2016 University of California Combined Research and Extension Annual Report of Accomplishments and Results

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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 (AES) faculty members conduct research and teach in three colleges and one professional school on the Davis, Berkeley, and Riverside campuses. The AES has over 600 academic researchers, most of whom also have professorial appointments representing dozens of scientific disciplines. Cooperative Extension (CE) 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 165 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 at RECs. The CE advisors are located in county-based offices and at 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 2016

UC ANR continued to make significant progress toward its Strategic Vision 2025 and launched a rigorous strategic planning effort to operationalize the vision. Representatives of programs and administrative units were enlisted to provide assistance, and the process drew upon strategic plans that already existed within the statewide programs, strategic initiatives, research and extension centers and budget plans. The Strategic Planning Committee completed four of the six workshops during FY2016. Throughout the process, stakeholders were engaged to provide feedback as the committee developed the plan. The new UC ANR Associate Vice President Wendy Powers, appointed by the UC Regents in 2016, was on board at the outset and identified two priority goals for her to lead over the next five years: 1) strengthen research

and extension partnerships; and 2) increase UC ANR's reach. In addition, the strategic planning process prioritized continued efforts for increased administrative efficiency. More specifically, the goal to ensure administrative functions are efficient and produce an 8% reduction in administrative costs by July 2021. Some of the strategies include: re-engineering business processes; establishing one consolidated business unit of UC ANR's dispersed employees group; and consolidating UC ANR financial information in the new UC systemwide financial reporting system. The UC ANR 5-Year Strategic Plan was finalized December 2016 and will be discussed further in the FY2017 federal annual report.

UC ANR continues the commitment to hire to exceed projected turnover, thus achieving the goal of academic growth. During FY2016, UC ANR conducted its biennial call for Cooperative Extension positions. The process engages a diverse group of internal and external stakeholders in identifying and developing position proposals, which strengthen and expand the ANR network to address programmatic gaps and emerging needs. Many internal stakeholders are also involved in reviewing the proposals. During FY2016, 10 CE specialists and 18 CE advisors were hired. Over the past several years close to 120 CE advisors and CE specialists have been hired. Additionally, there are over 60 approved CE academic recruitments, including 26 new CE positions that the UC ANR Vice President announced in FY2017.

UC ANR's internal competitive grants program has funded 69 projects for a total of $15.46M since 2011. During FY2016 there were 44 active projects, approved during the past four cycles. 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. Outcomes from these projects are highlighted in this report.

UC ANR completed the final year of the three-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. Three 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 work on the following five multidisciplinary, integrated 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. In October 2015, all five Strategic Initiatives coordinated the first Joint Strategic Initiatives Conference, with the following objectives: assess current and future directions for UC ANR; highlight impacts of the Strategic Initiatives for California; learn about impacts and policy relevance of Strategic Initiative programs; provide in-service trainings; and provide an opportunity for Program Teams and Workgroups to meet. The conference was well attended with 333 participants representing a diverse, integrated group, including CE Advisors, CE Specialists, AES Faculty, Program Directors and Academic Coordinators and programmatic staff. 78% of end of session respondents reported that they feel the Strategic Initiatives add value to their programs.

In addition, the Strategic Vision 2025 identifies an "initiative to improve energy security and green technologies through innovative science linking engineering, agricultural, biological, and environmental sciences." Although this is not officially launched as one of UC ANR's five Strategic Initiatives, the Division continues to work on this high priority area and knowing NIFA's interest in this area we continue to report separately on the Federal Planned Program Sustainable Energy.

For FY 2016, 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 2016 program highlights for these Federal Planned Programs.

Healthy Families and Communities

California faces several critical challenges in the area of human and community development. Nearly one-third of California's school children are overweight or obese, and according to the Centers for Disease Control, low-income and ethnic minority children are at especially high risk. This crisis comes at a cost, as California leads the nation in healthcare costs associated with obesity, estimated at $52.7 billion yearly. At the same time, many California households are food insecure, having limited or uncertain access to adequate food. Another challenge is that each year approximately 80,000 California youth do not graduate from high school and approximately one of every six 16-24 year-olds in the state is out of school and out of work. Promoting healthy pathways to college and work are urgent concerns, not only for individual youth and their families but also for the state's effort to remain economically competitive in the global economy.

UC ANR Healthy Families and Communities Strategic Initiative and Federal Planned Program addresses the following key program areas: healthy lifestyles (obesity prevention), youth development, youth science literacy, and community development.

During FY2016, 48 Hatch projects were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 17 research and extension projects. CE advisors worked on 212 extension projects and led an additional eight research projects under the Federal Planned Program Healthy Families and Communities. The following illustrates the breadth of work and includes selected examples highlighting accomplishments in this program area.

Healthy Lifestyles

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 hours of television or video games in a typical weekday. Intervention and prevention efforts point to the importance of multifaceted approaches 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.

- To address the 37% of low-income households that are food insecure in one county, UC Cooperative Extension reached 9,000 youth through the Get Fresh Project, working in partnership with the Department of Public Social Welfare Department and the Department of Public Health. The project included four-lessons and a cooking video to teach participants how to cook on a budget. The program was executed in classrooms, food pantries, and food distribution sites. After two years, evaluation showed that nearly 40% of participants increased their fruit and vegetable consumption for their main meal and 20% reported now using a shopping list when going to the grocery store, which reduces impulse buying unhealthy foods.
- A research study was conducted to analyze the factors that shape people's consumption choices. Specifically, an examination of the impact of sustainability information (environmental, social, and health ratings of products and companies) on consumer purchases while they shop online. The result of this work has been the development of integrated frameworks for learning, iteration, and scaling of sustainability innovations.

• The UC ANR Nutrition Policy Institute led a study in partnership with UC Santa Barbara as a part of the UC systemwide Global Food Institute. The study of 9000 graduate and undergraduate students, the largest of its kind at UC campuses, found a 19% prevalence of food insecurity with 54% new to food insecurity. The model of combining quantitative findings with qualitative analysis and stories was instrumental in informing UC President Napolitano's allocation of funding to address UC student issues with food access.

Youth Development

Positive youth development occurs through an intentional process that provides opportunities, choices, relationships, and the support necessary for youth to fully reach their potential. 4-H's unique role in youth development is based on scientifically valid research. California 4-H analyzes and documents the program's efforts to demonstrate an impact on youth and then disseminate our findings to further the field of youth development, to anticipate problems, and to develop practical solutions in the communities served.

• A study on social and ecological influences on child, adolescent, and adult development used archival and original data to illuminate how developmental experiences in children's lives and the circumstances in adults' lives shape their well-being. The research suggested day care carried developmental risk for children - most notably for those being somewhat more aggressive and disobedient. The researchers found supportive parents in the middle school childhood years could attenuate or eliminate the long-term effect. Further, problematic functioning for adolescents who began childcare in early life and with seemingly risky child experiences is preventable. These findings can have important implications for family life in the California and the U.S.

• UC ANR 4H helped launch the first 4-H Club in Mexicali, Mexico. Only 37% of the population in Ejido Sinaloa, Mexicali is employed, the average monthly income per household is $450, and the average level of education is 7th grade. UC ANR academics and Baja California's Secretaria de Fomento Agropecuario (SEFOA-BCM) staff conducted a community assessment to identify local needs and set program goals. UC academics provided youth development expertise, training, and resources, as well as technical assistance and support that allowed SEFOA's staff to work independently to recruit youth and adults for the 4-H program. UC ANR signed an agreement of cooperation with SEFOA to increase the academic, scientific, technological, and cultural relations between SEFOA-BCM and UC ANR in California.

Community Development

A key to UC ANR fulfilling its Healthy Families and Communities vision is ongoing efforts to conduct applied research activities that target the various dimensions of a community. Community development and public policy work in extension has two aspects: 1) it is an integrative dimension of all extension programs, which evolve in response to community needs or goals and are shaped by public policy priorities, conflicts, and processes; and 2) it is a particular area of extension focus and expertise, to which a smaller number of specialized extension professionals devote their full programs.

• Research was conducted to reconcile frontline work and program accountability models. Performance is a key concern for nonprofits providing human services. Yet our understanding of what drives performance remains incomplete. Interviews gave frontline staff broad leeway to describe how they work with clients to achieve intended outcomes. Discussions were organized around the three frequently mentioned tasks that constitute key aspects of co-determination work: (a) establishing a relationship, (b) working out an agenda, and (c) taking action. Each of the three dimensions of co-determination work was found with relative frequency in the interviews. Overall, evidence supporting the regularity and importance of co-determination work and our particular task and dilemma categorizations was fairly robust.

• The Cal-Adap project developed a web portal for understanding California's climate research. It is a visualization tool to showcase the wealth of innovative climate change research being produced by the scientific community in California. It further allows decision-makers, scientists, and residents of California to turn research results and climate projections into effective adaptation decisions and policies. The site

has had more than 68, 000 unique visitors from more than 170 countries. Cal-Adapt is being used to support the Climate Adaptation Guide prepared by the Governor's Office of Planning and Research.

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 has been an innovative leader in food production for more than a century. California is a major producer of vegetables, fruits, nuts (nearly 50% of the nation's supply), and dairy products (more than 20% of the nation's supply).

These are healthy and under-consumed sources of nutrition. More than 400 commodities are produced in the state. California agriculture faces unprecedented challenges to its sustainability, including climate change, water constraints (quantity and quality), regulation, labor, invasive species, urbanization, and other factors.

Much of the impact of California agriculture upon the nation and the world has been due to the UC's research and extension efforts, which demonstrate breadth and depth of expertise and innovation in urban agriculture and local/regional food systems, specialty crops, plant production and genetics, animal welfare and production management systems, and precision agriculture.

During FY2016, 198 Hatch and Multistate Research projects were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 65 research and extension projects. CE advisors worked on 494 extension projects and led an additional 58 research projects under the Federal Planned Program: Sustainable Food Systems. The following illustrates the breadth of work and includes selected examples highlighting accomplishments in this program area.

Food Access and Diversity in the Food System

The public's interest in agriculture and where their food comes from has grown exponentially over the last several years in California and the United States, especially among urban populations. This interest has led to an increased demand for research and extension programs that support a new and more diverse clientele through urban agriculture and local/regional food systems programs.

- One project supports farm-to-school programs with evaluation research examining the extent of local procurement as a result of cooking classes for food service staff and educational events for farmers and food service managers in Northern California school districts. A Marketplace Exchange event in which growers and buyers exchanged sales information in quick sequences resulted in 25% of farmer participants making a sale at the event and 80% saying they intended to follow up on leads. Researchers also organized two bus tours (Riverside and Sacramento) of innovative farm to school programs for policymakers.
- Enhancing the economic and ecological viability of the next generation of diverse California farmers and ranchers is the long-term goal of the "Growing Roots" project. The target audiences for this project include Latino, Southeast Asian, African American and other ethnic groups farming in urban, peri-urban and rural areas in 10 counties within central California. A collaborative team hosted workshops and events that covered ecological farming, business and marketing, food safety, value-added processing, urban agriculture and collaborative farming. These group learning opportunities also emphasized one-on-one technical assistance to 80 farmers and ranchers in 2016. 63% of program participants were women, and 36% were minority or social disadvantaged farmers and ranchers. Of those who currently farm, 82% have been farming less than 15 years. Meanwhile, 26% of participants said they are planning to start farming. 89% of participants reported an increase in learning, and 63% plan to implement or already have implemented new practices based on what they've learned as a result of these programs.

Specialty Crops

Californians produce more than 400 commodities with specialty crops including fruits and vegetables, tree nuts, and dried fruits contributing significantly to the economy. The diverse California environmental and climatic conditions allow for the production of many high-value specialty crops in which California is the production leader.

- A series of projects on precision technologies for specialty crop production (almond, walnut, and grape) - some using wireless sensor networks - had positive economic and environmental impacts through reduced water usage and more precise application of inputs to enhance crop yields. Development of these methods is critical in providing producers with tools that allow them to make informed irrigation decisions for greatest water use efficiency while maintaining productivity.
- Deficit irrigation and efficient nitrogen fertilization combined with selective pruning techniques in densely planted almond orchards have demonstrated improvements in canopy management. In addition to providing canopy management benefits, deficit irrigation management may make the orchards less susceptible to insect and/or fungal pests. Employing these techniques would provide direct benefits to growers by decreasing costs of production and reducing potential for worker and environmental pesticide exposure while producing products with reduced pesticide residues for consumers.
- Development of new cultivars can provide producers with additional market opportunities and consumers with better tasting, more attractive fruits and vegetables. Two varieties previously released by the program that have had significant impacts are Gold Nugget and Tango mandarin, both low-seeded mandarin (tangerine) varieties with excellent flavor and market acceptance. More than 4 million Tango trees are now planted in California, and there are increasing plantings in Florida and in other countries. In anticipation of future releases, three new citrus rootstocks were submitted to the UCR Citrus Clonal Protection Program to develop clean bud sources for distribution. One new asparagus variety with excellent spear quality was released and is being grown by some producers in California and other warm-climate zones, and release of a new hybrid asparagus variety is expected. These new citruses and asparagus varieties not only benefit the producer but also benefit consumers if their superior eating quality increases consumption of fruits and vegetables.

Plant Production and Genetics

Challenges in declining agricultural productivity within the context of climate change, water constraints (quantity and quality), regulation, invasive species, and other factors create an urgency to increase food production in ways that are more efficient and sustainable. Advanced genetic resources and more sustainable production practices must be identified and integrated into commercial agriculture to meet the challenges.

- 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 recovered one accession of S. cheesmaniae that was formerly considered inactive. A total of 7,041 seed samples representing 2,384 unique accessions were distributed in response to 355 requests from 258 researchers and breeders in 31 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 the 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 wheat breeding and genetics project continues to develop and evaluate common and durum wheat lines through regional variety trials for agronomic traits, quality characteristics, and disease resistance.
- The Assessment of Plant Fertility and Fertilizer Requirements for Agricultural Crops in California is an

effort to consolidate science-based information at a single website (https://apps1.cdfa.ca.gov/FertilizerResearch/docs/Guidelines.html) that allow growers and crop consultants to manage fertilizers more efficiently, reduce the risk of groundwater pollution, and comply with existing regulations. This project is ongoing and in collaboration with the California Department of Food and Agriculture and the Fertilizer Research and Education Program. Online guidelines for nitrogen, phosphorus and potassium management in prunes/plums, peaches/nectarines, potatoes, avocados, dry beans, onions, celery, carrots, and olives were made available. Safflower and sunflower have been written and are currently under review.

• In an effort to develop new salt-tolerant grain and forage crops for agriculture on saline soils in California and other western states, researchers hybridized wheat and wheatgrass (tritipyrum). A total of 970 backcross lines have been self-pollinated for two generations. Self-pollination of this material is planned for another two 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

Maintaining safe, healthy, and productive animal agriculture production practices while conserving natural resources is a key goal in the development of animal welfare and production management systems.

• The new California bovine respiratory disease (BRD) scoring system is a calf-side system to identify pre-weaned dairy calves that score positive for pneumonia. This system is now available as a validated mobile application in both English and Spanish. The 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. In addition, researchers continue development of 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 develop animal behavior measurement techniques to assess on-farm and backyard 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.

• Commercial freshwater and marine aquaculture in California is a diverse industry producing dozens of species of finfish and shellfish all with different methodologies and system designs for their culture. Program outreach in production technology and animal welfare has delivered information that has increased the skills of aquaculture company personnel in aquatic animal production technology, facility site selection, production system design, system management, species biology, disease, toxicology, animal welfare, permits and regulations in California and other states nationally. The technology and information improved the efficiency of these companies, which has led to increased profits. Work in shellfish sanitation has assisted state agencies in California and nationally to reassess how they monitor and assess sanitation conditions in shellfish growing areas to better regulate and safeguard public health. In the area of aquatic animal welfare, project efforts have led to changes in attitude of finfish producers towards the public's desire for adoption of animal welfare in aquatic animal production. There is now a growing change in the behavior by industry in accepting aquatic animal welfare concepts, which in turn has led to increased industry sustainability.

Technological Innovation

Technology and innovation are essential to address the challenges and demands of climate change, water constraints, regulations, pest management, and other factors facing production agriculture. Precision agriculture and decision aid tools should result in more efficient resource management, increased returns and sustainability.

• Researchers continue to simplify on-farm decision making through the use of innovative technology. The creation and integration of two tools have significantly helped farmers conserve water and make better use of nitrogen fertilizer while maintaining crop productivity and quality. 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 (https://cropmanage.ucanr.edu/) is an online application that makes both tools easy and accessible for growers to use in the field. Commercial-scale CropManage trials with broccoli used 48% less water than is used for conventional plantings, with no reductions in yield or crop quality. The nitrogen rate recommended by CropManage generated yields similar to those of the growers' standard practice, but with a significant reduction in nitrogen fertilizer applied. Commercial-scale trials in lettuce demonstrate that growers using CropManage can reduce nitrogen and water without compromising quality or yield. Commercial usage of CropManage continues to grow as crops are added -- crops currently supported include strawberry, head and romaine lettuce, broccoli, cauliflower, cabbage, celery, spinach, baby lettuce, cilantro, and mizuna. It will soon include leaf lettuce and bell peppers.

- Research on precision irrigation, fertilization, and management of specialty and other crops by wireless sensor networks features wireless nodes and actuation hardware/software. Previously reported sensor and control networks in almond and walnut orchards continue to be used for experiments with irrigation strategies based on real-time measurement of crop water stress with a unique plant water status sensor. Development and testing of a next-generation wireless sensor and control network are underway with the goals of reducing the cost of the wireless system and simplifying the use of the system for end users. Demonstration systems have been installed and are currently being evaluated in four commercial situations: alfalfa, orchard, vineyard, and container nursery. These types of precision agriculture should lead to economic and environmental benefits since they involve applying inputs such as chemicals and water on a site-specific or "prescription" basis to enhance crop yield, reduce inputs, and reduce environmental impact.

Endemic and Invasive Pests and Diseases

Pests threaten productivity, biodiversity, and health of California's natural areas and agricultural production, urban (including structures), and animal systems. These pests include arthropods, nematodes, mollusks, and other invertebrates, weeds, plant and animal diseases, vertebrates (e.g. birds, rodents, and other mammals) and other taxa. Many of the damaging pests are non-native to California, and these exotic pests enter the state in spite of state and federal regulatory programs and inspections at state and international borders and other ports of entry. Natural dispersal and adaptation of pests also lead to new pest management challenges in California, and this is often driven by changes in global climate patterns, crop selection, and crop or livestock management practices.

UC ANR has identified the Endemic and Invasive Pests and Diseases Initiative as a priority mechanism to coordinate and engage the resources of UC ANR to meet these significant pest challenges. This initiative addresses detection, biology, and management of pests and diseases that can impact human, livestock or plant health, stored products, postharvest products, buildings, or natural systems such as wildlands and waterways. This initiative's goals are to foster research and extension programs that 1) exclude pests, pathogens and diseases using diagnostics, detection, interception, response, and mitigation, 2) develop information that responds to emerging and re-emerging problems with pests and diseases, and 3) provide long-term integrated pest management (IPM) solutions for established pests that are economically and environmentally sustainable, and socially appropriate.

During FY2016, 145 Hatch projects were conducted by investigators at UC Riverside, Davis and Berkeley. CE specialists worked on 37 research and extension projects. CE advisors worked on 291 extension projects, and led an additional 74 research projects under the Federal Planned Program, Endemic and Invasive Pests and Disease. The following examples illustrate the breadth of work and include selected highlights of accomplishments in this program area. A significant amount of research and extension activity addresses pest management issues on specialty crops including vegetables, tree and vine fruit crops, and

crops.

Detection and Diagnostics

Early detection of pests, especially new invasive species, and proper diagnosis and identification, are critical steps for optimizing the chances of limiting establishment. Lack of early detection may result in expensive pest and disease management costs in the long-term, disruption in commerce and industry prosperity, and human and animal health impacts. However, eradication of pests and diseases may be feasible if an early detection system is in place.

- Molecular methods as the basis for rapidly identifying new pathogens in celery, grapevines, and citrus were developed. For example, unique citrus sRNA biomarkers were identified for early diagnosis of huanglongbing (HLB or citrus greening) with more than 80% sensitivity.
- Genomic diet analysis methods, utilizing feeding trials of rats and birds, were developed to understand invasion dynamics and subsequent impacts on food webs in natural and agroecosystems.
- A number of powerful attractants for detection and monitoring of pest insects were identified, synthesized, and protocols developed for practical use. Field trials with these attractants demonstrated the power of these compounds for surveillance programs for cerambycids (longhorned beetles).
- Work on the spotted-wing drosophila (SWD) resulted in development of a PCR-based molecular diagnostic for the rapid identification of all life stages of this pest.
- A multi-faceted extension program was used to reach nurseries, citrus growers, and home gardeners to educate them about the identification of HLB and management strategies for the vector Asian citrus psyllid (Diaphorina citri). Outreach was conducted to teach growers about the "NuPsyllid" a genetically engineered psyllid that would replace the wild psyllids and stop disease spread.

Emerging and Re-emerging Pests and Diseases

Emerging problems can arise from endemic or newly established invasive species, and these must be addressed to minimize their impacts on agriculture, natural resources, and urban systems. In contrast, re-emerging pests and diseases are those that were once major problems and then declined dramatically but are again becoming significant problems whose impact is increasing due to human activities or climatic and ecological changes. Re-emergence can result in severe crop losses, harm to natural resource areas, infection of animals and humans, increased fire hazard and other consequences.

- Discovery that resistance plant response to two studied herbicides is influenced by environmental conditions such that the resistance phenotype is expressed to varying degrees depending on the season and conditions at herbicide application. Herbicide resistant weed populations in rice are expanding. Workshops and an on-line course covering pesticide resistance were created to train growers and pest control advisers to minimize the spread and impact of herbicide resistance.
- A comprehensive epidemiological study using logistic regression models identified conditions conducive to reducing Salmonella Heidelberg (SH) in poultry processing plants. The results from the logistic regression and conditional decision trees were used to communicate a risk analysis of conditions that produce positive Salmonella in the processing plant.
- Bed bugs continue to increase and plague many cities in America. Various products containing plant-derived essential oils are available for general public consumers to control bed bug infestations. One exciting finding is that some of these low risk essential oil components can kill bed bugs as a vapor. Bed bugs' shed skins were found to retain four aldehyde pheromones and slowly release them, causing the bed bugs to settle close to the freshly-shed skins. These results could lead to the development of effective monitors for bed bugs.
- Springtails (Protaphorura fimata) were not considered to be pests of lettuce until field and laboratory studies showed P. fimata can cause severe feeding injury to germinating seeds or seedlings, thereby reducing their growth rate. This answered a long-standing question about why lettuce seeds did not have uniform emergence in some fields.
- Insecticide resistance assays and evaluations insecticide applications revealed the mosquito Aedes

aegypti population are resistant to class I pyrethroids but are susceptible to deltamethrin (class II pyrethroid) and malathion (organophosphate).

• Fusarium dieback/Polyphagous shot hole borer (Euwallaceae sp.) distribution was found to be widespread in California, affecting urban forests and commercial avocado groves. Management methods were evaluated for both the pathogen and the borer. Thermal thresholds and temperature development rate of the beetle were determined, and this information will be used to establish the potential range expansion of the insect.

• Work on biological control of Asian citrus psyllid (ACP), the vector for the bacterium causing HLB, has made major advances. Studies using micro-video cameras revealed that syrphid fly larvae and lacewing larvae are the most important predators of ACP nymphs. Diaphorencyrtus aligarhensis, a second ACP parasitoid, were released in southern California with recoveries made up to 6 miles from release sites.

• The occurrence of resistance-breaking root knot nematodes (RB-RKN) populations in processing tomato fields is increasing. A study found that RB-RKN populations are commonly found throughout the different growing areas and that the majority are M. incognita. This work resulted in grower recommendations about the risk of nematode infection even in resistant tomato varieties, and about the need for additional management strategies to reduce yield loss.

• Management programs to reduce the spread of emerging pests include development of biological and chemical control systems for Pierce's Disease of grapevines, spotted-wing drosophila (Drosophila suzukii), Virginia creeper leafhopper (Erythroneura ziczac), bagrada bug (Bagrada hilaris), and others.

• Fusarium Race 4 has become more problematic as cotton acreage expands in the central valley. In addition to a jointly operated UC and USDA-ARS breeding and screening program for host plant resistance, training and development and delivery of extension materials resulted in growers changing cultural practices to help slow disease spread.

• One hundred-forty pistachio orchards were surveyed for new and emerging diseases of pistachio. Almond orchards were investigated for limb dieback and canker diseases. This work increased knowledge of the current diversity of pathogens and helped growers adopt appropriate management strategies

Integrated Management of Established Pests and Diseases

Integrated management approaches are used to reduce the impact of established pests and diseases on agriculture, natural resources, and urban systems through the development of science-based pest management programs that are economically and environmentally sustainable, and socially appropriate. These integrated pest management (IPM) programs for existing, established pests require frequent refinement to stay relevant. Changes in the efficacy of current management tactics, adjustments in production strategies, revisions in crop landscapes, unusual environmental conditions, and other controllable and uncontrollable situations modify the impacts of pests.

• Several ANR researchers are using molecular approaches to understand mechanisms of plant defense to important plant pathogens including Xylella fastidiosa the bacterial agent that causes Pierce's Disease.

• Other studies centered on sharpshooter transmission of X. fastidiosa. Lipopolysaccharide macromolecules on the surface of bacteria were found to be involved in the acquisition of a pathogen by one of its vectors, the blue-green sharpshooter. Using a mutant that created a truncated O-antigen, researchers reported a reduction in acquisition by the vector. Work was also done to evaluate the levels of insecticide resistance on glassy-winged sharpshooter (Homalodisca vitripennis), another key vector of Pierce's Disease.

• Management methods were improved for bait delivery for Argentine ants, a pest of home, orchards, and natural areas. Based on a series of laboratory/field studies, hydrogel compounds were used to deliver the lethal doses of toxicants dissolved in aqueous bait solution. Because it does not require regular maintenance, hydrogel-based baiting systems might potentially revolutionize the way insecticidal liquid baits are used in the field. For the first time, researchers demonstrated that mixing insecticidal baits and a "trail-following" pheromone significantly improved baiting strategy. This strategy could lead to commercial pheromone-assisted bait products, which would greatly improve current baiting technologies.

• Preliminary research with the beneficial biological control nematode, Steinernema carpocapsae, found that when combined with protective gel and anti-UV ingredients, these nematodes have the potential for above-ground insect pest management.

• Research on alternatives to high toxicity fumigants for nematode management identified new nematicides with much-preferred toxicology profiles (e.g. rei 0 hr, caution label). Mustard seed meal reduced nematode damage in field tests, providing a possible management tool for organic growers. Several fungi (Dactylella oviparasitica, Fusarium oxysporum, Pochonia chlamydosporium and a Tetracladium sp.) were identified that suppress phytophagous nematodes.

• Weed management projects for strawberry, melons, and vegetable crops were conducted resulting in promising herbicides for use in these labor-intensive crops.

• Work to quantify ecosystem services in rangelands to facilitate IPM adoption improved understanding of how to develop site-specific long-term invasive plant management programs on rangeland as well as improved understanding of the costs and benefits of these programs.

• The VetPestX database of registered pesticides was updated with products from 21 states, and the associated "Insect Pests of Animals" website was updated to include management information on additional animal ectoparasites.

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. However, their sustainability is complex due to ecological diversity and mixed ownership.

The Sustainable Natural Ecosystems Strategic 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. 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 goal of the Sustainable Natural Ecosystems Strategic Initiative and Federal Planned Program is to maintain a large positive impact on California's natural resource ecosystems by ensuring that the three pillars of sustainability are balanced.

During FY2016, 118 Hatch and Multistate research projects were conducted by investigators at UC Berkeley, Davis, and Riverside. CE specialists worked on 24 research and extension projects. CE advisors worked on 117 extension projects and led an additional 16 research projects under the Federal Planned Program Sustainable Natural Ecosystems. Projects are being conducted in several areas that are essential to sustaining California's natural resources. The following illustrates the breadth of work and includes selected examples highlighting accomplishments in this program area.

Ecosystem Services & Working Landscapes

Ecosystems and working landscapes provide benefits or services vital to agriculture and the environment including natural diversity of plant and animal life, recreational space, and natural resource accessibility.

• A study on the economics, ecology, and politics of ecosystem services has sought to advance the understanding of the positive and negative feedbacks between economics, ecology, and political entities that encourage or discourage the sustainable delivery of ecosystem services. This project focused on provisioning and cultural services like fish catch, food production, biodiversity, and recreation. Preliminary results show that markets can incentivize the degradation of population diversity, reducing infra-marginal fishery rents and increasing variability in economic returns. Results also show that management can

conserve population diversity and improve welfare. A stepwise framework known as fisheries improvement projects (FIPs) is being used to guide fisheries towards sustainable practices and in some instances offers certification. Certification of sustainable FIPs is being pushed by retailers (e.g. Walmart).

Range Resources Management

Rangeland and grassland ecosystems provide benefits vital to agriculture and the environment including grazing and forage for livestock and native animals, watersheds for rural and urban uses, habitat for plants, insects, and animals, water for sustainable landscapes, areas for recreational activities, and renewable energy and mineral resources.

- A project that seeks to understand and predict rangeland plant community responses to severe drought surveyed around 120 vegetation plots in grassland and shrubland areas statewide to assess the plant community change in response to drought condition changes. Results showed which patterns in plant community response could be predicted by pre-drought responses to climate variation.
- A study is in progress to develop a model to predict rangeland restoration success as a function of biophysical and management factors as well as quantify the relation between rangeland restoration success and selected ecosystem services at the landscape level. This project will have major impacts with ranchers, land managers, and owners.
- Studies are underway to determine if rangeland exotic weed species are evolving with respect to climate change by changing leaf conductance, water use efficiency, and assimilation capacity in response to elevated atmospheric carbon dioxide. Results from this effort will help predict which invasive species will benefit from future climate change and will, therefore, need more attention and prioritization of management efforts.
- One project seeks to determine the interactive effects on California grassland plant communities including both desirable and undesirable species and ecosystem services. Preliminary results showed that three years of drought increased the prevalence of perennial grasses. However, seed production was reduced. Drought appears to significantly change above-ground litter accumulation, suggesting decomposition is more water-limited than plant production.

Wildlife & Fisheries

Wildlife and fisheries preservation and habitat enhancements are another component of California's natural ecosystems and the working landscapes. Beneficial uses of water include maintaining or improving water quality. Conflicts with wildlife occur in both the rural and urban settings.

- Current work with the national animal genome research program for rainbow trout resulted in the generation of high resolution genetic maps that improve genome assembly and reveal striking differences in the spatial distribution of recombination between sexes. These linkage maps can be applied to future aquaculture, conservation, and biomedical research. In addition, strategies were developed to identify genes and allelic variation that contribute to economically important phenotype and traits for rainbow trout.
- A study of climate change and population dynamics of two imperiled wildlife species, the Valley Elderberry Longhorn Beetle and the Tricolored Blackbird has sought to describe how their populations vary among habitats and how those populations depend on climatic factors. A review paper was published describing the effects of climate on changed spatial structure of habitat and changed dispersal.

Forestry

Trees are one of California's most valuable renewable resources. Not only do they provide products used in construction, but they are essential in habitat for wildlife, recreation, and carbon sequestration. Sustainable ecosystems must include forests, and they must be understood to preserve and protect them.

- A study designed to develop more effective equipment and methods for reducing wildfire in forest stands looked at two alternatives for residual biomass from fuel hazard reductions projects. The default alternative was open pile burning. The second option - use of biomass for electricity production - was

shown to produce energy and emission benefits. Revenue generated from monetization of the reductions in air emissions has the potential to make forest fuel reduction projects more economically viable.

• A study of genomics of California conifers sought to develop the technological capacity to measure and monitor the adaptive genetic potential of California forest tree species against man-caused threats, such as fire, land-use impacts, introduces pathogens and climate change. Results from this project will develop genomic-based tools that forest resource managers can use to assist in reforestation, conservation, and restoration programs on public lands in California. To date, five projects have been completed that will help develop those tools. Species include sugar pine, western white pine, limber pine, and white bark pine.

Water Quantity, Quality and Security

Water supply and quality for agricultural, urban, and environmental systems are one of the state's biggest challenges. During FY 2016, California continued to face its worst drought in decades.

UC ANR's Water Quantity, Quality and Security Strategic Initiative and Federal Planned Program works to directly impact California watersheds and California's water security. Projects are being conducted in areas that are essential to sustaining California's water resources: groundwater recharge and quality; water use efficiency; ecosystem conservation and restoration; and water policy.

During FY2016, 24 Hatch and Multistate research projects were conducted by investigators at UC Berkeley, Davis, and Riverside. CE specialists worked on 14 research and extension projects. CE advisors worked on 84 extension projects, and led an additional 8 research projects under the Federal Planned Program Water Quantity, Quality and Security. The following illustrates the breadth of work and includes selected examples highlighting accomplishments in this program area.

Groundwater Recharge

Management of groundwater recharge is important for both quantity and quality purposes. The drought has increased attention on sustainable groundwater management throughout the state.

• Work is assessing the potential to use storm/flood water on agricultural lands to increase groundwater recharge. The study considers the potential for stormwater/floodwater use on almonds, irrigated pasture, low-nutrient input row crops and alfalfa and will extend investigations to other crops depending upon results. This strategy would increase the amount of freshwater recharge and lessen overdraft in groundwater aquifers. This work will be increasingly important as precipitation variability will increase with climate variability.

Groundwater Quality

Increases in irrigation efficiency can lead to increased salt concentrations leached to groundwater aquifers.

• A study looks at irrigation sustainability at the centuries to millennia time scale to assess the potential for long-term salinity buildup in groundwater. Results show gradual degradation of groundwater quality throughout the state.

• Additional work is underway to look at the potential for recycled waste water to increase this degradation through increased salt accumulation. Mitigation for salt accumulation includes rainfall and irrigation with fresh water. 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 are underway to understand the potential impacts of these lower quality waters, often with increased salinity, on crop production and product quality.

Nitrate pollution in groundwater sources is a major concern in California.

• Research to reduce nitrate pollution has focused on the main pathway, leaching. By increasing irrigation efficiency and optimizing nitrogen applications, leaching can be reduced.

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

• Additional research on the use of bioreactors to clean up nitrogen-laden groundwater and surface water flows show promising techniques to increase efficiency. New research and curriculum development enhances capacity within the state to solve this problem.

Water Use Efficiency

Increasing water use efficiency is critical to creating value from out 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 helps 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 underway to increase the performance of soil moisture probes and leaf pressure chambers to refine water management recommendations.

• Additional work on strawberry production showed significant water savings from advanced irrigation systems. 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 is proceeding to reduce water use and manage salinity in turf grasses. Through breeding, genetics, weed control, and irrigation management, strategies to lessen the impacts of turfgrass in the state are evaluated. Management and irrigation scheduling can have significant impacts on water use by turfgrass.

• Results from work assessing the potential impacts of reuse of winery wastewater on vineyards and wine production and quality show that properly managed use of winery waste water does not impact production or quality. The use of this water can reduce vineyard water demand and lessen offsite impacts from winery waste.

Ecosystem Conservation and Restoration

Stream restoration modeling work helps 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 the El Niño Southern Oscillation, ENSO.

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.

• We have 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. Several studies in Southern California provided new evidence on the ability of price signals to impact urban water demand.

Sustainable Energy

California continues to pursue renewable sources of energy. Research is needed to understand the potential for both high-value renewable products and fuels created from agricultural and natural feedstocks and waste products. California has 132 waste-to-energy plants with the capacity to generate 1,000 megawatts of power. In 2015, biomass power plants in California produced 3.42 percent of the total electrical needs for the state. In 2016, six ethanol plants produce approximately 223 million gallons of ethanol using corn, sorghum, cheese whey, and beverage waste. Eight biodiesel production plants reported producing approximately 77 million gallons of biodiesel in 2016.

The UC ANR 2025 Strategic Vision for sustainable energy production outlined initiatives to improve the energy security of California through innovative research on green technologies science linking engineering, agricultural, biological and environmental research. 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 new technologies and marketing strategies, and use genetic, genomic engineering, and agronomic research to produce sustainable feedstocks from forest waste, agriculture production and waste. This research will develop science-based policies and information to guide policy makers on issues related to energy.

During FY2016, 23 Hatch and Multistate Research projects with a sustainable energy focus were conducted by investigators at UC Davis, Berkeley, and Riverside. Projects are being conducted in several areas that are essential to sustaining California's energy needs. The following illustrates the breadth of work and includes selected examples of high impact projects and programs.

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 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 diverse agricultural cropping systems and include crops such as sorghum, oilseeds, sugarbeets, and other potential crops.

• Projects are currently researching crops that are sustainable biomass feedstocks for various bio-based fuels and products and the potential for creating enhanced oil based biomass plants through gene expression. 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. The Department of Energy (DOE) ARPA-E program is funding two multi-disciplinary sorghum research programs, and based on outcomes genes and molecular markers will be identified to devise genetic strategies for improving drought tolerance in sorghum and other bioenergy crops. One project is

researching mechanisms for expressing oil accumulation in high biomass tissue that is capable of growing on vast geographical areas of marginal lands.

• 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 study is researching the evolutionary basis for root-nodule symbiosis and identification of conserved plant traits for nodulation that may help plants capture more nitrogen. These genes could potentially serve to create more efficient N use in bioenergy cropping systems, especially under nutrient poor soils.

• Photosynthetic microorganisms, such as cyanobacteria or unicellular microalgae, can grow to high densities within fully enclosed photo-bioreactors. Research is underway to optimize these photosynthesis-to-fuels systems for the generation of terpene hydrocarbons. Such a system would enable oxygenic photosynthesis to convert solar energy and store it in the form of hydrocarbons. Other research is evaluating lipid production and fatty composition through co-culturing of green alga and E. coli under high-substrate mixotropic conditions.

Biofuel 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.

• Research is underway to generate plants with "designer" cell wall structures representing novel biomaterials and feedstocks for biorefineries. The resulting biomass may be more efficiently fermented by certain bacteria. Work is also underway to alter the biosynthesis and composition of cell walls which could increase yields of biofuels from cell wall biomass. This work has led to an unexpected discovery of MT1, only the second gene known to cause attachment of methyl-ether groups to sugar residues in plant cell walls which may have impacts relative to plant water stress tolerance. Research focuses on bioconversion of agricultural residues through pretreatments to improve cellulose accessibility to cellulases.

• Research continues to improve production of clean power and fuels through thermochemical gasification and pyrolysis. Agricultural almond waste was gasified and has been evaluated for potential use as a feedstock.

Policy and Economics

Policy and economics of renewable electricity and fuels remain important in California.

• Work continued to quantify 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.

• Additional work has analyzed the low carbon fuels standards and renewable fuel standards and their impact on production of renewable fuels in California.

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.

• 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: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	317.0	0.0	434.3	0.0
Actual	291.8	0.0	384.9	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 FY2016, the five Strategic Initiatives held 12 panel meetings and 20 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 2016, there were 25 Program Teams meetings and 31 Workgroups meeting in conjunction with 1,275 total participants. In addition, the

Healthy Families and Communities Strategic Initiative held conferences, and all five Strategic Initiatives coordinated a Joint Strategic Conference. The conference was well attended with 333 participants representing a diverse, integrated group, including CE Advisors, CE Specialists, AES Faculty, Program Directors and Academic Coordinators and programmatic staff. The end of session survey captured that 92% of respondents felt their opinions were represented; 70% have a better understanding of the Strategic Initiatives' priorities; and 78% feel the discussion will shape the Strategic Initiatives' future plans. These groups looked at UC ANR's program priorities and determine efforts that will best address these needs.

During the beginning of FY2016, UC ANR completed its 2015 internal, competitive grants cycle. During fall of 2015, 45 full proposals were reviewed by ad hoc, technical committees recruited by the strategic initiative leaders. The membership of these committees depended on the proposals received and included external experts. 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. During November 2015, 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 five years. The awards ranged from approximately $50,000 to $450,000. This grants program is biennial, thus the next cycle's Request for Proposals was released FY2017.

UC ANR actively engages stakeholders in a thorough process to determine the highest priority CE 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 call for CE positions is released every other year; during FY 2016 a call was released.138 proposals were submitted; they were developed in consultation with stakeholders. The process allows as much time as possible for consultation and discussions with internal UC ANR stakeholders in all program areas. UC ANR also expects and strongly encourages engaging external stakeholders, including commodity groups, cooperating programs, agency partners, community groups, and others, to explicitly discuss the priority needs for these positions. The review process was completed May through August 2016, and it involves public comment which was open January through July 2016; over 600 people submitted comments. 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 to the Vice President, who then makes the final decision. Twenty-six new positions were approved in FY2017.

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.

UC ANR Strategic Planning
UC ANR continued to make significant progress toward its Strategic Vision 2025, and launched a rigorous strategic planning effort to operationalize the vision. During FY2016, the Strategic Planning Committee completed four of the six workshops. Throughout the process internal and external stakeholders were engaged to provide feedback as the committee developed the plan. A survey of internal stakeholders was conducted to identify priority program needs, with a 60% response rate. In addition during FY2016, there were 7 in-person input sessions. The stakeholder input received throughout the process helped clarify and refine the core values, strategic objectives, and goals.

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 FY2016, one center completed its strategic plan, and two others 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 strategic directions; each with specific goals, intended outcomes, and key actions that include identified implementation responsibility and anticipated deliverables.

Statewide Program and Institutes Strategic Planning & Reviews
Each of the Division's eight statewide programs and two statewide institutes undergoes a routine program planning and review efforts that are designed to solicit and incorporate significant input from key stakeholder groups. The strategic planning processes are highly collaborative, including a committee with representatives of diverse stakeholder interests. Those members then also outreach to additional stakeholder groups for their input. Similarly, 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 FY2016, one statewide program launched strategic planning and no such reviews were conducted.

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 2016, the five Strategic Initiatives held 12 panel meetings and 20 conferences calls, and 25 Program Teams met with 31 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.

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. During FY2016, UC ANR leadership worked with the Executive Committee of the California Commodities Committee to discuss reinvigorating the committee.

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
8018691	0	6933437	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	8996732	0	5512760	0
Actual Matching	8996732	0	5512760	0
Actual All Other	95756966	0	270177302	0
Total Actual Expended	113750430	0	281202822	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
304	Animal Genome	0%		1%	
305	Animal Physiological Processes	0%		6%	
502	New and Improved Food Products	0%		4%	
604	Marketing and Distribution Practices	0%		2%	
606	International Trade and Development Economics	0%		3%	
607	Consumer Economics	1%		1%	
608	Community Resource Planning and Development	1%		4%	
610	Domestic Policy Analysis	0%		3%	
701	Nutrient Composition of Food	1%		2%	
702	Requirements and Function of Nutrients and Other Food Components	1%		42%	
703	Nutrition Education and Behavior	25%		7%	
704	Nutrition and Hunger in the Population	0%		2%	
723	Hazards to Human Health and Safety	0%		3%	
724	Healthy Lifestyle	11%		4%	
801	Individual and Family Resource Management	1%		0%	
802	Human Development and Family Well-Being	6%		6%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	2%		2%	
805	Community Institutions, Health, and Social Services	0%		5%	
806	Youth Development	47%		3%	
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: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	9.5	0.0	17.4	0.0
Actual Paid	16.8	0.0	4.3	0.0
Actual Volunteer	700.0	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
2559040	0	815695	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2559040	0	815695	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
13636468	0	33684518	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 public service announcements (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

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	97876	0	457683	0

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

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	38	125	163

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2016	4606

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2016	126

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual
2016	30

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2016	2

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2016	4

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2016	56

Output #7

Output Measure

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

Year	Actual
2016	2

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2016	9

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 4-H and other youth development programs, 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 horticulture programs, gain knowledge about sustainable gardening practices.
17	Youth, participating in youth development programs, increase interest in science and environmentalism.

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, preparation, and preservation techniques.
20	Children and youth, participating in 4-H and other the youth development 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	Preschoolers learned smart shopping skills, laying a foundation early for life skills that support healthy eating and food security.
25	13 preschools adopt new wellness policy, changing school culture to reinforce healthy eating and food security.
26	Children practice healthy eating habits as a result of a collaborative UCCE Riverside and Alvord Unified School District program.
27	UCCE Alameda County revitalized 10 preschool garden-based nutrition-programs in Oakland.
28	Collaborative nutrition education effort results in healthy behavior changes.
29	California 4-H and UC-CalFresh Cooking Academy improves children's eating practices.
30	UCCE and partners reduce risks of zoonotic and animal disease risks at county fairs.
31	UCCE study improves child growth and dietary patterns in high-risk communities.
32	Children make healthier choices after participating in UCCE program to reduce obesity.
33	4-H youth (4th- 12th graders) make positive choices.
34	4-H youth (4th- 12th graders) effectively communicate.
35	4-H youth (4th- 12th graders) build connections.
36	4-H youth (4th- 12th graders) 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.

37	4-H youth (4th- 12th graders) express interest and engage in science.
38	4-H youth (4th- 12th graders) express positive attitudes and aspirations toward science.
39	4-H youth (4th- 12th graders) develop science skills and abilities.
40	4-H youth (8th-12th graders) apply learning, and make a contribution through science.
41	4-H youth (4th- 12th graders) appreciate cultural diversity.
42	4-H youth (4th- 12th graders) engage in community and community issues.
43	4-H youth (4th- 12th graders) have understanding of the democratic process.
44	4-H youth (8th-12th graders) have awareness of community and community issues.
45	4-H youth (8th- 12th graders) report having interpersonal skills such as teamwork and decision-making.
46	4-H youth (8th- 12th graders) report having intrapersonal (social-emotional) skills.
47	4-H youth (4th- 12th graders) choose food consistent with Dietary Guidelines.
48	4-H youth (4th- 12th graders) improve physical activity practices.
49	4-H youth (4th- 12th graders) avoid and prevent negative risk behaviors.

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 4-H and other youth development programs, 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
2016	6247

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
2016	822

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
2016	223

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
2016	5543

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.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	6880

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 #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
2016	4462

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 horticulture 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 and environmentalism.

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, preparation, and preservation techniques.

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	146

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, participating in 4-H and other the youth development 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.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	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
703	Nutrition Education and Behavior

Outcome #22

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	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
703	Nutrition Education and Behavior

Outcome #23

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	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
704	Nutrition and Hunger in the Population

Outcome #24

1. Outcome Measures

Preschoolers learned smart shopping skills, laying a foundation early for life skills that support healthy eating and food security.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Family food security is important in the quest to increase the consumption of healthy foods (Rasmussen, et.al). Families with limited funds need critical life skills to help them manage their resources smartly to pay their bills and feed their families. Preschool teachers in the Hayward Unified School District (HUSD) started early trying to teach preschoolers some of the basic concepts of how to manage limited food dollars.

What has been done
UCCE and Alameda County Nutrition Services helped develop wellness policies in 14 preschool sites. Teachers and staff participated in a year-long wellness policy development and approval process. UCCE worked with teachers to approve and set the newly developed policies in place. At UCCE's check-in meetings the teachers also discussed what was possible and how to incorporate activities that had been tried at other preschools. These discussions led teachers at HUSD to institute smart shopping hands-on experiences to teach the preschool children basic skills in managing the food dollar -- getting the most for their money.

Results
Teachers organized one farmers' market at school to reinforce smart shopping skills with produce donated from the school community. The children kept track of the "food bucks" they earned, the cost of different produce and decided how much they could afford. Smart shopping is one of the major life skills UCCE educators teach low- income adults and youth throughout the state to help families eat a healthy diet on limited food dollars. Spending wisely helps families reduce food insecurity, and when preschool children begin to learn the importance of these life skills early, it helps to build a foundation for healthy families and communities now and for the future. HUSD

plans to make these money management experiences regular events to build on lessons learned and continue to contribute to changing the culture of preschools to lay a foundation early for life skills that support healthy eating and food security.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #25

1. Outcome Measures

13 preschools adopt new wellness policy, changing school culture to reinforce healthy eating and food security.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity affects at least 17% of children and adolescents and almost 36% of adults in the United States. Data from 2,606 teens randomly selected from the 2005-2014 National Health and Nutrition Examination Survey showed nearly 1% had diabetes and almost 20% had pre-diabetes. Eating behaviors of young children can impact brain development and are linked to future food attitudes and health. Early Childhood centers need support to develop and adopt policies to promote healthy nutrition and lifestyle practices. Policy development starts with teachers, staff, and administrators who are expected to make a positive change in the environment and model healthy nutrition and lifestyle practices.

What has been done
UCCE partnered with Alameda County Public Health Department, Nutrition Services in 2014 to develop nutrition and wellness policies and standards. Facilities assessments were conducted at 14 sites, and a Food Behavior Checklist was collected from 32 teachers and 13 teacher's aides serving 1,072 preschoolers. Teachers and staff participated in a year-long wellness policy development and approval process. They also received education about reducing sugar, reading

food labels, making water more available to the children, offering healthy snacks, using fruit and vegetable tastings as snacks, making healthy eating fun, and integrating nutrition and physical activity into classrooms. Policies were in place at 12 sites during the 2015/16 school year, and a short-term follow-up assessment was conducted.

Results

Thirteen of the 14 sites reported two or more positive healthy changes, with ten schools reporting more than five healthy changes as a result of the policies. Specifically, three or more schools improved healthy food choices by reducing the use of processed meats, increasing the offerings of fruits and vegetables offered each week, and decreasing the amount of juice served each day. Seven schools began to offer culturally relevant food, and one school was able to bring a farmers market to the school. Eleven sites implemented a policy change by providing guidelines to encourage parents to provide non-food contributions for school celebrations. In addition to increasing healthy foods and changing school guidelines, the schools also modeled healthy eating practices such as serving child-sized portions, allowing children to serve themselves, and not requiring them to eat all of the food on their plates. Three sites talked with the students about nutrition and one provided nutrition information to parents. Eight schools also increased the emphasis on physical activity by promoting physical activity at school and home, while two schools increased staff training on nutrition and physical activity. Preschool staff promoted policy change by modeling healthy nutrition practices at the preschool sites.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #26

1. Outcome Measures

Children practice healthy eating habits as a result of a collaborative UCCE Riverside and Alvord Unified School District program.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Alvord Unified School District was awarded a $1.1 million Physical Education (PE) Program Grant for 2012-2015 and UC Cooperative Extension (UCCE) was a partner on this grant. In addition to improving PE programs, the grant objectives include increasing ongoing assessment and monitoring, increasing district and community support, and transitioning from a sports-based PE program to a wellness-based curriculum aligned to State standards. To be successful, Alvord Unified needed a team of dedicated partners. UCCE was one of the key partners working alongside others such as the Alliance for a Healthier Generation funded by Kaiser Permanente Thriving Schools, the Nutrition Education Obesity Prevention Program, and 15 other public entities and community-based organizations.

What has been done

Both nutrition programs at UCCE Riverside (UC CalFresh and EFNEP) contributed to Alvord's success transitioning to wellness-based physical education. UC CalFresh provided nutrition education, (EatFit and Money Talks Hunger Attack!), to seven middle and high schools in this school district and offered quarterly nutrition education training to PE teachers as part of their professional development. EFNEP taught Kindergarten through 3rd-grade students at eleven elementary schools using Happy Healthy Me, My Amazing Body, Good for Me and You, and It's My Choice. Both EFNEP and UC CalFresh provided taste-testing experiences so the students could try new fruits and vegetables. In addition, in the 2015-2016 school year, UC CalFresh provided Smarter Lunchrooms Movement training to cafeteria staff at Wells Middle and Norte Vista High and helped Wells revitalize their school garden to bring about environmental changes that encourage healthy eating. UC CalFresh also participated in the twice per year district-wide family health and wellness events and provided nutrition education to over 180 parents during the three-year period.

Results

The excitement and momentum around school wellness in Alvord Unified cannot be attributed to any one agency alone but is due to the collective impact of all major and minor partners in partnership with school PE teams and Alvord Food Service. In 2016, a total of nine schools in Alvord Unified were recognized by the Alliance for a Healthier Generation Healthy Schools Program. One school, Loma Vista Middle, was awarded gold and one school, Wells Middle, was awarded silver, while seven other schools received a bronze award. More importantly, the success in Alvord resulted in positive student outcomes. During the first year of the grant, 53% of the students were in the Healthy Fitness Zone for Body Mass Index (BMI), and after the third year, this number increased to 62%. During the first year of the program, 14% of middle school students consumed fruit 2 or more times and vegetables 3 or more times a day, and this percentage increased to nearly 29% after the third year of the grant.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #27

1. Outcome Measures

UCCE Alameda County revitalized 10 preschool garden-based nutrition-programs in Oakland.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Servings of fruits and vegetables consumed per day among all ages are below the Dietary Recommendations for Americans. Research shows that nutrition and gardening experiences, linked to academic standards for a specific age group, can increase vegetable and fruit consumption and physical activity. Gardening activities can help increase children's interest in eating fresh fruits and vegetables and improve their understanding of the health benefits and major nutrients found in the plants grown.

What has been done
UCCE Alameda was funded by the East Bay Community Foundation (EBCF) in 2012 to develop a garden-based curriculum to integrate garden education into an ongoing Oakland Unified School District Sustainable Nutrition Urban Garden (SNUG) program operating at 20 early childhood school sites. The school sites with gardening received teacher training and technical assistance on nutrition and physical activity in the classroom and playground. When EBCF funding ceased in 2013, the 20 school garden structures lay fallow. UC CalFresh funding allocated in 2014/2015 revitalized the gardening activities at six sites. UC CalFresh provided materials, tools, and educator-trained teachers at each site on the Grow it! Taste It! Like It! and Go Glow Grow curricula. Eight teachers engaged the children in the gardening experience and classroom discussions, and two parents at each site assisted with planting, harvesting, and taste-testing the fruits and vegetables.

Results
Over 200 preschool children at the six early-childhood revitalized garden sites learned to prepare the soil; use gardening tools; identify fruits and vegetables; planted seeds and buds; care for them; and then harvest and taste the fruits and vegetables grown. Studies have found that direct exposure to vegetable gardening, in combination with nutrition education, increases children's

willingness to taste, prefer, and consume vegetables. Furthermore, the experiences at these garden sites provided 2 or more additional hours a week of physical activity, which can help improve children's hand-eye coordination and fine motor skills. All eight teachers gained confidence using gardening as a learning tool. Four new sites now added for the 2015/2016 school year brings the total number of sites to ten, with 31 teachers serving almost 800 children.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #28

1. Outcome Measures

Collaborative nutrition education effort results in healthy behavior changes.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In Riverside County, the CalFresh program (federally known as the Supplemental Nutrition Assistance Program or SNAP) serves 289,188 low-income individuals. According to California Food Policy Advocates, 37% of low-income households in 2014 were food insecure, having limited or uncertain access to adequate food. Educating CalFresh participants about making healthy food choices and shopping on a limited budget can help to improve their nutrition and food security; however, the challenge is that this population is very hard to reach and may be at different stages of readiness to change behaviors.

What has been done
To address this challenge, UC Cooperative Extension (UCCE) established a unique partnership with Riverside County's Department of Public Social Services Welfare Department (DPSS) and Department of Public Health (DOPH), resulting in the Get Fresh Project. Through a collective impact approach, each partner identified their assets and together coordinated the Get Fresh Project, which reached 9,000 low income residents over a three year period. The team developed and evaluated the success of a four-lesson program and cooking video that teaches participants

how to prepare healthy home-cooked meals on a budget. The delivery method was modified from lessons learned to fit the population served and resulted in a combination of in-class teaching, food pantries or food distribution sites, and other locations.

Results
UCCE surveyed a sample of Get Fresh participants (n = 70) in 2015 and found the following statistically significant behavior changes about 2 weeks after receiving the Get Fresh intervention: 39% of participants increased their frequency of consuming fruits or vegetables at the midday meal, 41% included more than one kind of vegetable at the main meal daily, and 19% increased frequency of shopping with a grocery list. UCCE also measured participants' intent to change in 2014 and found that participants who received the Get Fresh intervention had significantly greater intent than the comparison group for the following behaviors: eating fruit and whole grains at breakfast, reducing sweet beverages, eating more than one kind of vegetable daily, and using a grocery list. This model of collaboration demonstrates the opportunities for multiagency management of programs in developing, delivering, and evaluating the effectiveness of nutrition education at food pantries and food distribution sites.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #29

1. Outcome Measures

California 4-H and UC-CalFresh Cooking Academy improves children's eating practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Thirty-three percent of children eat from a fast food restaurant daily, even though research has shown that food prepared at home is usually healthier, more economical and lower calorie. With

more than one third of children overweight in the United States, healthy eating habits lower the risk of developing related chronic diseases which impact the physical, social, emotional, and financial health of individuals and the country. Lack of cooking education in schools and homes are cited as a major factor for selecting fast food over home cooked meals. Cooking is a life skill that also increases self-efficacy in children and promotes independence, problem solving, family cohesion, and comprehension of abstract math, science and language skills.

What has been done
California 4-H and UC-CalFresh Nutrition Education Program in Yolo County coordinated a new project -- Cooking Academy, using the 4-H Cooking 101 series curriculum with elementary students from six different, ethnically diverse, low-income sites in Yolo County, California. The hands-on, experiential, skill-based program includes seven weeks of cooking and food safety instruction. Students learn basic nutrition information to plan meals, safely prepare and enjoy food, and try new foods like tofu, whole-wheat tortillas, and zucchini. Cooking Academy promotes the three pillars of dietary behavior change; skills, attitudes and knowledge. Students try new foods in delicious ways (attitudes), learn the skills needed to prepare fruits, vegetables, and other healthy items (skills) and increase food literacy around recipe reading and food preparation concepts (knowledge). This further shapes their eating behaviors by creating a healthy food environment at home for each student and their family.

Results
While learning to follow a recipe, there are opportunities to try foods from each MyPlate food group, such as zucchini (with 97% of students stating that they would eat it again). Among the various new foods prepared, students stated a willingness to ask for the food at home, (73% of students enjoyed whole wheat pasta and 94% enjoying blackberries). By introducing students to new foods like tofu, students increased the likability by 35% with willingness to eat the food at school. Formative testing showed increases in cooking at home, self-efficacy in trying new foods, washing hands before food preparation, and eating more than one fruit or vegetable at dinner. Further research is being planned.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #30

1. Outcome Measures

UCCE and partners reduce risks of zoonotic and animal disease risks at county fairs.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Evidence indicates that a widespread disease outbreak would have profound economic impacts on the U.S. animal agricultural industry. Thus, government agencies have identified bio-security related to animal agriculture as a matter of high priority. Since backyard farms and public animal exhibitions can serve as sources and vectors of disease, it is critical that individuals, who care for animals in these settings, including youth raising animals for 4-H animal science projects, become proficient in bio-security practices. Research and extension efforts are needed to improve understanding of disease risk factors among the owners, increase the knowledge and skills of youth who raise and show animals at public venues, and strengthen bio-security policies set by fair management.

What has been done
A team from UCCE, UC Davis, and the One Health Institute collaborated to mitigate zoonotic and animal disease risks in 4-H animal science. The team provided professional development for 4-H staff and volunteers, conducted analyses of animal housing on home premises and at fairs to determine levels of zoonotic pathogens, reviewed current bio-security practices at participating county fairs, and engaged youth in a bio-security education program. Dozens of 4-H youth from the Sutter and Yuba County 4-H Youth Development Program participated in a multi-week education intervention. Youth were introduced to key concepts and skills relevant to bio-security and completed surveys documenting their fair-specific bio-security practices.

Results
The results of this effort included empowering youth with knowledge and skills, improving communication and collaboration around topics important to animal and human health, and implementing enhanced bio-security practices that will help reduce the risks of disease outbreaks. The project team provided recommendations based on specific, identified risks for fair participants and their partnering fair officials. Participating 4-H youth similarly developed and presented a bio-security improvement plan to the Junior Livestock Committee of the Sutter/Yuba Fair with recommendations for best practices at the event. Their recommendations were taken into account and changes in practice were implemented. Examples included adding additional hand washing stations and signage, and replacing a practice of mixing species in "Champions Row" with individual champion pens in species-specific barns to reduce the risks associated with inter-species contact.

4. Associated Knowledge Areas

KA Code	Knowledge Area
723	Hazards to Human Health and Safety
806	Youth Development

Outcome #31

1. Outcome Measures

UCCE study improves child growth and dietary patterns in high-risk communities.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Prevalence of childhood obesity is higher (22.4%) in Latino children ages 2-19 years than in non-Latino white children (14%). Though obesity rates have recently decreased among 2-5 year olds nationwide, racial and ethnic health disparities persist and indicate the urgency of early prevention efforts in high-risk communities.

What has been done
In 2012, UC ANR specialists and advisors joined UC Davis faculty and students to conduct a childhood obesity prevention study in a rural community in California's Central Valley. Funded by the US Department of Agriculture, the Niños Sanos, Familia Sana was a three-year, community-based intervention that provided a monthly voucher to buy fruits and vegetables, an enhanced physical activity program at school, and nutrition education to Mexican-heritage parents with children ages 3-8 years old. A comparison community received non-nutrition related educational programs. The main goal of the intervention was to slow down weight gain in overweight Mexican-heritage children, residing in an agricultural community. Other expected outcomes among children included increased consumption of fruit and vegetables and decreased consumption of high-fat, high-sugar foods. The UC ANR specialist and advisors developed culturally-adapted lessons in collaboration with the community and provided oversight of the nutrition education program to parents over three years. UC CalFresh and EFNEP California provided school-based nutrition education to intervention children. 544 families and 700 eligible children participated in the study.

Results
This multifaceted, three-year, community-based intervention was effective in slowing weight gain among in children who were obese at the beginning of the study. By the third year, obese boys and girls in the intervention community had significantly slower increases in body mass index than

children in the comparison community. Findings also show a significant decrease in the frequency of consuming energy-dense foods (fast food and snack food items) among the intervention children but no change in comparison children (p <0.008). Interviews with the school staff in the intervention community revealed several important environmental changes, prompted by the program. This project also produced a culturally-adapted child obesity prevention curriculum, a policy brief on water quality, and a new validated tool for dietary assessment in Mexican-heritage pediatric populations.

4. Associated Knowledge Areas

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

Outcome #32

1. Outcome Measures

Children make healthier choices after participating in UCCE program to reduce obesity.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Over the last four decades rates of childhood obesity have more than tripled for school-aged youth. One out of six of these youth have measurable heart disease risk factors after the age of six years. If this obesity epidemic is not stemmed, one out of three children will get diabetes during their lifetime if obesity is not reversed. Recommendations from experts suggest that interventions to reduce sugary beverages and fast food consumption can be effective ways to reduce obesity. Thus, Cooperative Extension advisers working locally in counties throughout California agreed to utilize their nutrition efforts in schools and enlist their community partners to create healthier communities.

What has been done
Nutrition, Family, and Consumer Sciences Advisors developed an eight-class curriculum for

grades four to six which was delivered over two school years to 335 students in nine participating schools. An additional seven schools and 204 students were recruited as a control group to test the impacts of the curriculum. The purpose of the curriculum was to have students recognize the risk to their health of drinking soda and other sweetened beverages as well as fast foods, in general. The curriculum emphasized healthy alternatives such as having snacks of fresh vegetables and fruits and drinking water as a healthy alternative. UCCE advisors in two counties provided leadership to coordinate community-wide activities to deliver the messages to students in after-school programs, including 4-H and community settings. Partnerships with 29 community agencies contributed to the wide reach of the program.

Results

Results showed that the children in the participating schools and programs significantly improved their nutrition knowledge compared to the non-participants. Participants learned more about food and health and could identify healthy choices. Compared to the non-participants, fewer participating students liked to drink soda after the curriculum, and more of them chose to drink water from school fountains. The UCCE Statewide Curriculum Committee is evaluating the curriculum for use in all EFNEP California and UC CalFresh youth programs. Establishing patterns of healthy food and beverage consumption can help prevent childhood obesity, potentially improving the lifelong health of children and consequently saving Californians millions of health care dollars each year.

4. Associated Knowledge Areas

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

Outcome #33

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	355

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 #34

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	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
806	Youth Development

Outcome #35

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	415

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 #36

1. Outcome Measures

4-H youth (4th- 12th graders) 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
2016	397

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 #37

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	421

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 700 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 (94%), experimenting and testing ideas (94.8%), get excited about new discoveries (91.9%), and want to learn more about science (90.4%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #38

1. Outcome Measures

4-H youth (4th- 12th graders) 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
2016	349

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 700 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 (92.1%), are good at science (91.2%), would like to have a job related to science (71.8%), do science activities that are not for school (73.6%), think science will be important in their future (grade 8-12 only: 88.8%), and think science is useful for solving everyday problems (grade 8-12 only: 88.8%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #39

1. Outcome Measures

4-H youth (4th- 12th graders) 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
2016	428

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 700 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 (grade 4-7 only: 95.4%), tell others how to do an experiment (grade 4-7 only: 91.7%), explain why things happen in an experiment (grade 4-7 only: 90.5%), use scientific data to form a question (grade 8-12 only: 57.9%), design a scientific procedure to answer a question (grade 8-12 only: 55.1%), use data to create a graph for presentation to others (grade 8-12 only: 69.2%), create a display to communicate my data and observations (grade 8-12 only: 76.9%), 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 #40

1. Outcome Measures

4-H youth (8th-12th graders) 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
2016	107

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 700 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 (74.8%), used science tools to help in the community; for example: mapped with GIS, tested water quality (33.3%), taught others about science; for example: demonstrated, gave presentation at a community meeting or a school (62.6%), and organized or led science-related events (for example: science fair, environmental festival) (30.2%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #41

1. Outcome Measures

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
2016	421

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 700 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: 94.9%), explore cultural differences (grade 8-12 only: 87.8%), value learning about other cultures (grade 8-12 only: 96.9%), respect people from different cultures (grade 8-12 only: 100%), learned about people

who are different from them (grade 8-12 only: 98%), and enjoy hosting someone from another culture (grade 8-12 only: 89.8%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #42

1. Outcome Measures

4-H youth (4th- 12th graders) 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
2016	408

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 700 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 (98%), apply knowledge in ways that solve "real-life" problems through community service (96.9%), gain skills through serving their community that will help them in the future (96%), are encouraged to volunteer more (95.9%), plan to work on projects to better their community (96%), continue to work to better their community after high school (grade 8-12 only: 95.9%), are interested in a

career that helps others (grade 8-12 only: 94.9%), are interested in working in government (such as school board, Director of parks and rec, legislator, legislative aide intern), (grade 8-12 only: 51.5%), and can contact someone that had never met before to get their help with a problem (grade 8-12 only: 78.8%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #43

1. Outcome Measures

4-H youth (4th- 12th graders) 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
2016	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 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 700 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%), treat everyone fairly and equally when they are in charge of a group (96%), and are able to lead a group in making a decision (grade 8-12 only: 95.9%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #44

1. Outcome Measures

4-H youth (8th-12th graders) 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
2016	305

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 700 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 (86%), are aware of the important needs in their community (87.9%), care about their community (95.8%), talk to their friends about issues affecting their community, state, or world (80.6%), are interested in others? opinions about public issues (87%), listen to everyone?s views whether they agree or not (92%), and try to figure out if they are just telling one side of the story when they hear about an issue (91%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #45

1. Outcome Measures

4-H youth (8th- 12th graders) report having interpersonal skills such as teamwork and decision-making.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1665

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 develop critical interpersonal skills to be successful in both the workplace and school settings.

What has been done
Data was collected on nearly 700 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 interpersonal skills by indicating that they can: make decisions related to school or college (73.3%) and careers (74.7%), communicate effectively (75.7%), work with others to set goals and manage expectations (81.7%), and appreciate diversity in team members (94.2%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #46

1. Outcome Measures

4-H youth (8th- 12th graders) report having intrapersonal (social-emotional) skills.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	121

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 develop critical social-emotional skills to be successful in both the workplace and school settings.

What has been done
Data was collected on nearly 700 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 interpersonal skills by indicating that they have: high self-esteem (83.6%), conscientiousness (57.1%), and a growth mindset (57.7%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #47

1. Outcome Measures

4-H youth (4th- 12th graders) 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
2016	183

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 700 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 (98.6%), eat vegetables for a snack (91.8%), choose water instead of soda pop or Kool Aid when they are thirsty (96.6%), drink 1% or skim milk instead of 2% or whole milk (85.4%), choose a small instead of a large order of French fries (93 %), eat smaller servings of high fat foods like French fries, chips, snack cakes, cookies or ice cream (92.7%), eat a low fat snack like pretzels instead of chips (97.5%), drink less soda pop (96.4%), and drink less Kool-Aid (97.2%). By participating in a 4-H Healthy Living Program, youth learned about the foods that they should eat every day (98.9 %), what makes up a balanced diet (95.4%), why it is important for them to eat a healthful diet (98.9%), how to make healthful food choices (93.4%), how many calories they need to eat each day (grade 8-12 only: 76.1%), the importance of fruits and vegetables in their diet (grade 8-12 only: 97.8%), and the importance of whole grains in their diet

(grade 8-12 only: 89.9 %).

4. Associated Knowledge Areas

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

Outcome #48

1. Outcome Measures

4-H youth (4th- 12th graders) 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
2016	181

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 700 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: 87.6%), believe being active is fun (grade 4-7 only: 89%), believe being active is good for them (98.3%), 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 (66%), watched one hour or less of TV on an average school day (71.4%), 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: 51%).

4. Associated Knowledge Areas

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

Outcome #49

1. Outcome Measures

4-H youth (4th- 12th graders) 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
2016	112

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 700 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%), ask an adult before taking medicine when they are sick (94%), use pedestrian crossing when crossing the road (88%), tell their friends when they think they are going to do something unsafe (94%), avoid using substances that could harm them (96%), wear a helmet when riding a bike (grade 4-7 only: 80.1%), wear a helmet when they rollerblade or ride a skateboard (grade 4-7 only: 79.2%), wear a helmet when they ride an All-Terrain Vehicle (grade 4-7 only: 86.2%), wear a seatbelt when riding in a car (grade 4-7: 96.7%; grade 8-12: 100%), avoid riding in cars with unsafe drivers (grade 4-7 only: 94.6%) and have not ridden in a car driven by someone who had been drinking alcohol (grade 8-12 only: 75.5%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
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 2016, 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 notable research and extension examples from FY 2016. In addition, under the Federal Planned Programs State Defined Outcomes section, the significant success stories are reported as qualitative outcomes.

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	4%		2%	
201	Plant Genome, Genetics, and Genetic Mechanisms	1%		17%	
202	Plant Genetic Resources	3%		4%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	4%		7%	
204	Plant Product Quality and Utility (Preharvest)	7%		3%	
205	Plant Management Systems	33%		3%	
206	Basic Plant Biology	1%		15%	
212	Pathogens and Nematodes Affecting Plants	2%		7%	
216	Integrated Pest Management Systems	1%		3%	
302	Nutrient Utilization in Animals	2%		4%	
307	Animal Management Systems	9%		1%	
502	New and Improved Food Products	2%		3%	
503	Quality Maintenance in Storing and Marketing Food Products	3%		2%	
601	Economics of Agricultural Production and Farm Management	5%		3%	
603	Market Economics	1%		2%	
604	Marketing and Distribution Practices	3%		1%	
702	Requirements and Function of Nutrients and Other Food Components	0%		6%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	3%		3%	
723	Hazards to Human Health and Safety	1%		7%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	10.7	0.0	17.5	0.0
Actual Paid	15.2	0.0	17.8	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
2782140	0	1854947	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2782140	0	1854947	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
38793538	0	91931266	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 public service announcements (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

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	238181	0	396	0

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

Patent Applications Submitted

Year: 2016

Actual: 8

Patents listed

1. BOVINE MILK OLIGOSACCHARIDES
2. ENZYMES AND METHODS FOR CLEAVING N-GLYCANS FROM GLYCOPROTEINS
3. GAS CHROMOTOGRAPHY RECOMPOSITION-OLFACTOMETRY FOR CHARACTERIZATION OF AROMA MIXTURES
4. SYSTEM AND METHODS FOR MONITORING LEAF TEMPERATURE FOR PREDICTION OF PLANT WATER STATUS
5. PEACH TREE NAMED 'KADER'
6. STRAWBERRY PLANT NAMED 'PETALUMA' ('C231')
7. STRAWBERRY PLANT NAMED 'GRENADA' ('C232')
8. STRAWBERRY PLANT NAMED 'FRONTERAS'

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	88	514	602

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2016	125

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2016	389

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual
2016	64

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2016	18

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2016	38

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2016	256

Output #7

Output Measure

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

Year	Actual
2016	6

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2016	108

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 cultural practices and other 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 cultural practices and other 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 irrigation management and drainage.
11	Farm and landscaping owners/managers and allied industry professionals, participating in the program, gain skills to improve comprehensive management systems for plant production.
12	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.
13	Ranch owners/managers and allied industry professionals, participating in the programs, adopt improvements in aspects of comprehensive management systems animal production.
14	Ranch owners/managers and allied industry professionals, participating in the programs, gain knowledge of aspects of comprehensive management systems for animal production.
15	Farm, ranch and landscaping owners/managers and allied industry professionals, participating in the program, adopt recommended irrigation management practices.
16	Farm owners/managers and allied industry professionals, participating in the programs, are more likely to try out or adopt recommended cultural practices or other aspects of comprehensive management systems for plant production.

17	Farm and landscaping owners/managers and allied industry professionals participating in the program gain knowledge of aspects of plant nutrition management.
18	Ranch owners/managers and allied industry professionals, participating in the program, gain skills to improve comprehensive management systems for animal production.
19	Ranch owners/managers and allied industry professionals, participating in the programs, are more likely to try out or adopt recommended practices or other aspects of comprehensive management systems for animal production.
20	Youth-led urban agriculture tours help youth acquire acquired planning, teamwork, or other life skills, and build stronger relationships between UC ANR, urban farmers and gardeners, and youth leaders.
21	Community Supported Agriculture farms improve their financial situations and diversify their membership.
22	Farm and ranch owners /operators and managers and allied industry professionals, participating in agriculture education programs,were more likely to try out or adopt recommended cultural practices, pest and disease management, or other aspects of comprehensive management systems for plant production.
23	New data informs policy changes that support local producers and generates economic development in their communities.

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
2016	887

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 cultural practices and other 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 cultural practices and other 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
2016	436

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
2016	1202

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.

Not Reporting on this Outcome Measure

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.

Not Reporting on this Outcome Measure

Outcome #10

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 #11

1. Outcome Measures

Farm and landscaping owners/managers and allied industry professionals, participating in the program, gain skills to improve 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
2016	268

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #12

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 #13

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 #14

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 #15

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 #16

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #17

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 #18

1. **Outcome Measures**

Ranch owners/managers and allied industry professionals, participating in the program, gain skills to improve comprehensive management systems for animal production.

Not Reporting on this Outcome Measure

Outcome #19

1. **Outcome Measures**

Ranch owners/managers and allied industry professionals, participating in the programs, are more likely to try out or adopt recommended practices or other aspects of comprehensive management systems for animal production.

Not Reporting on this Outcome Measure

Outcome #20

1. **Outcome Measures**

Youth-led urban agriculture tours help youth acquire acquired planning, teamwork, or other life skills, and build stronger relationships between UC ANR, urban farmers and gardeners, and youth leaders.

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Urban agriculture is the production and distribution of food in urban spaces. It includes a wide range of activities, from backyard and community gardens to non-profit farms to high-tech commercial operations. In addition to food production, goals often include increasing community food security, developing youth leadership, or creating neighborhood green spaces. Urban agriculture is gaining momentum and has been shown to have a wide range of benefits. However,

urban farmers and gardeners face unique challenges, including limited availability of relevant information and technical assistance.

What has been done
An ANR project team led by UCCE partners in Los Angeles and UC's Sustainable Agriculture Research and Education Program (SAREP) in Davis organized a series of youth-led bus tours of urban agriculture sites in Oakland, Berkeley, Sacramento, and Los Angeles. The purpose of the tours was to foster youth leadership and connect urban farms to each other and ANR resources. Each tour was led by a team of youth who shared their perspectives on the benefits and challenges of urban agriculture. Regional ANR community partners attended the tours and helped provide pre-tour training during which, youth learned about storytelling and public speaking and had a chance to plan and practice their tours. A curriculum was developed based on the training, and two videos were produced featuring youth voices in urban agriculture across California. The videos can be found on the SAREP website: http://asi.ucdavis.edu/programs/sarep/research-initiatives/fs/supply/urban-agriculture

Results
The major impacts of this project were youth leadership development and increased connections between UC ANR and urban farmers. Youth tour leaders reported increased knowledge about storytelling, speaking in public, talking about their gardens, and planning a tour. The majority of UC ANR tour participants (93%) reported that the tours increased their capacity to serve the needs of urban farmers and gardeners in California, and 81% of non-ANR tour attendees reported that they are now more likely to reach out to UC ANR for support in the future. One community partner has already reached out to UC to explore opportunities for a more formal partnership. Additionally, the tours resulted in a deeper understanding of the impacts of social and racial injustices in urban communities (especially among youth), which is helping inform the development of the strategic social equity goals at SAREP and the UC Davis Agricultural Sustainability Institute.

4. Associated Knowledge Areas

KA Code	Knowledge Area
604	Marketing and Distribution Practices

Outcome #21

1. Outcome Measures

Community Supported Agriculture farms improve their financial situations and diversify their membership.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Community Supported Agriculture (CSA) is a relatively new type of direct marketing relationship in which consumers become members of a local farm and commit to supporting the farm and its operators. CSA is an increasingly important market channel for medium- and small-scale farms in California. Little is known about what contributes to the success of CSAs and what continues to challenge them. Greater understanding is needed about the strategies used by those CSAs that reach a broad membership base in terms of income, race/ethnicity, and geographic regions. Furthermore, high CSA membership turnover rates are a major problem facing CSA farmers; thus, information about what contributes to high and low turnover rates is needed.

What has been done
UC ANR funded research investigated many aspects of the experiences of CSA farmers and CSA members. The study focused on a number of questions including: What factors help CSAs succeed? What are the socio-economic and demographic characteristics of CSA members compared to former members and the general population? What strategies can CSA farmers use to improve their incomes and expand their member base, including historically underrepresented groups? The research team conducted four large surveys of 111 CSA farmers, 1,149 current CSA members, 409 former CSA members, and 1,283 household grocery purchasers throughout the state, and has used qualitative methods to understand the relationships between farms and their members for 20 CSAs around the state. The team shared the results of the surveys through presentations and workshops, factsheets and a website.

Results
Workshop participants indicated that they found the data informative, and intended to use it to influence changes to their CSA. Farmers that have already used the data have reported economic improvements to their businesses. For example, one CSA farm diversified their marketing channels and as a result improved the farm's financial situation. Importantly, the data showed that CSA members with very modest incomes of $25,000-$35,000 were willing to pay the most for their CSA share, and were very committed CSE members. This data paired with a presentation explaining how to become a vendor that accepts payment with Supplemental Nutrition Assistance Program Electronic Benefit Transfer cards (EBT), convinced many farmers to become an EBT-accepting vendor. Additionally, the study can provide much-needed information to state policymakers and small farm advocates about CSA in California since state legislators recently approved new statewide rules pertinent to direct marketing and CSA.

4. Associated Knowledge Areas

KA Code	Knowledge Area
604	Marketing and Distribution Practices

Outcome #22

1. Outcome Measures

Farm and ranch owners /operators and managers and allied industry professionals, participating in agriculture education programs,were more likely to try out or adopt recommended cultural practices, pest and disease management, or other 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
2016	91

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #23

1. Outcome Measures

New data informs policy changes that support local producers and generates economic development in their communities.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growing interest in local foods has raised questions about the extent that local and regional food systems promote regional economic development. For example, many restaurants and grocers in the Sacramento Region of California feature fruit, vegetables, and meats on their menus that is produced locally by small- and mid-scale farms and ranches. In 2012, there were over 5,000 farmers and ranchers in the region who sold some or all of their production direct to consumers, called direct marketing. However, there is a lack of data to guide public policy for food system interventions because traditional economic impact studies do not differentiate between farm size or whether they sell locally, or wholesale across the country.

What has been done
A UCCE team interviewed 110 farmers and ranchers in the Sacramento Region about their purchasing and marketing practices. The team collected data about purchases of inputs such as fuel, packaging materials, and labor, and services such as insurance and bookkeeping, as well as the revenues generated from selling their products both direct to consumers and through other channels. Additionally, the team interviewed 50 community organization leaders to assess their perceptions about the impacts of local food systems in their communities. The quantitative data has been presented to organizations such as the California Food Policy Council and the Association for Local Economic Development. The region's direct marketers purchased eighty-nine percent of their inputs within the region.

Results
The team was able to share key knowledge gained about the impact being created in the Sacramento region. For example, the direct marketers purchase eighty-nine percent of their inputs within the region, and for every dollar of sales, they are generating twice as much regional economic activity compared to producers not involved in direct marketing. The team's findings were included in testimony during a State Senate Budget Committee hearing on nutrition incentives. The outcome of the hearing was a new program that incentivizes low-income shoppers to shop at local farmers markets by providing them with a discount on fresh produce. Additional policy changes, such as increased support for local food marketing through changes in land-use policies, allowing for farm-stands and other forms of direct marketing, and support for small-scale aggregation and processing facilities, are expected after reports are presented to County Boards of Supervisors.

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 2016, 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 notable research and extension examples from FY 2016. In addition, under the Federal Planned Programs State Defined Outcomes section, the significant success stories are reported as qualitative outcomes.

V(A). Planned Program (Summary)

Program # 3

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%	
111	Conservation and Efficient Use of Water	0%		1%	
123	Management and Sustainability of Forest Resources	1%		1%	
135	Aquatic and Terrestrial Wildlife	2%		3%	
136	Conservation of Biological Diversity	1%		2%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		2%	
206	Basic Plant Biology	1%		1%	
211	Insects, Mites, and Other Arthropods Affecting Plants	16%		13%	
212	Pathogens and Nematodes Affecting Plants	20%		32%	
213	Weeds Affecting Plants	13%		2%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants	3%		0%	
215	Biological Control of Pests Affecting Plants	4%		16%	
216	Integrated Pest Management Systems	35%		10%	
305	Animal Physiological Processes	0%		3%	
311	Animal Diseases	0%		3%	
312	External Parasites and Pests of Animals	1%		3%	
503	Quality Maintenance in Storing and Marketing Food Products	0%		1%	
721	Insects and Other Pests Affecting Humans	2%		3%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%		2%	
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: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	7.2	0.0	9.7	0.0
Actual Paid	7.9	0.0	11.8	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**
1533014	0	1184624	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1533014	0	1184624	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
24513461	0	65699267	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 public service announcements (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

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	98678	0	0	0

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

Patent Applications Submitted

Year: 2016

Actual: 6

Patents listed

1.ACYL PIPERIDINE INHIBITORS OF SOLUBLE EPOXIDE HYDROLASE
2.FUNGI ANTAGONISTIC TO XYLELLA FASTIDIOSA
3.IDENTIFICATION OF SECRETED PROTEINS AS DETECTION MARKERS FOR CITRUS DISEASE
4.MOLECULES THAT INDUCE DISEASE RESISTANCE AND IMPROVE GROWTH IN PLANTS
5.PREDICTING LIGANDS FOR ODOR RECEPTORS AND OLFACTORY NEURONS USING CHEMICAL INFORMATICS
6.METHODS OF DIAGNOSING AND TREATING NEONATAL REVERSION TO FETAL CONSCIOUSNESS

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	243	343	586

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2016	85

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2016	55

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual
2016	10

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2016	22

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2016	40

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2016	194

Output #7

Output Measure

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

Year	Actual
2016	15

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2016	60

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	City of Irvine adopts new Integrated Pest Management policy solving pest problems while minimizing risks to people and the environment.
13	Improved management of Lygus bugs has reduced unnecessary insecticide applications reducing risk to crops and the environment.
14	New Integrated Pest Management strategies show potential to reduce chemical pesticide applications in strawberry, while solving pest problems and minimizing risks to people and the environment
15	UC IPM led a collaborative effort to develop chlorpyrifos guidelines that have informed pesticide policy makers.

16	New UC IPM decision-making tool and training increased growers' and pest control advisers' awareness of the importance of using chlorpyrifos only when necessary and of alternative practices.
17	A UC collaboratively developed, science-based response plan contributed to the eradication of European grapevine moth.
18	A UC ANR collaborative project reduces incidence of bed bug infestation in low-income housing complexes.
19	Research and extension increased coordination and communication on the emerging zoonotic disease West Nile Virus.

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
2016	893

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
2016	839

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
2016	531

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
2016	293

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

Outcome #12

1. Outcome Measures

City of Irvine adopts new Integrated Pest Management policy solving pest problems while minimizing risks to people and the environment.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Integrated pest management (IPM) in non-agricultural areas such as residential, commercial areas including schools and parks, and structural locations is becoming increasingly important as California's population grows. Pesticides used by both commercial and non-commercial applicators can impact water quality in local watersheds resulting in loss of use of their water bodies. Additionally, widespread use of pesticides can impact public health and disrupt naturally occurring pest management systems.

What has been done
At the request of the City of Irvine's Landscape Department, UCCE Advisors Cheryl Wilen and Darren Haver reviewed and revised the city's Integrated Pest Management Plan. This review was driven by community members' request to the City Council to reduce the amount of synthetic pesticides used by the city. Wilen and Haver provided input and revision to the new policy and Wilen attended the City Council meeting to provide technical support.

Results
The City of Irvine's new IPM policy was adopted 5-0 and put in place immediately on February, 23, 2016. The new policy includes a prioritization process when pesticides are used as part of the IPM Program. While the policy does not prohibit the use of synthetic pesticides, organic pesticides are used first and as long as they are effective managing pests to meet city's standards they are used. The guiding principles are to: emphasize use of effective organic pesticides in and on all city properties whenever practical; limit pesticides exposure to where children and the general public congregate; and use EPA Level III, II, or in extreme circumstances Level I pesticides in a targeted manner and only if deemed necessary to protect public health and economic impact, by a licensed pest control adviser and city staff, when pests cannot be managed by other methods. As a result, the amount of synthetic pesticides has been reduced. Organic herbicides are being

used where appropriate and mowing and hand-weeding used for larger areas. The city has implemented IPM by increasing monitoring and improved plant selection to minimize pest establishment. All 6700 acres of city's parks, open space, and streetscapes are affected by the IPM plan which approaches solving pest problems while minimizing risks to people (over 250,000 people live in Irvine) and the environment.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #13

1. Outcome Measures

Improved management of Lygus bugs has reduced unnecessary insecticide applications reducing risk to crops and the environment.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Tulare Lake Bottom is an area in Kings County, California that produces a variety of row, field, and vegetable crops. Crop rotations of safflower, cotton, and tomato are essential in maintaining soil quality and managing ground water issues. In the westside of Fresno and Kings Counties, major changes to cropping landscape took place in a single year. The shift to safflower overwhelmed the landscape and resulted in a breakdown of expected patterns of insect migration. In order to improve Integrated Pest Management (IPM), the management of key pests such as Lygus bugs must be considered at a larger and wider level then individual fields and farms.

What has been done
A UCCE advisor designed several projects to evaluate the source and sink relationships of crops surrounding susceptible fields to Lygus pest management. UCCE facilitated local participatory meetings to help inform growers and Pest Control Advisors (PCAs) of the situation. Educational outreach provided principles to situate crops in patterns which reduce the threat of Lygus

movement between crops within this mixed cropping landscape as well as manage pests within crop sources to prevent movement into susceptible crops.

Results
By applying the knowledge gained from these participatory group meetings, local research, and individual consultations, this community developed and adopted good management practices to mitigate Lygus bug movement. Specifically, focusing on the neighboring sources of the pest reduced the need to treat the primary focus crop because the pest never migrated. Twenty growers and PCAs now employ best management IPM practices to control Lygus bugs, within the constraints of crop rotations for soil health and ground water protection. The understanding of landscape level management has substantially improved the situation in managing Lygus bugs, reducing unnecessary insecticide applications and reduced risk to the cotton crop and environment.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #14

1. Outcome Measures

New Integrated Pest Management strategies show potential to reduce chemical pesticide applications in strawberry, while solving pest problems and minimizing risks to people and the environment

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Strawberry is the 5th most important agriculture commodity in California, contributing to 88% of the fresh strawberries produced in the U.S. (USDA-NASS, 2015). According to California Department of Food and Agriculture's Pesticide Use Report (2014), more than 200,000 pounds of chemical insecticide and miticide were used on strawberries in 2012. Arthropod pests such as lygus bug, western flower thrips, two-spotted spider mite, and the greenhouse whitefly are among

the important targets that require a significant amount of pesticide applications. Non-chemical alternatives are generally perceived to be less effective, and some of them are limited to organic agriculture. However, developing an effective strategy to balance the use of chemical and non-chemical alternatives without compromising the efficacy is essential.

What has been done
A UCCE Advisor for strawberry and vegetable crops led large-scale field studies to evaluate the potential of integrating botanical and microbial pesticides with current pest management practices to develop environmentally sustainable pest management strategies. The studies were carried out on commercial strawberry fields at Manzanita, Goodwin, and Sundance Berry Farms in Santa Maria from 2012 to 2015. The results of the studies demonstrate that existing and new chemistries, as well as combinations of botanical and microbial control options, are available and effective. The rotational programs in 2013/2015 tested 33 different treatment options.

Results
While some treatment options were more effective than others at reducing pest populations, the results demonstrate that incorporating non-chemical alternatives can have a significant impact. It was possible to reduce the number of chemical insecticide applications, and lower rates of chemical pesticides to reduce pests, while helping manage insect resistance to pesticides. These results also show potential for non-chemical alternatives beyond organic agriculture and their potential in conventional cropping systems. Incorporating these alternatives into an integrated pest management strategy reduces the reliance on effective chemical pesticides, which could become ineffective if overused.

4. Associated Knowledge Areas

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

Outcome #15

1. Outcome Measures

UC IPM led a collaborative effort to develop chlorpyrifos guidelines that have informed pesticide policy makers.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2016 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Combined, alfalfa, almond, citrus and cotton represent a value of over $10 billion, and are grown on 2.5 million acres of farmland. Chlorpyrifos is an agricultural insecticide used in these crops as well as other food, fiber, and forage crops in California. Chlorpyrifos is an important tool against invasive pests and endemic pest outbreaks due to its efficacy, value as a resistance management tool, and established international registration status for exporting agricultural commodities. Currently, there are ongoing evaluations at the state and national levels to assess potential human and environmental health risks from chlorpyrifos and to consider what, if any, regulatory actions on chlorpyrifos might provide further safeguards up to and including full cancellation of the registration. The results of the safeguards could change the use of chlorpyrifos, including increased use restrictions and could impact many well-established IPM programs previously developed by UCCE scientists.

What has been done

To equip California?s pesticide regulatory scientists with a comprehensive understanding of chlorpyrifos use in alfalfa, almond, citrus, and cotton, UC Statewide Integrated Pest Management Program (UC IPM) convened industry leaders to create commodity-specific guidelines regarding chlorpyrifos use. The commodity-specific crop teams included commodity representatives, UCCE, pest control advisers (PCAs), growers, and project staff from the California Department of Pesticide Regulation (DPR) and UC IPM. The goal of the crop teams was to characterize the most critical uses of chlorpyrifos in each crop -- determining key pests for which there are no or few alternatives and where chlorpyrifos plays a unique and necessary role in an IPM program. Other pest management methods, such as cultural control, biological control, and other insecticides were also noted. This information was specifically gathered in order to develop informed mitigation and prevention approaches where needed. The full report of these discussions is in Identifying and Managing Critical Uses of Chlorpyrifos in Alfalfa, Almonds, Citrus, and Cotton online at http://ipm.ucanr.edu/IPMPROJECT/CDPR_Chlorpyrifos_critical_use_report.pdf.

Results

This project served as a model to gather stakeholder input to identify and understand critical pest control tools in IPM and develop solutions. A better understanding of grower and PCA needs has informed pesticide policy makers about their development of prevention and mitigation tactics to protect human and environmental health while ensuring the protection of California's agriculture. DPR, California Department of Food and Agriculture, the U.S Environmental Protection Agency, and the cotton, almond, and alfalfa commodity boards have adopted several approaches identified by UC IPM during this project. Specifically they now convene industry stakeholders to review the current status of IPM on pest management tools, develop a critical use matrix to identify where gaps in management might occur, and take IPM alternatives into consideration when reviewing regulatory actions.

4. Associated Knowledge Areas

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

Outcome #16

1. Outcome Measures

New UC IPM decision-making tool and training increased growers' and pest control advisers' awareness of the importance of using chlorpyrifos only when necessary and of alternative practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Chlorpyrifos is an important insecticide in IPM programs for alfalfa, almond, citrus, and cotton due to its efficacy, value as a resistance management tool, and established international registration status. Public health and environmental concerns about chlorpyrifos resulted in an ongoing evaluation about its use in agriculture. Regulatory safeguards could include changes in use, up to and including full cancellation of registration. Crop teams, made up of industry leaders, agreed that stewardship and education are needed to ensure the safe and effective use of chlorpyrifos. Additionally, decision support tools are needed to enable pest control advisers (PCAs) and growers to recognize when chlorpyrifos use is necessary and justified. The new generation of PCAs coming into the field provides an excellent opportunity to train emerging professionals about chlorpyrifos use.

What has been done
UCCE developed an online IPM decision-support tool that mines information from the UC IPM Pest Management Guidelines. The tool presents management options for multiple pests in cotton, citrus, alfalfa, and almond. The tool guides PCAs and growers in thinking through pest control decision-making and lists alternatives and mitigation for those pests. A report documents the decision-making process, which can serve as an IPM plan for the farm. In addition to developing the online tool, UCCE held thirteen IPM training sessions throughout the state from El Centro to Yreka. Sessions were led by local farm advisors, UC IPM staff, and representatives from the Department of Pesticide Regulation, Natural Resources Conservation Services, and county agricultural commissioner offices. The training featured updated UC IPM Pest Management Guidelines, decision-support tool training, and information about chlorpyrifos.

Results

Through industry and regulator meetings, over 1700 people were educated about chlorpyrifos and the decision-support tool. Conversations with multiple participants indicated a positive response to the tool, as well as an expression of intent to use it. From October 2015 to August 2016 the tool received 6,038 page views, and 874 users went to the final report page, spending an average of 2 minutes on the report. Increased understanding by UCCE advisors of these grower and PCA situations strengthened the University's guidelines for managing pests and formulated better IPM training for this important clientele. The project created a truly innovative mobile-friendly tool that allows access to science-based information to support management decisions. Training increased grower and PCA awareness of alternative practices and the importance of using chlorpyrifos only when necessary. We anticipate that use of the tool will result in an increase in big picture considerations when managing a crop and could result in less pesticide use.

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

A UC collaboratively developed, science-based response plan contributed to the eradication of European grapevine moth.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

European grapevine moth (EGVM), Lobesia botrana, considered the most important insect pest of grape in Europe and the Middle East, was first detected in Napa Valley in 2009. The immature stages injure the berry, promoting the development of fungal infections that result in bunch rots. While moth populations were largest in Napa County, by 2011 the moth had also been found in nine other counties as far south as Fresno. If the moth became established it could increase production costs in all grape growing regions, result in economically damaging export restrictions on table grapes, and cause adverse environmental effects if it led to a greater reliance on

insecticides. In 2010, the US and California Departments of Agriculture began an eradication program to keep this insect from becoming established.

What has been done
UC ANR academics responded rapidly, working with public and private partners and international scientists to develop a pest management program that relied on a dual approach of deploying pheromone dispensers to disrupt mating and application of carefully-timed insecticides. In late 2009, UC scientists published an extensive literature review describing the current knowledge of life cycle and management on the UC IPM Exotic and Invasive Pests webpage. Next, UC scientists mounted a multi-pronged research program to study the biology, life cycle, host range, and management practices under California conditions. Growers used the information gathered by the UC scientists to monitor and control the pest, and regulators used it to formulate EGVM detection and dispersal regulations. Results demonstrated that low-toxicity conventional and organic insecticides gave excellent control without disrupting the natural biological controls for other grapevine pests, avoiding secondary pest outbreaks. This strategy allowed grape growers to continue to produce a competitive crop under quarantine restrictions. Information generated from field observations, and research trials was reported weekly or semiweekly through UCCE Napa County EGVM newsletter. A summary of the program was published in California Agriculture October/December 2014 issue.

Results
This multi-agency collaboration contributed to a successful science-based response plan to a serious pest threat. Over the span of seven years, the dual pest management approach was implemented, and EGVM detections declined from over 100,000 moths in 2010 to one moth in 2014 and none in 2015 or 2016. Subsequently, all previous 10 California infested counties have been deregulated, and EGVM declared eradicated from California and the United States. Lifting quarantine restrictions from table grape production areas enhanced the industry's ability to export its product and preserved community economic wellbeing.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #18

1. Outcome Measures

A UC ANR collaborative project reduces incidence of bed bug infestation in low-income housing complexes.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Bed bugs, their bites, and the associated social stigma continue to plague many Californians and draw widespread attention from the media. Although bed bugs can occur within a wide range of human habitations and income-levels, it is those who live in low-income, multiple-occupancy housing who appear to suffer the greatest. Integrated Pest Management (IPM), first developed by UC in the 1940s for agriculture, offers a theoretical framework for bed bug management in multiple-occupancy housing.

What has been done
Scientists from UC ANR and several other UC campuses collaborated with pest management professionals (PMPs) from three pest control companies. A two-pronged research approach was used, involving assessment of stakeholder needs followed by field demonstrations of IPM programs for bed bugs. First, surveys of PMPs and housing management professionals were conducted statewide to document attitudes, behaviors, and cognition about bed bugs, and to better understand common management strategies and potential IPM approaches. For the field demonstration part of the study, the target settings were three low-income, multiple-occupancy housing complexes. Classic components of IPM (monitoring, a combination of treatment techniques, and resident education programs) were featured and showcased by each participating PMP.

Results
Statewide surveys revealed that complaint-based services, visual searches, and heavy reliance on insecticides were the predominant aspects of management efforts directed at bed bugs prior to the IPM demonstrations. Findings from UC's efficacy tests showed a substantial reduction in the incidence of bed bug infestations ranging from 29 - 88%, as compared to levels before the demonstrations. Residents reported overall satisfaction with the IPM programs, with about two-thirds (68%) reporting they were "more satisfied" with bed bug control in their communities than before the one-year demonstrations. Common themes noted throughout the project were the need for proactive monitoring, regular surveillance, and teamwork by the PMPs, managers, and residents for bed bug IPM to be effective. Additional collaborative team projects, research, and a policy process directed at public and low-income housing facilities will be needed to fine-tune bed bug IPM models so that it will be financially sustainable while significantly reducing infestation levels and the amounts of pesticides used.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems
721	Insects and Other Pests Affecting Humans

Outcome #19

1. Outcome Measures

Research and extension increased coordination and communication on the emerging zoonotic disease West Nile Virus.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
West Nile virus (WNV) is a mosquito-borne disease that is the leading cause of viral encephalitis in the United States. Crows are extremely susceptible to WNV and they are known to pass the virus from bird to bird without mosquito vectors. Migratory crows might also act as transport hosts, introducing new strains of WNV to California, potentially with a different degree of virulence from other states. In recent years, WNV has unexpectedly resurged to outbreak levels in California. The reasons for these outbreaks are unclear. In particular, we have yet to identify the mechanisms by which the virus persists over winter, when mosquitoes are inactive. Identification of this mechanism could allow us to implement targeted, early-season intervention strategies aimed at stopping the virus before it amplifies and affects human health.

What has been done
UC ANR academics examined the role of large, urban crow roosts in the overwinter maintenance and amplification of WNV. Over the past two years, scientists investigated the prevalence and mechanisms of viral transmission in overwinter crow roosts. Through a combination of satellite telemetry and viral sequence data, scientists examined the extent to which migrants introduce novel strains of WNV and other diseases. Simultaneously, they examined the potential role of crows as transport vectors of food-borne pathogens, particularly Campylobacter jejuni, of special concern in California. Data from this work was presented at several conferences to representatives of mosquito and vector control agencies in California.

Results
The data disseminated as a result of this research has already led to increased communication and coordination. After the presentations the vector control districts recognized the value of sending mosquito pools to UC Davis to improve the understanding of WNV evolution at a statewide level. One county submitted a WNV isolate from a human case to UC for processing.

Additionally, the Vector Disease and Diagnostic Laboratory in another county contacted the researchers about sequencing WNV from their region to understand the viral genetic changes. The researchers will either conduct the sequencing or train the county staff to do the sequencing themselves. Finally, the results will be used to inform continually evolving and highly pro-active mosquito control strategies in California.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
312	External Parasites and Pests of Animals
722	Zoonotic Diseases and Parasites Affecting Humans
723	Hazards to Human Health and Safety

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 2016, 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 notable research and extension examples from FY 2016. In addition, under the Federal Planned Programs State Defined Outcomes section, the significant success stories are reported as qualitative outcomes.

V(A). Planned Program (Summary)

Program # 4

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	2%		7%	
102	Soil, Plant, Water, Nutrient Relationships	4%		9%	
111	Conservation and Efficient Use of Water	7%		2%	
112	Watershed Protection and Management	7%		3%	
121	Management of Range Resources	19%		4%	
122	Management and Control of Forest and Range Fires	4%		1%	
123	Management and Sustainability of Forest Resources	17%		2%	
131	Alternative Uses of Land	3%		2%	
132	Weather and Climate	1%		6%	
133	Pollution Prevention and Mitigation	3%		7%	
135	Aquatic and Terrestrial Wildlife	3%		8%	
136	Conservation of Biological Diversity	11%		10%	
141	Air Resource Protection and Management	5%		6%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		4%	
212	Pathogens and Nematodes Affecting Plants	0%		3%	
305	Animal Physiological Processes	0%		4%	
311	Animal Diseases	0%		4%	
605	Natural Resource and Environmental Economics	4%		10%	
610	Domestic Policy Analysis	1%		7%	
903	Communication, Education, and Information Delivery	9%		1%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	7.9	0.0	9.1	0.0
Actual Paid	9.2	0.0	6.4	0.0
Actual Volunteer	3.2	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**
1469350	0	936117	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1469350	0	936117	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
11416016	0	57205853	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 public service announcements (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

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	58607	0	0	0

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

Patent Applications Submitted

Year: 2016

Actual: 4

Patents listed

1.Microbial Metabolism of Chlorine Oxyanions as a Control of Biogenic Hydrogen Sulfide Production
2.Transcription Factors for Cellulosic Enzyme Production
3.CONTROL OF PLANT STRESS TOLERANCE, WATER USE EFFICIENCY AND GENE EXPRESSION USING NOVEL ABA RECEPTOR PROTEINS
4.SYNTHETIC COMPOUNDS FOR VEGETATIVE ABA RESPONSES

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	49	324	373

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2016	27

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2016	26

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual
2016	4

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2016	1

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2016	15

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2016	134

Output #7

Output Measure

- Videos, Slide Sets and Other AV or Digital Media Educational Products Created
  Not reporting on this Output for this Annual Report

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2016	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Farm, ranch, private and public forest and wildland owners/mangers, participating in natural resource management programs, gain knowledge of strategies and techniques for sustainable use of natural resources.
2	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.
3	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.
4	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.
5	Ranch and private and public rangeland owners/managers, participating in the programs, adopt recommended techniques for rangeland monitoring and management, and grazing and browsing.
6	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.
7	Forest landowners and agency personnel gain knowledge of management and sustainability for forest resources.
8	Rangeland Summit leads to greater interest in planning, collaboration, and use of livestock grazing as a pre-fire management tool to reduce wildfire severity.
9	Sierra Nevada forest inventory data research is being applied for forest management plans.
10	Park districts and public landowners gained awareness and communicated the value of working landscapes, and two parks reintroduced grazing.
11	California's niche hog producers gain knowledge of business and conservation management practices in an emerging market.
12	UCCE rangeland monitoring template helps public land cattle ranchers more easily and consistently meeting required grazing standards.
13	Participants including land managers and other decision -makers, in sustainable use of natural resources education programs, are more likely to use recommended practices for sustainable use of natural resources.

Outcome #1

1. Outcome Measures

Farm, ranch, private and public forest and wildland 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
2016	314

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 #2

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 #3

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 #4

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
2016	144

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 #5

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 #6

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 #7

1. **Outcome Measures**

Forest landowners and agency personnel gain knowledge of management and sustainability for forest resources.

Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

Rangeland Summit leads to greater interest in planning, collaboration, and use of livestock grazing as a pre-fire management tool to reduce wildfire severity.

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The increase in catastrophic wildfires in recent years has posed significant challenges to land managers and ranchers alike. Unfortunately, severe wildfires on public and private land can reduce the size of a herd, reduce foraging areas, destroy infrastructure and may eliminate future grazing use especially on public lands. Each of these losses leads to challenging management decisions for ranchers and can add substantial costs to their operations. However, opportunities exist for land managers and ranchers to work together on pre- and post-wildfire strategies.

What has been done
In January 2016, UCCE teamed up with the California Rangeland Conservation Coalition (CRCC) to host the 2016 Rangeland Summit for 300 ranchers, land managers, students, and nongovernmental organizations. Nearly half of the participants oversee more than 10,000 acres of rangeland. Sixty-five percent of the participants have had direct experience with rangeland wildfire and suffered loss of livestock, forage area, and future use of a public land grazing leases as a result. Speakers from UCCE, the California Cattleman's Association, CalFire, and local ranchers discussed the interaction between private and public lands, as well as the economic and management impacts of wildfires. Presenters identified prevention and preparation strategies, such as reducing understory vegetation, increasing firebreaks, and grading roads, as well as mapping roads and water sources and keeping water tanks full. Videos of each presentation are available here: http://ucanr.edu/2016summit.

Results
Survey results indicate that the Summit led to a better understanding of the relationship between private and public lands, the economic impacts faced by ranchers, as well as the barriers that limit agencies' ability to reduce wildfire impact. As a result of the Summit, there is greater interest in planning, collaboration, and use of livestock grazing. Attendees agreed that livestock grazing is valuable as a pre-fire management tool to reduce wildfire severity. Also, participants identified opportunities for collaboration, such as coordinating emergency response within and between agencies and ranchers; working more closely with fire departments; and explaining how local ranchers can help when fires occur. One rancher has already reached out to his UCCE advisor to create a communication and response plan with CalFire. Participants and presenters agree that more research is needed to help understand the impact of post-fire grazing, the value of different livestock species on fuel reduction, and ecological effects of grazing and long-term rest.

4. Associated Knowledge Areas

KA Code	Knowledge Area
122	Management and Control of Forest and Range Fires

Outcome #9

1. Outcome Measures

Sierra Nevada forest inventory data research is being applied for forest management plans.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Accurate historical characterizations of fire-frequent conifer forests are important to understanding contemporary conditions resulting from past forest management practices. However, historical data sets are often incomplete and highly localized, resulting in imperfect characterizations. Large areas (~16,000 ha) in the central Sierra Nevada were inventoried in 1911, and relocated and re-sampled approximately 100 years later following divergent management programs (widespread harvesting and fire suppression) and wildfire. This enables an unprecedented comparison of forest structure, species composition, regeneration, and fire effects. The present day forest is substantially altered compared to the 1911 forests, which had a lower density of trees and more variety. The changes can be largely attributed to the management practice of fire suppression and past logging. Fire, a key ecosystem process, frequently occurred in the study area until 1899.

What has been done
Researchers located 294 inventoried areas across 16,000 ha of forest and field crews established a network of 246 permanent plots within the areas. Supported by many field technicians, forest and fire science researchers, and collaborators over the years, a network of forest inventory plots and a database has been established from our ongoing work and is well suited for long-term studies. The 2013 Rim Fire occurred during the study period, and data was collected before and after the fire. We have already engaged with Federal agencies (USFS and NPS), forest managers, researchers, and the public regarding our results. As a result of our extension and social media, we have been contacted by dozens of managers, private landowners, environmental groups, and federal agencies to discuss our work. Our published papers are already being cited and will continue to be useful to those creating management plans to restore mixed conifer forests in the Sierra Nevada and elsewhere in California.

Results
Our network of inventory plots, with repeated measurements contrasting a century of different management strategies, is providing and will continue to provide robust information on forest ecology to supplement the USFS in their Forest Plan revisions in the Sierra Nevada. Some data is already being used for the USFS Forest Plan Amendment. Discussions with the public and other interested groups will foster additional research, which can build consensus on desired goals for forest restoration in the next several decades. Additionally, future inventories will provide insights on what impacts the 2013 Rim Fire had on mixed conifer forests in the Sierra Nevada.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #10

1. Outcome Measures

Park districts and public landowners gained awareness and communicated the value of working landscapes, and two parks reintroduced grazing.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Cattle grazing is the most substantial use of protected open space in the San Francisco Bay Area (Bay Area) and across California. Cattle grazing provides support to raise beef cattle for meat and other by-products and provides additional ecosystem services including vegetation and watershed management; fire fuel control; and, increasingly, management of habitat of rare and endangered species. These working ranches also contribute over $132 million per year to the regional economy and represent the third-highest value agricultural commodity in the region. Over 25 different public entities in the Bay Area, with a combined total of 2.5 million visitors, manage their open space lands with livestock grazing. However, decision- makers and the public have little knowledge of animal agriculture production or the ecosystems services provided by the livestock.

What has been done
To increase awareness and knowledge of working rangelands and ecosystem services, UCCE worked in cooperation with several regional park districts to develop an ecosystem service curriculum. The project leaders trained 127 park manager or interpreters, and provided them with a book of fact sheets focused on "Understanding Working Rangelands". Additionally, a set of three interpretive signs on "Why Cows?", "California Grazing", and "Sharing the Lands" will be installed on three regional trails.

Results

Providing comprehensive, research-based information that promotes animal agriculture literacy is a first step to educating park users, the public, and decision-makers on the importance of grazing as a tool in urban and suburban societies and is a key to keeping our rangelands working. Prior to the start of this project, park staff and interpreters had been reluctant to talk to the public and park users about their grazing programs. Additionally, grazing livestock had been removed from some parks because of conflict with park users. As a result of the project, six Park Districts/Public Landowners have begun to communicate the value of working rangelands via signage, brochures, and interpretative programs. Two parks have reintroduced grazing and are now proactively informing park users how to share open space with grazing animals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources

Outcome #11

1. Outcome Measures

California's niche hog producers gain knowledge of business and conservation management practices in an emerging market.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Outdoor hog production (commonly misnamed as "Pasture Pork") is an excellent opportunity for new and beginning ranchers to produce a desired niche market. However, since hogs cannot meet their nutritional needs on a pasture, and can be destructive due to their natural rooting behaviors, information is needed to ensure that ranchers can provide a healthy product and safeguard natural resources. There is information available for hog production in confinement, but there was a lack of information for outdoor hog production and a need from ranchers asking for help.

What has been done
UCCE Livestock and Natural Resource Advisors collaborated with the Alameda County Resource

Conservation District?s Beginning Farmer and Rancher Program and Cooperative Extension hog specialist in North Carolina to develop a resource guide for outdoor hog production in Northern California. The guide was developed after conducting an assessment of 10 different outdoor and alternative hog production sites in the region in 2013 and 2014. The resource guide was also used to educate Natural Resources Conservation Service (NRCS), employees about practices compatible with outdoor hog production, which helps develop a plan for cost share opportunities under the Environmental Quality Incentive Program. Additionally, advisors hosted field days for ranchers which included opportunities for attendees to network amongst each other and ask questions of Advisors and NRCS staff.

Results

There has been an increase in outdoor hog producers since beginning this project. New producers have benefited from networking with current producers who have made changes in management (location of feeding, improved pasture planting, rotating hogs, etc.) as a result of the Field Days and Resource Guide. One rancher noted that the guide "made available all of the information that I would need to create a feasible business plan: site planning, pasture and riparian management, farrowing practices, conservation practices, multi-species grazing systems, vegetation consumption and more. I now have a network of experts available to me [to help] with any questions that are raised in the future." UCCE Advisors expect to see more conservation projects, which safeguard natural resources and provide an economic benefit to producers as a result of the guide.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
131	Alternative Uses of Land

Outcome #12

1. Outcome Measures

UCCE rangeland monitoring template helps public land cattle ranchers more easily and consistently meeting required grazing standards.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Rangeland monitoring is a critical evaluation tool of management, but is generally not done well enough, consistent enough or with credibility to satisfy stakeholders and users of public rangelands. There is a need to teach and help implement effective rangeland monitoring in the intermountain region of northeastern California and the Sierra Nevada.

What has been done
UCCE Advisors and Specialists worked together to conduct a collaborative rangeland monitoring research project in Lassen and Modoc Counties to measure annual grazing use to correlate with existing rangeland trend data. The monitoring methods findings were shared with US Forest Service and livestock grazing permittees as a template for the required grazing standards monitoring.

Results
Public land cattle ranchers more easily and consistently met required grazing standards on the Lassen National Forest in 2016 season, as determined through observation and the data collected at 17 sampling locations on the Lassen National Forest. The expected long-term impact is the sustained meadow and rangeland function and ecosystem health along with economically viable ranches dependent on public land grazing.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources

Outcome #13

1. Outcome Measures

Participants including land managers and other decision -makers, in sustainable use of natural resources education programs, are more likely to use recommended practices 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
2016	418

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
121	Management of Range Resources

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 2016, 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 notable research and extension examples from FY 2016. In addition, under the Federal Planned Programs State Defined Outcomes section, the significant success stories are reported as qualitative outcomes.

V(A). Planned Program (Summary)

Program # 5

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%		22%	
103	Management of Saline and Sodic Soils and Salinity	7%		1%	
104	Protect Soil from Harmful Effects of Natural Elements	0%		2%	
111	Conservation and Efficient Use of Water	32%		13%	
112	Watershed Protection and Management	29%		16%	
122	Management and Control of Forest and Range Fires	0%		1%	
123	Management and Sustainability of Forest Resources	0%		1%	
124	Urban Forestry	2%		0%	
131	Alternative Uses of Land	0%		2%	
132	Weather and Climate	0%		7%	
133	Pollution Prevention and Mitigation	19%		14%	
135	Aquatic and Terrestrial Wildlife	0%		3%	
202	Plant Genetic Resources	0%		4%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		2%	
205	Plant Management Systems	1%		4%	
206	Basic Plant Biology	0%		3%	
403	Waste Disposal, Recycling, and Reuse	3%		0%	
405	Drainage and Irrigation Systems and Facilities	1%		0%	
605	Natural Resource and Environmental Economics	0%		4%	
723	Hazards to Human Health and Safety	0%		1%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	2.4	0.0	1.0	0.0
Actual Paid	2.6	0.0	1.3	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**
593542	0	247648	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
593542	0	247648	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
7357257	0	11775124	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 public service announcements (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

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	38893	0	0	0

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

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	28	54	82

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes/Short Courses Conducted

Year	Actual
2016	10

Output #2

Output Measure

- Workshops Conducted

Year	Actual
2016	6

Output #3

Output Measure

- Demonstrations and Field Days Conducted

Year	Actual

2016	2

Output #4

Output Measure

- Newsletters Produced

Year	Actual
2016	1

Output #5

Output Measure

- Web Sites Created or Updated

Year	Actual
2016	3

Output #6

Output Measure

- Research Projects Conducted

Year	Actual
2016	32

Output #7

Output Measure

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

Year	Actual
2016	17

Output #8

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2016	3

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 skills to conserve water and protect water quality.
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	New research on using micro-sprinklers in strawberry production shows potential for significant water savings without additional maintenance costs.
8	Farm, ranch, rangeland, and urban landscape owner/operators and managers, allied nursery industry professionals, public agency representatives, and members of the public, participating in water education programs, gained knowledge of best recommended management practices for preserving water quality and water use and conservation.

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
2016	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 #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.

Not Reporting on this Outcome Measure

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.

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 the programs, gain skills to conserve water and protect water quality.

Not Reporting on this Outcome Measure

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
2016	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

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

New research on using micro-sprinklers in strawberry production shows potential for significant water savings without additional maintenance costs.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2016 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Water is an important resource for growing plants, and it has become scarce due to epic drought conditions in California. Conserving water through improved irrigation practices is critical for maintaining acreage of a lucrative commodity such as strawberry. Strawberry growers typically provide supplemental irrigation through overhead aluminum sprinklers to mitigate the dry conditions of the region. However, they can be inefficient systems, because they require a significant amount of water, and because there is plastic mulch on the beds, which limits the water that enters the soil and increases runoff potential. Micro-sprinklers, commonly used in orchard systems, could offer an efficient alternative to conventional aluminum sprinklers.

What has been done

A study was conducted at Manzanita Berry Farms in Santa Maria during the 2014/2015 production season to evaluate the potential of micro-sprinklers in strawberry production. The study compared conventional aluminum sprinklers with micro-sprinklers on about one hundred and twenty 330-foot-long strawberry beds. Data were collected on the amount of water distributed, electrical conductivity of soil that determines salt condition, strawberry yield, and the incidence and severity of powdery mildew and botrytis fruit rot. While there were no conclusive findings about diseases, there were significant water savings without a negative impact on fruit yield. Detailed information about the study design and findings can be found at: http://ucanr.edu/micro-sprinklers.

Results

This study demonstrated 32% water savings in just 3 weeks of using the micro-sprinkler system. This new information can inform future growing practices for this important California crop, valued at $2.2 billion. An initial estimate by a vendor suggests that equipment and handling costs of the micro-sprinklers are more or less similar to those of the aluminum sprinklers. If adopted, strawberry growers could conserve resources without incurring additional maintenance costs or experiencing any changes to strawberry yield.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
205	Plant Management Systems

Outcome #8

1. Outcome Measures

Farm, ranch, rangeland, and urban landscape owner/operators and managers, allied nursery industry professionals, public agency representatives, and members of the public, participating in water education programs, gained knowledge of best recommended management practices for preserving water quality and water use and conservation.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	104

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

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 2016, 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 notable research and extension examples from FY 2016. In addition, under the Federal Planned Programs State Defined Outcomes section, the significant success stories are reported as qualitative outcomes.

V(A). Planned Program (Summary)

Program # 6

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%		1%	
111	Conservation and Efficient Use of Water	0%		1%	
133	Pollution Prevention and Mitigation	0%		2%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		6%	
202	Plant Genetic Resources	0%		15%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		6%	
204	Plant Product Quality and Utility (Preharvest)	0%		9%	
205	Plant Management Systems	0%		3%	
206	Basic Plant Biology	0%		23%	
212	Pathogens and Nematodes Affecting Plants	0%		1%	
402	Engineering Systems and Equipment	0%		1%	
403	Waste Disposal, Recycling, and Reuse	0%		5%	
503	Quality Maintenance in Storing and Marketing Food Products	0%		3%	
511	New and Improved Non-Food Products and Processes	0%		14%	
601	Economics of Agricultural Production and Farm Management	0%		1%	
605	Natural Resource and Environmental Economics	100%		4%	
609	Economic Theory and Methods	0%		1%	
610	Domestic Policy Analysis	0%		2%	
611	Foreign Policy and Programs	0%		1%	
701	Nutrient Composition of Food	0%		1%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.4	0.0	2.0	0.0
Actual Paid	0.3	0.0	2.9	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**
59646	0	473729	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
59646	0	473729	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
40226	0	9881274	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 public service announcements (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

2016	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:	2016
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	47	47

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Workshops Conducted

Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Web Sites Created or Updated

Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Research Projects Conducted

Year	Actual
2016	23

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.
2	Growers gained understanding of drought-tolerant sorghum's potential to save water, replace corn silage, and use as a renewable energy crop in California, contributing to increased acreage.
3	UC ANR research identifies optimal planting and irrigation strategies for winter annual oil seeds that will help meet state requirements.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	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
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Growers gained understanding of drought-tolerant sorghum's potential to save water, replace corn silage, and use as a renewable energy crop in California, contributing to increased acreage.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Sorghum is an annual crop that could be both a short-term and long-term solution for California's need for more drought-tolerant annual crops for use in food, feed, and renewable products and fuels. Drought has plagued California growers and drought-tolerant crops, such as sorghum, can help farmers mitigate some of the water issues they face. Sorghum is a C4 plant that is drought and flood tolerant and uses less fertilizer inputs than other crops. Quantifying and estimating economic benefits of sorghum in California will assist producers in making wise crop choices for their farming operations in the future.

What has been done
Replicated field trials of sorghum have been planted throughout the State at various UC ANR Research Centers and at UC Davis. These trials were aimed at evaluating grain and forage sorghum's potential as an alternative cropping system that would provide greater water savings and a wide range of end-use products that could enhance farming systems throughout California. This research will help answer whether forage sorghums can be used to replace corn silage, save water and increase profitability for dairy farmers of California, and whether sorghum can be used as a renewable, viable energy crop in California.

Results
UC ANR research provides better answers for sorghum growers including understanding the water use efficiency of sorghum under various growing conditions, and how to tailor irrigation to optimize sorghum yield and profitability. The payoff of this research can already be seen in the Central Valley as more forage sorghums are being planted to offset the limited water that is available to dairy farms for forage production. In 2014, FSA estimated that approximately 85% of all forage grown in the valley was corn silage; however, in conversations with various dairy personnel this number is looking to change. Some of this shift can be attributed to the information provided through research and educational efforts of this UC-ANR research grant, and the subsequent research projects that are resulting from this work. For example, in 2011, approximately 20,000 acres of sorghum silage were planted in the California according USDA-FSA data, and by 2015 those acres were reported to be approximately 55,871.

4. Associated Knowledge Areas

KA Code	Knowledge Area

102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

UC ANR research identifies optimal planting and irrigation strategies for winter annual oil seeds that will help meet state requirements.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is increasing demand for oilseed crops for food, biofuel, and to provide additional protein meals for livestock production in California. For example, biofuels are needed to meet the state's requirements for low carbon intensity fuels under the Low Carbon Fuel Standard. Additionally, recent drought has raised questions about the amount of water available to farmers for irrigation. Annual crops provide greater flexibility when irrigation supplies become constrained. Providing farmers with more oilseed crop options for winter, annual production, when most rainfall occurs, will increase the chances for productive land use during winter fallow periods or when water for irrigation is limited, while meeting increasing demand. However, most plant breeding and research on oilseeds in North America focuses on other regions; breeding programs have not included adaptation to California's desert and Mediterranean climate conditions, and new varieties have never been evaluated in California.

What has been done
A team of UC ANR researchers and advisors evaluated new varieties of canola and camelina oilseed species in the Brassica (mustard) family. Variety trials were carried out across the state over three years at several UC ANR locations. Crop yield, water use, oil content and quality, and the potential for both early season grazing and subsequent harvest for seed have been tested. Researchers tested the accuracy of and calibrated the Agriculture Production Systems Simulator (APSIM) for simulating canola production in California. Two handbooks on canola production and camelina research were produced, and an oilseeds website provides updated information. Data on the regional performance of the crops was also presented throughout the state at conferences,

field days, and workshops.

Results

Knowledge and experience has been gained on performance, water use, planning and rotation strategies, and how to combine canola and camelina for seed production and grazing. An existing tool, the APSIM model, has been calibrated so that it can be used in California to evaluate potential effects of climate change on future oilseed crop production. This knowledge and tool will be valuable as farmers opt to produce oil seeds to adapt to restrictions on agricultural water use and greenhouse gas reduction goals. Oils from these crops can be used to support the state's biodiesel industry, and with low yields and the use of otherwise fallowed lands, will generate low carbon intensity feedstocks and fuels needed to help the state meet its greenhouse gas reduction goals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
511	New and Improved Non-Food Products and Processes

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 2016, 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 notable research and extension examples from FY 2016. In addition, under the Federal Planned Programs State Defined Outcomes section, the significant success

stories are reported as qualitative outcomes.

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)	
153	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.