youth educators and program extenders, participating in the programs, including 4-H and SET, gain knowledge of best practices to extend science, engineering, and technology education and opportunities.

Not Reporting on this Outcome Measure

Outcome #15

1. **Outcome Measures**

   Teachers, participating in health and nutrition programs, adopt recommended practices to prevent childhood obesity and foster a school environment that reinforces nutrition education.

   Not Reporting on this Outcome Measure

Outcome #16

1. **Outcome Measures**

   Community garden managers, non-profit agency personnel, small business owners, and low-income members of the public, participating in Master Gardener and other urban horticultrure programs, gain knowledge about sustainable gardening practices.

   Not Reporting on this Outcome Measure

Outcome #17

1. **Outcome Measures**

   Youth, participating in youth development programs, increase interest in science.

   Not Reporting on this Outcome Measure

Outcome #18

1. **Outcome Measures**

   Families/caregivers, participating in nutrition education programs, gain knowledge of nutrition.

   Not Reporting on this Outcome Measure

Outcome #19

1. **Outcome Measures**

   Individuals participating in food safety education, gain knowledge of safe food handling and preparation techniques.

2. **Associated Institution Types**

   - 1862 Extension
   - 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	193

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #20

1. Outcome Measures

Children and youth, including those "at-risk," participating in 4-H and other the youth develoment programs, increase confidence in their leadership abilities.

Not Reporting on this Outcome Measure

Outcome #21

1. Outcome Measures

Families/caregivers, participating in nutrition education, adopt recommended dietary practices.

Not Reporting on this Outcome Measure

Outcome #22

1. Outcome Measures

Children and youth, participating in nutrition education programs, adopt recommended dietary and healthier lifestyle practices.

Not Reporting on this Outcome Measure

Outcome #23

1. Outcome Measures

Individuals, families, children and youth, will experience increased access to healthy food and greater food security.

Not Reporting on this Outcome Measure

Outcome #24

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who make positive choices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	81

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #25

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who effectively communicate.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	82

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #26

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who build connections.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	90

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #27

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who apply content knowledge and skills in health, citizenship and science to contribute to the health, growth, and well-being of self, family, community, nation, and the world.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	86

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #28

1. Outcome Measures

Percentage of of 4-H youth (4th- 12th graders) who express interest and engage in science.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	97

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to demonstrate interest and be engaged in science-related activities.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated their interest and engagement in science by indicating that they: like to see how things are made or invented (93.1%), experimenting and testing ideas (92.3%), get excited about new discoveries (90.8%), and want to learn more about science (89.3%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #29

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who express positive attitudes and aspirations toward science.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to express positive attitudes about science, see science in their futures, and recognize the relevance of science.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated their positive attitude and aspirations toward science by indicating that they: like science (89.8%), are good at science (90.3%), would like to have a job related to science (71.7%), do science activities that are not for school (70.3%), think science will be important in their future (grade 8-12 only: 83.7%), and think science is useful for solving everyday problems (grade 8-12 only: 84.7%).

4. Associated Knowledge Areas

KA Code	Knowledge Area

806 Youth Development

Outcome #30

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who develop science skills and abilities.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	88

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to demonstrate a capacity for science process skills.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated a capacity for science process skills by indicating that they can: do experiment to answer a question (94.8%), tell others how to do an experiment (93.1%), explain why things happen in an experiment (88.7%), use scientific data to form a question (grade 8-12 only: 67.7%), design a scientific procedure to answer a question (grade 8-12 only: 68.4%), use data to create a graph for presentation to others (grade 8-12 only: 75.5%), create a display to communicate my data and observations (grade 8-12 only: 79.6%), and use science terms to share my results (grade 8-12 only: 74.5%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #31

1. Outcome Measures

Percentage of 4-H youth (8th-12th graders)who apply learning, and make a contribution through science.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	80

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to apply science skills to issues in their community.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated the ability to apply science skills to issues in their community by indicating that they: have helped with a community service project that relates to science; for example: planted trees or gardens, road or stream clean-up, recycling (77.8%), used science tools to help in the community; for example: mapped with GIS, tested water quality (41.4%), taught others about science; for example: demonstrated, gave presentation at a community meeting or a school (59.2%), and organized or lead science-related events (for example: science fair, environmental festival) (40.2%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #32

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) appreciate cultural diversity.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	91

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to demonstrate value and respect for other cultures.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated appreciation of cultural diversity by indicating that they: enjoyed learning about people who are different from them (grade 4-7 only: 95.9%), explore cultural differences (grade 8-12 only: 86.5%), value learning about other cultures (grade 8-12 only: 93.9%), respect people from different cultures (grade 8-12 only: 100%), learned about people who are different from them (grade 8-12 only: 100%), and enjoy hosting someone from another culture (grade 8-12 only: 90.6%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #33

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who engage in community and community issues.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	93

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to engage in civic involvement, participate in community service and volunteer, demonstrate leadership efficacy, and maintain future intentions for civic engagement.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated their ability to engage in community and with community issues by indicating that they: can make a difference in my community through community service (97.2%), apply knowledge in ways that solve ?real-life? problems through community service (94.3%), gain skills through serving their community that will help them in the future (97.1%), are encouraged to volunteer more (96.4 %), plan to work on projects to better their community (96.7%), continue to work to better their community after high school (grade 8-12 only: 96.6%), are interested in a career that helps others (grade 8-12 only: 95.0%), are interested in working in government (such as school board, Director of parks and rec, legislator, legislative aide intern), (grade 8-12 only: 44.5%), and can contact someone that had never met before to get their help with a problem (grade 8-12 only: 86.6%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #34

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who have understanding of the democratic process.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	96

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to demonstrate their ability to work effectively in teams, improve their knowledge of parliamentary procedure, increase their interactions with local, state and national government, and intend to vote.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated their ability to understand the democratic process by indicating that they: help make sure everyone gets an opportunity to say what they think (96.7%), treat everyone fairly and equally when they are in charge of a group (99.2%), and are able to lead a group in making a decision (grade 8-12 only: 96.5%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #35

1. Outcome Measures

Percentage of 4-H youth (8th-12th graders) who have awareness of community and community issues.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	78

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to demonstrate reading or viewing news regularly and identify important issues, and engage in discussion with others and be critical consumers of information.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated their awareness of community and community issues by indicating that they: pay attention to news events that affect their community (88.2%), are aware of the important needs in their community (89.1%), care about their community (93.2%), talk to their friends about issues affecting their community, state, or world (79.3%), are interested in others? opinions about public issues (93.2%), listen to everyone?s views whether they agree or not (97.4%), and try to figure out if they are just telling one side of the story when they hear about an issue (93.2%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #36

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who choose food consistent with Dietary Guidelines.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	78

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to demonstrate consumption more healthy foods such as: vegetables, fruits, whole grains, fat-free or low-fat milk and milk products, seafood, lean meats and poultry, eggs, beans and peas, and nuts and seeds, consume less unhealthy foods, such as: sodium, solid fats, added sugars, and refined grains, and follow healthy eating patterns such as: eating breakfast, eating as a family, making healthy snack choices, etc.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated their choice in food consistent with the dietary guidelines indicating that they: eat fruit for a snack (79.7%), eat vegetables for a snack (53.5%), choose water instead of soda pop or Kool Aid when they are thirsty (72.5%), drink 1% or skim milk instead of 2% or whole milk (63.1%), choose a small instead of a large order of French fries (72.5%), eat smaller servings of high fat foods like French fries, chips, snack cakes, cookies or ice cream (55.2%), eat a low fat snack like pretzels instead of chips (74.7%), drink less soda pop (77.7%), and drink less Kool-Aid (87.4%). By participating in a 4-H Healthy Living Program, youth learned about the foods that they should eat every day (95.5%), what makes up a balanced diet (94.8%), why it is important for them to eat a healthful diet (95.6%), how to make healthful food choices (96.9%), how many calories they need to eat each day (grade 8-12 only: 71.6%), the importance of fruits and vegetables in their diet (grade 8-12 only: 94.8%), and the importance of whole grains in their diet

(grade 8-12 only: 92.3%).
By participating in a 4-H healthy Living Program, youth now take the following actions: eat more fruits and vegetables (84.9%) eat more whole grains (81.0%), eat less junk foods (74.4%), drink more water (95.6%), encourage their family to eat meals together (84.8%), think about what foods their body needs during the day (grade 8-12 only: 80.3%), make food choices based on what they know their body needs (grade 8-12 only 70.9%), make healthful food choices when every they can (grade 8-12 only: 77.6%), match their food intake to the number of calories they need to eat each day (grade 8-12 only: 50.0%), drink less soda (grade 8-12 only: 80.5%), and their family eats at least one meal a day together (grade 8-12 only: 86.3%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #37

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who improve physical activity practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	74

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to understand the benefits of physical activity, engage in 60 minutes or more of physical activity, reduce sedentary activity, and balance food intake and physical activity.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated their improvement in physical activity practices by indicating that they: do moderate physical activities like walking, helping around the house, raking leaves, or using the stairs (grade 4-7 only: 88.8%), believe being active is fun (grade 4-7 only: 91.0%), believe being active is good for them (98.0%), exercise 60 minutes every day (grade 4-7 only: 74.8%), and believe physical activity will help them stay fit (grade 4-7 only: 97.7%). In addition, youth in grades 8 or higher reported that they: were physically active for a total of at least 60 minutes per day for 4 or more days during the past 7 days (69.1%), watched one hour or less of TV on an average school day (67.7%), and played video or computer games or use a computer for something that is not school work for one hour or less on an average school day (grade 8-12 only: 49.5%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #38

1. Outcome Measures

Percentage of 4-H youth (4th- 12th graders) who avoid and prevent negative risk behaviors.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	80

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for youth to be prepared for work and life, youth need to demonstrate knowledge of risk prevention items, practice injury prevention behavior, prevent and reduce ATOD use such as: practice refusal skills, intervening to prevent use/abuse, etc., and understand the consequences of risk behaviors, advocate for avoiding risk behaviors among peers.

What has been done
Data was collected on nearly 400 youth in the California 4-H community club program. Youth ranged in age from 9 to 19 years old. The surveys were delivered via the California 4-H Online Record Book, a unique online platform programmed to mimic the traditional data collection from

the paper record book forms but added two components: a social media-like interface and outcome surveys for program evaluation.

Results
Youth have demonstrated their ability to avoid and prevent negative risk behaviors by indicating that they: are safe and careful when they cook food (95.9%), ask an adult before taking medicine when they are sick (92.1%), use pedestrian crossing when crossing the road (92.7%), tell their friends when they think they are going to do something unsafe (94.7%), avoid using substances that could harm them (95.3%), wear a helmet when riding a bike (grade 4-7 only: 84.2%), wear a helmet when they rollerblade or ride a skateboard (grade 4-7 only: 81.4%), wear a helmet when they ride an All-Terrain Vehicle (grad 4-7 only: 87.6%), wear a seatbelt when riding in a car (grade 4-7: 98.0%; grade 8-12: 86.5%), avoid riding in cars with unsafe drivers (grade 4-7 only: 95.4%) and have not ridden in a car driven by someone who had been drinking alcohol (grade 8-12 only: 79.8%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #39

1. Outcome Measures

Preschools adopt childhood obesity prevention policies.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	14

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The prevalence of childhood obesity in the US is a concern -- approximately 32 percent of youth, ages 2 to 19, are overweight or obese. School programs and policies that promote changes in the school environment (e.g., access to fresh fruits and vegetables in school) are needed, in addition to nutrition and physical activity instruction and parental involvement. Such integrated strategies are necessary to address the multiple, obesity-related factors and successfully target this complex issue.

What has been done
UCCE Alameda partnered with Alameda County Public Health Department's Nutrition Services to offer teacher education/training; develop policies for 14 low-income state preschools and Head Start sites that had no previous wellness policies; and to promote preschool education strategies for early childhood obesity prevention. The goal was to facilitate healthy nutrition and physical activities in the classroom and playground, and to promote preschool education changes at early childhood centers and in the home. Interventions included a preschool education assessment from 27 teachers, teacher trainings on the Let?s Move curriculum, and nutrition and physical activity policy development with administrators and teachers at the 14 sites in California.

Results
The fourteen preschool sites adopted childhood obesity prevention policies to be implemented during the 2015/16 school year. Preliminary outcomes during the policy development phase are positive, as evidenced by the actions taken by administrators, teachers, parents, and students. Fremont administrators have increased the purchasing of fresh fruits and vegetables from monthly to weekly. All teachers promote healthy eating and physical activity in the classroom and the playground. At home, parents promote healthy food and children encourage parents to reduce the intake of sugary drinks.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #40

1. Outcome Measures

Research on childcare nutrition practices changes food environments for California preschoolers through multiple California state laws.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

On any given day in the US, 84 percent of preschool-aged children drink sugary drinks, for the equivalent of 11 percent of their total energy intake. With nearly one in four of these young children overweight or obese, it is clear that too many children are entering school at an unhealthy weight and with unhealthy dietary habits.

What has been done
The 2008 UC ANR collaborative study with California Food Policy Advocates and the Samuels Center for Public Health Research and Evaluation recommended California needed beverage standards for young children in licensed childcare. The Healthy Beverages in Childcare Law (AB 2084) was signed into law in 2010, which stands as among the most comprehensive of any state laws on childcare beverages. In 2012, these researchers conducted another survey of childcare providers to identify whether the new law was working. They found that beverage options in childcare improved in all four areas ? however, only 60 percent of providers reported knowing about the law and only one quarter were fully compliant.

Results
Presented with these results, stakeholders suggested better nutrition education for providers, parents, and children. A year later, Foundations for the Healthy Nutrition in Child Care AB 290 became law. It will require newly licensed childcare providers receive one hour of training on child nutrition starting in 2016. Previously, no training in nutrition had been required. In 2014, the lead CE Specialist researcher served on the AB 290 Workgroup convened by California?s Emergency Medical Services Authority to develop the new nutrition curriculum standards for childcare licensing. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
703	Nutrition Education and Behavior

Outcome #41

1. Outcome Measures

Research informs policy to limit these kinds of unhealthy foods and beverages sold in K-12 schools.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2015 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Fueled by tight budgets and limited resources, schools had found that profits could be obtained by selling ?competitive foods.? Schools became a profitable market for companies, and students were a captive audience -- obesity rates skyrocketed. Advocates and policymakers turned their attention to limiting soda, candies, and chips in elementary and middle schools, but a law passed in response to this situation languished as an unfunded mandate.

What has been done
The California Department of Education called in researchers at the Atkins Center for Weight and Health at UC Berkeley to examine the financial implications of selling sodas, candies, and chips at schools. The findings from the study surprised everyone. When schools quit selling these snack foods and beverages, students were more likely to eat subsidized school meals, bringing more federal funding into the state. Most schools studied made more money by not selling foods and beverages that competed with school meals. And of course, school meals were more nutritious than competitive foods. The Center partnered with a variety of groups to disseminate information on best practices for schools wanting to limit junk food and improve the health of their meal programs.

Results
As a result of the work by advocates armed with data from this study, California became the first state in the nation to pass legislation to limit these kinds of unhealthy foods and beverages sold in K-12 schools. Studies of the Body Mass Index (BMI) of California students indicated a reduction in obesity after the policy change. These studies have contributed to positive changes in school foods nationwide, by informing the 2010 Healthy, Hunger-Free Kids Act which updates nutrition standards for schools. Beginning this school year, students nationwide may only have ?smart snacks? that meet nutrition standards in cafeterias, vending machines, and through fundraisers. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
703	Nutrition Education and Behavior

Outcome #42

1. Outcome Measures

School lunchrooms doubled milk sales, improved atmosphere, and increased student involvement.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
For many parents, an ongoing battle with their child is about healthy eating practices. With more than one-third of U.S. children overweight or obese, promoting healthy eating behaviors has never been more essential. Out of this national crisis, The Smarter Lunchroom Movement (SLM) was born, spearheaded by Cornell University's Center for Behavioral Economics in Child Nutrition Programs in 2009. Their evidenced-based approach helps nudge students to make healthier choices through low cost/no cost solutions; a lunchroom environment focus; promoting healthful eating behaviors; and using policy, systems, and environmental approaches to promote sustainability.

What has been done
In 2013, the UC CalFresh Nutrition Education Program partnered with the California Department of Education and the Dairy Council of California to initiate "The Smarter Lunchroom Movement (SLM) of California" and began training school Food Service Directors in SLM practices. To date, over 250 school districts have received training, with 2,500 attendees statewide. An example of the influence this program has had is illustrated in Yuba County, where, within a year and a half, the total number of schools involved leaped from 1 to 19. UC CalFresh Yuba-Sutter County, the Dairy Council of California, and the Food Service Director of the Marysville Joint Unified School District (MJUSD) created a plan that provides training and technical assistance to school cafeteria managers with kits that include monthly thematic posters; creative name labels for salad bars; and School Lunch Hero nametags, accompanied by monthly talking points. In addition, "product placement" (locating healthier foods within close proximity to students' reach) occurred. Johnson Park Elementary School in Olivehurst was the original site for Yuba County SLM strategies.

Results
MJUSD evaluation data from Johnson Park Elementary School indicates that improving the placement of white milk and increasing the number of servings offered has almost doubled sales at breakfast. A lunchroom self-assessment score card monitors school district progress toward the overall goal of improving the lunch atmosphere and student involvement, referred to as ?school synergy,? while decreasing waste. Within a year the school experienced a 69% increase in sales of reimbursable meals; a 44% increase in fruit displays; a 31% improvement in promoting vegetables and salad; and a 36% improvement in displaying the entrée of the day. Importantly, ?school synergy? increased by 30%.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
806	Youth Development

Outcome #43

1. Outcome Measures

Garden-based nutrition education improves student learning.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Though the percentage of schools with gardens is growing nationwide, schools with higher percentages of students from low-income families are less likely to have school gardens. Robert Bruce Elementary in Santa Maria has a high percentage of low-income students (96.7% qualified for the Free and Reduced School Meals Program). Following national trends, this school did not have access to a school garden, and 51.2% of its 5th grade students were found to need improvement in aerobic capacity on the CA Physical Fitness Report, as opposed to 35.1% of 5th graders in the county. Within its school district, this school was often referred to as the ?forgotten school? in terms of school beautification.

What has been done
UC CalFresh Nutrition Education Program (NEP) staff in San Luis Obispo/Santa Barbara (SLO/SB) Counties worked with the principal and several teachers at the school to identify priorities for improving student health, including the creation and maintenance of a school garden. Using donated equipment and some purchased materials, the work group (including the school principal, teachers, parent volunteers, students, and UC educators) turned an empty dirt patch at the back of the school into a school garden for hands-on, garden-based educational lessons. Throughout the year, NEP supported garden expansion alongside teachers and students; conducted over 40 train-the-trainer, garden-enhanced nutrition education lessons; and hosted a full-day workshop with 10 district educators. Produce harvested from the garden was used in

classroom demonstrations and sent home with families along with nutrition information and recipes. The school won a beautification award, which led to the installation of white picket fencing around the garden beds, school murals, and a tool shed.

Results
All responding teachers agreed that the school garden positively impacted their students? learning. Eight teachers reported conducting learning activities in the garden on their own without UC educators for periods of 4 hours to several times a week. It is well documented that children who have a hand in growing food develop and sustain 1) a more positive perception of fruits and vegetables, and 2) an increased understanding of the relationship between food and health. School gardens have been shown to positively impact students? fruit and vegetable consumption, while encouraging them to be physically active.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
806	Youth Development

Outcome #44

1. Outcome Measures

4-H youth improve their technological literacy by producing films showcasing 4-H impacts on communities.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Youth in the United States spend much of their time with digital technologies. However, the mere use of technological devices is not enough to succeed in today's world; young people need to learn to apply and adapt technological processes and tools. Fluency with technology will help them thrive and participate in issues affecting their communities. In order to do this, they need practical, hands-on experience.

What has been done
To promote scientific literacy in young people (now very linked to technological fluency), UC ANR supports the Enhancing Technological Literacy Through Filmmaking Project (ETLTFP), which addresses young peoples? needs to understand technological principles and gain the abilities to communicate and collaborate using digital tools. The ETLTFP was implemented across California by the state's 4-H Technology Leadership Team (TLT) with funding from BestBuy. Workshops on filmmaking and video production were hosted around the state. During the workshops, TLT presenters led small group activities on storyboarding (pre-production), filming (production) and video editing (post-production). After the workshops, county 4-H groups were able to check out digital camcorder loaner kits to produce videos of their own Revolution of Responsibility service-learning projects.

Results
Young peoples? evaluations of the workshops revealed statistically significant gains of confidence and ability in their technological competencies with film production. Participants felt especially confident in storyboarding and using digital camcorders. They reported (between "Strongly Agree" and "Agree," on average) that the workshops improved their ability to produce films. These 4-H Revolution of Responsibility workshops focused on helping young people show how they have identified and addressed community issues through their service-learning projects. Dozens of films showcasing these projects have been produced by 4-H youth teams. These videos follow an effective four-part format: defining a problem within a community; showing how 4-H can be a part of the solution; telling how the project impacted their community; and signing off with ?Join our Revolution.? All of the videos are available on the California 4-H YouTube channel at: https://www.youtube.com/user/California4H.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #45

1. Outcome Measures

UC Cooperative Extension worked with UC Master Gardener volunteers to develop a therapeutic horticulture program, improving the school environment.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual

2015 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Residents at a Girls' Rehabilitation Facility (GRF) in San Diego County attend school on the grounds. The facility offers an intensive program focusing on cognitive restructuring, but the asphalted area outside the buildings was seldom used. The Master Gardeners offered help in gardening and pest management education, which led to a multiagency effort to improve the grounds.

What has been done
With financial support from the county's Health and Human Services Agency, UC Cooperative Extension joined forces with UC Master Gardener volunteers and the San Diego County GRF, the San Diego County Agricultural Weights and Measures, and representatives from the Sustainable Living Institute to create a garden and greenhouse at the facility. Staff from these agencies share in educating the young women on how to design a garden, build healthy soil, water wisely, manage pests, and handle food safely.

Results
Ten young women detained at the GRF participated in designing, building and selecting plants for the garden. Their input encouraged the rest of the young women to become involved. Residents in the program work in the garden in small groups with UC Master Gardeners. They learn to make healthy snacks with the food they grow, and they recognize that gardens integrate science, math, social studies and language arts. They also learn about the positive results of collaboration, communication and teamwork, and a healthy, active lifestyle. Organizers of the horticultural therapy program hope that the success at these schools can be replicated at other sites in the Juvenile Court and Community School (JCCS) system.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
806	Youth Development

Outcome #46

1. Outcome Measures

Improved parenting behaviors result from school-based nutrition education program.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the U.S., 32 percent of children are overweight or obese. Intervention and prevention efforts point to the importance of multifaceted approaches that include both children and parents. Recent research establishes important links between warm and responsive parenting practices and children?s healthy diets and weight. With children spending much of their day at school, many current interventions for obesity prevention focus on the school environment. In such cases, it is important to establish links to parents and to address the parenting environment.

What has been done
The Shaping Healthy Choices Program (SHCP), funded by UC ANR, is a multicomponent, school-based program with five components: 1) nutrition education and promotion, 2) family and community partnerships, 3) integration of regional agriculture, 4) foods available on the school campus and 5) school wellness policies. The UC SHCP team created family partnerships through "Team Up for Families" monthly parent newsletters that contained 1) school-to-home lesson connections for the classroom-based nutrition, garden and physical activity curriculum and 2) information on parenting practices relevant to healthy diet and physical activity tailored to their child?s age. Team Up for Families had two goals: 1) teach parents the nutrition and physical activity information their children received in the classroom with ideas on how to use the information at home, and 2) promote positive parenting practices by providing information about developmental processes for children of this age, how to interact in a warm and responsive manner with their children, and how parenting behaviors affect children?s dietary and physical activity decisions.

Results
The Team Up for Families newsletters improved parenting behaviors linked to poor dietary quality and overweight children (restriction of, and pressure to eat certain foods), and increased desirable behaviors linked to better child outcomes (shared family meals, consistency). For children who lack the internal control associated with healthy weight, parenting was significantly associated with a positive decrease in body mass index. The use of Team Up for Families newsletters within the SHCP intervention provides a means to change parenting behaviors and contribute to bolstering changes in children?s health.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
802	Human Development and Family Well-Being

Outcome #47

1. Outcome Measures

Shaping Healthy Choices Program improves children's health.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Simply offering healthy options is not enough to motivate children to make healthy choices. Moreover, imposing restrictions rather than providing children with options to make healthy choices has long-term negative implications. With recent estimates of childhood obesity showing that approximately 32 percent of children are overweight or obese, it is clear a program that addresses multiple, obesity-related factors is necessary to successfully target this complex issue.

What has been done
The Shaping Healthy Choices Program (SHCP) is a multi-component, school-based intervention composed of five components: 1) nutrition education and promotion, 2) family and community partnerships, 3) integration of regional agriculture, 4) foods available on the school campus, and 5) school wellness policies. Using pre- and post-test measurements, we determined if schools utilizing the program have improved student outcomes compared to controls. As part of the program, a UC Davis and UC Cooperative Extension team provided 1) a standards-based curriculum with interactive classroom nutrition, garden, and physical activity education for fourth-grade students, 2) healthy cooking activities that link agriculture, food preparation and nutrition, 3) experiential nutrition and health-related activities at school events, 4) school garden technical support, 5) local grower and distributor connections to encourage regional sourcing, 6) support for increased fresh produce in the school cafeteria, and 7) the implementation of committees to integrate SHCP program activities into the school wellness initiatives.

Results
Results provided a base for state and national dissemination of a school-based multi-component program to prevent childhood obesity. Preliminary analyses show that children classified as overweight or obese dropped from 56 percent to 38 percent during the one year SHCP was implemented in Sacramento County. Using school sites for the SHCP components allows

students, families, school personnel, health partners, and community members to cultivate excitement and acceptance of nutrition and health behaviors that positively impact the school environment and the community. The success of the SHCP to promote health and prevent obesity enabled participating schools to sustain lasting improvements for the school community.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle
806	Youth Development

Outcome #48

1. Outcome Measures

Students eat healthy foods through the Healthy Shasta FARM (Fun at Redding Market) Club pilot.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recent studies indicate that obesity is a complex issue, with individual behavioral and environmental factors at its core. The problem can also be multigenerational, entrenched in family food choices passed from adult to child. Some experts believe that one of the most effective ways to address the obesity issue is through community-based nutrition education with "farm-to-fork" initiatives.

What has been done
UC CalFresh encourages counties to link their school-based nutrition education with farmers' markets. This includes using the CalFresh EBT system (Electronic Benefit Transfer) to procure fresh fruits and vegetables at these markets, with the added benefit of supporting local producers. In Shasta County, the NFCS (UCCE's Nutrition, Family and Consumer Science Program) has partnered with the "Healthy Shasta" movement to promote healthy food choices and active living for residents. The NFCS helped create a 5-year plan for fruit and vegetable promotion with many

local groups. Their workgroup created a pilot study, using the Healthy Shasta FARM (Fun at Redding Market) Club, to connect students to fresh local produce and promote its consumption. This pilot study worked with students at certain elementary schools, distributing FARM Club tokens to be used for purchasing produce at farmers' markets. All vendors selling produce at the market participated in the project.

Results
The Healthy Shasta FARM Club booth was present at the local farmers? market for 14 weeks. During this time:
?A total of 514 students enrolled in the FARM Club and increased their knowledge about local healthy food choices, the farmers' market, and the importance of consuming fruits and vegetables daily.
?A total of 3,561 free tokens were distributed to the students.
?A total of $7,122 in additional revenue was collected by local farmers due to the FARM Club.
?Of the participating students, 84% returned to the farmers' market to receive a free token.
A video was created to illustrate the students' intent to change behavior due to the intervention.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
806	Youth Development

V(H). 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 2015, 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.

V(I). 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 2015. In addition, significant success stories are reported qualitative outcomes under the State Defined Outcomes section.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Sustainable Food Systems

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	15%		7%	
111	Conservation and Efficient Use of Water	2%		2%	
201	Plant Genome, Genetics, and Genetic Mechanisms	1%		15%	
202	Plant Genetic Resources	3%		3%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	5%		9%	
204	Plant Product Quality and Utility (Preharvest)	7%		3%	
205	Plant Management Systems	33%		3%	
206	Basic Plant Biology	1%		13%	
211	Insects, Mites, and Other Arthropods Affecting Plants	2%		1%	
212	Pathogens and Nematodes Affecting Plants	1%		3%	
302	Nutrient Utilization in Animals	2%		2%	
307	Animal Management Systems	10%		1%	
501	New and Improved Food Processing Technologies	0%		3%	
502	New and Improved Food Products	2%		4%	
503	Quality Maintenance in Storing and Marketing Food Products	2%		2%	
601	Economics of Agricultural Production and Farm Management	6%		2%	
604	Marketing and Distribution Practices	3%		1%	
702	Requirements and Function of Nutrients and Other Food Components	0%		22%	
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%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	111.7	0.0	144.1	0.0
Actual Paid	7.2	0.0	16.2	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1163629	0	2050701	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1163629	0	2050701	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
40468185	0	102753500	0

V(D). Planned Program (Activity)

1. 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.

2. 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

3. 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.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	443646	0	273	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2015
Actual:	5

Patents listed

1. Engineering Demeter 5-methylcytosine DNA Glycosylase to Improve, Yield, Stability, and Solubility
2. BIFIDOBACTERIAL GENE SEQUENCES REQUIRED FOR CATABOLISM OF MILK OLIGOSACCHARIDES
3. WALNUT TREE NAMED 'SOLANO'
4. NEW STRAWBERRY CULTIVAR, 'C229' MERCED
5. A NEW SOLUTION FOR ALTERNATE BEARING

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	107	448	555

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2015	466

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2015	121

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual
2015	73

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2015	36

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2015	52

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2015	282

Output #7

Output Measure

- Videos, Slide Sets and other A/V or Digital Media Educational Products Created

Year	Actual
2015	4

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2015	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Farm and ranch owners/managers and allied industry professionals, participating in the programs, gain knowledge of crop and varietal selection factors and research-based performance data.
2	Farm and landscaping owners/managers and allied industry professionals, participating in the programs, adopt improvements in aspects of comprehensive management systems for plant production.
3	Farm, ranch and landscaping owners/managers and allied industry professionals, participating in the programs, adopt superior varieties of crops.
4	Farm and landscaping owners/managers and allied industry professionals, participating in the programs, gain knowledge of aspects of comprehensive management systems for plant production.
5	Farm and ranch owners/managers, participating in the programs, gain knowledge of business management practices and marketing strategies, including the costs and risks associated with producing specialty crops.
6	Tree fruit and nut orchard owners/managers and allied industry professionals, participating in the programs, adopt recommended pruning techniques or other orchard management practices.
7	Farm and ranch owners/managers, participating in the programs, gain skills in business management practices.
8	Farm and ranch owners/managers, participating in the programs, realize increased profitability due to lower production costs or diversification of income.
9	Farm and landscaping owners/managers and allied industry professionals, participating in the programs, gain knowledge of pest and disease management for plant production.
10	Farm and landscaping owners/managers and allied industry professionals, participating in the programs, gain knowledge of cultural practices.
11	Farm and landscaping owners/managers and allied industry professionals, participating in the programs, gain knowledge of irrigation management and drainage.
12	Farm and landscaping owners/managers and allied industry professionals, participating in the programs, adopt improvements in cultural practices.
13	Farm and landscaping owners/managers and allied industry professionals, participating in the program, gain comprehensive management skills for plant production.
14	Farm and ranch owners/managers and allied industry professionals, participating in food safety programs, gain knowledge on on-farm control of food contaminants and quality assurance programs.
15	Ranch owners/managers and allied industry professionals, participating in the programs, adopt improvements in aspects of comprehensive management systems animal production.
16	Ranch owners/managers and allied industry professionals, participating in the programs, gain knowledge of aspects of comprehensive management systems for animal production.
17	Farm, ranch and landscaping owners/managers and allied industry professionals, participating in the program, adopt recommended irrigation management practices.

18	Farm and ranch owners/managers and allied industry professionals, participating in the programs, are more likley to try out or adopt recommended cultural practices, pest and disease management, or other aspects of comprehensive management systems for plant and animal production.
19	Farm and landscaping owners/managers and allied industry professionals participating in the program gain knowledge of aspects of plant nutrition management.
20	Small farmers and community gardeners improve food safety practices.
21	Pollinator research informs policy and decision-making.
22	Community-based research improves urban garden health.
23	Farmers adopt business planning practices, increasing profitability.
24	UC Cooperative Extension develops easy, reliable method for community gardeners to weigh crop yields, and document economic benefit.
25	Specialty coffee production is a new crop alternative for growers in mild-winter areas of California.
26	UC Cooperative Extension develops new tools to increase productivity for berry growers.
27	UC Cooperative Extension facilitates small farmers to gain new market contacts with the potential to increase sales.

Outcome #1

1. Outcome Measures

Farm and ranch owners/managers and allied industry professionals, participating in the programs, gain knowledge of crop and varietal selection factors and research-based performance data.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1459

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)

Outcome #2

1. Outcome Measures

Farm and landscaping owners/managers and allied industry professionals, participating in the programs, adopt improvements in aspects of comprehensive management systems for plant production.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Farm, ranch and landscaping owners/managers and allied industry professionals, participating in the programs, adopt superior varieties of crops.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Farm and landscaping owners/managers and allied industry professionals, participating in the programs, gain knowledge of aspects of comprehensive management systems for plant production.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	963

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
601	Economics of Agricultural Production and Farm Management

Outcome #5

1. Outcome Measures

Farm and ranch owners/managers, participating in the programs, gain knowledge of business management practices and marketing strategies, including the costs and risks associated with producing specialty crops.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1120

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #6

1. Outcome Measures

Tree fruit and nut orchard owners/managers and allied industry professionals, participating in the programs, adopt recommended pruning techniques or other orchard management practices.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Farm and ranch owners/managers, participating in the programs, gain skills in business management practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	520

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #8

1. Outcome Measures

Farm and ranch owners/managers, participating in the programs, realize increased profitability due to lower production costs or diversification of income.

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Farm and landscaping owners/managers and allied industry professionals, participating in the programs, gain knowledge of pest and disease management for plant production.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	371

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

Outcome #10

1. **Outcome Measures**

Farm and landscaping owners/managers and allied industry professionals, participating in the programs, gain knowledge of cultural practices.

Not Reporting on this Outcome Measure

Outcome #11

1. **Outcome Measures**

Farm and landscaping owners/managers and allied industry professionals, participating in the programs, gain knowledge of irrigation management and drainage.

Not Reporting on this Outcome Measure

Outcome #12

1. **Outcome Measures**

Farm and landscaping owners/managers and allied industry professionals, participating in the programs, adopt improvements in cultural practices.

Not Reporting on this Outcome Measure

Outcome #13

1. **Outcome Measures**

Farm and landscaping owners/managers and allied industry professionals, participating in the program, gain comprehensive management skills for plant production.

Not Reporting on this Outcome Measure

Outcome #14

1. **Outcome Measures**

Farm and ranch owners/managers and allied industry professionals, participating in food safety programs, gain knowledge on on-farm control of food contaminants and quality assurance programs.

Not Reporting on this Outcome Measure

Outcome #15

1. **Outcome Measures**

Ranch owners/managers and allied industry professionals, participating in the programs, adopt improvements in aspects of comprehensive management systems animal production.

Not Reporting on this Outcome Measure

Outcome #16

1. **Outcome Measures**

Ranch owners/managers and allied industry professionals, participating in the programs, gain knowledge of aspects of comprehensive management systems for animal production.

Not Reporting on this Outcome Measure

Outcome #17

1. **Outcome Measures**

Farm, ranch and landscaping owners/managers and allied industry professionals, participating in the program, adopt recommended irrigation management practices.

Not Reporting on this Outcome Measure

Outcome #18

1. **Outcome Measures**

Farm and ranch owners/managers and allied industry professionals, participating in the programs, are more likley to try out or adopt recommended cultural practices, pest and disease management, or other aspects of comprehensive management systems for plant and animal production.

Not Reporting on this Outcome Measure

Outcome #19

1. **Outcome Measures**

Farm and landscaping owners/managers and allied industry professionals participating in the program gain knowledge of aspects of plant nutrition management.

Not Reporting on this Outcome Measure

Outcome #20

1. Outcome Measures

Small farmers and community gardeners improve food safety practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small farmers, school farmers, and community gardeners are facing increasing public and government pressure to ensure food safety on their farms and produce. In anticipation of new regulations and market demand, these small-scale farmers and gardeners are seeking simple, yet effective strategies to ensure food safety in their operations.

What has been done
UC ANR provided food safety training both on-farm and in workshop settings to over 90 small farmers, UCCE staff, farm managers, and community garden coordinators in Humboldt, Stanislaus, Merced, Marin and Alameda Counties. Participants learned about the primary causes of food borne illness, how to identify key food safety risks on the farm, how to develop standard operating procedures to minimize those risks, and how to develop and implement a food safety plan that is appropriate for their scale and mode of operation. Simple food safety guidebooks, assessments and manuals, as well as worker training guidelines were created, assembled, and provided free of charge.

Results
Workshop attendees increased confidence in their ability to not only identify but also mitigate on-farm food safety risks. Farm managers, including high school farm managers and community garden managers, gained increased knowledge and capacity to provide food safety training to their students, members and workers on their farms. In addition, there is now increased public access to simple, yet comprehensive training materials, given Good Agricultural Practices (GAPs) and Good Handling Practices (GHPs) are now available online at: https://www.dropbox.com/sh/4jt3qvrepj2zlqq/AAAouyB0hNydjZ4Rn8AS-sE2a?dl=0

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #21

1. Outcome Measures

Pollinator research informs policy and decision-making.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Honeybee colonies around the world are disappearing at rapid rates, while native habitat for other pollinators is shrinking to make room for intensive agriculture and development. This has cascading implications for the more than 75 percent of the world?s crops pollinated by insects. Yet the benefits of pollinator habitat have often seemed invisible to policymakers, and the problem is not yet well studied, making it difficult to develop a response. In California, some farmers depend on vulnerable, trucked-in honeybees to support large tracts of single crops. ?Ecosystem services? is a step toward defining the problem and potential solutions. It?s the name for the broad array of benefits, direct and indirect, provided by nature to humans.

What has been done
UC ANR researchers are working to understand how ecosystems deliver benefits like drinking water, pollination, and flood control to human populations. An AES faculty member has worked with farmers to plant hedgerows of flowering plants, shrubs and grasses that attract diverse pollinators to their crops. The research is finding that providing diverse habitat brings back a wide array of pollinators. Relying less ? or not at all ? on trucked-in pollinators provides a more sustainable food system, one that uses less fossil fuel and is more resilient to ever more-common climate shocks.

Results
This research is going global. Working with the Food and Agriculture Organization (FAO) of the

United Nations, existing programs and policies that support pollination throughout the world have been identified. The resulting document was developed to be accessible to policymakers and scientists alike, outlining practical methods to support pollinator habitat that put feasibility at the fore, thus offering an array of solutions not dependent on huge budget outlays. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #22

1. Outcome Measures

Community-based research improves urban garden health.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Green infrastructure, including gardens, is at the center of the conversation about a transition to sustainable cities. Urban gardens provide a local source of nutritious food and can help to strengthen community ties. However, there are tradeoffs to gardening in the city, including potential exposure to soil pollutants, such as lead which may have come from paint and gas. Lead in soil is a lesser-known source of human lead exposure than lead-based paint, but contaminated soil can also adversely affect humans, especially children, if accidentally inhaled or ingested. Lead paint was banned for homes in 1978. Older neighborhoods, with the highest soil lead levels, are often the same neighborhoods with limited access to fresh fruits and vegetables.

What has been done
UC ANR funded a collaborative transdisciplinary research program that includes ecologists and social scientists at UC Davis who work in partnership with local non-profit organizations in Sacramento who are working to support healthy, sustainable, and equitable communities by installing raised-bed gardens to improve access to local foods and build community cohesion and

empowerment. The ecologists have tested soil lead at more than 75 yards in three older, low-income neighborhoods in north and south Sacramento using handheld X-ray fluorescence. Now they are expanding to include all of the City of Sacramento and are actively seeking additional partnerships with regulatory, health, and family service organizations and agencies. The team?s social scientists have conducted resident surveys and interviews and facilitated activities that allow residents to tell their stories of place, contamination, and gardening. The researchers and residents are collaboratively evaluating the trade-offs between ecosystem services such as food provisioning and soil lead exposure.

Results
UC Davis researchers are able to provide to residents soil lead data within 10 days, which is used to determine where to place gardens and manage lead hazards in other areas of the yard. Researchers also deliver residents detailed maps of their property in person so that they can answer any questions and provide a list of low-cost strategies to mitigate high levels of lead. Data collected on yards will be used to make predictions at the scale of the city, helping to identify the role that landscape plays in the distribution of lead. Community-based research on lead, gardens, and place has strengthened relationships between UC Davis researchers, local non-profits, and community gardeners, together identifying ecosystem services that the community values and would like to manage for advancing the ultimate goal of healthy urban gardening. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
723	Hazards to Human Health and Safety

Outcome #23

1. Outcome Measures

Farmers adopt business planning practices, increasing profitability.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Placer and Nevada Counties are home to 2,097 farms, according to the 2012 USDA Census of Agriculture, and 32% of those farmers are considered beginning farmers, having less than 10 years? experience in operating a farm. The local food movement has contributed to a growing interest in small-scale farming. Other reasons for starting a small farm include a need for income from existing property and a desire to "get back to the land." Many beginning farmers have limited agricultural and business experience, so farm business management training is a critical need.

What has been done
UCCE-Placer/Nevada has been offering an annual Farm Business Planning class since 2008. The 6-week course covers mission and vision statements, enterprise analysis, economic planning for profit, cash flow analysis, operations planning, risk management planning, and marketing. In the final session, participants develop an action plan for the next 3 to 6 months. Participants then report back on their progress at a follow-up meeting 3 months later. Over 55 farms and ranches, including 85 producers, have completed the Farm Business Planning Course since 2008.

Results
A survey of Farm Business Planning participants since 2008 showed that more than 85% use profit and loss projections, cash flow statements, production and marketing records, and time and motion studies as part of their record-keeping system for decision making. Prior to taking the course, only 44% of participants practiced these strategies. Furthermore, 83% have remained in touch with other members of their farm business planning class; 79% have used risk management plans developed in the course to reduce on-farm risk; 41.4% have expanded the scale of their operations; and 39% stated that their profitability has increased.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #24

1. Outcome Measures

UC Cooperative Extension develops easy, reliable method for community gardeners to weigh crop yields, and document economic benefit.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There are more than a million community gardeners in the United States and the numbers continue to increase. As government policymakers determine how to allocate precious tax resources, there is one big question we must be able to answer: ?Do community gardens actually improve access to fresh produce in low-income communities?? A reliable method for documenting vegetable output and associated cost savings from community gardens can give decision makers valuable data as they determine whether to support the increase in number and/or size of community gardens.

What has been done
In partnership with the Parks, Recreation and Neighborhood Services Department of the City of San Jose, California, UC Cooperative Extension developed an easily reproduced method for weighing the vegetable output of community gardens. Ten community gardeners in San Jose used portable electronic scales to weigh vegetable output from their garden plots over a four-month, Spring-Summer growing season. Results indicate that community garden practices are similar to those of biointensive, high-production farming, a sustainable, small-scale farming system that focuses on soil quality without using nonrenewable resources. The plots produced 0.75 lb. of vegetables per square foot, more than conventional agricultural practices, which produce 0.6 lb./sq. ft. The gardens also produced an average of 2.55 lb. of vegetables per plant. Based on retail prices for produce, each plot produced $435 worth of food for the season. The research results showed that cost savings are greatest if vertical, high-value crops such as tomatoes and peppers are grown in community gardens, although actual individual plot yields vary, depending on growing conditions, the gardener?s skill level, the availability of water and other factors.

Results
Documenting the harvests of urban community gardens helps to define their role in the local food economy, particularly if crop yields are monetized, since most of the production and consumption takes place in an informal economy where dollar values are not otherwise tracked. The method of weighing pounds per crop per area in this study provides data on which crops provide the greatest cost savings to the community. The easy, reliable method for weighing crop yields developed by UCCE in this study empowers the gardeners themselves to track the output and cost savings of community gardens.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #25

1. Outcome Measures

Specialty coffee production is a new crop alternative for growers in mild-winter areas of California.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farm operators in California are often faced with limited market alternatives for traditional fruit and vegetable crops because of chronic oversupply and low prices. The development of promising new crops is one way to expand the range of options available to California farmers who want to increase the diversity of crops they grow and improve farm profitability. Specialty coffee production and marketing is a new crop enterprise alternative for frost-free areas of central and southern California. Coffee is being successfully produced, both in open-field solid plantings and as an intercrop within established avocado orchards. Coffee from California farms has now been successfully produced, processed, and commercially marketed over five successive seasons.

What has been done
A familiarity with coffee farms in Central America and Hawaii led a UC Small Farms and Specialty Crops farm advisor to import coffee seed for three coffee varieties in 2002, and establish field trials with the grower of Goodland Organics in Goleta (http://goodlandorganics.com). Together they conducted a multi-year, on-farm research and development program with the goal of producing a profitable, high-quality, specialty coffee. They established coffee plantings and evaluated alternative cultural practices to produce a consistent crop. In 2005 they added a small-volume coffee depulper, and then later modified it to handle the increasing volumes of coffee being produced. With the initial elements of coffee production and processing beginning to take shape, they evaluated cupping quality of the coffee and different marketing options via farmer?s market, farm tours, and internet sales. These efforts led to a slow, steady increase in the planting area and the range of varieties, followed by successful sales of processed coffee beginning in 2010. Expanded field production, processing, and cupping quality evaluations are continuing in 2015.

Results

Specialty coffee production and marketing offers a promising new crop alternative for several mild-winter counties in California. Field and processing trials for 15 distinct coffee varieties are underway to further develop new production and marketing options. Certified cupping evaluations indicate that California-grown coffee has flavor profiles consistent with the highest grades of specialty coffee currently in the marketplace. Coffee is now being harvested on three farms in southern Santa Barbara County, and market demand is outpacing supply. New plantings include open-field, homogeneous plantings as well as coffee interplanted in alternate rows of established avocado orchards. Additional new commercial plantings have expanded up and down the California coast from Cambria to Carlsbad and additional commercial plantings are planned for 2015.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #26

1. Outcome Measures

UC Cooperative Extension develops new tools to increase productivity for berry growers.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Market demand for blackberries is increasing steadily following similar market growth for raspberries and blueberries over the past 15 years. Newer cultivars of blackberries with better flavor, appearance, and consistency are behind an increase in consumption of these minor berry fruits. California growing areas continue to be the source for much of the North American fresh market blackberry supply, and production has increased in response to growing demand. Some newer blackberry cultivars offer a different growth habit that includes primocane fruiting, meaning they bear fruit in the first year rather than the traditional second year. This challenges growers with new alternative management options, including pruning and thinning practices, that would

best optimize production. Blackberry growers seek to control production to market fresh-market blackberries most effectively, and site-specific crop response information has been key to finding the most efficient management regime for different blackberry cultivars.

What has been done
Field trials with primocane fruiting cultivars in San Luis Obispo, Santa Barbara, Ventura and Santa Cruz counties by UCCE advisors have generated important, region-specific information to enhance management practices for primocane fruiting blackberries. This multi-year project, spread across three growing districts, has identified management practices, including a mow-down in January, early pruning, and ?tipping? to delay production. Once production commences under this regime, primocane fruiting cultivars can produce continually until late November or early December under California conditions. The primocane fruiting cultivars offer a marked improvement over traditional cultivars, and these management guidelines help growers improve their productivity. This information was shared with 132 growers at the Annual Central Coast Caneberry Meeting in 2015. Continuing field trials seek to define what adjustments are needed to the tipping regime in order to grow the berries in high tunnels and to find suitable pruning alternatives for different production regimes; results of ongoing trials will continue to be shared every year.

Results
Coastal California berry growers have new tools to efficiently manage primocane fruiting blackberry cultivars efficiently and productively in order to target profitable market windows. UC research has used market signals to guide field trials that are developing improved production alternatives for California blackberry growers, the leading producers of fresh market blackberries in the country. Field trials in the key production areas of the state have verified the optimum management practices for producers to enter the market early, produce high-quality fruit over an extended picking season, and potentially increase profits.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
601	Economics of Agricultural Production and Farm Management

Outcome #27

1. Outcome Measures

UC Cooperative Extension facilitates small farmers to gain new market contacts with the potential to increase sales.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
California?s Central Coast, with its superb growing conditions, has a diverse population of farmers who produce a dizzying array of high-quality, fresh products in a highly competitive environment. Small and recent-entry farmers may lack marketing experience, connections with area wholesale markets, or established relationships with produce buyers. Increasing consumer interests in small farms and locally produced foods, together with buyers? desire to support local farms and products, have created new and unique market opportunities for both farmers and produce buyers.

What has been done
Recognizing that small-scale farmers could benefit from increased knowledge about market venues and access to markets in their area, the UC Sustainable Agriculture Research and Education Program/UC Davis Agricultural Sustainability Institute and UC Cooperative Extension in Santa Cruz and Santa Clara counties teamed up to convene a full-day San Francisco Bay Area Market Tour that enabled farmers and buyers to meet one another and exchange information. Funds for the tour were provided by a grant from Co Bank, Farm Credit West, American AgCredit and Farm Credit Services of Colusa-Glenn. Forty-six farmers representing 44 producers along with representatives from several farm support organizations visited and learned about a variety of market venues including the San Francisco terminal market, the headquarters of a new on-line food hub, an institutional buyer, a wholesaler, and a retail grocer.

Results
Farmers learned about buyers? needs regarding pack, quality, food safety, and record keeping. Buyers, in turn, learned about farmers, their products, and seasonal availability. Participating farmers reported making an average of eight new contacts as result of this tour. Five farmers later indicated that they had followed up with those contacts and that these new relationships have the potential to increase their sales by 126%. Furthermore, 15 farmers (33% of participants) took the opportunity to consult with UC ANR academics and learn about strategies that can benefit their business, such as improved postharvest practices, marketing, and obtaining operating credit from Farm Credit and Farm Link.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

V(H). 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 2015, 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.

V(I). 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 2015. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Sustainable Natural Ecosystems

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	3%		5%	
102	Soil, Plant, Water, Nutrient Relationships	3%		14%	
103	Management of Saline and Sodic Soils and Salinity	3%		1%	
104	Protect Soil from Harmful Effects of Natural Elements	0%		2%	
111	Conservation and Efficient Use of Water	6%		4%	
112	Watershed Protection and Management	5%		3%	
121	Management of Range Resources	17%		3%	
122	Management and Control of Forest and Range Fires	4%		1%	
123	Management and Sustainability of Forest Resources	20%		1%	
131	Alternative Uses of Land	4%		3%	
132	Weather and Climate	2%		6%	
133	Pollution Prevention and Mitigation	2%		9%	
135	Aquatic and Terrestrial Wildlife	3%		10%	
136	Conservation of Biological Diversity	10%		12%	
141	Air Resource Protection and Management	7%		8%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		4%	
212	Pathogens and Nematodes Affecting Plants	0%		3%	
605	Natural Resource and Environmental Economics	4%		7%	
610	Domestic Policy Analysis	1%		4%	
903	Communication, Education, and Information Delivery	6%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	34.9	0.0	82.5	0.0
Actual Paid	7.9	0.0	12.2	0.0
Actual Volunteer	11.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
1278375	0	895875	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1278375	0	895875	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
11048994	0	56510318	0

V(D). Planned Program (Activity)

1. 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.

2. 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

3. 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.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	63996	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2015

Actual: 2

Patents listed

1. Identification of New Genes and Proteins Associated With Plant Cell Wall Deconstruction in the Filamentous Fungus, Neurospora Crassa
2. Diffusion-Based Method for Carbon Dioxide Assimilation and Isoprene Production in Microalgae and Cyanobacteria

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	61	361	422

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2015	91

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2015	24

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual
2015	10

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2015	3

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2015	6

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2015	135

Output #7

Output Measure

- Videos, Slide Sets and Other AV or Digital Media Educational Products Created

Year	Actual
2015	0

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2015	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Governmental agencies, agricultural and fishing organizations, resource managers and other stakeholders in inland fishery management issues, participating in the programs, gain knowledge of strategies and techniques for sustainable use of inland fishery resources.
2	Farm, ranch, private and public forest and wildlands owners/mangers, participating in natural resource management programs, gain knowledge of strategies and techniques for sustainable use of natural resources.
3	Fire protection and land management agencies, land and home owners, community organizations, and landscape professionals, participating in wildland fire education programs, gain knowledge on how to increase fire resistance of homes and landscaping.
4	Farm, ranch, and landscape owners/managers and allied industry professionals and governmental agency representatives, participating in air quality education programs, gain knowledge of the atmospheric system and/or how policies, products, plants, and practices can help improve air quality.
5	Ranch and private and public rangeland owners/managers, participating in rangeland management programs, gain knowledge of recommended techniques for rangeland monitoring and management, and grazing and browsing.
6	Ranch and private and public rangeland owners/managers, participating in the programs, adopt recommended techniques for rangeland monitoring and management, and grazing and browsing.
7	Farm owners/managers and allied industry professionals participating in soil quality education programs, gain knowledge of soil conditions and management practices to improve soil health.
8	Research informs new guidelines that are being adopted to help producers of livestock, poultry and animal feed calculate and assess their environmental impacts.
9	Research on the role of agriculture is critical to the development of California?s pioneering climate policy.
10	Research finds a potential low-cost and environmentally friendly solution for managers of natural reserves and grasslands to control invasive brome grasses.
11	Wildfire research and extension helps change the discussion on how to think about fire management.

Outcome #1

1. Outcome Measures

Governmental agencies, agricultural and fishing organizations, resource managers and other stakeholders in inland fishery management issues, participating in the programs, gain knowledge of strategies and techniques for sustainable use of inland fishery resources.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Farm, ranch, private and public forest and wildlands owners/mangers, participating in natural resource management programs, gain knowledge of strategies and techniques for sustainable use of natural resources.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	162

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

Outcome #3

1. **Outcome Measures**

Fire protection and land management agencies, land and home owners, community organizations, and landscape professionals, participating in wildland fire education programs, gain knowledge on how to increase fire resistance of homes and landscaping.

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Farm, ranch, and landscape owners/managers and allied industry professionals and governmental agency representatives, participating in air quality education programs, gain knowledge of the atmospheric system and/or how policies, products, plants, and practices can help improve air quality.

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Ranch and private and public rangeland owners/managers, participating in rangeland management programs, gain knowledge of recommended techniques for rangeland monitoring and management, and grazing and browsing.

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	176

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources

Outcome #6

1. Outcome Measures

Ranch and private and public rangeland owners/managers, participating in the programs, adopt recommended techniques for rangeland monitoring and management, and grazing and browsing.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Farm owners/managers and allied industry professionals participating in soil quality education programs, gain knowledge of soil conditions and management practices to improve soil health.

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Research informs new guidelines that are being adopted to help producers of livestock, poultry and animal feed calculate and assess their environmental impacts.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A growing global population is increasingly demand on eggs, meat, and dairy products. This creates the potential for a massive expansion of the food system?s carbon footprint ? a problem difficult to measure, let alone solve. We need to know what farms? current environmental impacts are before we can alter practices to lessen that impact. Secondly, we need to be able to quantify how effective the different mitigating methods are.

What has been done
In 2015, culminating a three year effort, the United Nations Food and Agriculture Organization (FAO) released new findings and guidelines to help producers of livestock, poultry and animal feed calculate and assess their environmental impacts. A CE Specialist chaired the first year of this effort through FAO?s Livestock Environmental Assessment and Performance Partnership (LEAP). As the first LEAP chair, he led a widely diverse group in establishing science-based methods to quantify livestock?s carbon footprint, create a database of greenhouse-gas emission factors for animal feed, and develop a methodology to measure other environmental pressures. The new guidelines are now publicly available at the LEAP web site. The researchers have also begun a blueprint for assessing and developing mitigating technologies to guide future carbon concerns.

Results
Multiple producers and industries have been equipped to quantify their impacts. Partners who have recognized and adopted the principles set out in the agreement include the International Feed Industry Federation, the International Egg Commission, International Dairy Federation, multiple NGOs and six FAO member countries. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management
610	Domestic Policy Analysis

Outcome #9

1. Outcome Measures

Research on the role of agriculture is critical to the development of California?s pioneering climate policy.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agriculture is among the economic sectors that will be most impacted by climate change, while at the same time, also a contributor to greenhouse gas (GHG) emissions. Adapting to temperature and precipitation changes from climate change, while also reducing agriculture GHG emissions, is necessary for a climate smart agriculture strategy. California is positioned as a leader in climate change policy and research is needed to inform state agencies? strategic planning and policy development on the agriculture dimensions of climate change mitigation and adaptation.

What has been done
For the California Energy Commission, AES faculty and staff authored the 2012 White Papers on Vulnerability and Adoption to Climate Change in California Agriculture, and California?s case study on Adaptation Strategies for Agricultural Sustainability. For the California Air Resources Board, Dept. of Water resources and CalRecycle, UC ANR researchers conducted intensive research to validate GHG emission factors and annual emission budget estimates for a variety of crops. California?s signature climate policy, AB32, created cap and trade regulations for greenhouse gas emissions. To examine how AB32 can incentivize reductions of emissions from agriculture, an AES faculty member authored the Assessment of Baseline Nitrous Oxide Emissions in California Cropping Systems for The Air Resources Board of California?s Environmental Protection Agency.

Results
UC ANR researchers provided key inputs to the agriculture section of the Climate Change Scoping Plan for implementation of AB32. While AB32 focuses on mitigation policy, a pending bill, SB367, provides financial incentives for agricultural investment in adaptation practices that will simultaneously reduce emissions and sequester carbon. AES faculty and CE Specialist research and engagement with policy makers has informed the scope of the practices outlined in this bill, including ways that farmland preservation contributes to both mitigation and adaptation to climate change. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management
610	Domestic Policy Analysis

Outcome #10

1. Outcome Measures

Research finds a potential low-cost and environmentally friendly solution for managers of natural reserves and grasslands to control invasive brome grasses.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Invasive plants are detrimental to natural ecosystem services and they reduce biodiversity. Red brome and medusahead are two abundant grass species that are much more invasive here in California than in their Mediterranean countries of origin. This is likely because they left behind their natural enemies, such as root and shoot pathogens, when they left their native habitat. UCCE researchers are trying to understand the effect of above- and below-ground changes in an effort to find a way to control these invasive grasses. Managers and owners of lands affected by the two highly invasive species will benefit from this research.

What has been done
Agricultural Experiment Station and UCCE scientists have collaborated with colleagues in Europe to collect plant and soil samples and study how the soil microorganisms foster or discourage the growth of invasive grasses. They examined roots and shoots of red brome and medusahead from sites in Spain and California using growth responses to inoculum from native and invaded soils in growth chambers, and microscopy and DNA sequencing to identify the microorganisms responsible for various growth responses. For red brome, they found a natural enemy in California in the head smut fungus, Ustilago bullata. The same fungus occurs in Spain, and was very likely accidentally introduced to California with brome grasses. Seed pathogens for head smut occurred with as much as 90% frequency in some California stands of red brome. They did not find a pathogen to help control medusahead, but realized that it grows less vigorously in low-nutrient soils. Additional studies with medusahead seeds from European populations are needed to identify potential biological control mechanisms.

Results
In this research UCCE scientists are currently culturing head smut and will use it to infect red brome populations in the greenhouse. The eventual goal is to inoculate red brome in the field as a

biological control agent. Commercial availability is some years away, but has the potential to provide managers of natural reserves and grasslands a low-cost and environmentally friendly solution to invasive brome grasses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity

Outcome #11

1. Outcome Measures

Wildfire research and extension helps change the discussion on how to think about fire management.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Fire affects all Californians, and indeed all taxpayers in the US, whether living in fire-prone environments or not. The people of California and beyond need to achieve a more sustainable coexistence with wildfire, and thus there is a need to provide a deeper scientific understanding of controls on fire regimes at different scales of space and time, as well as the inherent hazards of fire-prone landscapes.

What has been done
CE Specialist wildfire work is focusing more on extension modes that will directly affect policy, management, and planning decision. The work includes working with agencies (e.g., CalFire, CA DWR) on issues related to fire hazard mapping and integrating spatial projections of fire into agency activities, as well as increasingly working with NGOs and agencies at the national level to affect policy, management, and planning. Three CE Specialists are working on a research and extension project on Land Use Teleconnections. The target audience is fire managers and policy makers. One paper has been published from this project: Land Use and Wildfire: A Review of Local Interactions and Teleconnections in the peer reviewed journal Land. In addition, CE also contributes to the California Fire Science Consortium, which compiles and offers science briefs,

citation collections, webinars, and other resources. Due to high-profile publications about fire and climate change, these outputs also included quite a bit of media coverage of research products and associated messaging for extension goals. Lastly, in Santa Barbara County a one CE Specialist continued to train volunteers to start the first "citizen science" program for collection, analysis, and dissemination of near real-time live fuel moisture data.

Results

Land managers and the broader public are increasingly turning to the UC for answers, and wide-ranging media coverage of lessons learned through research has reached vast numbers of clientele. This work was presented at various meetings with the Public Policy Institute of California. This work is changing the dialog around fire management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
122	Management and Control of Forest and Range Fires
610	Domestic Policy Analysis

V(H). 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 2015, 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.

V(I). 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 2015. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Endemic and Invasive Pests and Diseases

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	1%		0%	
133	Pollution Prevention and Mitigation	0%		1%	
135	Aquatic and Terrestrial Wildlife	2%		3%	
136	Conservation of Biological Diversity	1%		3%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		3%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		1%	
206	Basic Plant Biology	1%		1%	
211	Insects, Mites, and Other Arthropods Affecting Plants	13%		13%	
212	Pathogens and Nematodes Affecting Plants	20%		30%	
213	Weeds Affecting Plants	12%		2%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants	3%		0%	
215	Biological Control of Pests Affecting Plants	3%		14%	
216	Integrated Pest Management Systems	41%		9%	
305	Animal Physiological Processes	0%		3%	
311	Animal Diseases	0%		3%	
312	External Parasites and Pests of Animals	1%		3%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		2%	
721	Insects and Other Pests Affecting Humans	2%		4%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%		3%	
723	Hazards to Human Health and Safety	0%		2%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	66.0	0.0	98.6	0.0
Actual Paid	7.1	0.0	12.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1141003	0	1438999	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1141003	0	1438999	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
26796735	0	77455276	0

V(D). Planned Program (Activity)

1. 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

2. 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

3. 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.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	121474	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2015

Actual: 6

Patents listed

1. INHIBITION OF SOLUBLE EPOXIDE HYDROLASE BY CONFORMATIONALLY RESTRICTED AND NON-UREA COMPOUNDS
2. ANALGESIC EFFECTS OF sEH INHIBITORS
3. Co-INHIBITION OF SOLUBLE EXPOXIDE HYDROLASE (sEH) AND KINASES FOR THE TREATMENT OF CANCERS AND OTHER DISEASES
4. DUAL INHIBITORS OF SOLUBLE EPOXIDE HYDROLASE (sEH) AND CYCLOOXYGENASE-2 (COX-2) FOR THE TREATMENT OF INFLAMMATION, PAIN, CANCERS AND...
5. ACYL PIPERIDNE INHIBITORS OF SOLUBLE EPOXIDE HYDROLASE
6. DRUG-LIKE COMPOUNDS THAT ENHANCE PLANT IMMUNITY AND GROWTH

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	165	366	531

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2015	49

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2015	45

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual
2015	8

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2015	12

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2015	22

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2015	219

Output #7

Output Measure

- Videos, Slide Sets and Other AV or Digital Media Educational Products Created

Year	Actual
2015	20

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2015	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, gain knowledge of pest management techniques, including Integrated Pest Management strategies.
2	Farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, gain knowledge of pesticide and pharmaceutical efficacy and optimal use.
3	Farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, adopt recommended prevention, detection and monitoring, and treatment practices for pest management, including Integrated Pest Management strategies.
4	Farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, realize lower costs for pest prevention and management.
5	Farm, ranch, rangeland, landscaping, and boat owner/operators and managers, allied industry professionals, and members of the public participating in the programs, gain knowledge of prevention, detection, and treatment strategies and techniques for management of invasive species.
6	Farm, ranch, rangeland, and landscaping owner/operators and managers, and allied industry professionals, participating in the programs, adopt treatment practices for invasive species.
7	Farm owner/operators and managers, pest control advisers, and other allied industry professionals, participating in the programs, gain knowledge on how to recognize and identify pests and diseases, and about detection and monitoring systems.
8	Farm owner/operators and pest control advisers, participating in the pest management programs, adopt pesticide and pharmaceutical efficacy and optimal use.
9	Farm, ranch, rangeland, and boat owner/operators, pest control advisers, and other allied industry professionals, participating in the pest and disease management programs, are more willing to adopt recommended strategies and techniques to control endemic and invasive pests and diseases.
10	Decreased incidence of endemic and invasive pests and diseases.
11	Farm and landscaping owner/operators and managers, and other allied industry professionals, participating in the programs, gain skills to detect, monitor, and treat endemic and invasive pests and diseases.
12	Research led to the creation of a rapid, plant screening tool for non-invasiveness which can proactively prevent the spread of invasive plants.
13	Research on Asian citrus psyllid informs general public and citrus industry management decisions.
14	California public schools adopt integrated pest management practices.
15	UCCE develops organic management options for new celery pest that decrease economic loss.

16	Farmers adopt recommended management practices to control the invasive Bagrada bug.
17	Research improves knowledge base and management of invasive pest problem on popular landscape plant.
18	Research on Thousand cankers disease creates new knowledge and solutions are being adopted by the walnut industry.
19	First UC app for integrated pest management improves outreach and education.

Outcome #1

1. Outcome Measures

Farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, gain knowledge of pest management techniques, including Integrated Pest Management strategies.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1556

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

312 External Parasites and Pests of Animals

Outcome #2

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, adopt recommended prevention, detection and monitoring, and treatment practices for pest management, including Integrated Pest Management strategies.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	141

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

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

Outcome #4

1. Outcome Measures

Farm, ranch, rangeland, and landscaping owner/operators and managers and allied industry professionals, participating in the programs, realize lower costs for pest prevention and management.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	642

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area

135	Aquatic and Terrestrial Wildlife
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
312	External Parasites and Pests of Animals

Outcome #6

1. **Outcome Measures**

Farm, ranch, rangeland, and landscaping owner/operators and managers, and allied industry professionals, participating in the programs, adopt treatment practices for invasive species.

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

Farm owner/operators and managers, pest control advisers, and other allied industry professionals, participating in the programs, gain knowledge on how to recognize and identify pests and diseases, and about detection and monitoring systems.

Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

Farm owner/operators and pest control advisers, participating in the pest management programs, adopt pesticide and pharmaceutical efficacy and optimal use.

Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Decreased incidence of endemic and invasive pests and diseases.

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Farm and landscaping owner/operators and managers, and other allied industry professionals, participating in the programs, gain skills to detect, monitor, and treat endemic and invasive pests and diseases.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	471

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
214	Vertebrates, Mollusks, and Other Pests Affecting Plants

Outcome #12

1. Outcome Measures

Research led to the creation of a rapid, plant screening tool for non-invasiveness which can proactively prevent the spread of invasive plants.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Invasive plants reduce vital wildlife and pollinator habitat, decrease agricultural yields, and displace native plants. Invasive plants reduce the quality of ecosystem services and are the second greatest overall threat to biodiversity after habitat loss. While the nationwide impact of invasive plants and the cost of management in natural areas, agriculture, and gardens have been estimated to be $27 billion a year, California estimates a more conservative $82 million for the cost of control, monitoring, and outreach. Unfortunately, 50% of the worst invasive plants in California and 85% of the invasive woody plants in the U.S. were introduced through the horticultural industry. Prevention is clearly the most cost effective approach to addressing the invasive plant problem. Ornamental plant producers make a significant financial investment developing new plants that may eventually become serious invasive plants. Evaluating potential plant introductions for invasiveness prior to being sold in the marketplace would be the ideal strategy for a plant producer to employ. Unfortunately, there is no reliable process or tool available to plant producers to proactively screen new plants.

What has been done
A team of UC ANR researchers designed and tested a 5-question Plant Risk Evaluation-Rapid Screening (PRE-RS) tool that will quickly evaluate large lists of ornamental plants for invasiveness. Based on the statistical predictability of each question, the percentage of times it could be answered, and the relevance of the question to screening ornamental plants, an ornamental plant can be accurately and rapidly screened for invasiveness in minutes versus hours using more extensive screening methods. The PRE-RS tool was 93% accurate in correctly categorizing invasive plant species and 97% accurate for non--‐invasive plant species.

Results

Through quantitative research by UC Davis researchers, an ornamental plant screening tool was developed for the California horticultural industry. With proper training and education on the use of PRE-RS, plant producers can effectively assess many plants for invasiveness prior to introduction into the marketplace. If the PRE-RS tool predicts invasive potential, it can then be re-screened with a more definitive set of questions using the 19-question PRE screening tool developed by the same researchers. Screening ornamental plants by plant producers with PRE-RS prior to plant propagation, production and distribution to retail stores will proactively prevent invasive plants from spreading throughout the California environment. This will save millions of dollars spent eradicating invasive plants and will proactively protect of our environment and ecosystem.

4. Associated Knowledge Areas

KA Code	Knowledge Area
213	Weeds Affecting Plants

Outcome #13

1. Outcome Measures

Research on Asian citrus psyllid informs general public and citrus industry management decisions.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
California citrus is a $2 billion industry and about 60% of Southern California residences have at least one citrus tree, according to the California Department of Food and Agriculture. But one bug has the potential to both decimate the commercial citrus industry and alter the landscape of California by eliminating citrus from residential properties. Asian citrus psyllid (ACP) is a vector of a devastating bacterial disease of citrus called Huanglongbing (HLB). There is no cure for the disease and it threatens to kill both commercial citrus and residential citrus.

What has been done
UC ANR entomologists, an economist and a programmer are complementing the citrus industry statewide efforts. They are using their expertise in ACP management strategies and spatial

mapping to provide recommendations and provide cost assessments of treatments for both homeowners and growers. Through this project, UC ANR has enhanced collaborations between CDFA, CPDPP, UC and legislators to provide a more effective psyllid and HLB management program. Additionally, the team has begun the development of a market model for California citrus industries to estimate the economic effects of the spread of the disease for both eradication and area-wide treatment programs.

Results
This information is integrated with, informs, and supports statewide CDFA regulatory efforts and citrus industry efforts to manage the pest and disease. A more informed general public and citrus industry will lead to a reduction in Asian citrus psyllid populations and slowing of their spread throughout the state. This in turn will slow the rate of spread of the bacterium that causes HLB and buy time for local and national researchers to develop a cure for the disease. This project will assist in protecting California?s $2 billion citrus industry and millions of residential citrus trees from the severe losses that Florida has already experienced. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

Outcome #14

1. Outcome Measures

California public schools adopt integrated pest management practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Healthy Schools Act mandated ?least-toxic? pest management methods for pesticide use in California public schools. The strategies employed in an outdoor IPM program include modifying

horticultural practices, such as adjusting mowing heights and managing irrigation appropriately. These practices can reduce the amount of pesticides used on school grounds to help schools to provide a safer and healthier environment for students, teachers, and staff.

What has been done
Since the bill?s enactment in 2001, both UC Cooperative Extension (UCCE) and the California Department of Pesticide Regulation (DPR) have been working with school districts in California to provide information about integrated pest management (IPM) inside buildings and for outdoor areas on school grounds. DPR has coordinated numerous workshops for school districts covering general landscape and building IPM topics. Attendees requested more detailed training about turf IPM for special areas like playgrounds and sports fields. DPR called on the experts at UCCE to help conduct hands-on training for school landscape staff throughout California. At each workshop, school staff was provided UCCE resources to assist them in implementing IPM at their schools.

Results
Seventy-five public school staff members across the state went back to their districts equipped to use fewer pesticides than before. The trainees recognized that many turf problems could be ameliorated through appropriate turf culture such as managing irrigation, mowing, and fertilization rather than the use of pesticides. Additionally, by demonstrating how to evaluate and improve irrigation systems, the trainees also learned about the impact of appropriately managing water to avoid runoff and improve water quality. The program was such a success that over the past two years, it has expanded to include four additional sites. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems
723	Hazards to Human Health and Safety

Outcome #15

1. Outcome Measures

UCCE develops organic management options for new celery pest that decrease economic loss.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual

2015 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A study conducted in 2009 estimated that California organic farms account for 97% of organic celery sales in the United States. A common challenge for organic growers is how to manage pests while continuing to follow organic practices, and many growers turn to UC Cooperative Extension (CE) for solutions.

What has been done
A large-scale vegetable grower contacted UC Cooperative Extension (UCCE) about a root aphid infestation and requested practical solutions to protect his production of organic celery. The pest problem had the potential to seriously affect organic celery production in the region and drive the grower out of business. A UCCE advisor responded and conducted a field study with a carefully compiled list of organic aphid management treatments.
Field trials determined that the infestations could be controlled with a combination of two organic pesticides: Mycotrol-O, based on the entomopathogenic fungus Beauveria bassiana, and AzaGuard, which is based on azadirachtin, a botanical insect growth regulator, insecticide and feeding deterrent. The combination treatment provided about 62% control of the aphids. The two species responsible for the problem were honeysuckle aphid, which had only one previous report of infestation on celery, and rice root aphid, which had never been reported as infesting celery.

Results
During the infestation, tens of thousands of pounds of organic celery failed to reach market and the grower was losing as much as $24,000 per acre on his farm, which plants 135 acres to organic celery throughout the year. The grower, who has now been applying the recommended combination of botanical and microbial pesticides for six months, has been able to resume normal levels of organic celery production. This information will be shared at future meetings to increase awareness of the aphid infestations and organic management options.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #16

1. Outcome Measures

Farmers adopt recommended management practices to control the invasive Bagrada bug.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Bagrada bug is an invasive pest in California that was first reported in 2008. It is now found in 22 counties in California and is spreading to other states including Hawaii, Arizona, Nevada, Utah, New Mexico, and Texas. Bagrada bug prefers cultivated and uncultivated cruciferous hosts and is a threat to several cole crops. It can also cause significant damage to a wide variety of hosts that include carrots, corn, peppers, and potatoes. Providing timely information on the pest, its identification, damage symptoms, biology, host preference, and control options is very important when dealing with an invasive pest.

What has been done
A UCCE Advisor for strawberry and vegetable crops, conducted research with nonchemical control options, which are especially important for organic growers and home and community gardens. He created outreach material, including 10 eNewsletter articles that have been viewed over 24,000 times and an instructional YouTube video that has been viewed over 2,100 times. He has been consulted by the California Department of Food and Agriculture, the Department of Pesticide Regulations, Agricultural Commissioners from different counties, clients from several counties in California, and people from other states about information on this pest.

Results
Clients and readers indicated that they obtained useful information about the pest and potential management options. Some have indicated that by adopting the recommended practices from this research, they were able to effectively reduce the infestation of Bagrada bug and halt the damage to crops, which then allowed growers to continue producing at normal levels. Some growers were able to completely eliminate the Bagrada bug and others are able to manage their populations. Others commented that the outreach materials on identifying the pest and estimating damage to crops have been valuable.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #17

1. Outcome Measures

Research improves knowledge base and management of invasive pest problem on popular landscape plant.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Myoporum plants, which are native to Australia and New Zealand, include several popular ground cover and tree species that are widely planted in California for erosion control and because of their aesthetic beauty, minimal management needs, and low water requirement. Until relatively recently, California plantings have not been bothered by any insect pests. Since 2005, however, an exotic thrips species new to the United States has caused great damage to Myoporum in landscape plantings and nursery stock throughout the coastal counties of California. Thrips damage to Myoporum is characterized by gall-like symptoms and distortion of new leaves. Terminal growth can be severely stunted and leaf curling or folding, with thrips populations present within the folds, is common and eventually leads to the death of the plant. Thrips populations in infested areas have grown to extremely high levels and large landscape plantings have been severely impacted. Until UCCE got involved, there was no scientific, research-based information available on the pest.

What has been done
UCCE San Diego County Advisors have been working in cooperation with local commercial landscapers and the San DiegoCounty Agricultural Commissioner?s office in an effort to identify solutions to the thrips problem. Although their research shows that at least one beneficial insect ? the minute pirate bug ? was present, it was not there in sufficient numbers to impact the thrips population. They conducted a series of management trials at various sites, including such well-known sites as the Del Mar Racetrack, to determine whether specific management methods could be used to control the pest and encourage plant recovery in the landscape.

Results
Through research-based studies by UCCE, the biology of the insect is better known. Several management methods, including some low-impact pesticides and application techniques, were

identified as effective against Myoporum thrips and able to be used in the landscape with minimal impact on beneficial insects and the environment. Treated plants showed excellent recovery from severely gnarled terminal growth. Trials were conducted on heavy populations in the summer so they were curative in nature. This information has been made available via trade magazines, allowing landscapers and pest control advisors to benefit from the research. Armed with this research-based information, growers and landscapers can provide their customers with a high-quality specialty commodity that will protect Myoporum so it may continue its important roles in erosion control.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #18

1. Outcome Measures

Research on Thousand cankers disease creates new knowledge and solutions are being adopted by the walnut industry.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Thousand cankers disease (TCD) is an emerging tree disease that is responsible for the death of ornamental eastern black walnut species throughout the country. In California, TCD is contributing to the decline of other native black walnut trees as well as English walnut trees in nut-producing orchards. TCD is caused by a fungal pathogen transmitted by the walnut twig beetle (WTB). There is great concern over the potential for further spread of TCD throughout the native range of eastern black walnut, as well as uncertainty about the disease?s potential agricultural and ecological impacts in the USA and in Italy, where it was first reported in 2013.

What has been done
UC ANR established a three-year project to study TCD in California and to inform stakeholders about the latest research. A team from UC Davis, the USDA Forest Service, and UCCE has been

working together to address critical gaps in our understanding of this new disease. The team has identified TCD frequently in native and ornamental stands of two species, in black walnut seed trees for rootstock production, and throughout commercial walnut orchards in both English and hybrid rootstocks. From this research the team has developed effective detection tools for both the beetle and the fungus, and these tools have been put into practice at both national and international levels.

Results
This research and the associated outreach programs have increased worldwide knowledge about disease biology and etiology for detection, generated interim solutions, raised awareness of TCD, and identified promising avenues for further study to limit the disease?s damage and spread. Growers who are particularly concerned about TCD are removing diseased trees and burning them to mitigate potential sources of the vector and inoculum in their orchards. Team members have actively engaged various stakeholders, including growers, regulatory biologists (CDFA and eastern state agencies), UC Master Gardeners, and scientists at state and national conferences. UCCE Advisors and the walnut industry in California have assimilated the new knowledge that this project has provided and are applying it in real-world conditions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
212	Pathogens and Nematodes Affecting Plants

Outcome #19

1. Outcome Measures

First UC app for integrated pest management improves outreach and education.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The strawberry industry in California is valued at more than $2 billion, producing nearly 90% of

the fresh market and processed strawberries in the United States. The crop is vulnerable to a number of pests and diseases, and timely information on identifying the specific problem and taking appropriate management action is critical to preventing crop losses. Smartphones have become very popular in the agriculture industry, and several growers and pest control advisors (PCAs) frequently use smartphones to access information for crop issues. UC?s Integrated Pest Management (IPM) statewide program maintains a website with valuable resources about pest and disease management information, but for a variety of reasons a number of growers and PCAs do not use the website. For instance, the website has a huge amount of information for the user to digest, few or no pictures to identify some problems, and no dedicated access point for strawberry concerns. In response to this, a free IPMinfo app was created as an improved outreach tool for members of the California strawberry industry.

What has been done

IPMinfo is the first integrated pest management information app from the University of California. It provides agricultural professionals with one-touch access to information about the biology, symptoms of damage, and management options for pests and diseases. For each pest, users will find information on its biology and damage symptoms as well as associated photos. Links in the management section take users to the UC IPM website for detailed information on control options. The disease section has information on symptoms and management options along with useful pictures. The free app was created by Cooperative Extension advisor Surendra Dara of San Luis Obispo, Santa Barbara, and Ventura Counties, a member of the UC Statewide IPM Program.

Results

Within just five months of its release, more than 300 people had downloaded the free IPMinfo app. Positive feedback from industry and community-based users has confirmed its usefulness, reliability, and user accessibility. IPMinfo currently has information in English on strawberry pests and diseases, but the app template can easily be expanded to include information for other crops as well as translations to other languages. Furthermore, this app was developed in only four months and on a very small budget, demonstrating the potential for UC ANR to improve outreach quickly and economically and to rapidly respond to California?s local and industry-wide needs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

V(H). 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 2015, 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.

V(I). 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 2015. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Sustainable Energy

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 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%		4%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		11%	
202	Plant Genetic Resources	0%		13%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		7%	
204	Plant Product Quality and Utility (Preharvest)	0%		1%	
205	Plant Management Systems	0%		1%	
206	Basic Plant Biology	0%		19%	
212	Pathogens and Nematodes Affecting Plants	0%		9%	
402	Engineering Systems and Equipment	22%		1%	
403	Waste Disposal, Recycling, and Reuse	0%		1%	
511	New and Improved Non-Food Products and Processes	0%		16%	
601	Economics of Agricultural Production and Farm Management	0%		3%	
605	Natural Resource and Environmental Economics	22%		6%	
608	Community Resource Planning and Development	34%		0%	
609	Economic Theory and Methods	0%		2%	
610	Domestic Policy Analysis	0%		2%	
611	Foreign Policy and Programs	0%		1%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.5	0.0	11.6	0.0
Actual Paid	0.4	0.0	2.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
66262	0	467608	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
66262	0	467608	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
195059	0	8870806	0

V(D). Planned Program (Activity)

1. 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.

2. 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

3. 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.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	50	50

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2015	0

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2015	0

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual

2015	0

Output #4

Output Measure

- Newsletters produced

Year	Actual
2015	0

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2015	4

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2015	22

Output #7

Output Measure

- Videos, Slide Sets and Other AV or Digital Media Educational Products Created

Year	Actual
2015	0

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2015	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Program participants gain knowledge about new improved methods related to producing sustainable energy.

Outcome #1

1. **Outcome Measures**

Program participants gain knowledge about new improved methods related to producing sustainable energy.

Not Reporting on this Outcome Measure

V(H). 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 2015, 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.

V(I). 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 2015. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Water Quality, Quantity and Security

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	6%		25%	
103	Management of Saline and Sodic Soils and Salinity	7%		0%	
111	Conservation and Efficient Use of Water	32%		12%	
112	Watershed Protection and Management	31%		11%	
124	Urban Forestry	2%		0%	
131	Alternative Uses of Land	0%		3%	
132	Weather and Climate	0%		7%	
133	Pollution Prevention and Mitigation	16%		11%	
135	Aquatic and Terrestrial Wildlife	0%		4%	
202	Plant Genetic Resources	0%		6%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		2%	
205	Plant Management Systems	1%		3%	
206	Basic Plant Biology	0%		3%	
216	Integrated Pest Management Systems	1%		0%	
311	Animal Diseases	0%		2%	
403	Waste Disposal, Recycling, and Reuse	3%		0%	
404	Instrumentation and Control Systems	0%		2%	
405	Drainage and Irrigation Systems and Facilities	1%		2%	
605	Natural Resource and Environmental Economics	0%		5%	
723	Hazards to Human Health and Safety	0%		2%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	21.3	0.0	12.2	0.0
Actual Paid	2.0	0.0	1.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
318382	0	184596	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
318382	0	184596	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
8552242	0	10102862	0

V(D). Planned Program (Activity)

1. 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.

2. 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

3. 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.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	136799	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	25	40	65

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2015	1

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2015	21

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual

2015	6

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2015	1

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2015	2

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2015	36

Output #7

Output Measure

- Videos, Slide Sets and Other AV or Digital Media Educational Products Created

Year	Actual
2015	0

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2015	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Farm, ranch, and rangeland owners/managers and allied industry professionals, participating in water quality education programs, gain knowledge of management practices for improving water quality.
2	Farm, ranch, and rangeland owners/managers and allied industry professionals, participating in water quality education programs, adopt management practices for improving water quality.
3	Farm owner/operators, allied industry professionals, and members of the public, participating in water conservation education programs, gain knowledge of water use and conservation practices.
4	Farm, ranch, and landscape owners/managers, and allied industry professionals and governmental agency representatives, participating in the programs, gain water conservation skills.
5	Farm owners/managers, allied industry and natural resource professionals, and members of the public, participating in the programs, adopt of water conservation practices.
6	Farm and nursery owner/operators, home gardeners, and water regulation and policy leaders, participating in water quality education programs, are more likley to use management practices for improving water quality and for water conservation.
7	Drought research informs policy and decision-making.
8	UC Cooperative Extension developed Best Management Techniques are being adopted by growers and policy makers.
9	CropManage app helps growers better manage nitrogen fertilizer and water.
10	Farm and ranch owner/operators and managers, and allied industry professionals, participating in the programs,gained knowledge of irrigation and water management practices.
11	UC research is incorporated into Northern Sacramento Valley water resource management plans.

Outcome #1

1. Outcome Measures

Farm, ranch, and rangeland owners/managers and allied industry professionals, participating in water quality education programs, gain knowledge of management practices for improving water quality.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	700

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #2

1. Outcome Measures

Farm, ranch, and rangeland owners/managers and allied industry professionals, participating in water quality education programs, adopt management practices for improving water quality.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #3

1. Outcome Measures

Farm owner/operators, allied industry professionals, and members of the public, participating in water conservation education programs, gain knowledge of water use and conservation practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	878

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water

Outcome #4

1. Outcome Measures

Farm, ranch, and landscape owners/managers, and allied industry professionals and governmental agency representatives, participating in the programs, gain water conservation skills.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	218

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

Outcome #5

1. Outcome Measures

Farm owners/managers, allied industry and natural resource professionals, and members of the public, participating in the programs, adopt of water conservation practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	164

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

Outcome #6

1. Outcome Measures

Farm and nursery owner/operators, home gardeners, and water regulation and policy leaders, participating in water quality education programs, are more likley to use management practices for improving water quality and for water conservation.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Drought research informs policy and decision-making.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
California is the midst of a historic drought. The challenge of allocating the existing water supply to agriculture and a growing urban population during a historic drought is the subject of much debate in the state. With many powerful interests at odds over a basic element of life, AES research from UC Berkeley is applying economic models and a look at recent history to potential solutions.

What has been done
Agriculture uses the majority of California?s water, and this study showed that conservation, fallowing less-productive land, and using groundwater are important responses to drought. Policy-relevant research is compiled in an online digest, the Agriculture and Resource Economics Update, and is widely read by regulators at state and national levels. A recent article in that publication quantified the impact of the UC Cooperative Extension?s work on drip irrigation in monetary terms.

Results

This AES research on the drought is frequently cited by stakeholders in public comments, in commission reports, and in studies on agriculture and environmental protection. In addition, the research on drip irrigation has helped increase its adoption among farmers and influenced state policy making to incentivize this method of water conservation. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
605	Natural Resource and Environmental Economics

Outcome #8

1. Outcome Measures

UC Cooperative Extension developed Best Management Techniques are being adopted by growers and policy makers.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Applying nitrogen and phosphorus with irrigation water is a common practice to help plants grow productively ? in the Imperial Valley and around the world. But if the fertilizers are applied incorrectly, some of the nutrients end up in drains rather than in the food. And that is not just a waste of resources. Nitrogen and phosphorus are the two main nutrients that cause massive fish kills in California?s Salton Sea. The nutrients lead to what are called eutrophic conditions, or high algal biomass and low dissolved oxygen concentrations. Current and proposed federal water quality standards for California require growers to improve the quality of drainage waters. To achieve both federal and state water quality objectives, growers will have to reduce the amount of phosphorus that reaches the drains and the Salton Sea.

What has been done

Irrigation management is one way to make an impact. Proper irrigation management practices reduce fertilizer and sediment loads in surface runoff water. UC Cooperative Extension Imperial County advisors evaluated various alfalfa and lettuce irrigation and fertilizer application practices on two irrigation systems: border irrigation (1.5 percent slope and 0 percent runoff) and freedraining graded furrows (1.5 percent slope and normal runoff). By comparing various water flow rates and the timing of fertilizer applications, they were able to develop recommendations on the most efficient and effective ways to meet the new water quality standards and conserve water.

Results

Growers are adopting the UCCE advisors? recommendations, called Best Management Techniques (BMTs). This is improving fertilizer use efficiency and reducing the load of nutrients in the Salton Sea watershed. Their educational materials also are used to implement plans to meet the Total Maximum Daily Load regulations. Irrigation management is a key factor in controlling the concentration and load of phosphorus in runoff water. Reducing the rate of surface runoff during and after phosphorus application events could reduce phosphorus load in surface waters by as much as 75 percent compared to standard irrigation practices. The researchers? BMTs were included in the Regional Water Quality Control Board (Region 7) silt/sediment Total Maximum Daily Load standards. (Adapted from Leveraging Research for Food and Agriculture Policy: Lessons Learned from the University of California, July 2015)

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
133	Pollution Prevention and Mitigation

Outcome #9

1. Outcome Measures

CropManage app helps growers better manage nitrogen fertilizer and water.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Vegetable crops produced on California?s central coast need sufficient moisture and nitrogen in the soil to generate optimum commercial yields and quality. Ground water from wells is used for watering crops and is also the primary drinking water source for coastal communities. After many years of over-irrigation and high nitrogen fertilizer application rates, intended to produce good yields for these commodities, many rural wells now show nitrate concentrations in excess of safe drinking water standards. In addition, over-pumping of agricultural wells has actually pulled seawater into some coastal aquifers, contaminating many freshwater wells with salt water. Recently adopted California water laws will soon require farmers to reduce pumping to levels low enough to stop long-term depletion of ground water supplies.

What has been done

Two UC ANR tools have great potential to help farmers conserve water and make better use of nitrogen fertilizer while maintaining crop productivity and quality: weather-based irrigation scheduling and the soil nitrate quick test.The soil nitrate quick test is an in-field test that lets growers quickly determine whether their soil has adequate nitrogen. Weather-based irrigation scheduling uses weather station data to determine actual crop water needs. Both tools use information about the specific crops to determine how much fertilizer and water each will need from the soil.

CropManage (ucanr.edu/cropmanage) is an online application that makes both tools easy and accessible for growers to use. A grower can access the app via smart phone, tablet, or desktop computer and quickly determine the crops? fertilizer needs based on in-field soil nitrogen tests and research-based guidelines for crop nitrogen use. The app also estimates crop water needs using weather data from the California Irrigation Management Information System together with crop development models. Growers can use CropManage to track and manage water and nitrogen fertilizer applications for each of their fields.

Results

Commercial-scale trials in lettuce demonstrated that growers using CropManage can reduce nitrogen and water without compromising quality or yield. The nitrogen rate recommended by CropManage generated yields similar to those of the growers? standard practice, but with an average reduction of 32% in nitrogen fertilizer. Commercial-scale CropManage trials with broccoli used 48% less water than is used for conventional plantings, with no reductions in yield or crop quality. Since the trials concluded, several major vegetable growing operations in the Salinas Valley have begun using CropManage to help make their water and fertilizer use more efficient. One lettuce grower using CropManage recommendations brought nitrogen applications down by more than 40%. As more commodities and features are added to the online tool, we expect increasing numbers of farmers to start using CropManage to reduce their costs, and improve environmental conditions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
133	Pollution Prevention and Mitigation

Outcome #10

1. Outcome Measures

Farm and ranch owner/operators and managers, and allied industry professionals, participating in the programs,gained knowledge of irrigation and water management practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	152

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

Outcome #11

1. Outcome Measures

UC research is incorporated into Northern Sacramento Valley water resource management plans.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Federal and state interests are focused on how to more effectively use both surface and groundwater resources in the Sacramento Valley so some of these water resources can be redirected from northern California to meet needs in other parts of the state. Regional and local efforts are focused on managing their existing water resources to assure long-term water needs are met locally and regionally before any water resources are transferred out of the area. There is a need to assist with integrating the best available research-based knowledge into policy-making and management of groundwater and surface water resources of the Sacramento Valley.

What has been done
On the topic of conjunctive surface and groundwater, UCCE co-organized five local events for agriculture water users and the general public, and collaborated with other local water resource agencies to organize outreach meetings. UC introduced a science-based method for evaluating groundwater conditions and how they relate to number of water wells constructed and the depths that they are constructed. The methodology predicts the percentage of water wells that may go dry if groundwater levels continue to decline. This methodology is being used to guide groundwater management plans, objectives along with management actions and regulatory restrictions in Glenn County.

Results
This extension program in conjunctive water management has heightened the interest and understanding of surface water and groundwater resources in the northern Sacramento Valley among more water users. It has helped reduce distrust and conflict between different interest groups. UC involvement has helped to ensure that the best available science is incorporated into local and regional water resource policy and management efforts. Specifically, new collaborations between local water agencies and UC Davis faculty and UCCE specialists have formed to evaluate opportunities to enhance groundwater recharge in areas of Glenn County that are experiencing declining groundwater levels and unreliable water supplies. Much work lies ahead to implement sustainable groundwater management mandated by the 2014 Groundwater Sustainability Act. In relative terms, these efforts as well as others have already helped Northern Sacramento Valley water users develop water resource management plans that leave them in a favorable position to manage and sustain groundwater supplies in the future.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water

V(H). 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 2015, 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.

V(I). 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 2015. In addition, significant success stories are reported as qualitative outcomes under the State Defined Outcomes section.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
1064	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.