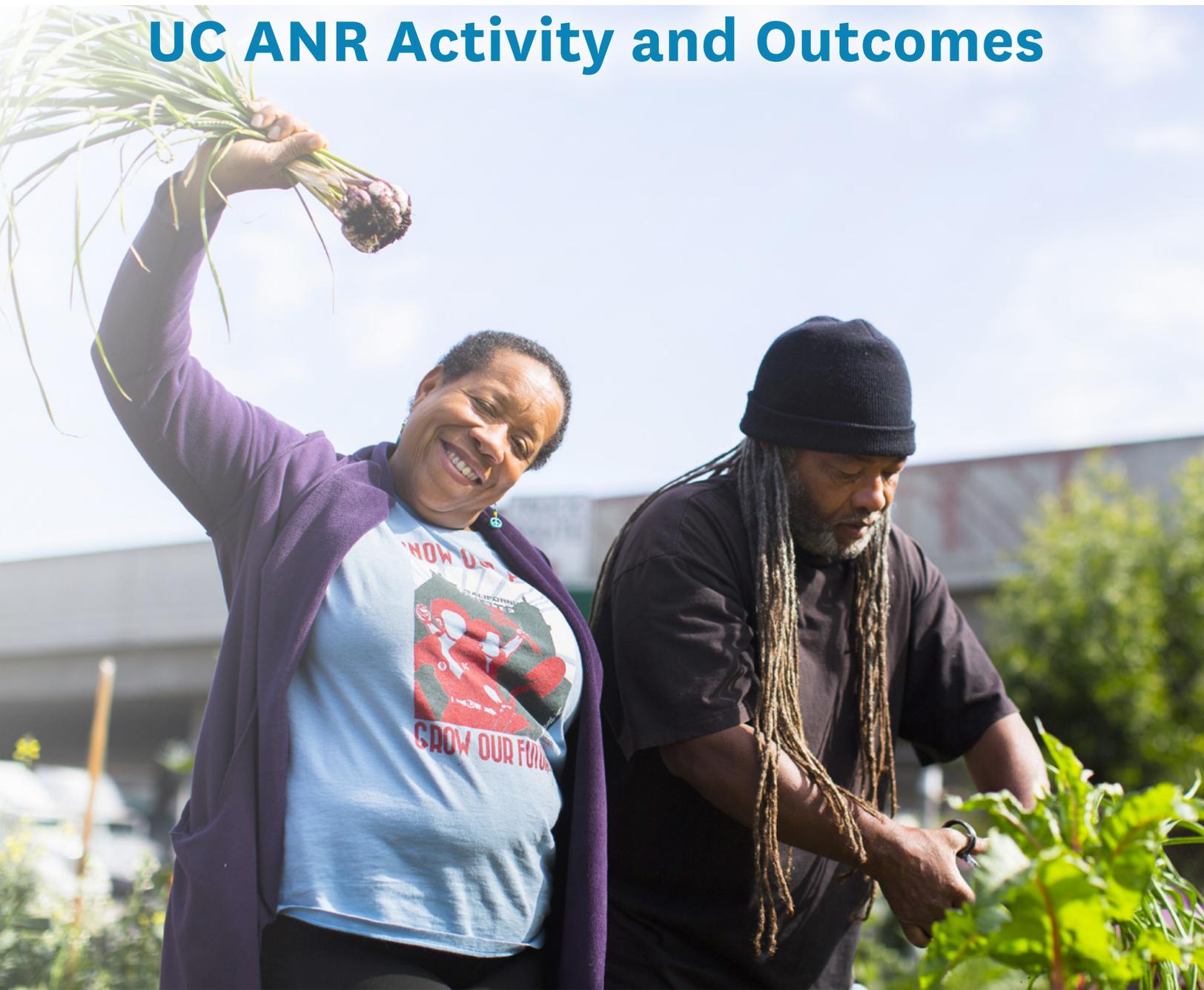


University of California

Snapshot of 2016

UC ANR Activity and Outcomes



University of California
Agriculture and Natural Resources



The UC ANR Program Planning and Evaluation Office leads divisionwide program accountability and reporting activities and serves as a liaison to UC ANR's federal partner the USDA National Institute of Food and Agriculture. To learn more about the Program Planning and Evaluation office, visit our website http://ucanr.edu/sites/anrstaff/Divisionwide_Planning/Program_Planning_and_Evaluation/

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Introduction

The information in this summary is from the 2016 federal annual report, which is required by our federal partner the National Institute of Food and Agriculture (NIFA). Most of the program information comes from the University of California Agriculture and Natural Resources (UC ANR) reporting system for Cooperative Extension academics (DANRIS-X) and the federal reporting system (REReport) required for Agricultural Experiment Station faculty. In 2016, 2,075 research and extension projects were conducted by investigators at UC Berkeley, Davis, and Riverside, and by Cooperative Extension advisors and specialists. The activities and results highlighted in this summary represent a snapshot of the UC ANR activities in 2016.

In 2016, there were more than 600 Agriculture Experiment Station faculty, 165 Cooperative Extension Advisors, and 115 Cooperative Extension Specialists,

including 28 new Advisor and Specialist hires. UC ANR received nearly \$8 million in Smith-Lever federal funds for extension and nearly \$7 million in Hatch federal funds for research in 2016.

Activities and accomplishments are organized by the following five strategic initiatives: Endemic and Invasive Pests and Diseases; Healthy Families and Communities; Sustainable Food Systems; Sustainable Natural Ecosystems; and Water Quantity, Quality, and Security. UC ANR is also encouraged by NIFA to provide a summary of activities related to Sustainable Energy each year. Although it is not a Strategic Initiative for UC ANR, an overview of Sustainable Energy projects is also included in this summary. This page summarizes activity across all initiatives. The following pages provide highlights of each category from the federal report to demonstrate the breadth of impact that occurred in 2016. This document is not exhaustive, and readers can view the entire federal report at: http://ucanr.edu/sites/anrstaff/Divisionwide_Planning/.

2016 Highlighted Outputs & Activity

> 1,800

publications



RESEARCH

18

novel ideas led to patent applications



> 990,000

adult and youth direct contacts/ educational exchanges



EXTENSION

> 5,500

courses, workshops and field days were held





Endemic and Invasive Pests and Diseases

2016 Highlighted Activity & Outcomes

The Endemic and Invasive Pests and Diseases (EIPD) Strategic Initiative provides a framework to coordinate and engage the resources of UC ANR to meet significant pest challenges. The EIPD initiative goals are to foster research and extension programs that 1) exclude pests and diseases through improved detection and diagnostics, 2) develop information that responds to emerging problems with pests and disease, and 3) provide long-term integrated pest management (IPM) solutions for established pests.

Updates to the VetPestX database

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. Prior to the development of the VetPestX database, veterinary pesticide product information was scattered online and hard to find. Both the website and database enable animal managers and extension professionals to quickly find what they need and learn about applicable IPM practices and technologies. ([Alec Gerry](#))

Eradication of European Grapevine Moth

European grapevine moth (EGVM), *Lobesia botrana*, was first detected in Napa Valley in 2009. UC ANR academics worked with public and private partners to develop a pest management program. Over the span of seven years, a dual pest management approach was implemented. EGVM detections declined from over 100,000 moths in 2010 to none in 2015 or 2016. Subsequently, EGVM was declared eradicated from California and the United States. ([Lucia Varela](#))

Decision tool for assessing pesticide use

UCCE developed an online IPM decision-support tool that aids pest control advisers (PCAs) and growers in making pest control decisions for several crops and helps determine whether to use the pesticide chlorpyrifos. The tool lists alternatives and creates a report that can serve as an IPM plan for the farm. UCCE additionally held 13 trainings that provided information about chlorpyrifos and how to use the tool. Use of the tool could result in less pesticide use. ([Lori Berger](#))

Extension about Asian Citrus Psyllid management

A multi-faceted extension program was used to reach nurseries, citrus growers, and home gardeners to educate them about the identification of Huanglongbing (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 the spread of disease. ([Elizabeth Grafton-Cardwell](#))

New integrated pest management plan for City of Irvine

UCCE Advisors were asked by the city to revise Irvine’s integrated pest management plan. All 6,700 acres of the city’s parks, open space, and streetscapes are affected by the IPM plan. The new policy includes a prioritization process when pesticides are used, and while the policy does not prohibit the use of synthetic pesticides, organic pesticides are used first and as long as they are effective. As a result of implementing the plan, the amount of synthetic pesticides has been reduced. ([Cheryl Wilen](#))



Endemic and Invasive Pests and Diseases (continued)

Analysis to understand invasion dynamics

Quantitative and molecular approaches using feeding trials of rats and birds were developed to understand invasion dynamics and subsequent impacts on food webs in natural and agroecosystems. A goal of this research is to develop tools and prioritization frameworks to help resource managers and environmental stakeholders better manage native resources, control invasive species, and promote ecosystem health. ([Erin Wilson Rankin](#))

Strategies to manage Lygus bug movement

A UCCE advisor designed several projects to evaluate the relationships of crops surrounding susceptible fields to Lygus bug pest management. Growers and PCAs were informed about principles to situate crops in patterns that reduce the threat of Lygus movement between crops. The community applied the knowledge gained from these meetings and mitigated Lygus bug movement. ([Peter Goodell](#))

Extension to reduce spread of disease in cotton

The soil fungus Fusarium Race 4 has become more problematic as cotton acreage expands in the central valley. UCCE offered training and extension materials and a jointly operated breeding and screening program for host plant resistance. As a result of these efforts, growers are changing cultural practices to help slow disease spread. ([Robert Hutmacher](#))

Regression models to predict Salmonella in poultry facilities

A UCCE research project focused on identifying the conditions to reduce Salmonella Heidelberg (SH) and the spread of SH in a commercial broiler poultry facility. The comprehensive epidemiological study used logistic regression models and conditional decision trees to identify several variables that can predict positive and negative Salmonella in a processing plant. ([Maurice Pitesky](#))

Herbicide resistance in plants

Research showed that plant response to two herbicides is influenced by environmental conditions. Specifically, the degree to which the resistance phenotype is expressed varies depending on the season and the conditions at the herbicide application. Workshops and an on-line training have been developed for growers and pest control advisers to minimize the spread and impact of herbicide resistance. ([Kassim Al-Khatib](#))

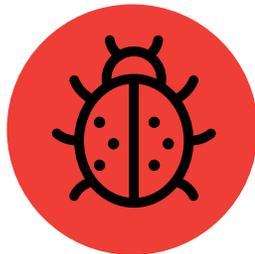
Pheromone-assisted bait products to control Argentine ants

Researchers demonstrated that mixing insecticidal baits and a “trail-following” pheromone significantly improved baiting strategy in Argentine ants. This strategy could lead to commercial pheromone-assisted bait products, and because it does not require regular maintenance, hydrogel-based baiting systems might potentially revolutionize the way insecticidal baits are used in the field. ([Dong-Hwan Choe](#))

Of the farm, ranch, landscaping, owners and managers; industry professionals; and public that participated in EIPD programs:

531

gained knowledge of detection and prevention strategies to manage invasive species



839

adopted recommended pest management strategies

Healthy Families and Communities

2016 Highlighted Activity & Outcomes

The Healthy Families and Communities Strategic Initiative addresses the critical issues of childhood obesity, positive youth development, and science literacy through research, education, and outreach.

Nutrition Policy Institute study on student food insecurity

The UC ANR Nutrition Policy Institute led a study in partnership with UC Santa Barbara as a part of the UC system-wide Global Food Initiative. The study of 9,000 graduate and undergraduate students found a 19 percent prevalence of food insecurity with 54 percent 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 food access issues. ([Lorrene Ritchie](#))

First 4-H club in Mexicali, Mexico

UC ANR academics and Baja California's Secretaria de Fomento Agropecuario 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. By the summer of 2017, 4-H Mexicali will graduate its first 25 club participants, and it is projected to triple its reach by the end of the year, engaging youth in activities that will nurture Baja California's next generation of leaders. ([Lupita Fabregas](#))

Cooking Academy for Yolo County youth

The UC CalFresh and 4-H programs in Yolo County facilitated Cooking Academy for elementary school students at six ethnically diverse, low-income sites. Students learned basic nutrition information, to plan meals, safely prepare and enjoy food, and try new foods. Cooking Academy incorporates three pillars of dietary behavior change: skills, attitudes, and knowledge. After the academy, students stated that they would be willing to ask for healthy foods at home, and increased their likability of healthy foods. 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. ([Angela Asch](#))

Curriculum about sweetened beverages and fast food

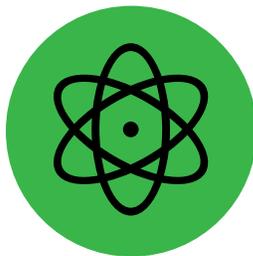
UCCE advisors developed an eight-class curriculum for grades four to six which was delivered over two years to 335 students in nine participating schools. An additional seven schools and 204 students were recruited as a control group to test the impacts of the curriculum. The purpose of the curriculum was to have students recognize the risk to their health of drinking soda and other sweetened beverages as well as eating fast foods. Results showed that participants significantly improved their nutrition knowledge compared to the non-participants. Compared to the non-participants, fewer participating students liked to drink soda after the curriculum, and more of them chose to drink water. The UCCE Statewide Curriculum Committee is evaluating the curriculum for use in all EFNEP California and UC CalFresh youth programs. ([Marisa Neelon](#))





6,880
adults adopted
recommended dietary
practices

71%
of 4-H youth would like
to have a job related
to science



457,683
youth directly
reached

Healthy Families and Communities (continued)

Revitalized school garden programs in Oakland

UC CalFresh revitalized gardening activities at ten school sites in Oakland with 31 teachers and almost 800 children. UC CalFresh provided materials and tools, and trained teachers. Preschool children learned to prepare the soil, use gardening tools, identify fruits and vegetables, plant seeds, care for growing plants, and harvest and taste fruits and vegetables. The teachers gained confidence using gardening as a learning tool. ([Tuline Baykal](#))

Influences on consumption choices

A research study examined the impact of sustainability information such as environmental, social, and health ratings of companies, on consumer purchases while they shopped online. The results have been used to develop integrated frameworks for learning, iteration, and scaling of sustainability innovations. ([Dara O'Rourke](#))

4-H bio-security for animal science projects

Government agencies have identified bio-security concerns related to animal agriculture as a matter of high priority. A team from UCCE, UC Davis, and the One Health Institute collaborated to mitigate zoonotic and animal disease risks in 4-H animal science. 4-H staff and volunteers received professional development and dozens of 4-H youth from the Sutter and Yuba counties 4-H Youth Development Program participated in a multi-week education intervention. The youth developed a biosecurity improvement plan that was implemented at the Sutter/Yuba County Fair. ([Martin Smith](#))

Get Fresh Project in Riverside County

UC Cooperative Extension established a unique partnership with Riverside County resulting in the Get Fresh Project. The partners reached 9,000 low-income residents over a three-year period. The team developed and evaluated the success of a program and cooking video that teaches participants how to prepare healthy home-cooked meals on a budget. Thirty-nine percent of participants increased their frequency of consuming fruits or vegetables at the midday meal, 41 percent included more than one kind of vegetable at the main meal, and 19 percent increased their frequency of shopping with a grocery list. ([Chutima Ganthavorn](#))

Nutrition education program for Mexican-heritage parents

In 2012, UCCE specialists and advisors joined others from UC Davis to conduct a childhood obesity prevention study in a rural community in California's Central Valley. The Niños Sanos, Familia Sana was a three-year intervention that provided nutrition education, an enhanced physical activity program, and monthly vouchers for Mexican-heritage parents with children ages 3 to 8 years old to buy fruits and vegetables. The intervention slowed weight gain in children who were obese, and participants decreased their frequency of consuming fast food and snack food. ([Marcel Horowitz](#))





Sustainable Food Systems

2016 Highlighted Activity & Outcomes

The Sustainable Food Systems Strategic Initiative focuses on the following broad areas: improving the competitiveness and productivity of agriculture; food safety; and supporting the sustainability of small farms, local and regional food systems, and urban agriculture.

Growing Roots workshops for next generation farmers

The Growing Roots project in Central California hosts workshops and events for the next generation of diverse Californian farmers. Sixty-three percent of attendees from the 10 participating counties were women, and 36 percent were minorities. Four-fifths of the participants have been farming for less than 15 years. Topics included ecological farming, business and marketing, food safety, value-added processing, urban agriculture, and collaborative farming. Most participants reported an increase in learning, and over 60 percent plan to implement or have already implemented what they learned.

([Jennifer Sowerwine](#))

New mandarin and asparagus varieties create market opportunities

Development of new cultivars can provide producers with additional market opportunities. Two varieties of mandarin previously released by the UC Riverside citrus breeding program, Gold Nugget and Tango mandarins, are low-seeded varieties with excellent flavor and market acceptance. More than 4 million Tango trees are now planted in California. Additionally, a new asparagus variety with excellent spear quality was released and is being grown by some producers in California, and in other warm climate zones. New fruit and vegetable varieties benefit the producer and the consumer if superior eating quality of the varieties increases consumption of fruits and vegetables. ([Mikeal Roose](#))

Tomato stocks distributed for research and breeding

One project focused on the conservation of tomato germ-plasm, including mutants, wild relatives and miscellaneous stocks maintained by the C.M. Rick Tomato Genetics Resource Center. More than 7,000 seed samples were distributed in response to 355 requests from 258 researchers and breeders in 31 countries. Recipients use the stocks to support a wide variety of research and breeding projects. ([Roger Chetelat](#))

Crop fertilizer needs made accessible on website

A project in collaboration with the California Department of Food and Agriculture and the Fertilizer Research Education Program consolidates science-based information about fertilizer use at a single website. The Assessment of Plant Fertility and Fertilizer Requirements for Agricultural Crops in California allows growers and crop consultants to manage fertilizers more efficiently, reduce the risk of groundwater pollution and comply with existing regulations. ([Daniel Geisseler](#))

Bus tours connect youth leaders and urban farmers with UC ANR resources

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. A UC ANR project team led by UCCE partners in Los Angeles and UC's Sustainable Agriculture Research and Education Program (SAREP) organized youth-led bus tours of urban agriculture sites. The tours fostered youth leadership and connected urban farms to each other and ANR resources. Youth tour leaders reported increased knowledge about public speaking and planning a tour. The majority of UC ANR tour participants reported that the tours increased their capacity to serve the needs of urban farmers and gardeners in California, and 81 percent of non-ANR tour attendees reported that they are now more likely to reach out to UC ANR for support in the future. ([Gail Feenstra](#))



Sustainable Food Systems (continued)

Outreach to aquaculture industry

Commercial freshwater and marine aquaculture in California is a diverse industry producing dozens of species of finfish and shellfish. 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, and permits and regulations. The technology and information improved company efficiencies which led to increased profits. Further, industry acceptance of animal welfare concepts has led to increased sustainability of the industry. (Fred Conte)

Research studies turnover in community supported agriculture membership

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. High CSA membership turnover rates are a major problem facing CSA farmers. A UC ANR research team conducted and analyzed surveys of CSA farmers, current CSA members, former CSA members, and household grocery purchasers throughout the state to understand the relationships between farms and their members for 20 CSAs. The team shared the results of the surveys and provided fact sheets and a website. Workshop participants indicated that they intended to use the information to influence changes to their CSA. Farmers that have already used the data have reported economic improvements to their businesses. (Ryan Galt)

Wheat improved through breeding

Wheat breeding and genetics projects continue to develop and evaluate common and durum wheat lines through trails with the goal of improving disease resistance and end-use quality. The characteristics being examined include increased protein content, gluten strength, and color. The germplasm and varieties developed by this project are publicly available and are being used extensively by California growers. (Jorge Dubcovsky)

Mechanized harvesting for specialty crops

Mechanical or automated harvesting of fruit crops is a critical issue in specialty crop production. One study focuses on the interactions between machinery and crop to create optimal solutions for improving harvesting, pruning, and thinning. (Stavros Vougiokas)

1,202

small farmers and ranchers gained knowledge of business management practices and marketing strategies



887

farm and ranch owners and managers and allied industry professionals gained knowledge of crop and varietal selection factors



Sustainable Natural Ecosystems

2016 Highlighted Activity & Outcomes

The Sustainable Natural Ecosystems Strategic Initiative research and extension efforts aim to identify and prioritize issues and solutions affecting forests, rangelands, wildlife, fisheries, and wetlands.

Rangeland survey to assess drought response

A project surveyed 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. ([Andrew Latimer](#))

Curriculum in parks explains working landscapes

Over 25 different public entities in the San Francisco Bay Area, with a combined total of 2.5 million visitors, manage their open space lands with livestock grazing. However, decisionmakers and the public have little knowledge of animal agriculture production or the ecosystems services provided by the livestock. 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. 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. ([Shelia Barry](#))

Imperiled wildlife populations vary with climate

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 published paper described the effects of climate on changed spatial structure of habitat and changed dispersal. ([Marcel Holyoak](#))

Sustainable delivery of ecosystem services

A project focused on fish catch sought to advance the understanding of positive and negative feedbacks between economics, ecology, and political entities. Preliminary results show that through management, population diversity can be conserved. Toward this end, a stepwise framework known as fisheries improvement projects (FIP) is being used to guide fisheries toward sustainable practices, and retailers such as Walmart are seeking fisheries with FIP certification. ([James Sanchirico](#))

Historic data on Sierra Nevada forests

Large areas of conifer forests in the central Sierra Nevada were inventoried in 1911 and relocated and resampled approximately 100 years later. This network of inventory plots, with repeated measurements which provide the contrast of a century of different management strategies, is providing 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. ([Scott Stephens](#))





Sustainable Natural Ecosystem (continued)

Resource guide for hog production

Outdoor hog production is an excellent opportunity for new and beginning ranchers to produce in a desired niche market. However, there was a lack of information for outdoor hog production and a need from ranchers asking for help. UCCE advisors collaborated with the Alameda County Resource Conservation District's Beginning Farmer and Rancher Program and a Cooperative Extension Hog Specialist in North Carolina to develop a resource guide for outdoor hog production in Northern California. The guide was developed based on an assessment of 10 alternative hog production sites in the region. 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. ([Theresa Bechetti](#))

Genetic linkage maps of rainbow trout

Researchers working with the National Animal Genome research program for rainbow trout generated 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 of rainbow trout. ([Michael Miller](#))

Model to predict rangeland restoration

A study is in progress to develop a model to predict rangeland restoration success as a function of biophysical and management factors. Select ecosystem services—such as forage, space for livestock production, biodiversity and recreation—will be quantified in relation to rangeland restoration success. This project will have major impacts for ranchers, land managers, and owners as it helps identify methods to reduce costs and increase the success of restoration efforts. ([Emilio Laca](#))

Methods to reduce wildfires

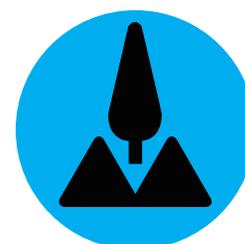
A study designed to develop more effective equipment and methods for reducing wildfire in forest stands looked at two alternatives of dealing with the residual biomass left behind from fuel hazard reduction projects. The default option was open pile burning, but the second option using the biomass for electricity production created both energy and emissions benefits. Additionally, revenue generated from monetization of the reductions in air emissions has the potential to make forest fuel reduction projects more economically viable. ([Bruce Hartsough](#))

Cal-Adapt website portal for climate change research

The Cal-Adapt 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 decisionmakers, 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. ([Maggi Kelly](#))

418

land managers and decisionmakers, in sustainable-use of natural resources education programs, are more likely to use recommended practices.



Water Quality, Quantity, and Security

2016 Highlighted Activity & Outcomes

The Water Quality, Quantity, and Security Strategic Initiative has three goals: 1) to increase system understanding and characterization of water quality and quantity conditions; 2) to develop and implement management practices to achieve water quality and quantity objectives, and 3) facilitate integrative research and extension program delivery.

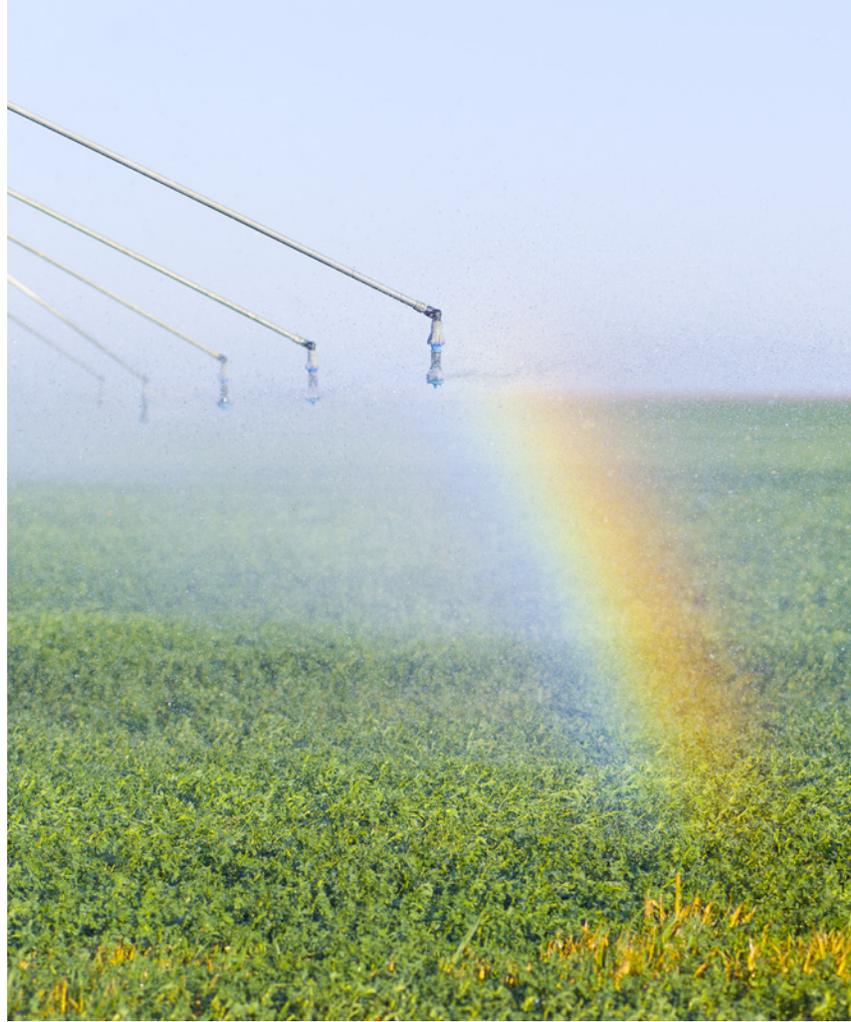
Groundwater recharge through agricultural lands

Groundwater recharge pilots are being conducted in the Central Valley to examine the water quality, infrastructure, economic and legal parameters of agricultural groundwater banking. Surface and groundwater models have been established, recharge sites have been identified, and a calculator has been developed with a feasibility and costs and benefits estimator. Researchers, water districts, and landowners are working together to examine the potential to use storm and flood waters during wet winter years on agricultural lands including, almonds, irrigated pasture, low-nutrient input row crops, and alfalfa to increase groundwater recharge. This work will be increasingly important as precipitation variability increases with climate variability.

(Helen Dahlke)

Degradation of groundwater quality

Results of one study show that there is gradual degradation of groundwater quality throughout the state resulting from both agricultural and urban sources of contamination. The study examined irrigation sustainability at the centuries to millennia time scale to assess the potential for long-term nitrate and salinity build-up in groundwater. The research demonstrated that both managed groundwater storage projects and recharge from rivers create regions of lower nitrate concentrations. New funding will support research to understand groundwater salinization caused by pumping and irrigation while identifying management strategies to reverse groundwater quality decline. (Graham Fogg)



Micro-irrigation applications

Research was performed on micro-irrigation technologies to maximize potential water savings and crop yields. By focusing on a plant-based technique of examining stem water potential to determine when crops needed water, participating walnut growers were able to delay water treatment 4 to 7 weeks, saving 10 percent to 30 percent of water. Research indicates that the highest water usage did not correspond to the highest crop yields suggesting water production function might depend on site specifics.

(Ken Shackel)

Acceptable salinity levels for crops

Agricultural production with recycled, reused, or otherwise low-quality water is of increasing importance in regions that face chronic water shortages. Preliminary field studies have identified acceptable applied water salinity levels and the minimum amount of rainfall needed to help growers determine if they should continue using salt-affected groundwater or recycled water for irrigation. This work could also provide guidance to regulators about the use of recycled water in crop irrigation. (Mark Grismer)

Water Quality, Quantity, and Security (continued)

Experiments on optimal fertilization

Field experiments are being conducted to determine optimal fertilization of irrigated crops to minimize leaching of fertilizers into groundwater and maximize nutrient efficiency. This research has the potential to influence fertilizer regulations. ([Jan Hopmans](#))

Canopy cover sensing

Canopy cover sensing helps determine orchard water use and water needs. The primary outputs from this remote-sensing data include improved descriptions of the physical characteristics of crop location, quantity, and biophysical characteristics such as how chlorophyll, water, and cellulose-lignin levels vary in time and space. This research will improve understanding of crop productivity and provide insight into vegetation development and health. ([Susan Ustin](#))

Tools to identify stream parameters

One research team is focused on developing and testing tools to assess and rehabilitate California streams and rivers. The researchers' work addresses a variety of concepts including fluvial geomorphology, hydrology, civil engineering, aquatic biology, and riparian ecology. Accomplishments include methods to improve spatial maps using modern data collection and modeling tools, new computer software to design river computer models, detailed studies and maps of rivers and drainage basins, and outreach to expand the use of best management practices. One study has begun to relate stream parameters to climate events such as the El Niño Southern Oscillation. ([Gregory Pasternack](#))

Price signals impact urban water demand

Work is underway to understand residential responses to water conservation 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. ([Kenneth Baerenklau](#))

Nitrate remediation

A project is underway to develop efficient nutrient management practices for the commercial vegetable industry. Outreach to industry and government agencies includes techniques to remediate nitrogen-laden surface water. Data on the effectiveness of denitrification bioreactors will be incorporated into written management guides. ([Timothy Hartz](#))

Microsprinklers in strawberries

Strawberry growers typically provide supplemental irrigation through overhead aluminum sprinklers to mitigate dry conditions. However, they can be inefficient systems requiring a significant amount of water. Additionally, because there is plastic mulch on the beds, runoff potential is increased. A study compared conventional aluminum sprinklers with micro-sprinklers. This study demonstrated 32 percent water savings in just three weeks of using the micro-sprinkler system. If adopted, strawberry growers could conserve resources without incurring additional maintenance costs or experiencing any changes to strawberry yield. ([Surendra Dara](#))

Strategies to manage salinity in turfgrass

Through breeding, genetics, weed control, and irrigation management, strategies to reduce water use and manage salinity in turfgrasses are being evaluated. Management and irrigation scheduling can have significant impacts on turfgrass water use. ([James Baird](#))





Sustainable Energy

2016 Highlighted Activity & Outcomes

Several research projects are examining sustainable biomass feedstocks for various bio-based fuels and products. These research projects will provide valuable information on the potential of sorghum as a viable feedstock for renewable fuel production in the state.

Conversion of starch to oil

The similarity between triacylglycerol (TAGs) in plant oils with the chemical structure in fossil fuels makes them a feasible energy substitute for petroleum-based diesel fuel. Current production of oil in plants is limited to the seeds, which can only produce a small amount of oil. One project is focused on reprogramming leaves and stalks to accumulate TAGs in plants that can grow in vast geographical areas of marginal lands. The research team is devising genetic strategies and analysis to convert starch to oil in plants, which could lead to decreased dependency on fossil fuels. ([Katayoon Dehesh](#))

Physiological and genetic research to create more efficient bioenergy crops

Several projects are looking at the physiology of plants and how they might enhance biomass yields under limited nutrient and water scenarios. One study is focused on the evolutionary basis for root-nodule symbiosis and identification of conserved plant traits that may help plants capture more nitrogen. These genes could potentially serve to create more efficient nitrogen use in bioenergy cropping systems. ([Alison Berry](#))

Renewable energy markets

Ongoing research has quantified how short-run volatility in renewable electricity (i.e. intermittency) affects the

amount of air pollution emitted by interconnected fossil fuel generating units in the California electricity market.

([Kevin Novan](#))

Optimizing photosynthesis-to-fuel systems

Photosynthetic microorganisms, such as cyanobacteria can grow to high densities within fully enclosed photo-bioreactors. Research is underway to optimize these photosynthesis-to-fuel systems and enable oxygenic photosynthesis to convert solar energy and store it in the form of hydrocarbons.

([Anastasios Melis](#))

Geospatial modeling to site biorefineries

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 site-specific and systemwide sustainability metrics. The integration framework includes poplar growth models, bioenergy crop adoption, statewide agricultural production models to examine crop substitution effects, and a geospatial bioenergy systems model to determine optimal siting for biorefineries based on desired regional outcomes. ([Bryan Jenkins](#))

Better understanding of biofuels

Biofuels are needed to meet the state's requirements for low carbon intensity fuels under the Low Carbon Fuel Standard. A team of UC ANR researchers evaluated new varieties of canola and camelina oilseed species in the Brassica (mustard) family. Variety trials examined crop yield, water use, oil content, quality, and the potential for early season grazing and harvest. The trials increased understanding of performance, water use, planning and rotation strategies, and how to combine canola and camelina for seed production and grazing. An oilseeds website provides updated information. Additionally, the Agriculture Production Systems Simulator (APSIM) tool can now be used to evaluate potential effects of climate change on future oilseed crop production. ([Stephen Kaffka](#))



To see the full extent of research and extension work that was reported to the Federal Government in 2016 please see the “2016 University of California Combined Research and Extension Annual Report of Accomplishments and Results”. http://ucanr.edu/sites/anrstaff/Divisionwide_Planning/