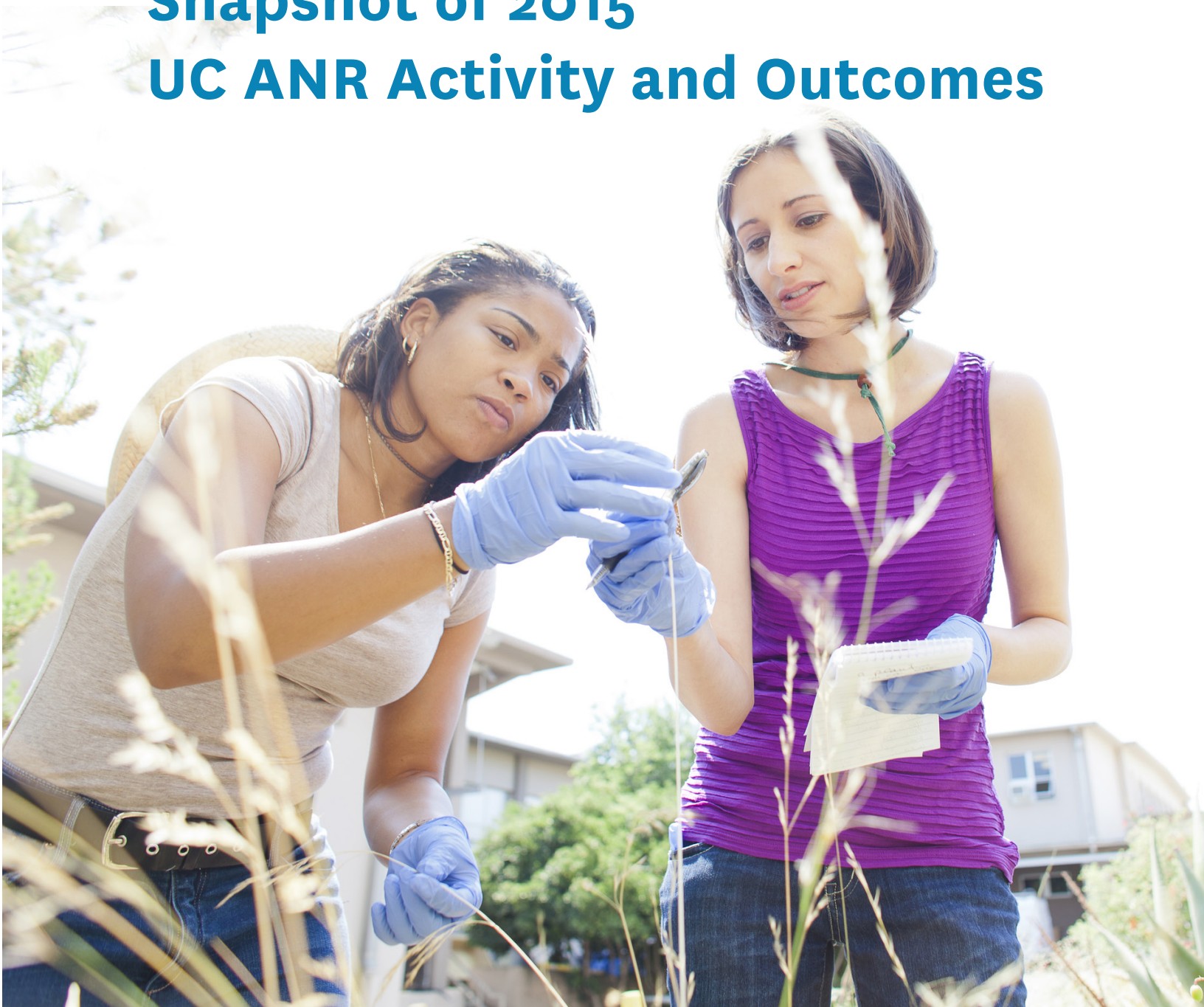


University of California

# Snapshot of 2015

## 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/](http://ucanr.edu/sites/anrstaff/Divisionwide_Planning/Program_Planning_and_Evaluation/)

For questions about this snapshot document please contact Jennifer Caron-Sale.  
jennifer.caron-sale@ucop.edu,  
510-987-0214

For questions about the UC ANR federal report please contact Katherine Webb-Martinez.  
katherine.webb-martinez@ucop.edu,  
510-987-0029

**University of California  
Agriculture and Natural Resources**

1111 Franklin Street, 10<sup>th</sup> Floor  
Oakland, CA 94607  
Online at: [ucanr.edu](http://ucanr.edu)

# Table of Contents

|  |    |
|--|----|
| Snapshot of 2015<br>UC ANR Activity and Outcomes ..... | 4  |
| Endemic and Invasive Pests and Diseases .....          | 5  |
| Healthy Families and Communities .....                 | 7  |
| Sustainable Food Systems .....                         | 9  |
| Sustainable Natural Ecosystems .....                   | 11 |
| Water Quality, Quantity, and Security .....            | 13 |
| Sustainable Energy .....                               | 15 |

# Snapshot of 2015 UC ANR Activity and Outcomes

The information in this snapshot is from the 2015 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 UC ANR reporting system for Cooperative Extension academics (DANRIS-X) and the federal reporting system (REEReport) required for Agricultural Experiment Station faculty. In 2015, 2,219 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 document represent a snapshot of the University of California's Agriculture and Natural Resources (UC ANR) activities in 2015.

In 2015 there were about 650 Agriculture Experiment Station faculty, 175 Cooperative Extension Advisors, and 115 Cooperative Extension Specialists, including 22 new Advisor and Specialist hires. UC ANR received nearly \$8 million in Smith-Lever federal funds for extension activities and nearly \$7 million in Hatch federal funds for

research in 2015. To provide additional support for the work occurring throughout the state, UC ANR continued its competitive grant program by awarding 17 grants totaling \$3.7 million.

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 snapshot. The following pages provide highlights of each program area in the federal annual report to demonstrate the breadth of activity that occurred in 2015. This document is not exhaustive, and readers are encouraged to view the federal report here: [http://ucanr.edu/sites/anrstaff/Divisionwide\\_Planning/](http://ucanr.edu/sites/anrstaff/Divisionwide_Planning/), to see the extent of research and extension that was summarized for the federal government.

## 2015 Highlighted Outputs & Activity

> 1,700

publications



RESEARCH

20

novel ideas led to patent applications



> 1,300,000

adult and youth direct contacts/ educational exchanges



EXTENSION

> 1,500

courses, workshops and field days were held





## Endemic and Invasive Pests and Diseases

### 2015 Highlighted 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.

#### New taxonomic knowledge on nematodes

Scientists are developing information on the biodiversity, species richness, and evolutionary relationships of nematodes that impact agriculture. The goal is to have an online identification and self-training system for diagnosis of parasitic and free-living nematodes. In 2015, new sequence data led to new systematic and taxonomic knowledge. ([Steven Nadler](#))

#### Plant risk evaluation screening to prevent spread of invasives

A team of UC ANR researchers designed and tested a five-question Plant Risk Evaluation-Rapid Screening (PRE-RS) tool that will quickly evaluate large lists of ornamental plants for invasiveness. Screening ornamental plants with PRE-RS before propagating, producing, and distributing plants to retail stores will prevent invasive plants from spreading throughout the California environment. This screening will save millions of dollars by reducing the need to eradicate invasive plants. ([David Fujino](#))

#### Detection methods to diagnose fungal pathogens in fruits

Infectious diseases caused by fungi are increasingly recognized as a threat to global food production, and globalization brings previously isolated hosts and pathogens in contact with each other, increasing the risk for the emergence of new diseases. Various UC ANR researchers are studying the role of effectors, small proteins secreted by plant pathogens and insects to suppress a plant host's immune system. One project will provide a deeper understanding of fungal pathogenesis on tomato and banana plants and will focus on the genomic and evolutionary changes associated with adaptation of plant pathogens to different hosts and lifestyles. ([Ioannis Stergiopoulos](#))

#### Recommendations for homeowners and growers to manage Asian citrus psyllid

Asian citrus psyllid (ACP) is a vector of a devastating bacterial disease of citrus called Huanglongbing. There is no cure for the disease, and it threatens to kill both commercial citrus and residential citrus. UC ANR entomologists, an economist, and a programmer are using their expertise in ACP management strategies and spatial mapping to provide recommendations and cost assessments of treatments for both homeowners and growers. A more informed general public and citrus industry can reduce ACP populations, slow their spread throughout the state, and in turn slow the rate of spread of the bacterium that causes HLB. By slowing the spread, researchers are buying time for local and national researchers to develop a cure for the disease. ([Matthew Daugherty](#))

#### Strategies to monitor and control stink bug invaders

The brown marmorated stink bug is a recent invader adapting to the state's agricultural systems. UCANR has responded to it by monitoring the spread of these pests and conducting pheromone trapping to delineate the distribution of this stink bug in California. Researchers have also imported and are evaluating biological control organisms. ([Mark Hoddle](#))



## Endemic and Invasive Pests and Diseases (continued)

### New mobile application for integrated pest management

IPMinfo, is the first integrated pest management information mobile device application (app) from the University of California. It provides agricultural professionals with one-touch access to information about the biology, symptoms of damage, and management options for pests and diseases. For each pest, users will find information on its biology and damage symptoms as well as associated photos. Links in the management section take users to the UC IPM website for detailed information on control options. The disease section has information on symptoms and management options along with useful pictures. Within just five months of its release, more than 300 people had downloaded the free IPMinfo app. Positive feedback, from industry and community-based users, has confirmed its usefulness, reliability, and user accessibility. ([Surendra Dara](#))

### Detection tools for thousand cankers disease

Thousand cankers disease, caused by the fungus *Geosmithia morbida*, threatens wild, landscape, and commercial

walnut trees. The fungus is spread by the walnut twig beetle, *Pityophthorus juglandis*. In 2015, UC Davis, UCCE, and the U.S. Forest Service partnered to develop effective detection tools for both the beetle and the fungus. The team engaged growers, scientists, and UC Master Gardeners. This outreach has increased worldwide knowledge about disease biology for detection, generated interim solutions, and identified promising avenues for further study to limit the disease's damage and spread. ([Richard Bostock](#))

### Management methods to protect a popular tree

Myoporum, a popular, widely planted ground cover and tree species, has faced extensive damage from an exotic thrips species. Through research-based studies by UCCE, the biology of the insect is better known. UCCE San Diego Advisors research shows that although one beneficial insect is present, its numbers are not sufficient to impact the thrips population. Several management methods, including some low-impact pesticides and application techniques, were identified as effective against Myoporum thrips and usable in the landscape with minimal impact on beneficial insect species and the environment. Treated plants showed great recovery from severely gnarled terminal growth. This information has been made available via trade magazines, allowing landscapers and pest control advisers to benefit from the research. ([James Bethke](#))

2,670

farm, ranch, rangeland, and landscape operators learned pest management techniques and the skills to detect, monitor, and treat endemic and invasive pests and diseases.



75

public school staff members went back to their districts across the state equipped to implement integrated pest management practices at their schools.



1,064

farm, ranch, rangeland, and landscape operators adopted best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.



# Healthy Families and Communities

## 2015 Highlighted 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.

### New program helps reduce obesity

In the U.S., 32 % of children are overweight or obese. The Shaping Healthy Choices Program (SHCP) is a multi-component, school-based intervention composed of nutrition education and promotion, family and community partnerships, integration of regional agriculture, foods available on the school campus, and school wellness policies. As part of the program, a UC Davis and UCCE team provided an interactive curriculum that included healthy cooking activities, school garden technical support, local grower connections, support for increased fresh produce in the school cafeteria, and committee support to integrate program activities. Preliminary analyses show that children classified as overweight or obese dropped from 56 % to 38 % during the one year SHCP was implemented in Sacramento County. ([Sheri Zinderberg-Cherr](#))

### 4-H promotes technology literacy

Young people need to learn to apply and adapt technological processes and tools. The 4-H Technology Leadership Team hosted filmmaking and video production workshops around the state. Trained 4-H groups used digital camcorder loaner kits to produce videos for their Revolution of Responsibility Service Learning projects. Surveyed youth said that they gained confidence in their ability to draft storyboards, use camcorders, and produce films. Each of

the videos, available on the 4-H YouTube channel, define a problem and show how 4-H is part of the solution. ([Steven Worker](#))

### Environmental justice analysis tools developed

The hazards in air, water, and food environments are exacerbated in areas of concentrated poverty and racial/ethnic segregation. One project involved the development, implementation, and impact assessment of environmental justice methodologies, which included environmental justice analysis tools, and participatory mapping workshops. Knowledge gained through the process will help to improve the health and well-being of the most vulnerable and underserved communities in rural areas of California. ([Jonathon London](#))

### School garden expansion and training

Schools with higher percentages of students from low-income families are less likely to have school gardens. UC CalFresh Nutrition Education Program staff in San Luis Obispo and Santa Barbara counties worked with the principal and teachers to identify priorities for improving student health at one such school, including the creation of a school garden. Throughout the year, CalFresh supported garden expansion and conducted more than 40 train-the-trainer, garden-enhanced nutrition education lessons throughout the district. Produce harvested from the garden was used in classroom demonstrations and sent home with families along with nutrition information and recipes. Teachers agreed that the school garden positively impacted their students' learning. Eight teachers reported conducting learning activities in the garden for periods of 4 hours to several times a week. ([Katherine Soule](#))





**88%**  
of 4-H youth gained  
hands-on science skills

**98,000**  
4-H youth engaged in science,  
engineering and technology  
programs



**26,000**  
4-H youth engaged in  
citizenship projects

## Healthy Families and Communities (continued)

### Master Gardeners help develop healthy habits at rehabilitation center

Residents at the Girls' Rehabilitation Facility (GRF) in San Diego County attend school on the grounds. The facility offers an intensive program focusing on cognitive restructuring, but the asphalted area outside the buildings was seldom used. With financial support from the county's Health and Human Services Agency, UCCE and UC Master Gardeners collaborated with GRF, and non-profit partners to create a garden and greenhouse at the facility. Staff from these agencies share in teaching the young women on how to design a garden, build healthy soil, water wisely, manage pests, and handle food safely. Residents in the program work in the garden in small groups with UC Master Gardeners. The young women learn to make healthy snacks with the food they grow, and also experience the positive results of collaboration, communication, and teamwork. ([Patti Wooten Swanson](#))

### School lunch room strategies create positive change

In 2013, the UC CalFresh Nutrition Education Program and partners initiated "The Smarter Lunchroom Movement (SLM) of California" and began training school food service directors in SLM practices. To date, more than 250 school districts have received training, with 2,500 attendees statewide. In Yuba County, within a year and a half, the total number of schools involved rose from 1 to 19. Johnson Park Elementary School

in Olivehurst was the original site for Yuba County SLM strategies. Evaluation data from Johnson Park Elementary indicates that improving the placement of white milk and increasing the number of servings offered has almost doubled sales at breakfast. Within a year sales of reimbursable meals increased 69% at the school. ([Jona Pressman](#))

### New nutrition policies for preschools

UCCE Alameda partnered with Alameda County to offer teacher education/training and develop wellness policies for 14 low-income state preschools and Head Start sites. The 14 preschool sites implemented childhood obesity-prevention policies during the 2015-2016 school year. Preliminary outcomes are positive, as evidenced by the actions taken by administrators, teachers and parents to promote healthy eating and physical activity. Students are purchasing more fresh fruits and vegetables. ([Mary Blackburn](#))







# Sustainable Food Systems

## 2015 Highlighted 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.

### Better blackberry management creates market opportunities

Some newer blackberry cultivars enable primocane fruiting, meaning they bear fruit in the first year rather than the traditional second year. UCCE field trials with primocane fruiting cultivars in San Luis Obispo, Santa Barbara, Ventura and Santa Cruz counties generated critical, region-specific information to enhance management practices for primocane fruiting blackberries. This multi-year project identified new tools for coastal California berry growers to manage primocane fruiting blackberry cultivars efficiently and productively in order to target profitable market windows. ([Mark Gaskell](#))

### Genetic research to develop drought-tolerant tomatoes

A molecular genetic improvement project has identified genetic regions in a wild tomato species conferring resistance to rapid-onset water stress caused by root chilling. In response to root signals, stomata close on the leaves, thereby preventing wilting. These results could lead to breeding water-stress tolerant tomato cultivars. ([Dina St. Clair](#))

### Techniques improve canopy management in almonds

Deficit irrigation and efficient nitrogen fertilization combined with selective pruning techniques in almond orchards have demonstrated improvements in canopy management. Results include lower input costs, reduced pesticide use, and potentially improved worker safety. ([Bruce Lampinen](#))

### CSA producers gain insight to expand service to at-risk populations

Surveys and research on community supported agriculture (CSA) access in California are leading to a better understanding of characteristics of CSA customers including historically under-represented groups. Results are expected to include a statewide map of CSA market saturation. Expanding CSA membership could lead to increased food security and improved nutrition for at-risk populations. ([Ryan Galt](#))

### Disease-resistant lettuce

A classical and molecular genetics project focused on improving disease resistance in multiple types of lettuce. Primary germplasm and advanced breeding lines are released to the seed industry so that companies with both large and small breeding programs can utilize these materials. These activities have resulted in improved lettuce cultivars that in turn provide higher quality lettuce and less reliance on chemical protectants. ([Richard Michelmore](#))

### Salt-tolerant grain crops

In an effort to develop new salt-tolerant grain and forage crops for agriculture on saline soils in California, researchers have hybridized wheat and wheatgrass. After self-pollination of three more generations, researchers will assess salt tolerance. ([Jan Dvorak](#))

### Help for beginning farmers

In Placer and Nevada counties, there are nearly 2,100 farms, with 32% of them run by beginning farmers. UCCE Placer-Nevada offers a six-week Farm Business Planning class to improve farm practices and profit margins while reducing risk. The percentage of participants that use planning tools increased from 44% before the course to 85% after the course. In total since the program began, 41% of participants have expanded their operations and 39% have seen an increase in profitability. ([Cindy Fake](#))



## Sustainable Food Systems (continued)

### Managing lead hazards in urban gardens

UC ANR-funded ecologists and social scientists at UC Davis worked in partnership with a Sacramento non-profit organization to improve access to local food and build community cohesion. The ecologists tested soil lead in more than 75 yards and are expanding to include all of the city of Sacramento. The social scientists conducted resident interviews and activities that allowed residents to tell their stories of place, contamination, and gardening. Researchers provided soil lead data and detailed property maps to determine where to place gardens and manage lead hazards in other areas of the residential landscape. ([Mary Cadenasso](#))

### New approaches to identify and prevent animal disease

A new scoring system was developed for field identification of bovine respiratory disease (BRD) in calves. The new system requires assessment presence or absence of clinical signs, which may make it more feasible for on-farm use than a previous system (Wisconsin respiratory scoring system in calves). An ongoing study is comparing the reliability of both scoring systems during field use by different personnel. In addition, researchers are developing management practices, including rationally applied therapeutic and preventative impact of BRD on cattle health, welfare, and productivity. ([Alison Van Eenennaam](#))

### Increased knowledge to understand poultry immunity

One poultry project increased knowledge about chromosome 16, which encodes the immunity-related genes involved in resistance and susceptibility to poultry diseases of this chromosome. Researchers also mapped a new set of genes to chromosome 16. ([Mary Delany](#))

### Fresh cut products workshops

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

1,120

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



1,064

growers adopted best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.

# Sustainable Natural Ecosystems

## 2015 Highlighted 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.

### Range management strategies to adapt to drought

Several studies identified how drought could impact invasive weeds on rangeland. For example, research suggests that drought conditions could increase the prevalence of native grasses, and decrease noxious weeds. Additionally, spring grazing during droughts can greatly decrease noxious invaders, but fall grazing can increase invaders. Understanding how drought impacts invasive encroachment on rangeland prepares California ranchers to better manage and protect the range. ([Valerie Eviner](#))

### Solutions to control invasive red brome grass

Invasive plants are detrimental to natural ecosystem services and they reduce biodiversity. To study how soil microorganisms foster or discourage the growth of invasive grasses, UCCE scientists collected plant and soil samples from Europe. The scientists used microscopy and DNA sequencing to identify the microorganisms that affect growth responses to red brome and medusahead. Scientists found that head smut fungus is a natural enemy to red brome and are currently culturing head smut. They will infect red brome populations in the greenhouse, with the eventual goals of inoculating red brome in the field and providing land managers a low-cost, environmentally friendly solution to invasive brome grasses. ([Edith Allen](#))

### Plant resistance informs grazing management strategies

A study discovered that plants use volatile cues to make cohorts of the same species more resistant to grazing herbivores. This information will have a significant impact on grazing management strategies, especially targeted grazing to remove brush or invasive weedy plants. ([Richard Karban](#))

### Creek flow design improves native salmon population

By examining the interactions among land use, water projects, and fish distribution, one researcher applied knowledge of the biology of freshwater fish to environmental decision-making in relation to agricultural and urban water supplies. Ongoing monitoring has shown that the water flow regime designed for the regulated Putah Creek can be an example of how to design a natural flow regime anywhere in the world with minimal water costs and large conservation benefits. Previously there were no salmon in Putah Creek, but as a result of the flow regime, there was a record salmon run in 2015. ([Peter Moyle](#))

### Agricultural native plant hedgerows aid pollinator communities

Widespread honeybee colony losses coupled with the evidence of native pollinator declines have created a need for methods to restore pollinator populations, particularly in agricultural landscapes. Recent work suggests that adding hedgerows of native plants in intensively managed agricultural landscapes promotes diverse pollinator communities. Results indicated that hedgerows significantly enhanced occurrences of native bee and syrphid fly species, including specialized and less mobile species. ([Claire Kremen](#))





## Sustainable Natural Ecosystem (continued)

### Urban landscape designs attract native bees

Studies on bees have expanded statewide to over 15 cities in botanical gardens, community gardens, homes, schools, and nurseries. Results identified that more than 400 different species of native bees depend on nearly 500 flower types. Importantly, the research suggests that urban areas have great potential for conserving bee diversity and abundance. In 2015, 10 pollinator garden designs were installed and helped to increase populations. Results demonstrate that high levels of diverse native bee species can be attracted to urban areas if gardens are properly designed. ([Gordon Frankie](#))

### Research measures the genetic potential of trees to adapt

The health and sustainability of California's forests are threatened by fire, land-use impacts, introduced pathogens and climate change. Research on the genomics of California conifers measures the adaptive genetic potential of species against these threats and can aid forest managers in reforestation, conservation, and restoration programs. In 2015, researchers at UC Davis released the first draft of a reference genome sequence for sugar pine (*Pinus lambertiana*). ([David Neale](#))

### Partnerships and citizen science improve wildfire knowledge and management

In order for Californians to achieve a more sustainable co-existence with wildfire, there needs to be a deeper scientific understanding of controls on fire regimes. The work of CE specialists in wildfire is focusing more on extension modes that will directly affect policy, management, and planning decisions. Work includes partnering with state agencies so that fire hazard mapping and spatial projections are integrated into fire agency activities. In addition to creating partnerships and sharing research, a citizen science program in Santa Barbara County is collecting and disseminating near real-time fuel moisture data. ([Van Butsic](#))

### Models provide insight into fire ecology and forest management

The impacts of fire ecology and frequency are the main factors that influence the management of mixed conifer forests in the Sierra. A study on the effects of climate change and fire regimes focused on developing models and testing the roles of fuel load, local weather, and regional circulation patterns to determine fire return times. Results suggest that fuels management could reduce fire intensity, increase forest resilience, and substantially increase tree survival. Treatments can be used strategically to protect people and property as well as to support the reintroduction of fire into forests where it has been historically suppressed. ([Andrew Latimer](#))

### Effort to calculate environmental impact from livestock and poultry

Using guidelines from the United Nations Food and Agriculture Organization, a CE specialist led diverse stakeholders to establish methods to quantify carbon footprints from livestock and poultry. Together they also created a database of greenhouse gas emission factors for animal feed and developed a methodology to measure other environmental pressures. Multiple producers and industries have been equipped to quantify their impacts as a result of this effort. ([Frank Mitloehner](#))

162

ranch and rangeland managers gained knowledge of strategies and techniques to use natural resources sustainably



176

ranch and rangeland managers gained knowledge of recommended techniques for rangeland grazing, browsing, monitoring and management



# Water Quality, Quantity, and Security

## 2015 Highlighted 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.

### Drought tolerant field crops

Ongoing research is using plant genetics to breed drought-tolerant varieties of several field crops. Researchers have developed a plant physiological model that simulates how changing plant traits related to drought affect crop productivity. The model predicts which traits in maize and soybeans help with changing water use. ([Matthew Gilbert](#))

### Benefits of irrigation and no-till planting

A research study examined precision overhead irrigation systems and no-till planting. The study found that water application for the overhead system is 93% uniform, resulting in less water needed to meet irrigation demand compared to other common forms of irrigation. The study also identified that 13% (4 inches) of soil water evaporation could be saved in the soil during a typical summer season when a thick mat of residue is left on the soil surface. This research shows the potential for California farmers to reduce water use and evaporation by combining overhead irrigation and no-till practices. ([Jeff Mitchell](#))

### Improvements in aquaculture systems

Researchers at UC Davis are improving aquaculture processes and equipment to increase water-use efficiency and minimize negative environmental impacts from aquaculture. Research was performed to reduce water uses and environmental impacts by converting from flow-through systems to a recirculating system that use filtration and other techniques to purify the wastewater before it is reintroduced into the system. Additional research on temperature controls and the impacts on seaweed production is providing important information for future operations of these systems. ([Raul Piedrahita](#))



### Micro-irrigation applications to reduce groundwater pollution

Work on micro-irrigation technologies has created several nutrient- and irrigation- related applications that will reduce groundwater pollution and leaching. One such integrated project will analyze crop nutrient status and crop nutrient demand so that irrigation and fertigation, the injection of fertilizers, can be coordinated. Researchers have developed new guidelines for almond and pistachio nutrient management. ([Patrick Brown](#))

### Waste water reuse in vineyards

The California wine industry is facing limited water availability due to increasing demands and climate change, which underscores the need to use alternative sources such as treated wastewater. One study demonstrated that no negative impacts were visible in grapevines irrigated with winery wastewater. Additionally, recycling within a vineyard/winery operation is a sustainable option that demonstrates a commitment to lowering on-site and off-site environmental impact. ([Anita Oberholster](#))

## Water Quality, Quantity and Security (continued)

### Groundwater recharge

Work is being performed to assess the potential to use flood waters, natural basins, and agricultural lands to increase groundwater recharge from storm events. This work will be increasingly important as precipitation variability will increase with climate variability.

(Graham Fogg)

### Remote Sensing Applications

UC ANR has been using remote sensing and Geographic Information Systems to monitor land use and manage water resources. One project is focused on using remote sensing-derived information to improve the understanding of crop and ecosystem productivity and evapotranspiration. The team has developed a method to analyze remote sensing imagery across regions and time to map species composition and the state of the vegetation in the landscape. (Susan Ustin)

### Science-based method to evaluate groundwater conditions

UCCE introduced a science-based method for evaluating groundwater conditions and how they relate to number and depth of water wells. The methodology predicts the percentage of water wells that may go dry if groundwater levels continue to decline. This methodology is being used to guide groundwater management plans and regulatory restrictions in Glenn County. These efforts, as well as others, have already helped Northern Sacramento Valley water users develop water-resource management plans that leave them in a favorable position to manage and sustain groundwater supplies in the future.

(Alan Fulton)

### Online applications help save water

Two UC ANR tools are helping farmers conserve water and improve their nitrogen fertilizer efficiency while maintaining crop productivity and quality. Weather-based irrigation scheduling and the soil nitrate quick test are accessible through the online application CropManage (<https://cropmanage.ucanr.edu>). Commercial-scale CropManage trials with broccoli used 48 % less water than is used for conventional plantings, with no reductions in yield or crop quality, and CropManage recommendations for a lettuce grower reduced nitrogen applications by 40 %. (Michael Cahn)

# 878

farm managers and natural resource professionals gained knowledge of water conservation practices



# 164

farm managers and industry professionals were able to adopt water conservation practices





# Sustainable Energy

## 2015 Highlighted Outcomes

### Renewable Fuel Standards

One project is focused on analyzing and designing policies for renewable fuels by analyzing how the Renewable Fuels Standard (RFS) and various forms of subsidies affect ethanol investment, production, entry, and exit decisions. Researchers will develop theoretical and empirical models to analyze the efficiency and cost-effectiveness of renewable policies and to design a renewable input mandate policy. ([C.-Y. Cynthia Lin Lawell](#))

### Improvements for renewable energy policies

Renewable electricity intermittency, (e.g. wind turbines generate energy when the wind is blowing, but stop when the wind stops), affects the amount of air pollution emitted by fossil fuel power plants. Researchers quantified the effects, and will recommend improvements in renewable energy policies that will mitigate the potential impacts of renewable intermittency. ([Kevin Novan](#))

### Models predict best locations for oil seeds

A project identifies the best varieties of canola and camelina for California and their expected yields in diverse locations throughout the state. The researchers are identifying critical management practices for the successful production of canola and camelina, and are using growth and economic models to predict yield and locations throughout the state where crop adoption should be profitable. ([Stephen Kaffka](#))

### Techniques to enhance biomass yields

Several projects are currently studying the physiology of plants and how they might relate to more efficient uses of nitrogen and water to further enhance biomass yields under limited nutrient and water scenarios. One study will characterize the molecular components that govern the response and adaptation of plants to stress-growth conditions such as drought, high salt, and low temperature. ([Sheng Luan](#))

### Analysis of microalgae as a biofuel

Research is underway to understand microalgae cell wall structure and starch accumulation so that microalgal polysaccharides can be used for biofuels. The research will characterize microalgae cell wall composition and test methods to alter it. The study will include a preliminary economic analysis of the possible selling price and volume for ethanol produced from microalgal polysaccharides. ([Jean VanderGheynst](#))

### Processes to lower the cost of biofuels

Biomass is a broad category that encompasses materials that could be used for renewable fuels. One research team is working to develop a new process to potentially lower the cost of biofuels production from cellulosic biomass. Among other tests, researchers investigated liquefaction and fermentation of whole sugarbeets for bioethanol. ([Zhiliang \(Julia\) Fan](#))

### Using commercial crops to generate biomass

A set of plant-derived genes is being engineered to convert the starch in the leaf and stalk biomass into triacylglycerol oils. This technology will be introduced into forage sorghum lines with enhanced yields of biomass. The goal of the project is to demonstrate the potential for efficiently generating lipid-rich biomass in a commercial crop. ([Katayoon Dehesh](#))



To see the full extent of research and extension work that was reported to the Federal Government in 2015 please see the “2015 University of California Combined Research and Extension Annual Report of Accomplishments and Results”.  
[http://ucanr.edu/sites/anrstaff/Divisionwide\\_Planning/](http://ucanr.edu/sites/anrstaff/Divisionwide_Planning/)