**UC ANR IMPACT STORIES 2017-2018**

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# PROMOTING ECONOMIC PROSPERITY IN CALIFORNIA

## Condition Change: UC ANR contributed to improved individual and household financial stability.

**Healthy Families and Communities**

**Issue**

California’s vibrant, diverse economy is the sixth largest in world. To maintain its competitive edge, California must overcome technical, social, and environmental challenges. Consumer spending contributes a majority of overall economic growth other and while California experienced historic low unemployment rates in 2018, other issues related to financial stability continue to rise such as lack of housing, inflation, and cost of living.

**Methods & Outcomes**

UC ANR conducts research and delivered education leading to improvements in individual and household financial management practices. UC ANR academics delivered the Money Talks program to 240 teens and young adults about financial literacy and housing security. UC ANR academics provided oversight, leadership, and guidance for the statewide implementation of the UC CalFresh Nutrition Education Program (UC CalFresh) and Expanded Food Nutrition and Education Program (EFNEP) statewide programs. Curricula such as Making Every Dollar Count are designed to help UC CalFresh adult participants gain the tools needed to take control of their money and which teaches families food buying/budgeting skills and food and resources management techniques. As a result of UC ANR outreach and education, participants learned and adopted financial management practices. Outcomes with specific indicators follow.

**Participants learned about and adopted financial management practices.**

* Money Talks program participants were observed applied new knowledge learned from the program in discussions and group activities about available housing resources in their communities. Participants also reported learning information that applies to real life and can see themselves utilizing resources and becoming more civically engaged (Derrick Robinson).
* About 1,000 UC CalFresh participants completed a retrospective survey about their participation in the Making Every Dollar Count program. The majority reported improvement in their knowledge about the topics covered such as knowing easy ways to save money on food (83%) and understanding food ads (83%).
* Over 4,000 EFNEP participants responded to a survey about their educational program experiences and 82% of participants showed improvement in one or more food resource management practices. EFNEP adult graduates reported an average monthly food cost savings of $38.20, which collectively saved California EFNEP families $2,916,340 **(**Katie Panarella).

These measured outcomes demonstrated improved knowledge and skills related to individual and household resource management. In this way, UC ANR contributes to the public value of promoting economic prosperity in California.

## Condition Change: UC ANR contributed to enhanced community economic development

**Healthy Families and Communities**

**Issue**

An estimated 1.3 billion metric tons of food is wasted each year, affecting our economy, our well-being and our environment. In industrialized countries food losses and waste amount to roughly $ 680 billion. Reducing the amount of food that is wasted can divert food from landfills to feed people, combat climate change, preserve natural resources, and save money.

**Methods & Outcomes**

UC ANR academics conducted research on food waste and methods to reduce waste. Academics partnered with non-profit organizations and state government agencies to develop the first annual Food Waste Prevention Week in 2018 (Wendy Gosliner). Specific measured outcomes follow.

**Science-based information was applied to food waste prevention efforts.**

* UC ANR’s collaboration and leadership in California’s inaugural Food Waste Prevention Week led to multiple state agencies engaging in food waste prevention efforts beyond their participation in the week-long messaging campaign, which resulted in multiple agencies across sectors circulating shared messages on a critical social, environmental, and health issues (Wendy Gosliner).

This outcome leads to improved knowledge and adoption of practices to reduce food waste, which can save communities money and improve community well-being. There is still much work to be done, with as much as 40 percent of the food produced in the United States being wasted. UC ANR’s efforts will contribute to the public value of promoting economic prosperity in California.

**Sustainable Food Systems**

**Issue**

California’s vibrant, diverse economy is the sixth largest in world. To maintain its competitive edge, California must overcome technical, social, and environmental challenges. Small farms and urban farms in particular face unique challenges such as managing the costs to support crops, marketing their produce, and understanding and complying with regulations. California small farms must innovate and adapt to maintain economic resilience and vigor.

**Methods & Outcomes**

UC ANR projects focused on identifying opportunities to help small and urban farmers gain a competitive edge. Activities that resulted in outcomes with specific measured indicators follow.

One project helped the urban agriculture sector grow in the Bay Area through collaborations and educational presentations about relevant, local land use policies (Rob Bennaton). UC ANR partners with public, non-profit, and private groups to help small farmers expand their market opportunities. Another project in Southern California conducted seminars and a tour focused on agricultural tourism, value added product development, dynamics of terminal markets, value-based marketing, regulatory issues and ordinances (e.g. Cottage Food Law, Winery Ordinance, Small Brewery Ordinance). The purpose of these events was to help farmers capitalize on current market trends to better sustain their operations (Ramiro Lobo).

**Participants learned about policies and business strategies to improve access to land and markets for local growers.**

* In the urban San Francisco Bay Area, policy makers and the public increased their understanding of local municipal and state land use and urban agriculture production policies. This helps provide a practical land access pathway for small urban growers (Rob Bennaton).
* Participants gained understanding about issues and challenges related to agricultural tourism (agri-tourism), value added product development, and wholesale and specialty product marketing opportunities. In addition, these seminar participants and local organizations are recognizing agri-tourism and value added products as legitimate business activities. This project expands value-added market opportunities for local growers (Ramiro Lobo).

These aforementioned measured outcomes demonstrate improved knowledge of practices that improve the profitability of urban and small farms. From 2012 to 2017, income from farm-related, agricultural tourism and recreational services increased in California by thirty percent. Improved practices enable Californians to create opportunities that lead to more economically sustainable management. In this way, UC ANR contributes to the public value of promoting economic prosperity in California.

**Sustainable Natural Ecosystems**

**Issue**

Working landscapes in California such as rangeland, cropland and timberland provide a basis of economic activity that supports millions of Californians. Rangelands provide a critical economic foundation for California’s livestock production with an annual gross value of cattle and sheep production exceeding $3 billion. These lands also play a vital role in providing food, fiber, wildlife habitat, recreation, energy, and ecosystem services. Science-based information is needed for land owners, managers, and policy makers to develop practices and policies that sustain economic vitality while protecting environmental quality.

**Methods & Outcomes**

UC ANR projects focused on identifying opportunities and addressing needs to reduce cost and increase profitability for ranchers and land owners. Research and activities that resulted in outcomes with specific measured indicators follow.

Projects addressed livestock production and incentives for ecosystem services to increase profitability. Several UC ANR academics worked with the Alameda County Resource Conservation District to conduct a needs assessment of the demand for local meat processing, assess resource concerns with regional hog operations, and develop a resource guide on outdoor hog production. Additionally, a Beef Cattle Cost Study was conducted to document the cost associated with cow-calf grazing that would support conservation on public lands. Additional research focused on grazing for biological conservation and was used to inform the development of local conservation plans (Shelia Barry). One project is creating case studies, based on surveys from landowners with large parcels that will include quantitative analysis of the services that occur on working lands throughout California. An additional component of the work was to gather feedback on whether land owners with conservation easements prefer one-time or ongoing payments for ecosystem services they provide. These findings were shared at the California Economic Summit (Stephanie Larson). Another academic provided programming for succession planning, business development, and regulatory compliance (Jeffrey Stackhouse).

**Participants learned about or adopted techniques for rangeland management, grazing and browsing.**

* The outdoor hog resource guide provided the information necessary to maintain a hog operation on public land and an opportunity for producers to access Environmental Quality Incentives Program funding from the USDA for implementing conservation practices on their operations (Shelia Barry).
* Science-based information led to significant improvements and cost savings associated with the Santa Clara Valley Habitat Conservation Plan and East Alameda County Conservation Strategy (Shelia Barry).
* Survey results have led to increased interest in new methodologies for paying landowners for ecosystem services provided from rangelands, and could lead to payments for ecosystem services (Stephanie Larson).
* The Working Landscapes subgroup from the California Economic Summit has met with a Senator and sought funding for ecosystem service pilots that incentivize landowners for bundled services. Monetary credits will be quantified with support of scientific research (Stephanie Larson).
* Through succession planning workshops, ten families successfully complete succession planning (Jeffrey Stackhouse).
* As a result of business development workshops, four agriculturalists received loans that they were previously unaware of to benefit their operations (Jeffery Stackhouse).

These measured outcomes demonstrate improved knowledge and adoption of practices to improve the profitability of rural working landscapes while conserving natural resources. From 2012 to 2017, the number of hog operations with sales increased by 73. Improved practices enable Californians to create opportunities that lead to more economically sustainable management. In this way, UC ANR contributes to the public value of promoting economic prosperity in California.

## Condition Change: UC ANR contributed to improved animal management, productivity and efficiency

**Sustainable Food Systems**

**Issue**

California is ranked fourth in the nation in total livestock receipts, with over $11 billion in 2017. It remains the largest dairy-producing state providing over 18% of the nation’s milk supply in 2017, and dairy is the state’s top producing commodity. Ranchers and dairy producers face many management and production challenges, like drought, water and air quality regulations, and invasive species, as they strive to maintain their competitive edge. Although livestock are a high value commodity, at the ranch level it can be difficult to be profitable. In fact, ranchers or their family members often need to work off the ranch in order to make ends meet and keep the ranch running. At the same time, there is the need to improve the ecological viability of these animal production systems.

**Methods & Outcomes**

UC ANR partnered with public, non-profit, and private groups to create and extend new knowledge about animal systems management. As a result of UC ANR research, outreach, and education, participants made changes improve animal production systems**. R**esearch and activities that resulted in outcomes with specific measured indicators follow.

Livestock health was identified as a high priority for ranchers so workshops focused on this topic were conducted, including on low-stress livestock handling and specific management practices for raising sheep and goats (Devii Rao). Another project focused on improving beef carcass quality. An annual beef carcass evaluation and contest was held for market beef cattle exhibitors at the Yolo County 4-H Spring Show and the Yolo County Fair**.** Ultrasound imaging provides carcass measurements that are used to evaluate and rank each exhibitor’s beef carcass quality. In this way, the project provides education on the importance of carcass quality, how to understand carcass quality data, and the exhibitor’s role in the beef cattle industry (Morgan Doran).

**Participants learned about and adopted practices for more productive and sustainable animal management.**

* 100% of 48 participants in livestock health workshops said they gained useful information and 79% said they would incorporate the information into their operations within the next twenty-four months (Devii Rao).
* 100% of the 13 who returned evaluation surveys said they would incorporate information about low-stress livestock handling into their operations within the next six months. This is a new approach to livestock handling that allows the producer to gather and place livestock in particular locations on the ranch without the need for additional fencing (Devii Rao).
* Over the past eight years of evaluating beef cattle carcasses at Yolo County exhibitions, there has been a notable improvement in overall carcass quality and more attention is given to selecting and feeding animals for improved carcass quality. The youth exhibitors and their advisors have learned the importance of carcass quality and the genetic limitations and feeding practices that affect carcass quality (Morgan Doran).

UC ANR conducted research and delivered educational information to dairy producers on management practices that support environmental stewardship. UC ANR continues as an important partner in the California Dairy Quality Assurance Program (CDQAP), working in collaboration with USDA Natural Resource Conservation System and others. The CDQAP partnership conducts quarterly meetings to bring industry, government agencies, and academia together to discuss concerns related to water and air quality. Technical support was provided to dairy producers in the North Coast, San Francisco Bay, and Central Valley Regions, and to the San Joaquin Air District. A decision-making tool was created and is available online for dairy producers to use. As a result, dairy producers gained important information to better understand how water and air quality regulations fit their specific operation. In addition, work on animal protein production continued. A regional research group, with colleagues from land grant institutions and USDA Agricultural Research Service, is conducting research and developing educational products for livestock and poultry stakeholders to increase food production with social, environmental, and economic sustainability. UC ANR participated in subcommittees to inform the California Air Resources Board on non-digester technology and research needs. This included working with members from state agencies, the dairy industry, consultants, and social justice interest groups to promote alternative manure management practices (Deanne Meyer).

**Science-based information applied to animal production systems policy and decision-making.**

During FY 2018, no dairy producers were prosecuted for off-site discharge. This is partially attributed to UC ANR’s education and outreach about management practices that have led to noted changes in producers’ attitudes. However, discharge was also reduced by the drought during that time (Deanne Meyer).

* In 2017, 780 dairies acquired the California Dairy Quality Assurance Program’s environmental stewardship certification. This results in a 50% fee reduction for water quality fees. The actual value to producers exceeds $2,250,000 annually (Deanne Meyer).
* To advance animal protein production, an improved chopped forage sampling protocol was developed and implemented. Educational programs improved the understanding of the forage sampling protocol and the variability in nutrient accounting. Implementation of the improved protocol, and the greater accuracy in measuring nutrient uptake by harvested plants, will improve nitrogen management and reduce nitrate impacts to groundwater (Deanne Meyer).

These measured outcomes demonstrate ranch or farm level advances, which help the state’s overall improvement in animal management and production. California’s total livestock and livestock products cash receipts went up nearly 7% from 2016, and the cash receipts for dairy products increased slightly over 8%. In addition, because of dairy producers doing a better job at managing manure there is less impact to surface or ground waters (Deanne Meyer). Thus, UC ANR contributes to the public value of promoting economic prosperity in California, as well as the ecological viability of the livestock industry.

## Condition Change: UC ANR contributed to increased agriculture and forestry efficiency and profitability

**Endemic and Invasive Pests and Diseases**

**Issue**

Pests and diseases decrease California’s agriculture and forestry efficiency and profitability. In agricultural systems, pests reduce yields, render crops unmarketable, and make rangeland unfavorable to livestock. Just one species can be detrimental to crop production and revenues. The invasion of spotted-wing drosophila, for example, caused conventional raspberry growers in California to lose $36.4 million in revenue between 2009 and 2014, and was on track to reduce California raspberry yields by as much as 50 percent. As the global, state, and local population increases, however, crop production must increase to meet the greater food demands.

**Methods & Outcomes**

UC ANR partnered with public, governmental, and private groups to extend new knowledge and develop integrated pest management plans to increase agriculture and forestry efficiency and profitability. As a result of UC ANR research, outreach, and education, participants learned and adopted practices that led to increased agriculture and forestry efficiency and profitability. Research and activities that resulted in outcomes with specific measured indicators follow.

UC ANR academics addressed pests that affect grapes grown in the central coast, conducting research and extension programs to address new and existing pest concerns of wine grapes on the Central Coast (Larry Bettiga).In another project, applied research and trials were conducted to develop key integrated pest management plans. UC ANR’s Citrus Clonal Protection Program (CCPP) tested nearly 2,000 tree sources representing 400+ citrus varieties for budwood distribution, and then distributed citrus material to more than 2,000 users who ordered over 80,000 buds from 300+ citrus varieties (Georgios Vidalakis).

**Participants adopted recommended pest management practices, including Integrated Pest Management strategies.**

* 140 grape growers in the Salinas Valley adopted management practices and formed a cooperative pest control district and local neighborhood groups to share mealybug trap catch lessons learned and coordinate control practices between all growers in the county – particularly between adjacent vineyard properties – to reduce the impact of mealybug spread of leafroll virus (Larry Bettiga).
* At UC ANR-directed CCPP, a record number of users ordered a record number of citrus buds. Five years ago, just under 350 people were using CCPP produced budwood. Today, over 2,100 are ordering budwood for varieties that typically are not produced commercially in California. Therefore, not only has UC ANR achieved a measurable change in behavior – a 600% increase in the use of pathogen-tested citrus propagative materials – but has also reduced the risk of people smuggling desirable citrus varieties in to California (Georgios Vidalakis).

UCCE’s Rice Team developed a set of Best Management Practices (BMPs) on weedy rice, conducted a series of hands-on trainings, field days, and workshops for growers and PCAs, and launched a new website, <http://www.caweedyrice.com/> (Whitney Brim-DeForest).

**Participants adopted recommended treatment practices for invasive species.**

* UC ANR’s work on invasive weedy rice helped to change the California state seed laws concerning certification of rice seed. The laws went into effect in the spring of 2018, after extensive work from the California Rice Commission Seed Certification Committee. Recommendations for the certification committee came directly from the Best Management Practices developed by the UCCE Rice Team. As of 2019, rice growers in California can no longer save seed produced by the Rice Experiment Station, even for their own use. A new Quality Assurance Program was developed for those rice varieties that cannot be patented. It is administered by the California Crop Improvement Association (CCIA) and it ensures that seed of those varieties will also be weedy rice free (Whitney Brim-DeForest).

UC ANR scientists diagnosed production issues of large scale vegetable crop growers in California’s Central Valley, including Beet curly top virus (BCTV) in tomatoes which avoided losses approaching $100 million and providing for garlic and onion growers with GPS maps of white rot infested areas within fields to improve planting decisions (Thomas Turini). Another UC ANR scientist conducted field trials on weed control in mixed alfalfa orchardgrass hay throughout the Intermountain Region, extending research through newsletter articles, online reports, and an Alfalfa Symposium (Thomas Getts).

**Participants adopted pesticide and pharmaceutical efficacy and optimal use practices for efficiency and profitability.**

* Four very large tomato growers reduced the acreage treated with the pesticide Verimark, which is effective but costs more than $100 per acre. Due to low disease incidence present in 2018, this expense would have been unnecessarily applied to more than 20,000 acres, at a cost of more than $2 million. Additionally, one of the major processors of garlic is now treating fields at planting with fungicide, which is reducing risk of white rot and saving a substantial percentage of the crop. Damage in replicated studies has been reduced by as much as 68% with the use of a fungicide, making the savings to the garlic industry in Fresno County as high as $5 million per year in garlic (Thomas Turini).
* Data generated by the project on mixed alfalfa grass was used by the chemical manufacturer of the herbicide Saflufenacil, not currently registered in mixed alfalfa grass production in California, to submit for a California label change (Thomas Getts).

UC ANR scientists diagnosed production issues of large scale vegetable crop growers in California’s Central Valley, including Beet curly top virus (BCTV) in tomatoes which avoided losses approaching $100 million and providing for garlic and onion growers with GPS maps of white rot infested areas within fields to improve planting decisions (Thomas Turini). Another UC ANR scientist conducted field trials on weed control in mixed alfalfa orchardgrass hay throughout the Intermountain Region, extending research through newsletter articles, online reports, and an Alfalfa Symposium (Thomas Getts).Partnering with the rice industry, UC ANR scientists have also maintained a monitoring network for armyworms, created an email alert system to share results weekly with clientele, and conducted outreach to educate rice growers about monitoring and managing armyworms (Luis Espino).

**Participants used recommended pest and disease management practices for efficiency and profitability, which resulted in reduced crop losses and thus more economic gain.**

* Due to the rapid diagnosis of late blight in tomatoes, removal of the symptomatic plants, and treatment of all houses, growers have saved over $1.2 million (Thomas Turini).
* In conversations with alfalfa growers, approximately 40% of them were able to utilize the information from UC ANR’s research to prevent yield loss (Thomas Getts).
* UC ANR’s research on armyworm, another pest of rice, was fundamental to securing an emergency registration of an effective insecticide. This insecticide was used in 30,000 acres in 2018, resulting in armyworm control, and avoiding yield losses that can be as high as 20% (Luis Espino).

These measured outcomes can create, improve, and enrich the state’s ability to prevent, control, and mitigate pests and diseases. In 2017, California farms and ranches increased cash receipts for their output by almost 6% compared to the previous year, collecting over $50 billion. In these ways, UC ANR contributes to increased agriculture and forestry efficiency and profitability and the public value of promoting economic prosperity in California.

**Sustainable Food Systems**

**Condition Change: UC ANR contributed to increased agricultural efficiency and profitability.**

**Issue**

California is a national leader in agricultural production, leading the country in cash receipts for agricultural products, with farms and ranches receiving over $50 billion for their output. The state produces over two-thirds of the country’s fruits and nuts and a third of the country’s vegetables. The state’s farmers and ranchers must innovate and adapt to technical, social, and environmental challenges to maintain the economic vigor of California’s agricultural food production. Factors such as high input prices (e.g. labor, fertilizers, and pesticides) and regulations affect the profitability of farm and ranch businesses. These factors often more adversely affect small-scale and limited resource farmers because they often lack the skills or resources that larger farmers have.

**Methods & Outcomes**

UC ANR partners with public, non-profit, and private groups to create and extend new knowledge about agricultural management for farmers large and small and rural and urban. As a result of UC ANR research, outreach, and education, participants learned and adopted practices that can lead to increased agricultural efficiency and profitability. Research and activities that resulted in outcomes with specific measured indicators follow.

Research and outreach was conducted to increase plant production system efficiencies. One project focused on vineyard cultural practice optimization disseminated results through the seminar and symposia presentations and during farm calls. (Ashraf El-Kereamy). The Young Orchard Handbook was published and hundreds of copies were distributed from the website and by multiple Pest Control Advisor companies as part of their training materials. It was written about in two separate articles by Western Farm Press. In addition the information was extend through meetings with clientele (Katherine Jarvis-Shean). Research on rice was conducted to develop better fertility guidelines and explore alternative water management practices, and on diagnosing and managing weedy rice in rice cropping systems. Outreach included publications and presentations (Michelle Leinfelder-Miles & Luis Espino). In sorghum, applied research was augmented to support a growing industry. Seeding rates were trialed in grain sorghum to provide information that is relevant to California climatic and environmental conditions (Michelle Leinfelder-Miles).Further North near the Oregon border, results from an organic potato study documented how cover crops and amendments influence soil and plant nitrogen helping growers increase yields, reduce input costs, and prevent nitrate losses in the environment. These studies generated interest from USDA Natural Resources Conservation Service (Rob Wilson).

**Participants learned and adopted cultural practices or other aspects of comprehensive management systems for plant production.**

* Most of the growers in the production area for the Autumn King grape variety are now using different plant growth regulators to improve the fruit quality. This is one of the major late table grape varieties. It is anticipated that this will lead to an increase in vineyard productivity with high fruit quality, helping promote table grape marketing and profitability (Ashraf El-Kereamy).
* Growers and managers have increased their understanding of research-based approaches to establish orchards and manage young orchards. On-farm conversations/informal interviews indicate knowledge gained based on the more advanced questions they are now asking (Katherine Jarvis-Shean).
* 20 growers and industry consultants improved their understanding of planting and tillage practices in rice systems as a result of the extension presentations (Michelle Leinfelder-Miles).
* After presenting the sorghum trial results, 92% of 60 growers and industry consultants expressed a willingness to plant the low seeding rates that performed best in trials. Before the workshop most growers were planting higher seeding rates because of industry recommendations. This increased efficiency should result in good yields with lower seed inputs, and thus increased profitability (Michelle Leinfelder-Miles).
* As a result of an organic potato study, around five of potato growers in Northeast California planted over 250 acres of cover crops on their farms and/or switched their organic amendment program to match the study recommendations (Rob Wilson).

There were a number of ongoing variety trials to improve productivity. On the Central Coast research findings were extended to vineyard growers to inform planting decisions to improve yields and quality (Larry Bettiga). In the Central Valley, one collaborative project is looking for tree rootstocks that can decrease boron toxicity, given growers are asking how to properly manage this over-supplied, naturally occurring element in soil and water. Research findings were extended through local meetings and the statewide meeting hosted by the Almond Board of California, and through an interview with an industry news outlet (Katherine Jarvis-Shean). Other trials evaluated the suitability of rice varieties to various California microclimates (Luis Espino). Further North near the Oregon border, variety trials and management trials helped growers successfully grow new potato varieties including Classic, Teton, and Canela (Rob Wilson). Lastly, findings from small grain variety trials were extended through many field-based educational efforts as well as a new interactive web-based tool that provides users with customized results to be able to select the most productive and profitable varieties (Mark Lundy and Sarah Light).

**Participants adopted superior varieties of crops for plant production.**

* Research and extension on almond rootstocks in high boron conditions has led to decreased planting of the least boron tolerant almond rootstock that was previously one of the most planted rootstocks in Yolo County. Sales data from two nurseries indicate a significant increase in planting the rootstocks the trial found to be superior: sales doubled over the last few years (Katherine Jarvis-Shean).
* Vineyard growers on the Central Coast are using planting stock with preformed trunks, given it was shown to have earlier plant development with higher initial yields and labor savings from reduced training. In addition, they are avoiding rootstocks that were shown to be most susceptible to winter cold injury (Larry Bettiga).
* Growers, breeders, and other industry professionals are selecting more productive and profitable small grain varieties to grow across the diverse agroecosystems in the state. After one indoor grower meeting, 72% of the audience indicated that they were likely to use the web-based tools that help users to select superior varieties (Mark Lundy).
* Two varieties (M-210 and Calaroma-201) that were included in the trial program were released for commercial production. The variety trials results helped growers select varieties better adapted to their location. Approximately 95% of California’s rice acreage is planted to varieties that have been evaluated in the variety trials, indicating very high levels of adoption of improved varieties. These varieties have allowed growers to maintain high productivity, averaging 8,500 lbs/acre in the past ten years, which is 20% higher than average yields in other US states. Good yields and quality translate into improving economic returns for the rice industry (Luis Espino).

Education and outreach for small farmers and urban agriculturists was provided through

web-based resources and in-person workshops (Rachel Surls and Rob Bennaton). Workshops were held that focused on building producers’ skills in business management, risk management and planning, economic and market analysis, and on labor related issues (Cindy Fake and Ramiro Lobo). Additional efforts worked with state and local farm service agencies to reach Spanish-speaking audiences, and developed and maintain the Ag in Uncertain Times en Espanol Spanish website. Risk management tools and materials were developed and made available through the eRight Risk California website (<http://erightrisk.com/california/2014/default.htm>). (Ramiro Lobo). Lastly, a multi-state collaboration with University of Wyoming, Colorado State and the University of Nebraska has given California farmers access to expertise, tools, resources and educational opportunities on business and risk management not previously easily available (Ramiro Lobo).

**Participants learned about farm business management practices and marketing.**

* 90 training participants reported through a follow-up survey that they used the information after a Los Angeles area workshop on “Marketing and Business Management for Urban Farmers.” 54% to develop a new or improved marketing plan. 33% to change one or more business practice. In addition, 26% to improve sales (Rachel Surls and Rob Bennaton).
* As a result of one small farm economics and viability program in Sierra Foothills:
  + 58 producers increased their knowledge of farm and ranch risks; identified key risks; and developed a risk assessment for their operation.
  + 24 producers assessed the current profitability and determined the appropriate scale of their operations to meet the profitability benchmarks they set, and developed a plan to meet their benchmark.
  + 20 producers developed business plans, including marketing and operations plans, cash flow and capital expenditure budgets.
  + 14 producers conducted an in-depth economic analysis of their business; analyzing the operational components; evaluating costs of production and marketing; projecting potential sales; and assessing the profitability of each enterprise. These analyses help farmers and ranchers make better business decisions, and allow them to accurately assess the profitability of new enterprises and markets.
  + One rancher reported that he was able, as a result of this class, to take on a new enterprise, improving the profitability and viability of his business.
  + 20 producers developed and implemented financial analysis and recordkeeping systems, including enterprise analysis, cash flow, and profit and loss (Cindy Fake).
* As a result of the Surviving in Ag Risk Management Education Series that targeted small-scale, limited resource farmers in San Diego County. Growers have increased their understanding and ability to manage risks impacting their agricultural businesses (Ramiro Lobo).

The UC ANR Urban Ag Collaborative team rolled out a workshop series in four of the state’s largest urban communities: the San Francisco Bay Area, Los Angeles, Sacramento, and San Diego. A total of 16 one-day trainings were held reaching 581 participants. To extend the training beyond day-of-event attendees, workshop materials were made available online via UC ANR’s Urban Agriculture information portal (Rachel Surls and Rob Bennaton). Collaborative research on the specialty crop pomegranates focuses on improving fruit production, primarily the production and postharvest attributes of pomegranate. The post-harvest work evaluated pomegranate juice and fruit quality and consumer preference for different cultivars grown in the two different climatic conditions (Donald Merhaut).

**Science-based information applied to food production policy and decision-making.**

* 90 training participants reported through a follow-up survey that they used the information after the on “Legal Basics of Urban Farming” workshop in the Los Angeles area. 63% to connect with an organization they learned about at the workshop. 40% to become engaged in urban agriculture advocacy or policy work. And 33% to take steps towards participating in urban agriculture incentive zones (Rachel Surls and Rob Bennaton).
* Post-harvest information on pomegranates has been used by the juice industry in determining the actual percentage of pomegranate juice in commercial juices (Donald Merhaut).

Research and extension was conducted to increase agricultural efficiency and profitability.For example, work continued to improve production of strawberries and vegetable growers continued along the Central Coast (Surendra Dara). In addition, there are ongoing efforts to improve farm profitability, with a number of projects focusing on helping small farmers and ranchers. For example, in the Sierras Foothills workshops were held to build producers’ skills in business management, risk management and planning, economic and market analysis, and on labor related issues (Cindy Fake).

**Participants benefit from more profitable farm businesses.**

* From surveys over the last five years, 86% of small farm businesses in the Sierra Foothills who participated in UCCE farm business planning activities reported being profitable and paying themselves a salary. This is in contrast to the last USDA Ag Census (2012) which reported that less than 25% of farms and ranches in Placer and Nevada Counties had net gains, a measure of profitability (Cindy Fake).
* In a survey conducted between 2016 and 2018, 94% of respondents indicated adoption of recommended practices (including irrigation, nutrient, and pest and disease management) applied on over 145,000 acres, resulting in a minimum yield increase of 16.5% and at least $2 million additional revenues (Surendra Dara).

These measured outcomes strengthened diverse California farm businesses by helping to increase their economic returns given increased yield, reduced inputs, or improved business management and marketing. These outcomes contribute to increased agricultural efficiency and profitability; and thus, the public value of promoting economic prosperity in California. In 2017, California farms and ranches increased cash receipts for their output by almost 6% compared to the previous year, collecting over $50 billion.

## Condition Change: UC ANR contributed to increased emerging food economies and markets

**Sustainable Food Systems**

**Issue**

California is the nation’s largest agricultural producer and exporter. The state’s agricultural sector is vibrant and diverse, producing more than 400 commodities. For many of these specialty crops, California is often a major producer; for example, the state produces about 90 percent of the nation's avocado crop. The agricultural sector’s economic viability faces uncertainty at the individual farm, industry, and global levels. Competition based on price and quality requires all commodity groups and all farmers and ranchers to continually innovate to stay abreast of market forces. Small-scale and limited resource producers are more exposed to risks and more susceptible to failure, and thus need different market opportunities.

**Methods & Outcomes**

UC ANR developed new scientific knowledge and technological innovations that help create new food products and market opportunities. As a result of UC ANR research, outreach, and education, participants learned and adopted practices that help strengthen food economies and markets, local to global. Research and activities that resulted in outcomes with specific measured indicators follow.

Work continues to help growers remain competitive. UC ANR partners with public, non-profit, and private groups to help small farmers expand their market opportunities (Ramiro Lobo). Since 1995, UCCE has collaborated with the California Avocado Commission and the California Avocado Society to develop and deliver a seminar series to provide avocado growers with science-based practices so the industry can maintain its competitive edge, especially with the increase of labor constraints and water costs. (Sonia Rios, Etaferahu Takele, Ben Faber). Two projects in the San Francisco Bay Area worked to help growers diversify their operations. One project customized content for unique pastured poultry systems (Julia Van Soelen Kim).

**Participants learned about or were more likely to try out new market opportunities.**

* 73% of the attendees reported gaining knowledge from the Avocado Educational Grower Seminar Series on topics they requested to help them remain competitive, including economics, labor, pest management, water quality and usage, soil science, pruning techniques, biocontrol, salinity, and harvesting (Sonia Rios, Etaferahu Takele, and Ben Faber).
* To help support diversified farming, 71 farmers, ranchers, and agriculture supporters celebrated the Marin County agricultural community’s accomplishments over the last 40 years and envisioned the future. 88% of evaluation respondents indicated they will use what they learned in their work (Julia Van Soelen Kim). Similarly, 21 current and prospective poultry producers learned science-based information for small-scale pastured poultry production, an opportunity for diversified farming operations. 90% of evaluation respondents indicated that they will use what they learned in their work (Julia Van Soelen Kim).
* As a result of efforts to increase market opportunities for farmers in Southern California, participants identified solid leads and/or product ideas to diversify their farms, and four market tour participants established market connections for their products (Ramiro Lobo).

UC ANR scientists tested varieties and played key roles in introducing new varieties that are responding to food and marketing needs, ranging from forage crops for the low desert (Oli Bachie) to and pistachios in the San Joaquin Valley (Craig Kallsen). Information was extended locally and internationally to diverse clientele groups including growers, the food processing industry, nursery professionals, and Commodity Boards.

**Participants adopted superior varieties of crops creating new market demand.**

* Both the Giant King grass and Rhodes grass are forage varieties that are now adopted for commercial endeavor. In particular the yield and nutritive values of the Rhodes grass as a forage crop attracted the attention of various commercial growers, from the southernmost Imperial County to the Central Valley, with a planned commodity export to the United Arab Emirates (UAE) (Oli Bachie).
* The pistachio varieties Golden Hills and Lost Hills and the male pollinizer Randy gained acceptance by growers, who planted them instead of the industry standard Kerman. The earliest planted commercial acreages of these novel cultivars began bearing in 2011 and total acreage now exceeds 50,000. Significant acreage has been planted in Arizona. In addition to having superior nut quality characteristics, these earlier maturing UC cultivars are reducing the need for large expansions in huller capacity and harvesting equipment that would have been required had the industry only planted the Kerman variety. In the past two years combined, royalty and fee payments for Golden Hills alone were close to $ 4M (Craig Kallsen).

These measured outcomes helped create new market opportunities, which can expand revenue sources and thus strengthen local food systems and emerging food economies. In this way, UC ANR helps maintain the competitive edge of the California food system and the state’s role as a global leader in agriculture -- contributing to the public value of promoting economic prosperity in California. In 2017, California’s exports increased slightly over the year before, and almost double the amount 10 years ago.

# Safeguarding abundant and healthy food for all Californians

## Condition Change: UC ANR contributed to improved food security

**Healthy Families and Communities**

**Issue**

One out of every eight Californians does not know where their next meal will come from. Of the 4.6 million Californians facing food insecurity, 1.7 million are children. Food insecurity for youth increases school absences and behavioral problems, and reduces children's concentration and academic achievement.

**Methods & Outcomes**

UC ANR’s research creates practical solutions and delivers educational programs promoting improvement in individual and household food budget practices. As a result of UC ANR research, outreach, and education, participants learned and adopted practices that lead to improved food security. Policy engagement activities contributed to knowledge gain and science-based decision making. Specific activities that resulted in outcomes with measured indicators follow.

UC ANR academics provided academic oversight, leadership, and guidance for the statewide implementation of the Expanded Food Nutrition and Education Program (EFNEP), UC CalFresh Nutrition Education Program (UC CalFresh), and the UC Master Gardener Program, which delivered direct education to participants related to food security. UC ANR piloted new programs and methods to reach new communities that are potentially food insecure. For example, EFNEP piloted a program at a public library in Riverside County as a method to improve low participation rates of SNAP-eligible, potentially food insecure families in the federally funded summer meals program. Feedback from the families confirmed that providing educational enrichment activities in conjunction with the meals is an effective strategy for improving participation. UC ANR academics developed relationships with communities to develop new curricula and deliver culturally relevant educational programs. For example, one UC ANR academic collaborated with the Karuk, Yurok, and Klamath tribes in delivering workshops and seasonal food camps focused on understanding, finding, gathering, and processing edible native foods and fibers as well as other subsistence skills (butchering, canning, bread baking etc.) as part of the Tribal Food Security Project.

**Participants learned about and improved food resource management practices.**

* EFNEP participants responded to surveys about their participation in a nutrition education program and 47% of over 4,000 EFNEP participants showed improvement in one or more food security indicators (i.e., not eating less than you wanted so there was more food for your family or having enough money to get food for your family).
* Over 1,200 UC CalFresh participants responded to a survey about their experiences with the Plan, Shop, Save and Cook curriculum, designed to help adult participants stretch food dollars by learning shopping strategies and meal planning.
  + Participants adopted resource management behavior changes such as planning meals more often (42%), shopping with a list more often (45%), and comparing unit prices more often (44%).
  + Participants reported improved food security by running out of food less often (36%).
* Over 800 participants of Master Gardener volunteer-led public education events responded to a survey about their food gardening practices related to food security. Participants reported applying gardening practices that reduced food loss (45%) as well as donating produce to community programs that distribute food to individuals in need of food assistance (13%).
* EFNEP participants of the pilot program in Riverside County completed surveys which show that over 85% of children improved in at least one core area: diet quality, food safety, and physical activity. As a result of this nutrition education program, families utilized the summer meals program, even though they were not intending to (Chutima Ganthavorn).
* The Tribal Food Security Project reached approximately 1450 participants in its final year. Program evaluations indicate that between 80-100% of participants learned something new at each camp, and between 63 – 100% of participants wanted to learn more or implement their new learning, which can contribute to food security (Jennifer Sowerwine).

UC ANR conducted policy engagement activities, including providing evidence-based, participating in networks, developing relationships, and facilitating information transfer. UC ANR academics’ work informed decision-makers at the state level, such as the California Department of Health, and at the local level, such as the Marin County agencies and food policy councils.

**Science-based information applied to food security policy and decision-making.**

* As a result of UC ANR Nutrition Policy Institutes’ collaboration with the California Department of Public Health in research-to-policy efforts, counties utilized profiles developed to communicate the need for SNAP-Ed work, and help them target specific areas of need during their Integrated Work Plan planning process to achieve better food security and health outcomes for individuals reached by the program (Amanda Linares).
* UC ANR’s local policy engagement activities in Marin County led to increased awareness of the issues among the food policy council board of supervisors; greater interdepartmental collaboration between UC Cooperative Extension, Health and Human Services, and the Community Development Agency; and increased alignment and an elevated urgency around two pressing policy priorities: low rates of CalFresh participation and lack of a grocery store in Marin City. Subsequently, these efforts informed the resurgence of county-wide taskforces on Healthy Eating Active Living (Julia Van Soelen Kim).

These measured outcomes demonstrated learning and behaviors changes related food resource management and informed decision-making that can lead to food policy changes at the state and local levels. According to the USDA Economic Research Service, the estimated percentage of food-insecure households in 2013-2015 was 12.6%, which decreased by 3% from 2010-2012 estimates. UC ANR’s efforts contribute to the public value of safeguarding sufficient, safe, and healthy food for all Californians.

## Condition Change: UC ANR contributed to improved food safety

**Healthy Families and Communities**

**Issue**

California is a national and global leader in food production and agricultural export. The state faces social, regulatory, economic, and environmental challenges that affect our agricultural and food systems, our communities, and our public health. The Center for Disease Control and Prevention estimates that 1 in 6 people get sick from foodborne diseases each year, including 128,000 hospitalizations.

**Methods & Outcomes**

UC ANR delivers educational programs promoting improvement in farm, individual, and household food management practices. As a result, participants learned about and adopted farm, individual, and household food safety behaviors. Specific activities that resulted in outcomes with measured indicators follow.

UC ANR academics provided research-based information and programmatic oversight to statewide program extenders, such as UC Master Food Preserver (UC MFP) volunteers, who were then able to provide information to the public. UC MFP was delivered in 17 California counties by over 400 volunteers, who donated over 19,000 volunteer hours. In San Luis Obispo and Santa Barbara Counties, almost 900 low-income residents, the majority of whom are Spanish-speaking, received safe food preservation information and tools such as ice cube trays for implementing new practices. Other statewide programs that extended food safety information included the UC 4-H Youth Development Program, UC CalFresh Nutrition Education Program (UC CalFresh), and Expanded Food and Nutrition Education Program (EFNEP).

**Participants learned and adopted home food safety practices.**

* Over 600 participants in San Luis Obispo and Santa Barbara Counties responded to surveys about their experience with the UC Master Food Preserver program and reported increases in knowledge of food safety and/or safe food preservation techniques (99%) (Katherine Soule).
* Over 1,000 4-H youth responded to the Healthy Living common measures survey about what they may have learned at 4-H and 75% of youth report knowing how to keep a cooking area clean to stop spreading of germs.
* EFNEP surveyed over 4,000 participants and over 5,700 youth participants about behavior changes as a result of participating in the program.
  + 83% of adult participants showed improvement in one or more food safety practices, such as washing hands before preparing food or using a meat thermometer).
  + 50% of youth participants used safe food handling practices more often or gain knowledge such as washing fruit and vegetables before eating or putting foods back in the refrigerator within 2 hours.

UC ANR academics delivered both online and in-person farm food safety workshops; in-person workshops enable peer-to-peer sharing of knowledge and experiences which can lead to earlier adoption of new practices. Almost 600 urban farmers throughout California attended online and in-person workshops about food safety basics. Specialty Crop producers in Placer and Nevada Counties participated in on-farm workshops about food safety and managing risks. In Mendocino and Sonoma Counties, 71 small-scale produce farmers attended workshops about farm food safety workshops.

**Participants adopted farm food safety behaviors.**

* 90 urban farmers responded to a survey after completing online food safety workshops and reported the following behavior changes (Rachel Surls).
  + 68% of respondents identified food safety risks on their farm.
  + 53% of respondents developed and implemented a food safety plan for their farm.
  + 35% of respondents kept records of date and type of food sold/donation.
* Specialty crop producers in Placer and Nevada Counties identified key food safety risks and developed a plan to manage those risks on their farms after attending on-farm workshops (Cindy Fake).
* Small-scale produce farmers in Mendocino and Sonoma Counties increased their food safety knowledge, enhanced their ability to comply with regulations, and improved wholesale readiness in the region (Julia Van Soelen Kim).

These measured outcomes demonstrate improved knowledge and skills around farm, individual, and household food safety practices. In this way, UC ANR contributes to the public value of safeguarding sufficient, safe, and healthy food for all Californians.

# Protecting California’s natural resources

## Condition Change: UC ANR contributed to improved management and use of land

**Sustainable Natural Ecosystems**

**Issue**

Public and private land in California is managed for a wide variety of uses, and one of the most significant challenges in the state is serving areas where land uses are changing. Challenges include addressing sprawl, loss of productive working landscapes, the growing urban/rural/wildland interface, human and wildlife conflicts, protecting water quality and better understanding ecosystem services. These challenges can be addressed through planning, and research and extension are needed to help land managers and owners balance the social, economic and ecological benefits of these landscapes. Land management decisions at the local level will be increasingly important to the health of our natural environment and communities.

**Methods & Outcomes**

UC ANR activities focus on management strategies with regard to livestock, wildlife and land maintenance. Research and activities that resulted in outcomes with specific measured indicators follow.

Field data collection and extension addressed issues with livestock, wildlife, and road maintenance. A Beef Cattle Cost Study was conducted to document the cost associated with cow-calf grazing that would support conservation on public lands. Additional research focused on grazing for biological conservation and was used to inform the development of local conservation plans (Shelia Barry). One researcher collected local data for a statewide project to determine erosion capability from rangelands. This data came from the long-term forage production project of measuring biomass as it relates to bare ground and was compiled to model erosion statewide. Further efforts focused on collaboration with a Resource Conservation District and the Society of American Foresters to design and implement a road design and maintenance workshop (Royce Larsen).Another research project examined the impact of wild horses on private land and rangeland grazing allotments. Research-based information was shared with range managers and the public through briefing papers, tours, interviews, popular press articles, presentations and social media reaching over 10,000 people (Laura Snell).

**Participants learned about or adopted strategies and techniques for sustainable use of range, forest and wildland natural resources.**

* Projects have contributed to at least four public agencies managing over 149,000 acres of grazing land, re-evaluating their lease arrangements to improve rancher sustainability (Shelia Barry).
* Surveys for the road maintenance workshop indicated that 100% gained useful information. Also, 60% will implement what they learned within 6 months, while 25% will within 12 months, and 15% within 24 months (Royce Larsen).
* Due to the extension efforts to improve the understanding of wild horses on rangeland, in 2018 nearly 1,000 wild horses were gathered from rangelands and adopted. The project received the National Rangeland Management Award from the US Forest Service (Laura Snell).

One academic surveyed ranchers to understand their familiarity with non-lethal control methods for wildlife and their experience of success or failure with those methods. Reports including the survey results were prepared for the local Board of Supervisors (John Harper). Another project conducted research in response to suggestions from local groups to eliminate grazing access in Sierra National Forest given the concern that it posed a threat to water quality. However, the test demonstrated that E. coli levels were safely below the EPA threshold (Rebecca Ozeran).

**Science-based information was applied to public land policy and decision-making.**

* A Board of Supervisors used science-based information to make decisions about continuing a contract with professional wildlife control agents once they understood the science behind non-lethal tools as a form of wildlife control (John Harper).
* Water quality testing validated the USFS grazing standards, in response to claims of livestock-related pollution. By continuing to allow livestock to graze, local livestock producers have access to high-quality forage in the summer and the forest ecosystem benefits from grazing to keep meadows open and reduce brush encroachment(Rebecca Ozeran).

The aforementioned measured outcomes demonstrate improved knowledge and adoption of land management practices. UC ANR has contributed to improvements in land use policies and land management practices that can help maximize the benefits that managed lands provide. Thus UC ANR contributes to the public value of protecting California’s natural resources.

## Condition Change: UC ANR contributed to improved air quality

**Sustainable Natural Ecosystems**

**Issue**

Ozone and air pollution can harm people and crops, among other things. San Joaquin Valley, home to 10% of California’s population, has some of the most polluted air in the United States. This pollution causes 1,300 premature deaths per year, as well as asthma attacks, emergency room visits, and lost school and work days costing valley residents $11 billion each year. California has been at the forefront of developing ways to mitigate air pollutant concentrations and the impacts of existing air pollution. Projects have provided information to growers, producers, and regulators regarding impacts and sources of air pollutants related to agricultural productivity.

**Methods & Outcomes**

UC ANR partners with public, governmental, and private groups to extend new knowledge and develop agricultural management practices to improve air quality.As a result of UC ANR research, outreach, and education, participants learned and adopted practices that lead to improved air quality. Specific research and activities that resulted in outcomes with specific measured indicators follow.

UC ANR scientists have collaboratively conducted numerous fungicide efficacy trials for powdery mildew control in tomatoes, beginning with sulfur. Educational programs for growers and pest control advisers (PCAs) have outlined the best management practices for sulfur use to guide the behavior of growers and PCAs. In particular, UC ANR researchers recommended the application of sulfur by ground equipment rather than airplane or helicopter, which should lead to less off-target movement of pesticides and thus improved air quality (Brenna Aegerter).

**Participants adopted recommended pest management practices, including integrated pest management strategies.**

* Data analysis that was just completed indicated that there was a 26% greater use of dust versus sprayable sulfur and greater use of ground application versus air, from 18% of acres treated by ground in 2006 to 58% of acres treated by ground by 2015 – 203,105 more acres were treated by air application to ground application (Brenna Aegerter).

Further research has been focused on understanding the impact that air pollution from particulate matter has on plants. Recent projects have shown that particulate matter pollution increases plant water loss and reduces the plant's ability to regulate water loss. Additionally, the studies demonstrated that some invasive weeds are much more resistant to ozone and drought than the crops with which they compete (David Grantz). Another study focused on measuring greenhouse gas emission estimates on dairies. Specifically, academics measured precursors to greenhouse gases and identified primary housing and manure storage /treatment systems that are essential to include in greenhouse gas dairy sector emissions estimates (Jennifer Heguy).

**Science-based information was applied to air quality policy and decision-making**

* The work on the impacts of particulate matter on plants has been incorporated into US Environmental Protection Agency (EPA) supporting documents for the process of developing a secondary welfare standard for both ozone and for particulate matter. For context, EPA secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" air pollutants (David Grantz).
* Information on greenhouse gas estimates for dairies has been relayed to the Air Resources Board of California via progress reports and the results will assist in their work to regulate greenhouse gas emissions moving forward (Jennifer Heguy).

These measured outcomes demonstrate the state’s ability to preserve natural ecosystems alongside increases in agricultural productivity. Thus, while in 1967, there were 239 Stage 1 & 2 smog alerts, in 2016 there were zero Stage 1 & 2 smog alerts. In these ways, UC ANR contributes to improved air quality and the public value of promoting healthy communities.

## Condition Change: UC ANR contributed to protected and conserved soil quality

**Sustainable Natural Ecosystems**

**Issue**

Soil health is essential for productive agriculture lands. Critical issues that require solutions in California include addressing salinity and nutrients in the soil. More than half of California’s irrigated cropland is affected by salinization. Salinity can challenge growers’ ability to grow crops, especially under conditions of reduced water flows during droughts. In recent years, 88,000 acres of farmland have been retired in two central valley counties because the soil is too saline to grow food. Additionally, nitrogen fertilizer use can lead to excess nitrogen in the soil and further leach into water supplies. When soil is healthy, nitrogen leaching is reduced and more nutrients can be used by crops again. Proper understanding and care of soil is essential for a healthy and abundant food supply for Californians.

**Methods & Outcomes**

UC ANR develops research projects and extends information throughout the state to better monitor and understand soil composition, impacts from agricultural uses, and improved management strategies to conserve soil. As a result of UC ANR research, outreach and education, growers learned and adopted practices that demonstrated improved soil quality and conservation practices. Research and activities that resulted in outcomes with specific measured indicators follow.

Three salinity projects, spanning three years, focused on intensive soil and water sampling to gain knowledge on leaching fractions in alfalfa soils in the Sacramento Delta region and to better understand how surface water quality and rainfall were affecting leaching fractions. This applied research led to newsletters, blog articles, and presentations and included information for growers on the impact conversion to drip irrigation has on water use and soil salinity (Michelle Leinfelder-Miles). Another set of collaborative projects studied the levels of nitrate in tile drainage water in Monterey County. UC ANR research has shown what levels of nitrogen (N) fertilizer reductions are possible with different levels of nitrate-N in the water. Trials consisted of farm-scale projects evaluating the use of nitrate-N in irrigation water for crop production, increase nitrate retention in soils, determining nitrogen uptake by vegetable crops, and evaluating nitrate immobilization in winter-fallow beds (Richard Smith).

Other projects have focused on improving or maintaining interactive online soil survey applications. This work includes a package of interactive Web-Apps called SoilWeb, including SoilWeb GMap, SoilWeb Earth, California Soil Properties App, Soil Series Extent Explorer, and the Soil Data Explorer. These apps continue to receive an average of 500 to 1,000 visits per day (Anthony O’Geen). In addition to the applications, decision support tools have been repackaged to include soil survey models. These interactive tools help stakeholders characterize water resource challenges and apply mitigating management practices. Specifically, one tool predicts annual soil loss for rangelands, nitrate leaching hazard ratings for all agricultural soils, and characterization of water resources in soils to identify water saving opportunities (Anthony O’Geen).

Participants learned about or adopted recommended soil and water management practices.

• Forty-one percent of meeting participants gained knowledge on effective salinity management. Outreach occurred at the peak of a drought, when winter rainfall was too low to provide leaching, and it was valuable for growers to understand how they could augment leaching by leveraging rainfall with irrigation (Michelle Leinfelder- Miles).

• Several growers have begun using controlled release fertilizers to improve Nitrogen Use Efficiency and a new nitrification inhibitor is being registered for use on leafy vegetables (Richard Smith).

• Growers’ interest has increased in organic soil amendments with high carbon content as a means to sequester nitrate in the soil during the winter fallow period to help reduce nitrate leaching with rain (Richard Smith).

• The SoilWeb app has been adopted as a practice to learn about soil management for a variety of land use applications, including open water, wetlands, rangelands, grasslands, forest, urban land, and crop land. Thousands of people are using the survey apps each year to better understand data available on soils (Anthony O’Geen).

These measured outcomes demonstrate growers learned and adopted practices that improve soil quality and conservation. California launched the Healthy Soils Program in 2017, for which UC ANR is a partner, and has resulted in grants awarded to 84 farms for improved on-farm soil fertility. An improved understanding of salinity and nitrate management will help to protect and conserve soil quality. Thus, UC ANR contributes to the public values of protecting California’s natural resources.

## Condition Change: UC ANR contributed to increased ecological sustainability of agriculture, landscapes, and forestry

**Endemic and Invasive Pests and Diseases**

**Issue**

Endemic and invasive pests and diseases cause widespread damage to agriculture, landscapes, and forests. The spread of invasive pests has increased in recent decades, linked to global travel, produce trade, and climate change. According to the USDA, invasive species are responsible for $137 billion per year in economic losses in the United States. In 2016, the California Department of Pesticide Regulation notes that California used over 208,000,000 pounds of pesticide. Pesticide often used to control weeds, insects, and other pests, when used incorrectly, can cause environmental problems. Growers, land managers, and forestry experts need pest management tools and strategies that minimize impact on natural pest enemies and pollinators, potential for water quality problems, impact on aquatic invertebrates, and endangered species.

**Methods & Outcomes**

UC ANR partners with public, governmental, and private groups to develop and extend new knowledge about integrated pest management (IPM) for growers and land managers. As a result of UC ANR research, outreach, and education, participants learned and adopted practices that led to increased ecological sustainability of agriculture, landscapes, and forestry. Research and activities that resulted in outcomes with specific measured indicators follow.

One project conducted field trials on tomatoes to evaluate the impact of varying spray intervals and chemical groups on powdery mildew disease (Brenna Aegerter). For strawberry crops, another UC ANR scientist conducted field studies identifying solar-light traps as effective against pests; effective botanical and microbial fungicides on fruit diseases; and fungi that can promote fruit yield (Surendra Dara). To slow the loss of oaks to Goldspotted oak borer (GSOB), UC ANR researchers developed best management practices (BMPs), integrated pest management (IPM) strategies, and mapped the extent, intensity and history of the spread of Goldspotted oak borer (Thomas Scott). Additionally, IPM research focused on managing white rot and maggots in garlic and onions (Rob Wilson). One UC ANR academic coordinated a webinar series for California Invasive Species Awareness Week that had over 100 viewers, covering topics like tree pests, aquatic invasive species, and the interaction between invasive plants and fire (Sabrina Drill). For UC ANR’s Healthy Garden – Healthy Home Program, UC Master Gardeners provided education about least-toxic pest management methods, reducing runoff, and other related issues for 103 community events around San Diego County, reaching approximately 27,500 individuals (Cheryl Wilen).

**Participants learned or adopted pest management techniques, including Integrated Pest Management strategies.**

* New knowledge about mildew has been used by chemical manufacturers, growers, and pest control advisers (PCAs) on 120,000 acres working to manage this disease and minimize fungicide resistance development (Brenna Aegerter).
* For the strawberry and vegetable IPM program, online post-surveys of meetings indicated that 100% of 58 respondents gained useful information and 85% would use information. Feedback for related eJournal articles showed that 98% of 291 respondents found the information useful and 91% have used/will use information on strawberry and vegetable IPM (Surendra Dara).
* In pre- and post-tests of pest management, water quality, and runoff knowledge for the Healthy Garden – Healthy Home Program, 98% of 103 respondents indicated that they learned 2 or more least-toxic pest management methods, techniques or ideas that they would use in the future and 93% indicated that that they learned 3 or more methods, techniques or ideas that they would use in the future (Cheryl Wilen).
* For white rot and maggots in onions and garlic, nearly all growers in Tulelake, several growers from the Central Valley, and many growers from outside California have adopted recommendations resulting in improved management of one or all these pests (Rob Wilson).
* 40 participants of California Invasive Species Awareness Week who completed a short survey all felt they learned something, nearly half planned to share the information, 31% planned to look for signs of pest infestation, and 42% planned to undertake activities to prevent the spread of invasive pests, like not moving firewood or draining and cleaning gear that went in the water (Sabrina Drill).
* In efforts to protect California oaks from Goldspotted oak borer, there are now 14,800 acres of treated demonstration woodlands involving over 100 cooperators 11 locations. GSOB maps have been used by the California Department of Forestry (CDF) to develop and amend the zone of infestation for GSOB. The maps have also been used to identify communities at risk for importation of GSOB-infested firewood, to calculate the rate of spread for GSOB, and to show the impact of UCCE outreach to slow human-transportation of GSOB to new locations (Thomas Scott).

One project conducted brown marmorated stink bug (BMSB) sampling in peach and almond orchards, finding BMSB adults in peach, which was the first report of the BMSB invasion in California agriculture, and subsequently discovering BMSB infestation in almonds, the first report of BMSB infestation in almonds in California and elsewhere; this information has been extended to the Almond Board (Jhalendra Rijal). For Asian citrus psyllid, a serious pest of citrus native to the Indian subcontinent that spreads a citrus-killing bacterium, UC ANR researchers have employed biological control, importing its natural enemies, mass rearing, and releasing them to establish, spread, and impact the target pest populations (Mark Hoddle). Another project promoted the use of Aphytis wasps to control California red scale by facilitating releases with growers (Cindy Fake).

**Participants learned or adopted recommended treatment practices for invasive species.**

* 86% of 42 farmer and landscaper participants in an invasive pest management seminar were able to correctly identify key fruit tree and vine pests discussed, 85% were able to identify damage or impacts of key pests, and 95% were able to identify appropriate actions to manage those key pests (Cindy Fake).
* The almond industry has gained awareness of BMSB as a new pest in almonds. Several growers and PCAs are now using the new trap for brown marmorated stink bug (BMSB) detection and UC ANR’s feeding damage pictures have been used by trade magazines and other farm advisors in their educational programs (Jhalendra Rijal).
* With respect to Asian citrus psyllid, more than 10 million natural parasitoid enemies have been mass reared and released in California in cooperation with the California Department of Food and Agriculture (CDFA). Establishment has been confirmed at 95% of release sites, parasitoids have spread up to eight miles without human assistance, and pest populations have declined on average by about 70% (Mark Hoddle).

UC ANR academics investigated chemical and non-chemical alternatives to the now banned methyl bromide pre-plant fumigant for strawberries and caneberries through hand-in-hand coordination with the Santa Cruz County Agricultural Commissioner (Mark Bolda). In pesticides, one project conducted field trials and monitoring the control of medusahead, an invasive weed, which allowed the return of perennial grasses (Thomas Getts). Another project organized and conducted educational presentations to a total of 469 attendees explaining pest management for sorghum and general IPM principles of controlling pests in dairy forage crops (Nicholas Clark). Field tests of new nematicides have been conducted for control of Columbia Root-knot nematode in potatoes to collect local data for California registration of several new low-risk nematicides labeled in other states (Rob Wilson). UC ANR scientists conducted fumigant studies in strawberry grower fields, disseminating in-progress information and final results during field days and meetings, online, and through publications (Oleg Daugovish). Another led field trials on tomatoes to evaluate the impact of varying spray intervals and chemical groups on powdery mildew disease (Brenna Aegerter). Another project promoted the use of Aphytis wasps to control California red scale by facilitating releases with growers (Cindy Fake).

**Participants adopted pesticide and pharmaceutical efficacy and optimal use practices for ecological sustainability.**

* Commercial field trials on fungicides helped the vegetable industry obtain new registrations, including Vivando, Luna Sensation, Rhyme, and Orondis Ultra (Brenna Aegerter).
* Data generated from the study of Indaziflam to control medusahead on rangelands has helped the manufacturer submit to the EPA for a grazing label and will be utilized for Indaziflam labeling in California (Thomas Getts).
* Metam potassium (KPAM) crop termination is being used as an alternative to standard fumigant use on the Central Coast (Mark Bolda).
* Ventura County phased out methyl bromide fumigant for strawberries and adopted fumigant application technologies identified and shared by UC ANR scientists, including tarps that reduce emissions and allow reduction in fumigant application rates (Oleg Daugovish).
* For pest management in potatoes, the nematicide trial provided necessary data to allow for the California registration of Velum Prime and Nimitz to control Columbia root knot nematode (Rob Wilson).
* Five years of UC ANR research made possible the temporary registration of Sulfoxaflor, an insecticide mainly for Lygus bugs in strawberry with an attractive environmental profile (Mark Bolda).
* Data from UC ANR research supported the registration of several insecticide labels in California for the management of Sugarcane Aphid in sorghum as well as the registration of a novel use of an existing insecticide for the same purpose which will improve efficacy of the insecticide while reducing risk to workers, non-target organisms, and the environment. As a result, these researchers observed a reduction in the use of unnecessary insecticide applications -- reduced number of less-effective insecticide applications and reduced number of insecticide applications by improved early season control and pest monitoring methods (Nicholas Clark).
* 41% of citrus orchards in Placer County now use Aphytis wasps rather than spraying (Cindy Fake).

One UC ANR scientist presented the results of strawberry and vegetable studies at various extension meetings, in trade and extension articles, and added through an IPMinfo app (Surendra Dara).

**Participants used recommended pest and disease management practices for ecological sustainability, which resulted in reduced crop losses and thus more economic gain.**

* Survey of strawberry and vegetable growers indicated that new IPM practices were applied on 6,305 acres with a 100% change in behavior contributing to 15% of yield increase valued at $550,000 (Surendra Dara).

These measured outcomes can create, improve, and enrich the state’s ability to prevent, control, and mitigate pests and diseases. In these ways, UC ANR contributes to the increased ecological sustainability of agriculture, forestry, and urban landscapes and the public value of protecting California’s natural resources, helping California realize the many benefits of the state’s rich and diverse natural resources. However, there is more work to be done, as the agricultural sector contributes to 8% of greenhouse gas emissions in California, one of the indicators of climate change.

**Sustainable Food Systems**

**Issue**

California’s growing population of over 40 million people raises environmental concerns, including decline in pollinator populations, green waste, and water-related issues, for the state’s urban landscapes and urban-rural interfaces. There is opportunity to improve landscape management industry practices; for example, fertilizer and pesticide applications that can reduce negative impacts surface water contamination. There is also the need to conserve water, such as by reducing water use in turf landscapes like playing fields, golf courses, and office parks. In addition, California’s Assembly Bill 341 mandates a 75 percent reduction in the amount of green waste going to landfills by the year 2020. The decomposition of green material in landfills produce methane, a greenhouse gas with global warming potential approximately 25 times higher than carbon dioxide.

**Methods & Outcomes**

UC ANR translates research into actionable management strategies to promote increased ecological sustainability of landscapes. UC ANR partners with public, non-profit, and private groups to create and extend new knowledge about environmental horticulture. Through UC ANR outreach and education, management of landscapes is being made more ecologically sustainable. Research and activities that resulted in outcomes with specific measured indicators follow.

In FY 2018, over 6,000 UC Master Gardener volunteers offered close to 400,000 volunteer hours in over 50 counties sharing research-based information on environmental horticulture to help the public more sustainably grow home, community, and school gardens. Lastly, a more specific effort worked to promote the sustainability of California’s many palms, which are widely planted and increasingly common components of California landscapes. New research-based information about selection and management of palms under California’s climate regimes and soil types was developed and extended. In these ways UC ANR translated research into actionable management strategies to protect our urban environments.

Another environmental horticulture effort has graduated a total of 56 Qualified Green Gardeners, with 15 during 2018, from large and small landscape companies, school districts, parks departments, Regional Conservation Corps, California State University Stanislaus, and UC Merced (Karrie Reid). Lastly, another project focuses on promoting the sustainability of California’s many palms (Donald Hodel).

**Participants learned and adopted recommended practices for sustainable landscaping**.

* Members of the public participating in the volunteer-led UC Master Gardener education events reported the following, through a statewide follow up survey:
* Created and enhancing pollinator friendly gardens: For example, 70% (of 424 participants) started or improved their use of plants that attract and support pollinators, and nearly 55% started or improved the practice of providing water sources for pollinators. They also learned about creating nesting habitats. They reported applying what they learned to over 2 million square feet of pollinator habitat. This improves yields in home food gardens and supports local agriculture productivity.
* Used recommended green waste reduction practices; for example, 68% of 719 started or improved selecting plants for size, sun, needs, water needs, and maintenance level. This reduces plant mortality and contributes to less green waste in landfills.
* Adopted improved landscape water use efficiency practices; for example, 67% of 587 started or improved selecting low water-use plants. In addition, participants reported removing over 135,000 square feet of turf. These practices reduce water use, helping conserve California’s precious water resources.
* Adopted integrated pest management practices; for example, 54% of 632 started or improved removal of or not introducing invasive plants. This slows their spread and protects natural and managed ecosystems.
* As a result of the Qualified Green Gardeners program, 100% of participants reported, through in-course exit surveys, that they gained important knowledge in one or more areas covered and 94% reported the intention to implement all 16 sustainability practices polled (Karrie Reid).
* As a result of the palm project, clientele surveys showed 50% to 70% participants used irrigation guidelines which help to reduce landscape water use and runoff; and nutrition guidelines which emphasize applications of slow-release fertilizers that help to reduce nutrient leaching and runoff. Together these reduce landscape water use and contamination of California’s groundwater resources. In addition, awareness of the South American palm weevil helps reduce tree mortality, resulting in less green waste in landfills (Donald Hodel).

Together these measured outcomes demonstrate that because of UC ANR’s efforts some landscapes are more ecologically sustainable. They now better protect water quality and reduce green waste going to landfills, which helps improve air quality. In this way, UC ANR contributes to the public value of protecting California’s natural resources. However, there is more work to be done – the statewide recycling rate, which includes composting, continues to decrease.

**Sustainable Natural Ecosystems**

**Issue**

Nearly 33 percent of California’s landscapes are covered by forest and rangeland covers an additional 57 percent of the state. These landscapes provide clean air, carbon sequestration, clean water, and habitat for plants and wildlife. There is a critical need for land owners and managers to understand the effects of different management practices including restoration and conservation to these services. Identifying methods for ecosystem restoration and ecosystem management practices will ensure that California’s plants, wildlife, and other natural resources can continue to thrive.

**Methods & Outcomes**

UC ANR has led collaborative research and extension efforts and provided support to develop new policies in an effort to increase ecological sustainability of forests and rangelands. Research and activities that resulted in outcomes with specific measured indicators follow.

UC ANR activities in 2018 included research on rangelands, development of new technological tools, and extension of new policies and regulations. Advisors have worked with the East Bay Municipal Utility District (EBMUD) staff and rangeland permittees to develop a monitoring program for the EBMUD managed Mokelumne Watershed. This work included developing an online platform to collect data in the field and creating a web-based resource guide and map of Bay Area rangelands (Theresa Becchetti). Projects like this are supported by resources and technology from UC ANR’s Informatics and Geographic Information Systems Program which has delivered 52 workshops across California since July 2015 and reached nearly 800 people. These include workshops included GIS for Forestry, GIS for Agriculture, Drone Technology, WebGIS, Mobile Data Collection, and other topics (Maggi Kelly). At the request of CalFire, one academic extended information about reforestation after bark beetle infestations at three workshops reaching 82 landowners and partners. Workshop topics included effective reforestation, planting needs at different scales, procuring seedlings, mortality in plantations, technical and financial assistance (Susie Kocher). In 2018, with information based on UC ANR research, California Senate Bill 901 allowed landowners to use a permit process to carry out forest harvests in an effort to preserve or restore oak woodlands. UC ANR’s research provided the much-needed evidence for the policy changes (Yana Valachovic). Additionally, to support the new permit process and facilitate understanding, UC ANR provided outreach, presentations, field tours, and data to interested stakeholders, Board of Forestry members, foresters, landowners, and legislative representatives. Finally, UC ANR provided oversight on a collaborative project focused on the restoration and management of deciduous oak woodlands (Lenya Quinn-Davidson).

Another project focused on rangeland restoration. Restoration is important to provide quality forage for livestock as well as to protect an ecosystem, but restoration costs can exceed $350 per acre. Two long-term ongoing restoration projects are testing the seeding of native and introduced perennial grasses following weed control applications. Restoration treatments that include introduced perennial grass species have been more effective at preventing weed re-infestation, but had less overall plant species diversity compared to treatments of pure native perennial grasses and annual grass species. The information from these projects will help evaluate potential success and the value of ecosystem services provided from both high-cost restoration options with native species and low-cost options with introduced species (Doran).

**Landowners adopted recommended strategies and techniques for sustainable use of range, forest and wildland resources.**

* The changes to the watershed monitoring program were adopted by the EBMUD staff and have been well-received by staff and permittees. The GIS platform developed greatly reduces the time to create maps in the office after field collection of data (Theresa Becchetti).
* Workshop participants increased their understanding of tree mortality and reforestation (98% knew how to approach tree mortality and replanting, compared to 24% at the start of the workshops) (Susie Kocher).
* Seven new permits that enable landowners to restore oak forests were utilized in 2018 and three more are currently in development as a result of this outreach (Yana Valachovic).
* Extension about oak restoration has led to planning and contracting several projects covering 300 acres. In 2018, 212 acres of oak woodland have been successfully restored. Additionally, with support from UC ANR, the Natural Resources Conservation Service now has a legal permitting pathway for their oak restoration programs (Lenya Quinn-Davidson).
* The rancher who hosted a Napa County research project was sufficiently convinced of one treatment to invest in a range seeding drill and has since seeded an additional 80 acres, an investment of approximately $40,000. Another livestock producer seeded a 40 acre field to perennial grass species after seeing early results at a field day (Morgan Doran).

Other research projects provided support to policy development to protect forest and stream health. One project focused on developing tools that help landowners and managers rapidly assess forest health. Specifically, researchers evaluated seasonal timing and spatial patterns of tree stress and insect attacks to identify the optimal biological window in which to conduct unmanned aerial system (UAS) detection flights. In partnership with private and public forest managers GIS tools were developed to support management strategies that minimize tree stress and mortality from bark beetle infestations. This work led to two policy oriented publications that identified how to use existing tools to overcome barriers to forest management, and how forest management plans can help establish healthy resilient forests (Jodi Axelson). Researchers are also studying how water use for cannabis cultivation may impact stream flows needed for health and survival of endangered and other aquatic organisms. Other cannabis cultivation related research includes understanding the impacts on wildlife interactions and movement. The Berkeley Cannabis Research Center has been founded at UC Berkeley and researchers have focused on a variety of scientific methods to research the ecosystem impacts of cannabis, including remote sensing, spatial econometric techniques, and surveys to gather scientific data. Outreach to grower organizations, local and state government agencies, and non-profits is helping facilitate research and sharing of results (Van Butsic).

**Science-based information was applied to forestland policy and decision-making.**

* Science-based research supported the development and adoption of state bills, AB 616 (The California Forest Carbon Plan) and SB 901 (Wildfires), which is a “...a comprehensive forest health bill aimed at reducing future wildfire risk and improving the condition of California’s forests and wildlands”, and SB- 462 (Forestland Restoration Workforce Program) (Jodi Axelson).
* Science-based research has also provided support to the Board of Forestry by informing changes to reforestation practices outlined in the California Forest Practice Rules (Jodi Axelson).
* Research on the impacts of cannabis has been used directly by several water quality control boards, planning departments, and boards of supervisors for decisions regarding where and how much cannabis to allow (Van Butsic).

As the aforementioned measured outcomes demonstrate, UC ANR supports the implementation of forest and rangeland restoration practices and policy and regulation. Increased ecological sustainability of range and forest landscapes helps California realize the many benefits of the state’s rich and diverse natural resources. Thus, UC ANR contributes to the public value of protecting California’s natural resources.

## Condition Change: UC ANR contributed to improved water quality

**Water Quantity Quality and Security**

**Issue**

Poor water quality can result from a variety of point and non-point sources of pollution such as land development, land use practices, stream modification from agriculture or forestry practices, or pollutants and sediment in runoff from storm water in urban and agricultural sites. Water quality regulations for irrigated lands in California require that growers monitor water use and nutrient discharges to limit movement of fertilizers into groundwater and surface water. In addition to managing agricultural lands, protecting water quality from rangelands is also a major concern as surface runoff and ground water on rangelands provide important sources of municipal water for regional communities.

**Methods & Outcomes**

UC ANR uses applied research to better understand the impacts of agricultural and rangeland management practices on water quality and extends outreach to growers, ranchers and the public. As a result of UC ANR research, outreach and education, participants learned and adopted practices that lead to improved water quality. Research and activities that resulted in outcomes with specific measured indicators follow.

Activities span a wide range of research and extension efforts. One collaborative project is focused on conducting salinity modeling under altered irrigation strategies, and tests have been carried out in the avocado groves at one Research and Extension Center (Darren Haver). Additionally, a study is examining the baseline contribution of water quality impairments from livestock (Matthew Shapero). UC ANR is also performing ongoing testing of a slow sand filtration system that treats nursery water runoff so that water can be reused or discharged without violating water quality regulations (Darren Haver). Field days in the Sacramento Valley have been used to share best irrigation and nitrogen practices in almond and walnut crops to protect groundwater (Allan Fulton). Outreach has been provided to producers through award-winning ranch water quality short courses (Shelia Barry). Water district personal have been reached through workshops and sharing research articles and fact sheets (Shelia Barry). An academic also provided an interactive program on stream monitoring and stewardship using aquatic insects at UC ANR’s Elkus Ranch (Igor Lacan).

**Participants learned about recommended management practices for preserving water quality and intend to adopt or have adopted practices to preserve water quality.**

* The Avocado Commission is using UC ANR research findings on salt movement in the soil to extend information about salt management strategies to avocado growers (Darren Haver).
* With the help of UC ANR’s science-based information and assistance with facilitation between ranchers and watershed managers, ranchers have been able to participate in the development of proposed regulations and identify workable solutions for agencies and ranchers (Matthew Shapero).
* Low-cost technologies have been adopted by nurseries, in response to regulations and in part UC ANR research. Adopted technologies include slow sand vegetative filter technology, which allows for an alternative to expensive water treatment systems requiring highly skilled staff to operate (Lorence Oki and Darren Haver).
* Growers in the Sacramento Valley increased awareness of the connection between irrigation efficiency and non-point source agricultural pollution (Alan Fulton).
* Three San Francisco Bay Area Water Districts have maintained or reintroduced grazing programs on 11,500 acres. As a result of informed research provided by UC ANR, the water districts adopted controlled calving or grazing seasons to reduce risk from pathogens and have implemented comprehensive annual rangeland monitoring programs (Shelia Barry).
* 67 attendees at Elkus Ranch increased their knowledge and understanding of stream monitoring practices and reported they would change some of their practices (e.g., reduce use of algaecides; begin monitoring soil water content) to better use and manage water and storm water (Igor Lacan).

Applied research is also being carried out to improve nitrogen use efficiency of agronomic crop systems. Information has been extended to 400 agricultural professionals about how to improve nitrogen use efficiency while remaining in compliance with local environmental regulatory requirements. Additionally, nutrient management research results were shared through a video interview with California Dairy Magazine (Nicholas Clark). Additionally, research is being conducted through collaborations with the Department of Pesticide Regulation and the Orange County Stormwater Division. These projects monitor pesticides and deliver training tools to pest control professionals (Darren Haver).

**Science-based information was applied to water quality policy and decision-making.**

* The Central Valley Dairy Representative Monitoring Program used original research-based information to support the mandate to recommend revisions to the Regional Water Quality Control Board’s waste discharge requirements for dairies (Nicholas Clark). Research is enabling the Department of Pesticide Regulation to continuously monitor pesticides in residential runoff. This partnership with the agency has provided an avenue for large-scale reductions in pesticide toxicity in water conveyances, such as statewide product re-registration based on the research and extension results (Darren Haver).

These aforementioned measured outcomes lead to improved knowledge and adoption of mitigation management practices. Thus, UC ANR contributes to the public value of protecting California’s Natural Resources. By reducing pollutants such as nitrates from fertilizers, pesticides, and animal waste that runoff or leach from agricultural and rangelands into water supplies, UC ANR helps preserve water quality. Additionally, improved practices enable managers to reduce inputs and costs leading to more economically and environmentally sustainable farming and ranching.

## Condition Change: UC ANR contributed to improved water-use efficiency

**Water Quantity Quality and Security**

**Issue**

Eighty percent of the water used in California is for agricultural purposes and the state faces challenges to meet its water demands. As the state’s population expands and agricultural uses of water are curtailed to meet new sustainable groundwater management guidelines, there is an expected decrease in water availability and increased competition between urban, environmental, and agricultural water uses. These issues create a need to identify new solutions to improve water use efficiency on agricultural lands and in the urban sector in and around homes, to meet increasing demands.

**Methods & Outcomes**

UC ANR develops research projects throughout the state to identify more efficient water practices and extends them to growers, managers and the public to transform how Californians use water. As a result of UC ANR research, outreach and education, participants learned and adopted practices that lead to improved water use efficiency. Research and activities that resulted in outcomes with specific measured indicators follow.

Research and extension activities have included improvement in water application methods, introducing drought resistant crops, and helping homeowners understand how to use water more efficiently. The California Institute for Water Resources trained over 1,000 Certified Crop Advisors in nutrient and irrigation management. Training included how to manage water use and evaluate the economic impact of using irrigation management tools (Doug Parker). Drought tolerant plant nurseries have been established at two UC ANR Research and Extension Centers. Other efforts to expand understanding of drought tolerant plants includes extending research on forage and grain yield trials, using drone data to better understand plant growth, launching a website to provide information on sorghum, and publishing identification and control guides for the weed, Johnson grass (Jeffrey Dahlberg). At a Southern California REC, public presentations and tours led by Master Gardeners highlighted landscapes that use drought tolerant native plants and new irrigation technologies (Darren Haver).

**Participants learned about water use and conservation practices and intend to adopt, or adopted recommended management practices for water conservation.**

* Over 800 visitors learned about garden and landscaping practices designed to have less impact on water resources in urbanized environments. Eighty-three percent of respondents plan to adopt one or more of the water conserving best management practices they learned about, including planting low water use plant material, rescheduling the irrigation controller, installing a new irrigation system, and replacing turf (Darren Haver).
* As a result of the training from the California Institute for Water Resources, crop advisors are now certified by the state to sign off on grower nutrient management plans and will be working with 70% of the growers in the state. Participants reported improved understanding of nitrogen management (95% good or complete understanding compared to 60% at the start). Participants also improved their capacity to advise on a nitrogen management approach (84% good or complete understanding compared to 47% at the start) (Doug Parker).
* 800 agricultural water users intend to use water flow meters to help them comply with agricultural regulations (Alan Fulton).
* Sorghum acres in California increased from 10,000 acres in 2011 to approximately 60,000 acres in 2018 because of their inherent ability to tolerate deficit irrigation and still produce acceptable yields (Jeffrey Dahlberg).

A variety of projects around the state have focused efforts on informing and training growers to adopt improved water and soil management and irrigation practices. Examples include extension to inform adoption of zone irrigation systems (Alan Fulton), trainings on how to use pressure chambers for precise, plant-based irrigation management (Luke Milliron) and how to use flow meters (Alan Fulton). Information on using pressure chambers and research on how to determine the water stress of dormant orchard trees was further relayed through publications (Luke Milliron). Research focused on methods to identify water stress in trees and delay the first orchard irrigation application until trees demonstrate water stress instead of based on soil moisture (Kari Arnold). Additionally, UC ANR conducted research and outreach projects on reduced runoff, improved irrigation management techniques, variable rate irrigation practices, automation of surface irrigation systems, subsurface drip irrigation, deficit irrigation, and new crop varieties that tolerate salinity and limited water supplies (Khaled Bali).

**Participants intend to adopt or have adopted recommended irrigation or other water and soil management practices.**

* Information shared with 175 farm managers in the northern San Joaquin Valley led to adoption of recommended irrigation or other water and soil management practices. Managers and consultants are now incorporating orchard stress indicators measured with a pressure chamber, using real-time crop water use estimates, and/or conducting soil moisture monitoring into their routine on-farm water management practices and decisions (Alan Fulton).
* Four growers collectively with 3,500 acres of almonds and walnuts adopted zone irrigation systems in orchards with highly variable soils (Alan Fulton).
* 17 surveyed participants at a field meeting reported improved understanding of what pressure chamber measures (100% marked yes from 19% at the start), how to take the measurement (100% up from 41%) and how to interpret the results for refined irrigation management (100% up from 29%) (Luke Milliron).
* Variable rate irrigation systems have been implemented on one commercial field and this technology is expanding to other fields in California. Automation of irrigation delivery gates has already been adopted by local growers on 80-acre and 160-acre fields in Holtville, and those fields have been used as demonstration sites for other interested growers (Khaled Bali).
* Because of a hands-on field meeting, 88 % of respondents reported an increased likelihood to adopt pressure chamber readings (Luke Milliron).
* As a direct outcome of research on irrigation practices, two collaborating growers intend to change their irrigation practices and begin using the pressure chamber for better irrigation management (Kari Arnold).

In the San Francisco Bay area, Garden Walks inform residents about water saving measures and academics have tracked the resulting water savings from homeowners that implemented suggested practices as a result of these educational walks (Steven Swain).

**Participants saved water after adopting recommended measures.**

* Garden Walks program participants saved over 9000 gallons a year on average when compared to control groups. Total water savings for all participants over the lifetime of the program are over 27 million gallons to date, and the program has cost less to run over that same time-frame than it would cost to simply buy 27 million gallons at the average rate paid by the Metropolitan Municipal Water District residential customers (Steven Swain).

These aforementioned measured outcomes have enabled water users to better understand and adopt water use efficiency measures to help California reduce its water demand while maintaining crop yields, and the benefits of home landscapes. Thus, UC ANR contributes to the public value of protecting California’s Natural Resources. For example, through collaboration with the SWEEP program, alone, UC ANR has helped growers save 100,000 acre-feet of water since 2014, enough to fill 50,000 Olympic size swimming pools. Ultimately, improved water management will increase water cost savings, and reduce water usage, benefiting the end user and reducing the over pumping of groundwater in California.

## Condition Change: UC ANR contributed to improved water-supply security

**Water Quantity Quality and Security**

**Issue**

California’s climate has the largest precipitation and streamflow variability in the contiguous United States. Further, groundwater pumping chronically exceeds natural recharge in many agricultural regions of the state, in fact, statewide groundwater overdraft estimates range from 500,000 to 1.5 million acre feet per year. Identifying new ways to ensure and secure a safe water supply are essential to the health and prosperity of California.

**Methods & Outcomes**

UC ANR extends new knowledge using both real and virtual methods to increase understanding of groundwater resources and conservation. As a result of UC ANR research, outreach, and education, participants learned and adopted practices that lead to increased water supply security. Research and activities that resulted in outcomes with specific measured indicators follow.

UC ANR academics inform consumers and water supply managers about water resources through a variety of practices including extension workshops, newsletters to Northern Sacramento Valley water users, and collaborations with the 4-H youth program (Alan Fulton).

**Participants learned about recommended management practices for water security.**

* Northern Sacramento Valley water users increased their interest and understanding of surface water and groundwater resources in the Northern Sacramento Valley. Distrust and conflict between different interest groups has been reduced. Water users in the valley are now more prepared to manage and sustain groundwater supplies in accordance with the Sustainable Groundwater Management Act (Alan Fulton).

One program has developed decision support tools by repackaging soil survey data into models and interactive apps that help stakeholders characterize water resource challenges and apply mitigating management practices. Specifically, the program has created an agricultural groundwater banking index, which evaluates the suitability of soils to accommodate groundwater recharge (Anthony O’Geen).

**Science-based research is applied to water supply policy and planning.**

* The on-farm groundwater banking index tool has now been integrated into the California Department of Water Resource’s land use viewer to support groundwater basin assessment reports. These reports are a necessary first step in the new Sustainable Groundwater Management Act (Anthony O’Geen).

These measured outcomes strengthened understanding of water supply and helped improve the actions taken to ensure a stable water supply to meet California’s demand. UC ANR research and extension will support communities as they develop groundwater management plans to bring pumping and recharge into balance by 2042 in compliance with the state’s Sustainable Groundwater Management Act. Thus, UC ANR contributes to the public value of protecting California’s natural resources.

# Promoting healthy people and communities

## Condition Change: UC ANR contributed to improved health for all

**Healthy Families and Communities**

**Issue**

California’s rapid population growth increases pressure on community resources, presenting numerous challenges to health and safety. Adult and childhood obesity is a public health crisis for the state and nation, resulting in a range of negative health consequences. Nearly 30% of California’s youth in grades 9-12 and over 60% of California’s adults are overweight or obese, according to the Center for Disease Control and Prevention. California spends over $52 billion annually in healthcare costs associated with obesity (Katherine Soule).

**Methods & Outcomes**

UC ANR produces tools, programs, and policy-relevant research that result in healthy living for individuals. As a result of UC ANR extension efforts, participants learned about and adopted healthier lifestyles. Specific activities that resulted in outcomes with measured indicators follow.

UC ANR academics provided oversight, leadership, and guidance for the statewide implementation of the UC 4-H Youth Development Program. UC 4-H provided hands-on, experiential learning opportunities about healthy lifestyles to almost 25,000 youth.

**Participants learned healthy lifestyle and decision-making practices.** Over 1,000 4-H youth responded to the healthy living and positive youth development common measures survey about what they may have learned at 4-H.

* Youth reported healthy behaviors such as getting 8 hours or more of sleep per night (75%) and paying attention to how active they are each day (77%).
* 74% of youth reported having a growth mindset related to health and being healthy.
* 93% of youth reported social and emotional skills (e.g., character, growth mindset, persistence, decision-making and ethics) necessary for academic or workplace success.
* Youth report that is it not okay or usually not okay for others to engage in risky behaviors such as texting and driving (96%), riding a bike without a helmet (78%), not wearing a seatbelt (96%), and someone their age drinking alcohol (97%), smoking (98%), or taking drugs (99%).

UC ANR academics provided oversight, leadership, and guidance for the statewide implementation of the UC CalFresh Nutrition Education Program (UC CalFresh), Expanded Food Nutrition and Education Program (EFNEP), and UC 4-H Youth Development Program. EFNEP and UC CalFresh delivered nutrition education programs to over 138,000 youth as well as policy, systems, and environmental change strategies to prevent overweight and obesity. For example, Butte County Cluster’s EFNEP and UC CalFresh Nutrition Education Program collaborated to deliver a dual series-based presentation of curricula over an 8-week period. The participants were families (specifically mothers and their children) living at the Migrant Farm Housing. EFNEP staff facilitated adult lessons using the Eating Smart, Being Active curriculum and UC CalFresh Nutrition Education Program staff facilitated the youth lessons using the Happy Healthy Me curriculum. The two programs collaborated to make it their goal during lesson delivery for both the parent and the child to be introduced to the same terminology and concepts so that they could have a common language at home**.** UC 4-H provided hands-on, experiential learning opportunities about healthy lifestyles to almost 25,000 youth. UC 4-H delivered teens as teachers programs such Cooking Academy, a collaborative project with the UC CalFresh in Sutter and Yuba Counties. Twelve teens learned culinary techniques, behavior guidance strategies, and how to prepare each recipe featured in the curriculum. The teens then delivered seven weeks of cooking and food safety instruction where younger youth.

**Participants changed attitudes toward and adopted healthy eating practices.**

* EFNEP received survey responses from over 4,000 adult participants and over 5,700 youth participants about their participation in a nutrition education program.
  + Adult participants showed improvement in one or more diet quality indicators (95%) and in one or more physical activity behaviors (86%).
  + 81% of youth improved their abilities to choose foods according to federal dietary recommendations or gain knowledge.
* Over 800 UC CalFresh adult participants responded to Food Behavior Checklist pre/post surveys after participating in a nutrition education program.
  + Participants reported eating more than one kind of fruit (44%) and more than one vegetable (44%) each day more often.
  + Participants increased the amount of fruit and vegetables eaten in cups (68%).
* 97% of 700 UC CalFresh trained teachers reported on behalf of their 17,099 students that students are now able to identify healthy food choices.
* UC CalFresh implemented over 4,000 healthy food tastings with over 89,700 students. You participants indicated that they were willing to eat the food again at school (67%) and willing to ask for this food at home (63%).
* Migrant farm workers in Butte County Cluster made healthier food choices as a result of their nutrition education such as eating more fruits (78%) and eating more vegetables (22%) (Chelsey Slattery).
* Over 1,000 4-H youth responded to the healthy living common measures survey about what they may have learned at 4-H. Youth reported healthy habits such as never or only some days eating fast food (95%), eating breakfast (83%), eating a meal with their family most or every day (85%), and paying attention to how much water they drink each day (72%).
* In Sutter and Yuba Counties, teens who were trained as teachers increased their overall self-confidence, ability to act as mentors, and ability to speak before a group. Almost 70% of the teens reported that they eat more fruits and vegetables, drink less soda, and consume more water. Additionally, the younger youth reported an increase by 28% in their willingness to try new foods increased as a result of participating in the Cooking Academy (Chelsey L. Slattery).

UC ANR academics provided oversight, leadership, and guidance for the statewide implementation of the UC Master Gardener Program. Volunteers delivered public education workshops and participants responded to a survey about any changes made as a result of attending.

**Participants adopted edible gardening practices and spent more time outdoors.**

* 68% of 841 respondents started or improved growing edible plant(s) and 56% expanded varieties of edible plant(s) grown. These behaviors are correlated with increasing consumption of fruits and vegetables.
* Respondents applied knowledge gained on 1,378,985 square feet of food gardens, potentially increasing their access to produce.
* 71% of 1,505 respondents spent more time gardening and outdoors, which is associated with improved individual emotional and physical health.

UC ANR academics provided oversight, leadership, and guidance for the statewide implementation of the UC CalFresh Nutrition Education Program (UC CalFresh). In San Luis Obispo County, the UC CalFresh Shaping Healthy Choices program reached 138 students in five schools that have predominantly Latino youth population and youth who qualify for free or reduced cost meals. Additionally, UC ANR academics conducted research on the efficacy of healthy lifestyle interventions and participant outcomes. For example, UC ANR academics collaborated on a 5 year Agriculture and Food Research Institute (AFRI) USDA-funded obesity project, which involved delivering evidence-based curriculum as well as family and community level interventions, to Mexican origin families in Central California.

**Participants improved individual health.**

* Evaluation findings from San Luis Obispo County indicate a statistically significant decrease in Body Mass Index percentile in youth participants (Katherine Soule).
* 392 children received an intensive, multi-faceted, childhood obesity intervention including nutrition education over several years. Children had greater improvement over two years in skin carotenoid intensity scores than those in a comparison community. Increased skin carotenoid scores indicate an increase in fruit and vegetable consumption as a result of this intervention (Marcel Horowitz).

UC ANR academics provided evidence-based information to state-level decisions makers, such as the California Department of Public Health regarding the curricula, strategies, and program guidance for the implementation of Supplemental Nutrition Assistance Program – Education (SNAP-Ed) in California.

**Science-based information applied to healthy food policy and decision-making.**

* Evidence-based recommendations to the California Department of Public Health regarding SNAP-Ed nutrition education curricula and program guidance has led to the adoption of at least two new curricula, “My Plate. My Way. Everyday!” and “Cooking for Healthy Academic,” and the adoption of new requirements for local health departments in their implementation of SNAP-Ed. Agencies must now utilize multiple strategies from a menu of evidence-based nutrition education curricula and obesity prevention approaches. The adoption of these new curricula and program guidance will lead to stronger, more focused SNAP-Ed interventions and ultimately, better health outcomes for individuals reached by the program (Katie Johnson & Carolyn Rider).

These measured outcomes lead to and demonstrate improved health for Californians where they learn, work, and play. Collectively these efforts contribute to the public value of promoting healthy people and communities.

## Condition Change: UC ANR contributed to improved community health and wellness

**Healthy Families and Communities**

**Issue**

California’s rapid population growth increases pressure on community resources, presenting numerous challenges to health and safety. Adult and childhood obesity is a public health crisis for the state and nation, resulting in a range of negative health consequences. Nearly 30% of California’s youth in grades 9-12 and over 60% of California’s adults are overweight or obese, according to the Center for Disease Control and Prevention.

**Methods & Outcomes**

UC ANR produces tools, programs, and policy-relevant research that result in healthy communities. As a result of UC ANR research, policy engagement, outreach, and education, participants learned about and adopted strategies to improve community health and wellness. Specific activities that resulted in outcomes with measured indicators follow.

UC ANR conducted research about and shared findings with California food policy councils. Findings from this study of 31 of the 33 known food policy councils indicate that significant policy change can be achieved through small sub-groups and that information-sharing is seen as the most valuable food policy council activity. Food policy councils are uniquely positioned to engage with agricultural, economic, environmental, and social issues in California (Dave Campbell).

**Participants learned promising food policy council practices.**

* Over 80% of participants reported they will use what they gained at the event in their work, such as expanded use of promising practices and continuing to build relationships across food policy councils and with UC ANR, which may contribute to increasing their overall effectiveness.

UC ANR academics provided oversight, leadership, and guidance in educational programs and policy, systems, and environmental (PSE) interventions delivered through the UC CalFresh Nutrition Education Program (UC CalFresh). UC CalFresh provided training and technical assistance to low-income communities on evidence-based programs and strategies for participating sites to increase consumption of health foods, improve physical activity opportunities, and implement or update wellness policies.

**Participants adopted community-level changes to prevent overweight and obesity.**

* UC CalFresh reported PSE changes at 350 SNAP-Ed locales, contributing to improved community health and wellness for more than 140,000 people.
* Over 180 UC CalFresh program sites in 27 counties made at least one physical activity-related PSE change, reaching over 80,000 individuals. About half of the sites changed the quality of structured physical activity.
* The Smarter Lunchrooms Movement was utilized by 102 UC CalFresh program sites to encourage the selection of healthy options in cafeterias. Twenty-one sites with more than one scorecard increased cafeteria assessment scores by 5.9 points over the school year due to adopting evidence-based, low-cost/-no-cost cafeteria makeover strategies.
* 13 UC CalFresh county programs adopted youth engagement strategies after receiving training and technical assistance. As a result, 189 young people provided direct and indirect nutrition education and PSE strategies that contribute to improved community health and wellness.
* Behavior changes in Kings County include 113 teachers enrolling to implement nutrition lessons in the classroom and one teacher aligning nutrition lessons with common core standards for English Language Arts and Health Education. The effective partnership and program led to changes to the district’s school wellness policy to improve healthy eating (Deepa Srivastava).

UC ANR academics provided oversight, leadership, and guidance in educational programs and policy, systems, and environmental (PSE) interventions delivered through the UC CalFresh Nutrition Education Program (UC CalFresh). UC ANR academics also provide oversight, leadership, and guidance to the UC Master Gardener Program, who then extend research-based information and technical assistance to members of the public. In addition, ANR founded the Oakland Food Web, which encourages and facilitates knowledge-sharing about school gardens and healthy foods.

**Participants applied practices that improve overall community wellness.**

* UC CalFresh evaluated program delivery by surveying teachers in 22 of the 32 counties served. In total, 724 teachers reported on behalf of their 17,099 students. Over 50% of teachers reported more frequently encouraging students to be physically active and to eat breakfast and 97% indicated that more students are now able to identify healthy food choices
* Participants of UC Master Gardener volunteer-led educational programs started or improved practices on over 2,700,000 square feet of home gardens in California. This is important because a 2016 study found that living near greenery may help you live longer.
* As a result of participating in the Oakland Food Web and focused work on recycling and composting, three middle school sites experienced waste reduction (Christy Getz).

UC ANR academics provided oversight, leadership, and guidance in educational programs and policy, systems, and environmental (PSE) interventions delivered through the UC CalFresh Nutrition Education Program (UC CalFresh).

**Participants increased access to fresh produce.**

* 136 UC CalFresh sites implemented edible gardens where participants eat, work, and learn.
* 30 UC CalFresh sites adopted or continued to improve their Farm‐to‐School/Fork initiatives, providing increased access to healthy foods.
* In San Mateo and Santa Clara County school districts, UC CalFresh sites adopted cafeteria promotion, farm-to-school, and school garden strategies to introduce 36 local produce items (Wei-ting Chen).
  + Student selection, consumption, and interest in new produce items increased.
  + One school food service director aligned the produce served in the cafeteria to what is grown in the school garden.
  + Parents shared the desire to purchase new produce items because their children tried and liked them at school.
* As a result of participating in UC CalFresh, two elementary school communities in Tulare County have increased access to fresh fruits and vegetables due to a partnership with a local food bank. The produce is available to nearly 500 students and community residents at no cost (Deepa Srivastava).

UC ANR academics conducted research on nutrition policies, participation levels in nutrition assistance programs like the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), obesity prevention, and food hubs. Findings from this research as well as other evidence-based recommendations were shared by academics with decision-makers at local and state levels through policy engagement activities.

**Science-based information applied to community health and wellness policy and decision-making at the local and state levels.** The following indicators are related to efforts of UC ANR’s Nutrition Policy Institute.

* As a result of UC ANR academics’ policy engagement activities (meeting with decision-makers, providing resources and recommendations), California state government provided funding for a new project to assess satisfaction with WIC services and the WIC food shopping experience before the state transitions from paper to electronic benefit cards, as well as possible updates to the WIC food packages. This project will enable future assessments of and improvements to WIC participation, contributing to greater food security and nutrition among low-income families with young children (Lorrene Ritchie).
* Evaluation findings of a new campus vending policy, developed by UC ANR and colleagues, confirmed increased access to healthy foods for university students. UC Berkeley vending audits show that 44% of snack vending machines were compliant with the policy, an improvement from 31% the year before, and about 1/3 of the top selling snacks are healthy. Furthermore, at least two other campuses implemented similar nutrition standards in vendor specifications (Janice Kao).
* As a result of UC ANR research, Mandela Marketplace in Oakland has increased understanding of their effectiveness as a food hub in reaching their target clientele of community residents of color. They report intent to use the findings in fundraising efforts and identifying strategies for financial sustainability (Gail Woodward-Lopez and Janice Kao).
* As a result of UC ANR providing evidence-based information and resources, the California Department of Public Health adopted a new SNAP-Ed theme, “drink water, not sugar-sweetened beverages,” which will be required of every SNAP-Ed Local Implementing Agency in California (Christina Hecht).

UC ANR academics conducted research and policy engagement activities on child and adult care nutrition, participation levels in nutrition assistance programs like Women, Infants, and Children (WIC), obesity prevention, and testing for lead in water in schools and child care settings. Decision-makers at federal and national levels were engaged through activities such organizing policy convenings, participating in briefings, testifying at hearings, and participating in briefings and network

**Science-based information applied to community health and wellness policy and decision-making at the federal and national levels.** The following indicators are related to efforts of UC ANR’s Nutrition Policy Institute academics.

* Several policy convenings were led by a UC ANR academic to share childcare research findings, which informed nutrition policy at both federal and state levels, informing revisions to the federal Child and Adult Care Food Program nutrition standards. Additionally, the academic shared study findings indicating the readiness of childcare providers to adopt the new requirements, demonstrating the feasibility of policy implementation (Lorrene Ritchie).
* UC ANR conducted a study on WIC infant and toddler feeding practices and why eligible participants leave the program. Findings were shared at a USDA briefing, which informed ongoing federal and state efforts, ensuring that more young children who need the nutrition and education provided by WIC remain on the program (Lorrene Ritchie).
* National research conducted by UC ANR and collaborators confirmed that successful nutrition and obesity prevention efforts of communities require sustained implementation over 4-6 years and strategies of greater intensity, such as changing food environments and focusing on behaviors not to do as well as behaviors to do. The findings align with SNAP-Ed’s newer requirements for agencies to deliver more than one policy, system, and environment strategy in addition to nutrition education (Lorrene Ritchie).
* Evidence shared from a UC ANR research study assessing Body Mass Index in schoolchildren provided support for the introduction of a new federal school nutrition wellness bill by Ohio Congressman Tim Ryan (Lauren Au).
* As a result of policy engagement activities and providing academic expertise about the current status and considerations in drinking water lead testing programs, UC ANR contributed to the following (Christina Hecht).
  + The Environmental Protection Agency adopting a requirement in their new grant program for states to test for lead in school and childcare drinking water.
  + Renewed and new authorizations related to eliminating lead exposure in school and childcare drinking water in America’s Water Infrastructure Act of 2018.
  + The passage of California legislation (AB2370), which will require lead testing in childcare facilities and allocates state budget funds for implementation and remediation of any lead contamination.

These measured outcomes demonstrated learning, action, and policy changes the can lead to improved community health and wellness, including improved access to healthy foods and safe drinking water. Collectively these efforts contribute to the public value of promoting healthy people and communities.

## Condition Change: UC ANR contributed to improved access to positive built and natural environments

**Healthy Families and Communities**

**Issue**

There are documented health benefits of spending time in nature, yet children in the U.S. spend a daily average of 7.5 hours in front of a screen. Furthermore, 30% of Californian youth do not have parks, sidewalks, and community centers in their neighborhood and 30% of adults do not meet physical activity guidelines. Adult and childhood obesity is a public health crisis for the state and nation, resulting in a range of negative health consequences.

**Methods & Outcomes**

UC ANR delivers educational programs and policy, system, and environment (PSE) interventions to youth with the goal of improving access to positive built and natural environments. As a result of UC ANR educational and PSE activities, participants learned about the environment and increased access to positive built environments. Specific activities that resulted in outcomes with measured indicators follow.

UC ANR academics provided oversight, leadership, and guidance in the statewide implementation of the UC 4-H Youth Development Program. One academic piloted a new program that provides outdoor experiential learning opportunities titled, ¡Descubre Outside! Discover Afuera!

**Participants learned about and changed attitudes about the environment.**

* Forty-three, mostly Latino youth, participated in ¡Descubre Outside! Discover Afuera! and participated in a pre-post evaluation about their experiences. All of the participants noted that they now enjoy spending time outdoors. Youth expressed that they care about the environment (97%) and said this program has helped them to learn about environmental issues (80%) (Russell Hill).

UC ANR academics delivered educational programs and policy, system, environment (PSE) activities that increased access to green spaces, improved outdoor physical activity, and increased appreciation of the environment. UC ANR academics provided oversight, leadership, and guidance in the statewide implementation of the UC CalFresh Nutrition Education Program (UC CalFresh) and UC Master Gardener Program.

**Participants improved access to green spaces and the outdoors for youth.**

* Thirty UC CalFresh program sites across the state newly adopted or continued adoption of playground stencils. Combined with teacher training and delivery of evidence-based physical activity lessons, the stencils provided outdoor, engaging, and structured physical activity.
* Two schools participating in the UC CalFresh Shaping Healthy Choice Programs in Riverside County implemented gardening during physical education class. One of these schools implemented a school garden for the first time. The hands-on gardening activities enhanced student interest in learning about healthy food choices. The pre/post student evaluation showed a significant increase in nutrition knowledge (Chutima Ganthavorn).
* As a result of participating in collaborative programming between UC Master Gardener and UC CalFresh in Fresno County, one community-serving rehabilitation organization revitalized its garden. Five garden beds were planted by residents and their children, who continued to regularly spend time in the garden (Karina Macias).
* The Imperial County school district’s participation in the UC CalFresh Smarter Lunchrooms Movement resulted in the adoption of comprehensive strategies to prevent child overweight and obesity, while at the same time, created opportunities for children to spend time outdoors. The district adopted stencils, which created opportunities for outdoor physical activity for 488 students. Eight teachers adopted garden-enhanced nutrition education, among other physical and nutrition education activities (Paul Tabarez).
* As a result of participating in the UC Master Gardeners pilot gardening program for incarcerated youth in Tulare and Kings Counties, one juvenile center created opportunities for youth to learn technical skills and belonging while spending time outdoors. Detention facility staff reported a clear uptick in interest and pride in the garden by the youth, as well as pride in donating produce to the local food pantry and filling a critical community need. Gardeners observed youth taking great pride in sharing their landscaping efforts with visiting family members, connecting their efforts to an improved physical environment (Sue Gillison and Maggie Reiter).

These measured outcomes demonstrated individual learning gains related to the environment and PSE changes that created more opportunities to spend time in gardens and outdoors. In this way, UC ANR improved access to green spaces and the outdoors for people and communities where they live, learn, work, and play. Collectively these efforts contribute to the public value of promoting healthy people and communities.

# Developing a qualified workforce for California

## Condition Change: UC ANR contributed to increased workforce retention and competency

**Healthy Families and Communities**

**Issue**

California requires a highly skilled workforce to remain a competitive, prosperous, and an innovative global leader. A Pew Research Center study projects that U.S. job growth will increase as it has in the past 35 years in occupations that require higher levels of education, training, and experience. A qualified workforce is needed especially in youth education and obesity prevention, two areas in which California ranks among the worst in the country. Additionally, California is the largest agricultural producer in the U.S., thus education and training must be provided to enhance agricultural productivity and capacity to innovate.

**Methods & Outcomes**

UC ANR’s extensive network links campuses and communities across California to develop information and tools needed to train workers within educational settings and urban, agricultural, and natural resource communities.As a result of UC ANR research, outreach, and education, participants learned about and adopted strategies to improve workforce retention and competency. Specific activities that resulted in outcomes with measured indicators follow.

UC ANR academics affiliated with Expanded Food and Nutrition Education Program (EFNEP) and the UC 4-H Youth Development Program (UC 4-H) provided professional development opportunities to school teachers and staff, who then deliver evidence-based curricula to youth. EFNEP partnered with school districts, such as Hayward Unified, and provided two years of nutrition education training and curriculum materials. UC 4-H trained after school enrichment staff in projects. In Sacramento County, 20 after school staff were trained in and delivered 4-H Water Wizards to 488 students and animal agricultural production. In Kern County, school enrichment staff received 4-H Avian Embryology project training and supplies for implementing the project with youth. Furthermore, UC ANR academics and multi-state collaborators conducted research on the application of “lesson study,” an iterative and educator-centered approach to professional development, in youth development settings. Findings from this research revealed the potential for “lesson study” to improve data-driven decision-making, content knowledge, lesson planning, and implementation among Cooperative Extension educators, adult 4-H volunteers, and 4-H teens.

**Participants learned about and applied new evidence-based information in youth education programs.**

* Thirty after school staff members applied food and fitness knowledge in delivering six lessons to 1,400 students in Hayward Unified School District, in addition to adopting food and fitness behavior changes in their own lives.
  + Staff implemented pre and post evaluations to find that 72% of students improved skills in choosing foods consistent with federal dietary guidelines and 47% improved their food safety practices (Marisa Neelon).
* Program evaluations of 4-H Water Wizards program in Sacramento County revealed that after school staff were confident in delivering their projects, while youth increased their knowledge about water. Furthermore, 77% of 20 after school program staff indicated they better understood how inquiry relates to science (Marianne Bird).
* In Kern County, 4-H Avian Embryology project trainings improved abilities of after-school instructors as 87% of those trained reported a significant increase in knowledge and confidence in delivering the project. All teachers reported increased student engagement and a desire to learn in class (John Borba).
* As a result of findings from the new research on “lesson study” in youth development settings, one land grant institution adopted lesson study as a professional development for all new and early-career 4-H agents (Martin Smith).

UC ANR academics developed curricula and delivered professional development opportunities for individuals who work in agricultural production and landscape management. UC ANR delivered continuing education classes in Spanish and in English for individuals to renew their California Department of Pesticide Regulation Maintenance Gardener licenses. A UC ANR academic in Monterey County co-developed eight curricula in Spanish for growers, including owners, managers, supervisors, and foremen. This effort reached over 5,000 Hispanic growers in the state using several methods, including developing a new contact and distribution lists to increase the reach of Hispanic and potential growers. Almost 90 hours of training was completed through 17 workshops, 12 of which were in Spanish. Furthermore, one UC ANR academic in the San Francisco Bay Area delivered 35 workshops to clientele about soil quality, attended by 653 participants.

**Participants learned about and applied new evidence-based information in landscapes and agricultural production.**

* All 29 respondents that participated in the continuing education classes to renew their gardener licenses indicated that they gained useful pest management information (Chris Greer).
* Post-pre surveys indicate an average of 25% increase in knowledge in growers who attended workshops delivered by the UC ANR academic based in Monterey County (Maria de la Fuente).
* Over 70% of participants in the San Francisco Bay Area reported increased knowledge of soil management practices and improved food safety (Rob Bennaton).

UC ANR academics provided training and technical assistance to local health departments in their implementation of Supplemental Nutrition Assistance Program – Education (SNAP-Ed). Several webinars and an in-person workshop were delivered about evaluation, reporting, and communications. Additionally, UC ANR hosted and managed an information-sharing platform that includes an online discussion forum as well as evaluation tools, templates, and protocols for its 133 registered users.

**Participants applied program planning and evaluation skills to requirements for federal and state nutrition programs.**

(Carolyn Rider and Amanda Linares)

* Over 70% of almost 40 webinar participants and over 70 in-person workshop participants reported that they were able to apply what they had learned in their SNAP-Ed needs assessment and evaluation work. Furthermore, 97% of 29 respondents that attended the “PEARS Points” webinar series indicated that they were able to apply what they learned to effectively report their programs.
* Adoption of the information-sharing platform was observed as local health departments and resulted in more dialogue around SNAP-Ed local evaluation work, strategies, troubleshooting, and requests for technical assistance to complete nutrition program implementation requirements.

These measured outcomes demonstrate changes in learning and improvements in how participants work. Youth development professionals, nutrition educators, decision-makers, growers, and land managers learned cutting-edge skills that increase workforce retention and competency. In 2018, California unemployment was 4.1%, a 0.4% decrease from the previous year. In addition, developing a more qualified landscape management and agricultural production workforce contributes to poverty reduction for smallholders and other marginalized groups, which then also facilitates interaction with commercial markets. In this way, UC ANR contributes to the public value of developing a qualified workforce for California.

## Condition Change: UC ANR contributed to increased effective public leaders

**Healthy Families and Communities**

**Issue**

In the last ten years, 37-56% of U.S. adults approved of the U.S. president’s job performance and 48-74% were confident that the U.S. president would do the right thing in world affairs. Furthermore, only 64% of U.S. adults say the overall quality of candidates running for congress in their districts was good. These 2018 public opinion studies conducted by the Pew Research Center indicate a continued need for increased effective and responsive public leaders.

**Methods & Outcomes**

UC ANR’s extensive network and youth development programs equip the next generation of public leaders. UC ANR developed, evaluated, and delivered evidence-based educational programs that provided youth with leadership skills. UC ANR academics provided oversight, leadership, and guidance for the statewide implementation of the UC CalFresh Nutrition Education Program (UC CalFresh) and the UC 4-H Youth Development Program. Youth participants in these programs were empowered to take on leadership roles in research, teaching, and service-learning projects to improve their communities. As a result of UC ANR educational programs, youth participants learned and applied scientific methods, leadership, presentation, and advocacy skills. In some cases, youth participants engaged in environmental change or policy engagement activities that led to decision-makers adopting evidence-based recommendations. Outcomes with specific indicators follow.

**Participants learned leadership skills and extended evidence-based information to their peers and decision-makers.**

* Over 1,000 4-H youth responded to the universal positive youth development common measures survey about what they may have learned at 4-H and 87% of youth report social and leadership skills, including the ability to communicate through multiple methods and value and respect for other cultures.
* In testing new science literacy curricula, 4-H youth increased their understanding of scientific concepts, including county fair bio-security practices and animal husbandry practices to help mitigate predator and livestock interactions. Youth applied leadership skills by extending evidence-based information to their peers and community members through videos and outreach (Martin Smith).
* In Contra Costa County, six 4-H teens learned about and utilized research skills to understand water consumption and water access at their school, then delivered evidence-based recommendations to their peers, school site staff, and school board members, advocating for water filling stations for their school. As a result, the board members approved added a water filling stations in the schools’ renovation plans. Over 300 students at the school completed post surveys and reported a 19% increase in choosing water as their first choice of beverage and a 15% increase in selecting water from the first floor, the location of the a new water refilling station, thereby demonstrating increased access to safe and good-tasting water can influence students’ beverage choices (Charles Go and Marisa Neelon).
* As part of the Healthy School Farmer's Market initiative of UC CalFresh nutrition education program in Tulare County, 20 4-H youth selected to be Nutrition Ambassadors applied new knowledge and skills in delivering evidence-based healthy food information and resources to their peers and families (Deepa Srivastava).
* In Yolo County, seven UC CalFresh participants became teens as teachers and taught nutrition education, food preparation, and cooking lessons to 77, 5th & 6th-grade student chefs. After the intervention, 100% of the leaders felt that they could successfully work with younger youth. One school expanded their efforts by developing a Student Nutrition Advisory Council, which led a health education campaign focused on increasing water consumption and decreasing sugar-sweetened beverages on campus (Marcel Horowitz and Anne Iaccopucci).
* Youth who participated in UC CalFresh’s pilot Youth Engagement Initiative applied research and presentation skills, resulting in the following school-level policy changes: (Andra Nicoli).
* Youth in San Mateo County applied research skills by surveying their peers and then advocated to add smoothies to the lunch menus. After presentations to school and district officials and their peers, their recommendations were implemented.
* Youth in Imperial County applied research skills by surveying their peers and analyzing physical fitness and obesity data to advocate for new physical activity equipment and approval of a playground stencil project. After presentations to school and district officials as well as their peers, their recommendations were approved.

These measured outcomes demonstrated that leadership skills were learned and applied for the benefit of local California communities. In this way, UC ANR contributes to the public value of developing a qualified workforce for California.

## Condition Change: UC ANR contributed to improved college readiness and access

**Healthy Families and Communities**

**Issue**

California requires a highly skilled workforce to remain a competitive, prosperous, and an innovative global leader. California is ranked 42nd in the nation for 2016 performance and has a high school graduation rate of 83%, which is slightly lower than the national average of 85%. Improved college readiness and access can contribute the development of a qualified workforce for California and a robust and thriving state economy.

**Methods & Outcomes**

UC ANR’s youth and community development programs equip the next generation for college and successful careers. UC ANR academics provide oversight, leadership, and guidance for the statewide implementation of UC 4-H Youth Development Program (UC 4-H). UC ANR academics advance the field of youth development by conducting research and extending new knowledge to UC 4-H staff and volunteers and other youth development professionals. As a result of UC ANR research, outreach, and education, participants learned skills and reported positive aspirations that can lead to increased college readiness. Specific activities that resulted in outcomes with measured indicators follow.

UC 4-H reached over 142,000 youth- an increase of 30% from the previous year- participating in clubs, afterschool programs, and camps. Almost 20,000 adult volunteers contributed over 1,700,000 hours, estimated at almost $50 million in value.

**Participants learned information or gained skills to prepare them for college.** Over 200 California youth responded to the college & career readiness common measures survey about what they may have learned at 4-H.

* Youth reported learning information to prepare them for college and a career:
  + 90% of youth reported when choosing a career, it is important to be passionate about the work they do
  + 80% of youth report that for the type of career they want, it is important to go to college
  + 87% have thought a little or a lot about how to pay for college
  + 59% of youth have an idea of what they would like to major in
* Youth reported intrapersonal professionalism skills such as it being important to arrive on time for work (100%), be trusted by an employer (99%), do their job well (100%), show respect for others (100%) and have a professional image on social media (90%).

UC 4-H provided hands-on, experiential learning opportunities in science, engineering, and technology to almost 170,000 youth. UC ANR academics provided training to teen teachers to deliver science programs to younger children, such as the Youth Experiences in Science program delivered by 21 teens to 276 younger children in Sacramento County. UC 4-H delivered training to school teachers; for example, in Kern County, the Avian Embryology school enrichment program was implemented in three elementary schools and reached a total of 804 students, of which 789 were Latino. UC 4-H also sent teens to represent California at the National Youth Summit on Agri-Science.

**Participants learned about science to prepare them for college and careers.**

* Over 1,000 4-H youth responded to the science common measures survey about what they may have learned in the 4-H program.
  + Youth reported science skills and abilities such as asking questions about how things work (88%), trying new things to see how they will work (87%), looking at how things are the same or different (83%), and comparing how different things work (77%).
  + Youth grades 8 to 12 reported positive attitudes and aspirations towards science such as liking science (83%), liking a job that involves using science (72%), and studying science after high school (70%).
* In Santa Clara County, over 70 4-H youth responded to a survey about their experiences and reported learning new things about computer science (93%), interest in a job in computer science (77%), and interest in learning about engineering (76%) (Fe Moncloa).
* Teen teachers in Sacramento County reported an increase in their understanding of the science process in teaching youth (91%) and how inquiry relates to science (87%) (Marianne Bird).
* Program evaluations from the Kern County Avian Embryology program indicated that the students showed increased levels of knowledge of food sources (John Borba).
* National Youth Summit on Agri-Science indicated that all 13 teens increased their knowledge of agricultural science, agricultural career options, and the role of technology and science in agriculture (Charles Go).

These measured outcomes demonstrated knowledge and skills learned and positive attitudes related to science, college, and careers, which are the pathway to entering the workforce. In this way, UC ANR contributes to the public value of developing a qualified workforce for California.

## Condition Change: UC ANR contributed to increased civic engagement

**Healthy Families and Communities**

**Issue**

California requires a highly skilled workforce to remain a competitive, prosperous, and an innovative global leader. Volunteering and civic engagement can develop skills and confidence that make individuals employable as well as create attachment to communities that encourages people to invest, spend, and hire. Increased civic engagement can contribute the development of a qualified workforce for California and a robust and thriving state economy.

**Methods & Outcomes**

UC ANR delivers educational programs that increase civic engagement. The UC 4-H Youth Development Program reached over 142,000 youth- an increase of 30% from the previous year- participating in clubs, afterschool programs, and camps, who were involved in projects around civic engagement, healthy lifestyles, and science, engineering & technology. Civic engagement projects included four focus areas: community engagement, service, civic education, and personal development. Teens as teachers programs created opportunities for teens to learn skills and contribute to their communities by delivering education to younger children. Almost 20,000 adult volunteers contributed over 1,700,000 hours, estimated at almost $50 million in value. As a result of UC ANR outreach and evidence-based educational programs, participants learned and adopted civic engagement skills and attitudes. Outcomes with specific indicators follow.

**Participants learned about and adopted civically engagement behaviors.** Almost 800 4-H youth responded to the Civic Engagement common measures survey about what they may have learned at 4-H.

* Youth reported that they like to help people in their community (99%) and feel a responsibility to help their community (93%).
* 76% of youth report having critical teamwork skills related to diversity. These are skills that become increasingly important as the population in California and the U.S. are becoming increasingly racially and ethnically diverse.
* Youth reported they have done a community service project (83%) and look for ways to help when they learn about a problem in the community (85%).
* 4-H teen teachers in Sacramento County delivered the semester-long Youth Experiences in Science program to 276 children and 97% of 21 teens agreed that they made an important contribution to their community (Marianne Bird).

These measured outcomes demonstrated learning gain and behavior change related to civic engagement. Research shows civic engagement outcomes can lead to employability, emotional connection to communities, and a more qualified workforce. In 2018, California unemployment was 4.1%, a 0.4% decrease from the previous year. UC ANR’s youth development programs equip the next generation to be active participants in their communities, which can contribute to a robust and thriving state economy.

# Building climate resilient communities and ecosystems

## Condition Change: UC ANR contributed to increased preparedness and resilience to extreme weather and climate change

**Sustainable Natural Ecosystems**

**Issue**

The associated effects of climate change are increasing the risk of extreme weather events that negatively impact California’s ecosystems. For example, cyclical droughts are expected to worsen with climate change. Because of our changing climate, rangelands and forests are experiencing the effects of intense wildfires and persistent droughts. Land managers and land owners need effective response and adaptation strategies to best manage the land so they are better prepared to deal with the growing risks. Communities need to be better prepared to deal with the growing risks of hazards from fires and droughts.

**Methods & Outcomes**

UC ANR collaborates with agencies and land owners that have been impacted by catastrophic fires and droughts and provides science-based information to aid in recovery and prevention efforts and develop improved practices. Specific research and activities that resulted in outcomes with specific measured indicators follow.

After the catastrophic fires, academics extended knowledge about fire recovery, fire preparation and prevention, and climate change. Academics organized forest stewardship workshops, including Living with Fire at Sonoma State University, and the North Coast Fire Resiliency Workshop. The North Coast Fire Resiliency workshop was designed to both inform the local citizenry of the coastal areas north of the Russian River about how to deal with fire (Steven Swain). Several academics around the state organized meetings for the ranchers affected by the Waverly, Thomas, Tubbs and Camp Fires. Information was presented on management practices that can safeguard resources, how to prevent soil erosion, as well as an overview of how to estimate the cost of replacing forage losses on annual rangelands to nearly 40 landowners (Theresa Becchetti). Another academic gave presentations on the building envelope to fire safe councils, UC Master Gardeners, garden clubs, and the general public (Kate Wilkin). Other academics collaborated to organized nine prescribed burns and successfully demonstrated using fire to treat over 700 acres across the state (Jeffrey Stackhouse). One project resulted because drought conditions were not being accurately depicted on the US Drought Monitor, (USDM) which is the nationwide geospatial tool that tracks drought conditions and determines federal insurance payouts to agriculturalists. As a result, UC ANR advisors worked with authors of USDM and the California Cattleman's Association and identified the need to connect authors with rangeland professionals. The advisors developed procedures for range managers to relay conditions on the ground to the USDM authors and UC ANR livestock advisors statewide now provide monthly feedback regarding their local drought conditions to the USDM (Matthew Shapero).

**Participants learned how to manage their properties or adopted strategies to recover from and prevent future wildfire and drought damage.**

* 30% of workshop participants increased their knowledge on fire recovery practices (Steven Swain).
* 89% of ranchers that participated in loss claim workshops were able to use the information to prepare a loss claims from the wildfire that impacted their land (Theresa Becchetti).
* Workshops and live-fire trainings in other counties have spurred the creation of six other prescribed burn associations across the state (Jeffrey Stackhouse).
* After attending the prescribed fire workshops, trained participants extended training in their communities (Kate Wilkin).
* Three property owners applied the knowledge gained to apply for grants with the Natural Resources Conservation Service to put in fire lines (Kate Wilkin).
* 90% of workshops participants that didn’t understand fire resistant structures prior to workshops left with a nuanced perspective and an action plan to prepare their properties for wildfire (Kate Wilkin).
* USDM utilized information from UC ANR academics to update the drought severity listing on California rangelands. This project has also resulted in partnership between UCCE, the USDA Climate Hub (Davis, CA), the National Drought Mitigation Center, and the National Oceanic and Atmospheric Administration (Matthew Shapero).

A wide variety of research and extension led to opportunities to inform policy related to fire resiliency. The North Coast Fire Resiliency workshop was used to collect feedback what residents were most interested in volunteer outreach at people’s homes what residents were most interested in learning (Steven Swain). Fire probability maps have been developed or updated which model extreme fire hazard conditions and fire spread under different future climate scenarios to predict future fire frequencies (Max Moritz). Fire knowledge has been shared with local, national and international media and through numerous educational events and interactions with policy makers (Yana Valachovic). Another academic conducted a field survey of the aquatic habitat in Matilija Creek after 90 percent of the watershed burned in the Thomas Fire. Once one of the Ventura River’s primary spawning areas for steelhead trout, a few months post fire there was no sign of fish presence. The academic made presentations to 220 people about erosion control and how to recover their landscapes to prepare for future fire events (Sabrina Drill). One academic worked with local livestock producers and USFS personnel on dealing with post fire grazing and worked with a local municipal utility district to develop a Range Health Conditions Assessment and Monitoring Program. After the King fire in El Dorado County burned 97,000 acres, UC ANR helped livestock producers begin grazing a year earlier than the current policy allowed (Scott Oneto).

Other projects informed policy related to drought and climate change resiliency. One project produced a detailed review paper on Climate Change Trends and Impacts on California Agriculture, which garnered significant international, national, and state attention (Tapan Pathak). In collaboration with UC ANR advisors, campus academics, ranchers, and rangeland managers, an academic examined on-ranch management decision-making and social-ecological resilience to drought. This work, draws on more than 600 surveys and interviews of California ranchers (Leslie Roche). Another collaborative effort, has built an online framework for data sharing in the interest of understanding a changing climate in California, including Cal-Adapt.org (Maggi Kelly).

**Science-based information was applied to fire resiliency policy and decision making**

* Information gathered at the fire resiliency workshop helped shape Sonoma County’s fire planning (Steven Swain).
* Fire hazard research has directly contributed to more sophisticated modeling of fire hazards and have been incorporated directly into CAL FIRE’s evaluation protocol for proposed fuel treatment projects, grounding their program in the most current scientific understanding of climate/fire interactions at broad scales (Max Moritz).
* Information to policy-makers, informed SB 901 which is about improving fire resiliency (Yana Valachovic).
* The city of Mill Valley used UC ANR science-based information to help create a new defensible space ordinance (Yana Valachovic).
* A collaborative group of resource agencies, public works agencies, non-profits, and other stakeholder groups, used science-based information from UC ANR research to develop a published Strategic Plan for the recovery of watersheds after fires and debris flows (Sabrina Drill).
* The research from this work is helping guide US Forest Service policy decisions on what factors are the most critical for evaluating the return interval for grazing post fire and what on-the-ground practices ranchers need to implement. This work will guide return intervals for post fire grazing and will be a model for other areas across California. One rancher said “without UCCE we would no longer be ranching” (Scott Oneto).
* The California Climate and Agriculture Network (CalCAN) has used the paper, Climate Change Trends and Impacts on California Agriculture, to pursue legislation to fund the development of farm-level, science-based agricultural climate adaptation decision support and planning tools (Tapan Pathak).
* The study on rangeland resilience to drought has informed USDA climate vulnerability assessments (Leslie Roche).
* Cal-Adapt has been used by several companies and agencies as a planning tool (Maggi Kelly):
  + three electric and gas utility companies in California used Cal Adapt to support climate-resilient design of compressor stations and substations, and to explore intensity and duration of projected mid-century heat waves,
  + the USDA Forest Service used it for planning a fuel treatment with future climate conditions,
  + and the Caltrans’ Transportation Adaptation Planning Grant Program (which distributes $20M to local and regional agencies for adaptation planning) used it as a tool to support applicants.
* Cal Adapt has also been used by the California Department of Public Health to generate county-level reports of climate-related risks to public health (Maggi Kelly).
* The California Governor’s Office of Planning and Research released guidance for Planning and Investing for a Resilient California (pursuant to B-30-15), and directs state agencies to use Cal-Adapt.org as a source for peer-reviewed, state-sanctioned data depicting projected climate risks and for map overlays to facilitate planning and investment (Maggi Kelly).

The aforementioned measured outcomes demonstrate participants learning about and developing new management paradigms to address the challenges that come with a changing climate. Policy informed by science-based research will help increase forest and rangeland resiliency and decrease the risk of catastrophic fires and droughts.

# Developing an inclusive and equitable society

## Condition Change: UC ANR contributed to improved living and working conditions for California’s food system and farm workers

**Sustainable Food Systems**

**Issue**

There are 21.6 million full- and part-time jobs related to the agricultural and food sectors – 11% of total U.S. employment. Migrant and seasonal farm workers are a vital component of those jobs, yet they continue to live in poverty with limited access to health care services and poor health indicators. A variety of mechanisms have been used to promote social justice and improve the working conditions of farmworkers, including union organizing, policy interventions and, more recently, social certification. Social certification in agriculture is increasingly viewed as a promising mechanism to ensure ethical treatment of farmworkers on U.S.-based farms, but more information is needed.

**Methods & Outcomes**

UC ANR continues its efforts to reach underserved groups working in California’s food system. UC ANR’s research, outreach, and education is leading to changes that promote social justice in California agriculture. Research and activities that resulted in outcomes with specific measured indicators follow.

One collaborative project targets beginning farmers and ranchers, and specifically those who are small-scale, minority, and socially disadvantaged, to help improve their livelihoods. The long-term goal is to support the economic and ecological viability of the next generation of diverse California farmers including urban, peri-urban, and rural farmers and ranchers from diverse communities.Over the past three years, nearly 150 workshops were conducted reaching over 2,000 participants, 36% of whom were minorities/socially disadvantaged and 55% of whom were women. The project also developed over 50 culturally relevant, multimedia educational resources in four languages (English, Spanish, Hmong, and Mien) (Christy Getz and Jennifer Sowerwine).

**Participants experienced changes that will improve their food system livelihood.**

87% of the diverse group of beginning farmer and rancher participants reported learning something new and 44% of workshop participants implemented at least one thing they learned after six months (Christy Getz and Jennifer Sowerwine).

* 14 beginning farmers gained access to land and are starting to farm (Christy Getz).

UC ANR academics collaborated with the Equitable Food Initiative (EFI) to develop a business case for improved farm labor conditions. They researched the costs and benefits of providing equitable farm labor conditions. They are also working to evaluate the EFI Leadership Teams model, which is an innovative labor-management model that promotes improved channels of communication between field workers and farm management. Focus groups with agricultural workers in the United States and Mexico were conducted, as well as in-person observation of a weeklong Leadership Team training session in Mexico, and individual and group interviews with farm managers and field workers. While much of this research is still in process, two reports have been finished: 1) Making the Business Case for Improved Farm Labor Conditions: Evaluating the Equitable Food Initiative (EFI) Leadership Teams Model and 2) Making the Business Case for Positive Farm Labor Practices (Christy Getz and Ron Strochlic).

A related effort is conducting a comparative analysis of agricultural social certification in the U.S. Three principal social certification labels are being studied -- the Equitable Food Initiative (EFI), Fair Trade USA, and the Coalition of Immokalee Workers. The project is developing indicators for measuring and tracking internal costs and benefits associated with certification and improvements in farm labor conditions. In addition, the project is exploring the impact of EFI certification on health care access and health outcomes among female indigenous farmworkers (Christy Getz and Ron Strochlic).

**Science-based information informed labor policy and decision-making.**

* As a result of extending the business case for improved labor conditions: (Christy Getz and Ron Strochlic).
  + California Labor Commissioner Julie Su would like to use the information to help advise what the state can do to promote and develop impactful labor legislation.
  + The Equitable Food Initiative (EFI) was asked to present at a joint hearing of the Senate Judiciary Committee, the Senate Select Committee on Women, Work & Families, and the Legislative Women’s Caucus on an alternative model of accountability in creating a harassment-free culture in California. There has been continued dialogue with the Labor Commissioner’s office regarding ways to apply this model to other workplace settings, particularly with low-wage and vulnerable workers.
  + The findings also informed the collaborator’s (EFI) internal evaluation processes and interactions with the California legislature.
* The effectiveness of agricultural social certification programs has improved, both through internal programmatic enhancements and through informing related local, state and federal policy (Christy Getz and Ron Strochlic).

These measured outcomes demonstrate changes to improve the living and working conditions for those working in the California food system, many of whom live in poverty and have poor health. In this way, UC ANR contributes to the public value of d**eveloping an inclusive and equitable society.** These efforts also benefit the farm system through workforce retention, improved safety, and improved product quality. UC ANR’s involvement to advance the growing social certification movement, in particular, helps create new markets to meet consumer demand for food produced under socially sustainable conditions.

## Condition Change: UC ANR contributed to increased diversity, inclusiveness, and cultural competency in California’s workplaces

**Healthy Families and Communities**

**Issue**

California is the most diverse state in the nation by many standards, including race/ethnicity, languages, and socio-economics. It is a minority-majority state, where no single ethnic group forms a majority of the population. However, more than half of the children in California are Latino. The median annual income for Latino, Native American, and African American households in California are well below the state median income. This income gap correlates to opportunity gaps, in critical areas like access to high-quality youth development programs and early preparation for college. California continues to be challenged by social, health, and economic inequities.

**Methods & Outcomes**

UC ANR builds cultural competency skills, implements community-centered programs, and develops proactive policies to increase diversity and inclusiveness. UC ANR engages in intentional efforts to ensure that all members of the public have equitable access to the resources we provide. UC ANR academics live and work in communities building trust and credibility to solve local problems together through research, outreach, and education. As a result of UC ANR’s multipronged efforts to better reach underserved audiences, the internal audience gained cultural competency skills and it increased engagement with Latino and tribal communities. Research and activities resulted in internal organizational outcomes that then led to increased engagement with underserved groups. Specific measured indicators follow.

The UC ANR 4-H Youth Development Program continued the UC 4-H Latino Initiative, a three year pilot to develop culturally relevant and responsive programs to welcome Latino youth, families, and volunteers to 4-H in seven counties. Local programs developed partnerships with other organizations serving Latinos and identified the needs of the California Latino community. The program is testing new delivery modes, ways to remove barriers to participation, and recruiting volunteers from under-represented groups. Programming introduces 4-H projects to Latino youth through schools, building trusting relationships over time and developing programming relationships with key volunteers in influential leadership positions in Latino communities (Katherine Soule). A cultural awareness training for 4-H staff and volunteers was developed and conducted. Peer-reviewed publications, including three journal articles, and popular press articles were developed that extend best practices and lessons learned from this effort. The UC program now leads the largest 4-H effort to serve Latino youth in the nation, and chairs the National 4-H Council Latino Advisory Committee. It is also an adviser on 4-H in Mexico (Shannon Horrillo and Lupita Fabregas).

**UC ANR better engages underserved communities.**

* In 2017 there was a 34% annual increase in Latino participation (45,528 Latino children), and a 52% annual increase in Latino adult volunteer participation (2,259 Latino adult volunteers) (Shannon Horrillo and Lupita Fabregas).
* The Latino Initiative’s local 4-H Career Pathways programming grew, with an almost 50% increase in Latino youth participation over the last year. In FFY 2018, 7,549 youth and 29 peer educators were engaged. Survey results showed that 95.3% of participants “think science will be important in their future,” with 96.8% of youth “reporting they are now good at science.” These youth members also reported that they feel they can “weigh the pros and cons of future college options.” National research findings indicate the 4-H Career Pathways initiative “shows promise for empowering youth to achieve the attitudes, aspirations, and skills needed for successful STEM careers.” The effort also produced a number of best practices for STEM education, career exploration, and engagement of girls and underrepresented youth (Katherine Soule).
* 45 Latino 4-H youth recruited through the UC ANR 4-H Latino Initiative attended the California 4-H Youth Summit and reported feeling a sense of belonging among participants – an important inclusion indicator. Bilingual and bicultural Latino chaperones also participated. They accompanied the youth during the experience to help them feel confident and welcome (Lupita Fabregas).
* UC ANR established a partnership with Segorea Te Land Trust, an urban Indigenous women-led community organization in the San Francisco Bay Area. Cultural food plants have been established on an Agricultural Experiment Station urban farm and there have been associated educational events (Jennifer Sowerwine).

UC ANR continues effort to build successful relationships with tribes. A new work group on Native American Community Partnerships was formed. They organized two professional development workshops for the UC ANR internal audience, which included collaborative and participatory agenda setting and deep listening to communities of color and other under-represented groups. There were 114 participants. Additional materials and resources are under development (Jennifer Sowerwine). A UC 4-H Youth Development qualitative study identified promising practices of Latinx youth serving organizations, in regards to recruiting, engaging, and sustaining Latinx youth participation in youth programs. It conducted interviews with youth-serving professionals and youth served by 13 youth organizations in California. The preliminary findings were extended in California to 4-H academics and staff from 10 counties, the statewide program office, and the 4-H Foundation. This information also was provided to national audiences using an asset-based community mapping process and tools, through two webinars, a poster presentation, and three journal articles (Fe Moncloa).

**UC ANR academics, staff, and volunteers learned skills to better engage diverse audiences.**

* 88% of the 40 evaluation respondents felt increased confidence in their ability to reach out to tribes (Jennifer Sowerwine).
* 35 Extension professionals, 30 4-H volunteers and nine 4-H youth learned new practices to engage Latino populations as evidenced by tests (Fe Moncloa).

The findings from the UC 4-H study that identified promising practices of Latinx youth serving organizations was provided to 4-H academics and staff from 10 counties, the statewide program office, and the 4-H Foundation. Information was shared on recruiting, engaging, and sustaining the participation of Latinx youth in youth programs (Fe Moncloa). In addition, The Karuk-UC Berkeley Collaborative, which is a partnership between the Karuk Tribe and UC Berkeley, developed a guiding policy to inform the work with their allies to enhance the “eco-cultural revitalization” of the people and landscapes within Karuk ancestral lands (Jennifer Sowerwine).

**Science-based information applied to community engagement policy and decision-making.**

* New knowledge about how to better engage Latino audiences in 4-H youth development work was integrated into 4-H programming. For example, bilingual staff teach Spanish speaking youth and families, all programs and leadership conferences are free, and free transportation is offered (Fe Moncloa).
* The Karuk Tribe is using the new guiding policy as the basis for agreements with all researchers and project leaders who propose collaborative projects with the Karuk Tribe that affect the Karuk people, culture, traditions, and/or Karuk ancestral lands and territory. This document is part of an adaptive process whereby they revise the guidelines to fit the evolving needs of the Karuk Tribe (Jennifer Sowerwine).

These measured outcomes demonstrate how UC ANR has strengthened its internal capacity to do effective outreach to diverse audiences, and as a result expanded and sustained important partnerships with both the Latino and tribal communities. UC ANR increased access to opportunities and created environments where different kinds of people can thrive and succeed. In this way, UC ANR contributes to the public value of developing an inclusive and equitable society. The UC Berkeley Hass Institute of Fair and Equitable Society listed California as the fourth most inclusive state in the nation based on their inclusiveness ranking system in 2017. Nevertheless, there is still a lot of work to do.