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**PROMOTING ECONOMIC PROSPERITY IN CALIFORNIA**

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

**Issue**

While California is the world’s fifth largest economy, the effects of the pandemic are still rippling through the economy, impacting the buying power of individual households. Inflation is finally starting to come down from 9% in 2022 and is now hovering around 3-4%. But the price of most goods is still higher than before the pandemic. For many families, wages have not kept up with inflation. Resource management, particularly for families living below the poverty line, has been critical to making ends meet.

**Methods**

In partnership with communities and allied organizations, UC ANR conducts research and delivers education leading to improvements in food resource management practices.

The CalFresh Healthy Living, UC (CFHL, UC) State Office at UC Davis provided statewide oversight, leadership, and guidance for the CalFresh Healthy Living Program. UC Cooperative Extension (UCCE) academics and CFHL, UCCE supervisors offered local leadership and guidance in program implementation and evaluation. UCCE academics also provided oversight, leadership, and guidance for the Expanded Food and Nutrition Education Program (EFNEP) statewide program. Curricula, such as *Plan, Shop, Save, Cook,* are designed to help adult participants gain the tools needed to take control of their money by teaching families food buying and budgeting skills, and food resource management techniques. (CFHL, UC and EFNEP)

As a result of UC ANR’s research and education, participants learned and adopted financial management practices. Outcomes with specific indicators follow.

**Outcomes**

**Participants improved food resource management practices.**

* After participating in CFHL, UC education, a statewide survey of 1009 adult participants showed that 87% of participants reported improvements in at least one food resource management skill, such as comparing unit prices (52%) and shopping with a list (54%). (CFHL, UC) Local highlights follow:
  + In San Mateo and Santa Clara counties, 92% of participants in *Plan, Shop, Save, Cook* classes reported an improvement in at least one food resource management behavior. One participant shared, “I learned how to compare units and price when comparing store brand and a popular brand. This has helped me save money and buy what is more quantity for a better price.” (Laura Vollmer)
  + In Contra Costa and Alameda counties, post-survey results of 231 adult EFNEP graduates showed that 94% and 96% in each county, respectively, improved food management skills such as planning meals before shopping, making a shopping list, comparing food prices, and checking for food on hand. (Marisa Neelon)
  + In Los Angeles and Orange counties, pre-/post- survey results of EFNEP participants showed that 94% of participants in each county improved in at least one food resource management practice. (Natalie Price)

**Change in condition: Participants saved money.**

* EFNEP graduates statewide averaged a $63.95 savings in their monthly grocery budget, which is a $767 savings a year per family. After completing EFNEP classes, the number of participants reporting they were unable to afford balanced meals decreased from 89% to 37%. (EFNEP) Local highlight follows:
  + Pre-/post- survey results of EFNEP participants showed that participants in Los Angeles County saved an average of $70.60 a month on groceries and participants in Orange County saved an average of $32.10 a month. (Natalie Price)

The food resource management outcomes reported above demonstrate improved individual and household financial stability. Longitudinal studies of graduates indicate that they maintain positive behavior change two to six months after completing the program. 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

**Issue**

California needs community economic development approaches to foster economic resilience and vigor across its working landscapes, especially after several years of the economic effects of the COVID-19 crisis. The state’s working landscapes span fishing to agriculture and ranching and from mining to renewable energy. In 2018, the nine working landscape segments paid workers $85 billion in earnings and generated $333 billion in sales; these include: agricultural distribution, agricultural production, agricultural processing, agricultural support, fishing, forestry, mining, outdoor recreation, and renewable energy. Collectively, these segments contribute significantly to the state’s economic vitality and account for more than 1.5 million jobs and nearly 70,000 business establishments. In particular, small-scale producers face challenges managing costs, marketing, and understanding and complying with regulations.

**Methods**

UC ANR’s efforts focus on California’s agriculture, ranching, and forestry to identify opportunities for economic development through innovation and entrepreneurship while also fostering environmental and social sustainability.

The UCCE Small Farms Network provided outreach and technical assistance in English, Spanish, Hmong, Lao, Mandarin, Korean, Vietnamese, and Iu-Mien to support small-scale farmers in applying for state government grants to address drought, flood, and COVID relief. (Ruth Dalhquist-Willard, Hung Doan, and Aparna Gazula)

As a result of UC ANR research and extension, participants learned about and adopted agricultural business management practices that contribute to community economic development. Outcomes with specific indicators follow.

**Outcomes**

**Participants secure funding to sustain small farms.** NEW

* As a result of technical assistance provided by UCCE to small farmers from socially disadvantaged communities:
  + In Fresno County, 14 of 20 farmers who received UCCE assistance received funding for a total amount of over $335,000 in economic relief funding from state and federal programs. Some farmers who had lost sales mentioned these grants would provide their startup costs for the next production season. (Ruth Dalhquist-Willard)
  + The UCCE program on the Central Coast resulted in all 73 underserved farmers getting $232,625 in Coronavirus Food Assistance Program grant funds. (Aparna Gazula)
  + In Riverside County, a post-evaluation survey revealed that 31 out of 37 underserved farmers applying for grants with UCCE assistance were awarded a total of $350,000 in funding for economic relief from COVID-19, drought, and flood. (Hung Doan)
  + In the High Desert region, 16 farmers collaborated to establish the Growing for Profit Garlic Market Crop CO-OP. (Hung Doan)

These aforementioned measured outcomes demonstrate changes that improve the economic, environmental, and social sustainability of California’s working landscapes. 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**

The dairy industry is California’s leading commodity in cash receipts. California’s total livestock and livestock products cash receipts are over $12.8 billion (2021). Ranchers and dairy producers face many management and production challenges, like drought, increasing temperature, water and air quality regulations, as they strive to maintain their competitive edge. Although livestock is a high-value commodity, it can be challenging to be profitable at the ranch level. Ranchers or their family members often need to work off the ranch to make ends meet and keep the farm running. Simultaneously, there is the need to improve the ecological viability of these animal production systems.

**Methods**

UC ANR partners with public, non-profit, and private groups to create and extend new knowledge about animal systems management for dairies and livestock operations.

A UC Cooperative Extension (UCCE) Poultry Specialist at UC Davis organized and presented at a virtual symposium on Poultry Welfare Assessments in collaboration with the national Poultry Extension Collaborative. There were 159 participants from 20 different countries, including the United States, United Kingdom, Canada, Mexico, Nigeria, Pakistan, Iraq, Jamaica, Germany, Turkey, and Brazil. Attendees’ professional backgrounds included veterinarians, poultry industry stakeholders, researchers, University faculty or staff, students, government employees, and consultants. (Richard Blatchford)

A UCCE Livestock and Natural Resources Advisor in rural Northern California hosted an Ag Legacy Symposium at the Chico State Farm. This one-day event was designed for ranchers, farmers, and agri-business owners, big or small, to plan for the transition to the next generation. The sessions covered legal aspects, financial topics, political factors, family dynamics, and provided real life scenarios for attendees to consider incorporating into their succession plan. The event drew 73 in-person attendees and an additional three ranching operations with eight participants online. After the event, a 3-part editorial series was published in the California Cattlemen Magazine on succession planning: 1) Lessons from farmers and ranchers, 2) Tax Planning, and 3) Legal Aspect. (Tracy Schohr)

A UCCE Livestock and Natural Resources Advisor in the Central Sierra region disseminated information to livestock producers, as well as small acreage landowners via meetings, workshops, Beef Quality Assurance certification training, and ranch calls. (Flavie Audoin)

A UCCE Livestock and Natural Resources Advisor, and County Director, working in the San Francisco Bay Area held a workshop on business solutions for ranching, including liability insurance, housing, and rancher/manager collaboration. (Sheila Barry)

As a result of UC ANR research and extension, participants made changes that improve animal production systems. Outcomes with specific indicators follow.

**Outcomes**

**Participants learned and intended to adopt practices for more productive and sustainable animal management.**

* When asked in a post-event survey, 100% of the 63 respondents said they would use the information presented in the symposium on poultry welfare, and 94% were likely to change their behavior based on the information provided. (Richard Blatchford)
* After the symposium on succession planning, 96% reported that the event provided new knowledge and that the event inspired them to change/modify/create an Ag Legacy plan. Attendees predicted they will share some aspect of the event in the next 12 months with 458 additional people. (Tracy Schohr)
* Of the 34 workshop attendees who responded to the evaluation survey, 65% reported learning business solutions that they will apply to improve sustainability of livestock production systems. (Sheila Barry)

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

* As a result of UCCE efforts, some Central Sierra livestock producers are changing their vaccination plans. Additionally, 32 livestock producers from 14 different counties were certified in Beef Quality Assurance. (Flavie Audoin)

These measured outcomes demonstrate ranch-level advances, which help the state’s overall improvement in animal management and profitability, thus contributing 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 improved animal management, productivity and efficiency

**Sustainable Natural Ecosystems**

**Issue**

California’s total livestock receipts are over $12.1 billion (2021). Forage crops linked to the livestock industry are an important economic driver in California’s food-producing system. Although livestock is a high-value commodity, it can be challenging to be profitable at the ranch level. Ranchers or their family members often need to work off the ranch to make ends meet and keep the farm running. Simultaneously, there is a need to improve the ecological viability of these animal production systems.

**Methods**

UC ANR partners with public, non-profit, and private groups to create and extend new knowledge about animal systems management for livestock operations.

A UCCE Advisor serving the Anderson Cottonwood Irrigation District evaluated and developed custom seed mixes for local vendors to sell. These custom seed mixes are critical for ranchers, given most blends of pasture seeds available simply do not work for local clientele. In addition, the advisor linked the seed vendors with drill operators capable of doing a quality service of planting pasture. This provided water users with an opportunity to either plant a quality pasture on their own or simply pay to have it done for them. (Josh Davy)

A UCCE Advisor continued to organize and deliver the San Benito Weed Management Area’s Annual Rancher seminar. (Devii Rao)

As a result of UC ANR research and extension, participants made changes that improve animal production systems. Outcomes with specific indicators follow.

**Outcomes**

**Participants learned and intended to adopt practices for more productive and sustainable animal management.**

* Rancher Seminar participants were asked when they would incorporate what they learned. Out of 30 responses, 27 people (90%) said they would incorporate information they learned at the workshop within six to 12 months. In general, this would potentially lead to more effective weed management and increase ecological sustainability of rangelands. (Devii Rao)

**Participants adopted practices for more productive animal management.**

* By tracking local seed sales from vendors, it was found that 25% of the Anderson Cottonwood Irrigation District was seeded with UCCE-research-proven seed and more are being planted. According to pasture manager interviews, pastures not replanted with UCCE-researched seed mixes were found to produce less than a third of properly seeded pastures, and many reported having to bring in outside forage sources. Thus, adoption increased both the quality and quantity of pasture production over both pre-drought and nonplanted pastures due to the higher quality of pasture plants currently seeded. (Josh Davy)

These measured outcomes demonstrate forage and rangeland advances, which help the state’s overall improvement in animal management and profitability, thus contributing 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 agricultural and forestry efficiency and profitability

**Sustainable Food Systems**

**Issue**

California is a national leader in agricultural production, leading the country in cash income received for agricultural products, with farms and ranches receiving more than $49 billion for their output (2021). The state's leading crops remained fruits, nuts, and vegetables. California farmers and ranchers must innovate and adapt to technical, social, and environmental challenges to maintain the economic vigor of California’s agricultural 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 affect small-scale farmers more adversely, as many lack the resources or skills that larger farms have.

**Methods**

UC ANR creates and extends new knowledge about agricultural production from variety trials to post-harvest.

*Ag tech*

A UC Cooperative Extension Specialist (UCCE) of agricultural mechanization at UC Davis continued cutting edge work in digital agriculture. He employs advanced web app development tools to create a suite of decision-support applications. The GDD Calculator offers a streamlined way for farmers to calculate growing degree days (GDD) for various crops, aiding in critical farming decisions such as planting and harvesting. Another application, the Radiative Transfer Modeling (RTM) Simulator, draws upon the PROSPECT model to simulate leaf optical properties, significantly enhancing the utility of remote sensing data in agriculture. The 'When to Fly?', a cornerstone of this suite, empowers users to determine optimal drone mapping times. He delivered 19 talks at diverse forums, wrote articles for Grower's magazine, and manages various online platforms to provide up-to-date extension materials. (Ali Pourezza)

A UCCE Viticulture Advisor working in the Central Valley evaluates the suitability and effectiveness of novel mechanization and automation technologies to improve management efficacy in table grape vineyards. She provides growers with cost analyses to facilitate their decision on adopting evaluated technologies. She has evaluated three mechanical pruning tools for vineyards. (Tian Tian)

*Small farms and organic production*

A UCCE Food Systems Advisor in the Central Sierra region conducts research and extension to maximize environmental and community benefits related to sustainability and competitiveness of local agriculture. The Central Sierra region consists of over 2,900 farms (2017 USDA Ag Census), ranging in size from sub-acre plots to a few hundred acres. Farmers grow a multitude of crops year-round, with the majority being sold at farmers markets, roadside stands, community-supported agriculture programs, grocers, restaurants, and other retailers. The clientele includes paraprofessionals lacking agricultural experience who have relocated to the region to start new agricultural enterprises, as well as young beginning farmers. Due to the lack of local professional agronomy and pest control advisor services, there is a crucial demand for scientifically accurate pest, nutrient, and irrigation management information from UCCE. (Hardeep Singh)

To address challenges small agricultural producers face in the larger San Francisco Bay Area, a UCCE Small Farms Advisor developed educational materials to help their operations be competitive and sustainable, covering topics such as organic fertilizers and composts, managing mycorrhizae, and using biostimulants.She also held a seminar, in English and Spanish, on why and when to choose between open-pollinated, hybrid, land-race seeds, where there were 41 organic small farmer attendees. (Aparna Gazula)

UC Sustainable Agriculture Education and Research Program (UC SAREP) continued a collaboration with the Organic Farming Research Foundation to assess the impacts of an original 6-module, English-language online training program, using a survey. These modules include Soil Health, Water Management and Irrigation, Weed Management, Insect and Mite Pest Management, Disease Management, and Business Management and Marketing. Each module requires at least four hours to complete the most basic parts, and 8-10 hours if all components are completed in their entirety, for a total training roughly equivalent to a 3- to 5-day intensive workshop. (Sonja Brodt)

The Extension Coordinator for the UC Organic Agriculture Institute assisted in the development of four in-person workshops and one webinar series on diverse topics in organic production with 188 participants. Extension topics included soil nutrient management, pest and weed management, pathogen and disease management, and best practices in organic crop production. (Rob Straser)

The UCCE Specialty Crops and Horticulture Advisor working on the North Coast established a field trial at three private farms in the region to assess the viability of overwintering cauliflower, which is a novel crop for the region. In collaboration with the UC Organic Agriculture Institute a field day was held to extend information on the production, fertilizer, and pest considerations for this crop. The workshop had 38 participants. (Eddie Tanner)

*Orchards*

A UCCE Orchard Crops Advisor is conducting research and working with clientele to improve orchard efficiency by selecting a variety and rootstock which are well-suited for the field conditions at particular planting sites, finding alternatives to expensive hand labor for orchard operations, and improving management practices to ensure a large and profitable crop. A collaborative almond variety trial, planted at California State University in Chico, will give growers valuable information about the performance of different almond varieties in the area. Other collaborative research is being done on prunes, including surveying orchards for incidence of prune brownline disease, and developing research-based recommendations on resistant rootstock, on reducing hand labor, and on how to moderate orchard temperature during bloom to ensure sufficient fruit set. (Reported by Natalia Ott; collaborators mentioned: Luke Milliron and Franz Niederholzer)

*Row crops*

A UCCE Vegetable Crops Advisor continued experiments on 18 commercial fields to investigate and compare the impacts of a wider in-row spacing on grafted watermelon yield, quality, and economic gains compared to the traditional system. Grafting is an ancient production tool widely recognized to improve fruiting vegetable yield, enhance disease resistance, and tolerate nutrient and water deficiency; however, prior to UCCE’s research, grafted watermelons had not been effectively tested in California. Findings were disseminated to the cooperative growers and broader stakeholders through a field day, variety trial tour, and newsletter. (Zheng Wang)

The Vegetable Crops and Soils Advisor in the Central Valley conducted a yield survey of sweet potato at the request of many growers, who wanted third party estimates of sweet potato production earlier than is reported by USDA or the County Crop Report. (Scott Stoddard)

*Agronomy*

A UCCE Specialist in agronomy at UC Davis continued collaborative Extension activities aimed to improve nitrogen use efficiency on the grain acreage in the state and better net returns to growers. Seven training seminars were held across the six counties where small grains are widely grown. The objective was to educate crop and pest consultants about the suite of nitrogen management tools UCCE has developed over the past several years and illustrate their use via the on-farm case studies UCCE has compiled. In all, 51 individuals attended the seminars. In addition, he continued collaborative work with UCCE Agronomy Advisors from across the state to actively demonstrate improved nitrogen fertilizer management practices for cool season cereals on production farms throughout the state. They have conducted 19 on-farm demonstrations across the state. (Reported by Mark Lundy; collaborator mentioned: Konrad Mathesius)

A UCCE Agronomy Advisor works with farmers and their consultants, largely pest control advisers and certified crop advisers, to address irrigation water quantity, regulations, and market economics. These topics were identified as high priority through a recent statewide collaborative needs assessment survey of 483 agronomic crops growers, consultants and allied industry professionals in California. One significant event in 2023 was a public meeting with 65 clientele in attendance. (Nick Clark)

As a result of UC ANR research and extension, participants learned and adopted agricultural management practices. Outcomes with specific indicators follow.

**Outcomes**

**Participants learned and intend to adopt recommended practices for plant production.**

* The deployment of the web applications has led to a notable increase in knowledge and skills among over 1,000 specialty crop growers and agricultural professionals. The extension efforts increased the audience's awareness and understanding of digital agriculture, reflecting a shift in attitudes towards more technologically driven farming practices*.* (Ali Pourezza)
* The 2023 Northern Sacramento Valley Walnut Day grower meeting provided an evaluation to the 102 participants, 96% of the 27 survey respondents indicated an increase in knowledge on the meeting topics after the meeting. (Natalia Ott)
* The Northern Sacramento Valley Prune Day grower meeting provided an evaluation to the 81 participants, 94% of the 17 survey respondents indicated an increase in knowledge on the meeting topics after the meeting. (Natalia Ott)
* As a result of the one-on-one consultations through farm calls, two wine grape growers intended to do the petiole sampling tests for nutrient management in vines. The other nine individuals included the current growers and prospective growers who increased knowledge of specialty crops (olives, wine grapes, blueberries, apples, etc.) suitable to local conditions, starting a new farm, and identification of pests, diseases and abiotic factors leading to crop damages. ​​(Hardeep Singh)
* Eighty percent of the respondents indicated that the online organic farming training program increased their or their students/clientele's knowledge about organic farming and inspired or motivated them to farm organically. Approximately 60% indicated that it increased their or their students'/clientele's confidence in farming organically. (Sonja Brodt)
* Of participants who completed a short survey following the Organic Agriculture Institute events, 92% felt that the event greatly or somewhat improved their knowledge on organic production and reported they were interested in obtaining more resources on organic agriculture specifically tailored to their production region. (Rob Straser)
* After the workshop, 92% or survey respondents indicated greatly improved knowledge on growing overwintering cauliflower, a novel crop for the region. (Eddie Tanner)
* As a result of the Organic Fertilizers and Composts seminar, 36 organic, small-scale farmers increased their knowledge of organic crop nitrogen management and 27 indicated that they would adopt one or more practices discussed during the workshop on their farm. (Aparna Gazula, Lucy Diekmann, Margaret Lloyd, Hung Doan)
* As a result of the seminar on why and when to choose between open-pollinated, hybrid, land-race seeds, 25 organic small farmers increased their knowledge of seed type selection. Fourteen organic small farmers indicated that they would adopt one or more practices discussed during the workshop on their farm. (Aparna Gazula, Lucy Diekmann, Margaret Lloyd, Hung Doan)
* Using post-surveys after the nitrogen (N) management seminars, 34 individuals indicated large increases in knowledge related to the use of N rich reference zones, the soil nitrate quick test, and The Nitrogen Fertilizer Management Web Tool. Further, 65-68% indicated that they were likely or highly likely to use N rich zones and the soil nitrate quick test in the future, which will improve the precision of N fertilizer management in California by enabling growers and crop consultants to optimize productivity while reducing overall input use. The respondents collectively advise more than 100,000 acres of small grain crops in California, indicating that our educational efforts and extension tools are having broad impact across California small grain agroecosystems. (Mark Lundy and Konrad Mathesius)
* In a post-event survey of all 65 attendees, 96% of the 12 respondents reported learning something new during the event on agronomic production and 83% intended to use that information in their work. (Nick Clark)

**Participants adopted recommended practices for plant production.**

* Four growers changed their practices and decision making based on the recommendations. A fig grower implemented exclusion techniques to protect young trees from gophers, following UC IPM guidelines. An olive grower adjusted irrigation practices for replanted trees based on recommendations. Integrated pest management recommendations were adopted by another olive grower in accordance with UC IPM guidelines. A wine grape grower adjusted nutrient application based on the petiole and soil sampling test results. (Hardeep Singh)
* Two grape growers adopted the mechanical pruning tools tested by UCCE, contributing to the economic viability of their operations. (Tian Tian)
* Farmers trained through the nitrogen management for agronomic production programs are now implementing the UCCE tools and methods without the direct assistance of UCCE. (Mark Lundy)

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

* There is widespread use of the digital tools When to Fly and RTM Simulator. Based on feedback, use of these tools has increased the efficiency of farming decisions among users. Adopting these digital tools will significantly improve crop yield and resource management. Furthermore, the project enhances digital literacy and technology adoption among the farming community, preparing them for a more resilient and adaptive approach in the face of environmental changes and challenges. (Ali Pourezza)
* The information from the sweet potato yield survey was used by the County Agricultural Commissioner for Merced County agriculture production estimates for 2022. (Scott Stoddard)

**Change in condition: Participants have economic benefits.**

* The gross planting area of grafted watermelons in California increased from less than 250 acres in 2018 to over 2,200 in 2023, which provides economic benefits through reduced input costs and increased production. Growers previously reported that successfully grafted fields could produce 15-25% more watermelons than the non-grafted fields per acre using the same amount of water and fertilizers. In addition, the plant population in grafted fields is about two-thirds of that in non-grafted fields, which lowers growers' input costs for grafted transplants up to 35%. In all, the economic benefits of growing grafted watermelons is the increase in net income by up to $6,000 per acre compared to the non-grafted production system, given California’s historically high market value of watermelon according to the latest USDA’s record. (Zheng Wang)

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 the public value of promoting economic prosperity in California.

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

**Endemic and Invasive Pests and Diseases - through the UC IPM Program**

**Issue**

Pests, diseases, and invasive plants decrease California’s agriculture efficiency and profitability. Pests reduce yields, render crops unmarketable, and negatively impact revenues. According to the Center for Invasive Species Research at UC Riverside, agriculture losses to exotic pests exceed three billion dollars annually in California alone. According to calag.ucanr.edu, Pierce’s disease alone costs California $104 million dollars a year with $56.1 million borne by the grape growers themselves for the cost of loss of production and vine replacement. (Cindy Kron) As the global population increases, crop production must increase to meet the greater food demands despite lagging resources for detection of plant pests and diseases. Science-based information is needed for growers, managers, and policymakers to develop practices and policies that sustain economic vitality while protecting environmental quality.

**Methods**

The UC Statewide Integrated Pest Management Program (UC IPM) helps growers, land managers, community leaders, and professional pest managers prevent and solve pest problems by drawing on expertise of UC scientists to develop and distribute through UC Cooperative Extension (UCCE) science-based information on managing pests using safe and effective techniques and strategies that protect people and the environment.

A UCCE Area IPM Advisor conducted research and extension in a wide range of crops, systems, and pests present in Southern California, especially in areas where IPM practices are not being used or are less frequently used. Digital and in-person extension events were developed in response to a needs assessment. Hundreds of growers and Pest Control Advisers (PCAs) attended extension events, which included 12 seminars and four meetings on IPM topics, such as thrips management and IPM in pitahaya and organic agriculture. (Eric Middleton)

Another UCCE Area IPM Advisor for San Luis Obispo, Santa Barbara, and Ventura Counties conducted research and extension activities related to soilborne pathogens impacting high value strawberry and vegetable production on the Central Coast. These systems often rely solely on pre-plant soil fumigation that is expensive, often not effective, and poses a health hazard. To address this issue, the advisor has been collaborating with a UCCE Specialist from UC Santa Cruz on a USDA National Institute of Food and Agriculture (NIFA) grant to explore the efficacy of non-fumigant disease management options, such as cover crops, rotational crops and soil amendments. (reported by Christopher Greer; collaborator mentioned: Joji Muramoto)

A UCCE Area Citrus IPM Advisor developed a research and extension program to address the pest management issues of citrus growers in the San Joaquin Valley, where 210,000 of California’s 270,000 acres of citrus are found. Extension activities included an UC Expert Seminar on citrus mealybug, more than 15 presentations related to the topic of citrus mealybug at various growers, industry, and scientific meetings, seven popular press articles on informing clientele about citrus mealybug, disseminated information via email. Additionally, screening field populations of citrus thrips showed that nearly all populations in the San Joaquin Valley have developed resistance to spinetoram. This finding will impact management strategies and was communicated to the industry via talks, posters, and popular press articles. (Sandipa Gautam)

The same UCCE Area Citrus IPM Advisor conducted research and extension activities related to the emergent issue of lemon pitting, including making 20 farm calls and collecting and studying samples. Based on consultations with experts, including horticulturists, plant pathologists, entomologists, plant physiologists, veteran advisors, the advisor determined that no-one had an answer to the issue of lemon pitting. In response, the advisor shared her observations through a talk at the 13th Annual Citrus Meeting organized by Nutrien. (Sandipa Gautam)

The Area Citrus IPM Advisor also collected important data needed for the registration of ethyl formate fumigant for use in bulk citrus. She presented the findings at scientific and grower meetings and published an article in Citrograph magazine, which has a readership of around 3,500 citrus industry stakeholders. UCCE also produced a webinar on citrus leprosis disease organized via the Citrus Research Board. The YouTube recording has 59 views. (Reported by Sandipa Gautam; collaborator mentioned: Spencer Walse)

The same Area Citrus IPM Advisor evaluated the impact of regulatory requirements imposed by USDA APHIS on California growers to ship fruit to South Korea. A collaboration with USDA Agricultural Research Services, the California Citrus Quality Council (CCQC), and an Emeritus UCCE Entomology Specialist developed a monitoring protocol. In 2023, 26 citrus orchards were surveyed using the protocol. The advisor also presented 11 talks at the California citrus quality council and methyl bromide alternatives outreach meetings, reviewed USDA Animal and Plant Health Inspection Services - Pest Risk Analysis (PRA) document, and helped CCQC prepare responses to PRA for three different countries. (Sandipa Gautam; collaborators mentioned: Jim Cranny, Spencer Walse, Beth Grafton-Cardwell)

As a result of UC ANR research, outreach, and education, participants learned and adopted pest management practices that increased agriculture efficiency and profitability. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants gained knowledge of detection and control practices for invasive and endemic pests and diseases.**

* Southern California growers and pest control advisers learned new information and intend to adopt integrated pest management strategies. Across all extension events, 208 participants responded to post-event surveys, 98% that they learned something from the event, and 98.5% that they would implement something from the event in the future. (Eric Middleton)
* Feedback from the presentations on citrus mealybugs showed that 75-85% of the responders agreed they gained new knowledge from the UCCE educational presentations and 75-80% agreed that the information was relevant and helped them monitor and manage citrus mealybugs. (Sandipa Gautam)
* After attending the webinar on citrus leprosis disease, 70% participants reported learning gains about the disease and disease symptoms. (Sandipa Gautam)

**Participants adopted recommended treatment and management practices for invasive and endemic pests and diseases.**

* After seeing results of UCCE research on non-fumigant disease management, a few growers are starting to feel more comfortable with reduced fungicide rates and questioning the traditional attitude that the highest rate of fumigant is best. One Ventura grower has asked UCCE to help him expand the practice on his ranch from the 8-acre research trial once the research project has ended. (Christopher Greer)
* After attending citrus thrips field days in 2021 and 2022, 70% of the Pest Control Advisers shared that they now recommend a different mode of action. These findings also lead to researching alternate chemistries and non-chemical options. (Sandipa Gautam)
* Twelve orchards were surveyed with a UCCE monitoring protocol developed to meet regulatory requirements for exporting citrus to South Korea. None of the orchards had sprayed Thiamethoxam in September, and all were free of fuller rose beetle. This is noteworthy because normal protocol dictates two applications. Because of UCCE work, growers only had to make one application to stay in compliance with export regulations. Anticipated long term impact is reduced use of insecticides, which will, in turn, will improve worker safety, reduce environmental impacts, and improve citrus pest management. (Sandipa Gautam)

**Science-based information was applied to integrated pest management policy and decision-making.**

* A UCCE Area Citrus IPM Advisor’s presentation provided the first alert to the citrus industry about the issue of lemon pitting, which resulted in the Citrus Research Board inviting a team of researchers to research this issue for which the advisor will serve as a Co-PI. Consultant testimonial: “I had emailed several researchers, sent samples to a lot of people and invited them to visit my field to try and figure out what this issue was. Everyone came, said it was something they didn’t know and did not revisit the issue. You are the only researcher who followed this issue and your presentation at the grower meeting pushed the citrus industry to fund research to understand what was causing pitting in lemons and making it unmarketable. Your dedication has helped us get the attention this issue deserved.” Chuck Hornug, Nutrien (Sandipa Gautam)

The measured outcomes reported above improved the state’s ability to prevent, control, and mitigate pests and diseases and create new opportunities for economic sustainability. Research demonstrates that increased IPM adoption saves money and in certain cases can reduce pesticide applications (Mullen et al. 2003, Gouge 2006). (Tunyalee Martin) In these ways, UC ANR contributes to increased agricultural efficiency and profitability and the public value of promoting economic prosperity in California.

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

**Endemic and Invasive Pests and Diseases - in Viticulture and Orchard Systems**

**Issue**

Pests, diseases, and invasive plants decrease California’s viticulture and orchard systems efficiency and profitability, reducing yields, rendering crops unmarketable, and negatively impact revenues. For example, walnut blight is a disease that spreads in rain events during bloom and can directly reduce yield by over half. Walnut blight could put a grower out of business as the industry faces its most devastating financial situation in industry memory with very low crop price and record high cost of production. (Luke Milliron) Science-based information is needed for growers, managers, and policymakers to develop practices and policies that sustain economic vitality while protecting environmental quality.

**Methods**

UC ANR conducts research and partners with public, governmental, and private groups to extend new knowledge and develop integrated pest management plans to increase agriculture efficiency and profitability.

A UCCE Specialist located at UC Davis continued research in the identification and control of plant pathogens affecting the fruit and nut crops. The lab processed 180 plant sample submissions and the specialist visited 25 orchards to support advisors and pest control advisers (PCAs) with disease diagnosis. Research trials were conducted with collaborating growers and at UC ANR’s Kearney Agricultural Research and Extension Center (REC) on the use of the fungicide, Oxathiapiprolin, to reduce risks of Phytophthora root rot in pistachio and the biological control product, Vintec, to protect almond trees against canker pathogens. Findings were shared with clientele, who include representatives of commodity boards, agrochemical and biocontrol companies, growers, fieldworkers, PCAs, field workers, and the California Department of Food and Agriculture (CDFA). In 2023, the specialist delivered 20 talks at local field days, field meetings, and short courses to extend current knowledge for disease management. (Florent Trouillas)

A UCCE Advisor developed and delivered educational resources related to the impacts of drought and climate change on major pests, including beet leafhopper in processing tomatoes and the flatheaded borer in walnuts. Recent drought conditions triggered the earlier migration of beet leafhoppers from the west foothill to newly transplanted tomato fields in the valley, resulting in tomato infestation of beet curly top virus and devastating loss of stand. In young trees, flatheaded borer infestation could result in the death of over 90% of the trees resulting in substantial economic loss due to the need for replanting. Drought conditions and increased walnut acreage contribute to flatheaded borer resurgence. Because this pest was never a significant problem before, information on its biology and monitoring and management tools were scarce. To address this issue, the advisor surveyed multiple orchards, identified the pest species as the Pacific flatheaded borer, and educated growers on identifying this pest infestation and implementing improved management solutions. Educational resources included eight talks, one podcast, one UC IPM AgExpert webinar, and five extension articles. (Reported by Jhalendra Rijal; collaborators mentioned: Tapan Pathak, Prakash Jha, Zheng Wang)

A UCCE Viticulture Advisor continued a network-based approach to learning that actively involves stakeholders in the creation and dissemination of knowledge. Participating growers shared data on farming practices, pioneered a new sampling approach for vector monitoring, contributed regional data on vector distribution, contributed to the development of a new technique for sample collection for virus detection, tested the accuracy and reliability of a vision-based decision support tool, implemented aggressive vine removal strategies, and collaborated with neighbors in regional management. In 2023 emerging information on red blotch disease ecology was extended to 201 attendees through workshops. The vision-based decision support tool that was developed performed with an accuracy of 70.5% for leafroll disease and 96.9% for red blotch disease. (Monica Cooper)

A UCCE Specialty Crops and Horticulture Advisor on the North Coast is building relationships with producers in this region, both established and beginning, and connecting them with current research and best practices that would support their efficiency, profitability, and ecological sustainability. He engaged in focused conversations and one-on-one consultations and conducted a workshop with winegrape growers that had 12 participants. (Eddie Tanner)

A UCCE Entomology Advisor for Kern County conducted research and extension activities associated with the management of arthropod pests in the southern San Joaquin Valley. Significant efforts have been made to conduct extension programs related to the hydrogels and their use. The potential impacts of this technology were measured using surveys during three extension meetings that were conducted during the fall of 2023. With sponsorship from the Department of Pesticide Regulation hydrogel project, three ant education workshops were conducted: one in the Central Valley, one on the Central Coast, and one in Southern California. These workshops were attended by 205, and 92 participants completed a post-workshop survey, 71.7% of which self-identified as growers or Pest Control Advisors (PCAs). The remainder work for universities, the government, or agrochemical companies. (David Haviland)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices that increased agriculture efficiency and profitability in viticulture and orchard systems. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants gained knowledge of and intended to adopt recommended detection and control practices for invasive and endemic pests and diseases.**

* An evaluation after speaking engagements at two workshops in Washington that focused on increasing awareness of regional management of leafroll disease, 100% of the 71 attendees reported they will apply knowledge gained; specifically, they will increase trapping, scouting, record-keeping, and vine removal to reduce spread of leafroll disease. (Monica Cooper)
* After attending ant education workshops, the overwhelming majority reported knowledge gains:
  + All participants who work for universities, the government, or agrochemical companies agreed (16.7%) or strongly agreed (83.3%) that the workshop had increased their knowledge about ants and their management.
  + Respondents that were growers or PCAs with 98.5% stating that the workshop had increased their knowledge about ants and their management.
  + Ninety-eight percent of growers and PCAs stated that they will consider information they learned at the meeting when making pest management decisions about ants.
  + Further, 93% of growers and PCAs anticipated that they will change their pest management practices due to information learned at the workshops, with 61% stating that those changes in practices will be made routinely.

The growers and PCAs that completed surveys stated that they influence the pest management decisions that are made on 75,303 acres of citrus, 16,621 acres of lemons, 11,630 acres of wine grapes, and 13,110 acres of table grapes. According to annual crop reports prepared by local Agricultural Commissioners, the acreages of the commodities reported have an approximate crop value of $1.8 billion annually. (David Haviland)

**Participants adopted prevention and detection practices for invasive and endemic pests and diseases.**

* UCCE supported adoption of the loop-mediated isothermal amplification (LAMP) assay, a low-cost technique for identifying diseases, by seven local growers, representing more than 3000 acres. Users assayed over 20,000 vine samples and identified asymptomatic vines, thereby improving vine removal accuracy by an average of 3-10% and reducing ongoing economic impacts of red blotch disease. Grapevine red blotch disease has significant economic impacts resulting from altered sugar, acid and phenolic accumulation. Economic losses may reach up to $170,000 per acre over the lifespan of a vineyard, including vine removal and replanting, as well as cost penalties for suboptimal fruit and detraction from negotiating power for price points.(Monica Cooper)
* In follow-up surveys and consultations, more than 90% of attendees are implementing strategies learned in workshops to detect vector populations, reduce virus inoculum, and improve disease management outcomes. A participant acknowledged: "Thank you so much for your time today. It meant a lot to all of us there. Been a long battle at that ranch and hopefully some light shining at the end of the tunnel!" (Monica Cooper)

**Participants adopted recommended treatment and management practices for invasive and endemic pests and diseases.**

* After listening to AgExpert talk, 140 participants responded to a post-event survey; 96% reported gaining knowledge, and 35% indicated they would utilize their newfound knowledge to control the flatheaded borer—reflecting a positive behavior change. If a grower avoids replanting the orchard by preventing the borer attack, that saves $3,809/acre (i.e., $1,809/acre for replanting, plus $2,000/acre from the 1-year-delay loss). (Jhalendra Rijal)
* UCCE research findings on oxathiapiprolin allowed the broad adoption of the Orondis fungicide by pistachio growers. Orondis was used as a strategy to reduce risks of Phytophthora root rot infections following accumulation of the pathogen in orchard soils due to flooding in 2023. (Florent Trouillas)
* The North Coast Specialty Crops and Horticulture Advisor received feedback from eight winegrape growers who are now scouting for Pierce’s disease, and two who have removed vines to slow the spread of this disease. (Eddie Tanner)

**Science-based information was applied to integrated pest management policy and decision-making.**

* The Almond Board of California has expressed great interest in UCCE recommendations to use the biological control product Vintec (Trichoderma atroviride SC1) as an alternative to chemical fungicides for the protection of pruning wounds of almond trees against canker pathogens. UCCE demonstrated that the product can be applied in orchards using grower's conventional sprayer systems and be as efficient as Thiophanate methyl, the chemical standard. This allows growers to deliver the product effectively and quickly to almond trees for protection following pruning. This work also has gained global attention and raised interest among almond farmers and researchers in France, Spain, and Australia. (Florent Trouillas)

**Change in condition: Participants experienced reduced loss.**

* After adopting UCCE recommendations, two growers reported a change in their brown rot management of peaches and nectarines that has led to an estimated 10% decrease in losses and 15% reduction in fungicide use. Two additional growers reported reduced losses from cabbage maggot, with one grower estimating a 75% reduction in transplant mortality, and the other reporting an 80% reduction in loss in one of their turnip plantings. (Eddie Tanner)

The measured outcomes reported above can improve the state’s ability to prevent, control, and mitigate pests and diseases and create new opportunities for economic sustainability. For example, using mating disruption to reduce navel orangeworm increased the crop value in almonds by more than $250 per acre, which is more than twice the cost of using the technique. In these ways, UC ANR contributes to increased agricultural efficiency and profitability and the public value of promoting economic prosperity in California.

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

**Endemic and Invasive Pests and Diseases - In Agronomy and Vegetable Crops**

**Issue**

In agricultural systems, pests reduce yields, render crops unmarketable, and negatively impact revenues. For example, beet leafhopper (BLH) is one of the damaging insects to California's processing tomatoes mainly because of the transmission of beet curly top virus (BCTV). BCTV-infected tomato plants usually die, and there is no effective treatment for this virus. Entire fields can be lost to BCTV in its worst years. (Zheng Wang) Furthermore, as organic sales in the U.S. rose 31% between 2016 and 2019, organic growers face pest problems that are barriers to growth. (Margaret Lloyd) Science-based information is needed for growers, managers, and policymakers to develop practices and policies that sustain economic vitality while protecting environmental quality.

**Methods**

UC ANR conducts research and partners with public, governmental, and private groups to extend new knowledge and develop integrated pest management plans to increase agriculture efficiency and profitability.

A UCCE Entomology Specialist at UC Davis conducted research on endemic and invasive pest management in lettuce, safflower, melon, cotton, alfalfa, and rice. Research findings were shared with industry boards, growers, Pest Control Advisers, and state agencies via presentations, reports, meetings, and individual consultations. (Ian Grettenberger)

A UCCE Small Farms Advisor in Santa Clara County continued to identify or develop research-based information for pest management in peppers and specialty Asian leafy vegetables and extend research-based information on the safe handling and use of pesticides labeled for application on these crops to farmers. Educational materials were developed in Chinese, English, and Spanish and extended via seminars, workshops, and technical assistance. In 2023, workshops included Recruiting Owls and Raptors for pest management (77 attendees), Weed Management on Small Farms/Organic Systems (71 attendees), Biology and Management of Thrips (21 attendees), Management of Soil-Borne Plant Pathogens with Organic Amendments (51 attendees), and How to ID and Scout for Insects (65 attendees). (Aparna Gazula)

A UCCE Advisor in plant pathology implemented an extension education and problem-solving research program to address clientele’s needs on plant disease management. The tri-county area (Santa Cruz, Monterey, and San Benito counties) is the leading producer of cool-season vegetables and strawberries. The production gross value was over $4.1 billion of all agricultural commodities with lettuce and strawberries being the top crop (County Crop and Livestock Report, 2021). However, this agriculture system continuously faces threats of new emerging and reoccurrence plant diseases, which cause yield and quality loss. For example, Impatiens necrotic spot virus (INSV) along with Pythium wilt caused significant loss in lettuce since 2019. In 2022, the loss caused by INSV was estimated to be over $150 million. To address these concerns, the advisor conducted and extended research through multiple avenues, including field days, social media, and direct contact. More than 100 attendees participated in two field days. The social media extended information to an additional 30+ individuals. Over 88 individuals were also contacted and consulted about their plant disease issues in this review period. (Yu-Chen Wang)

A UCCE Vegetable Crops Advisor conducted five trials evaluating effects of nematicides, including Salibro, Nimitz, Velum, Majestene, MeloCon, and Vydate, on okra and carrot. Findings from these trials have been shared through two field days, eight clientele meetings, one book chapter, five extension newsletters, and other extension outreach. (Philip Waisen)

A UCCE Vegetable Crops and Soils Farm Advisor in the Central Valley conducted multiple on-farm and on-campus research trials to evaluate robotic and mechanical methods to control weeds in tomatoes and melons. Other projects investigated crop safety as well as fumigation and fumigation alternatives for management of nematodes in sweet potatoes. Results were presented at the California Melon Research Board annual meeting, the California Tomato Research Institute annual meeting, the Sweetpotato Collaborators Group, and at the Vegetable Workgroup meeting at UC Davis. (Scott Stoddard)

Another Vegetable Crops UCCE Advisor also conducted applied research on the economic benefit to grafted watermelon growers from adopting biofungicides as an alternative to widely used soil fumigation. Most fumigants used pose significant risks of air contamination, skin and eye irritation, maternal toxicity, and soil and water pollution. In contrast to the risks of applying conventional fumigants, using soil-derived microbial biofungicides can diversify soil beneficial microbial communities, avoid hazardous by-products, reduce leaching to groundwater systems, minimize volatilization, and prevent soil-borne fungal pathogens. (Zheng Wang)

Two UCCE Advisors conducted research and extension activities related to weedy rice, a serious weed of rice that cannot be controlled with conventional rice herbicides, including field surveys, two field days, one workshop, and targeted meetings with PCA groups and Ag Commissioners offices to limit the spread of this weed. (Reported by Luis Espino: collaborator mentioned: Whiney Brim-DeForest)

A UCCE Advisor conducted studies and outreach to improve management of armyworms. Extension activities included maintaining a trapping network, which alerts growers in real time of the need to monitor for this pest in the field. Research activities included several insecticide trials that showed what products were effective in managing this pest and field studies to improve monitoring guidelines. In collaboration with a UCCE specialist at UC Davis, the advisor revised the action thresholds for this pest. (Reported by Luis Espino; collaborator mentioned: Ian Grettenberger)

A UCCE Advisor conducted studies and outreach to improve management of diseases impacting rice, including stem rot, aggregate sheath spot, kernel smut, bakanae, and blast. (Luis Espino)

Field research projects at the UC ANR Intermountain Research and Extension Center (REC) and extension activities addressed pest management challenges for growers in the region. Research projects focused on pests impacting alfalfa, peppermint, potatoes, and grain, such as blue aphid, alfalfa weevil, mint root borer, cereal leaf beetles. (Reported by Rob Wilson; collaborators mentioned: Godfrey, Tollerup, Orloff, Long, Grettenberger)

A UCCE Advisor at the UC ANR West Side REC worked closely with industry to extend information and encourage adoption of a sanitation/crop rotation/fungicide program to address white rot of garlic. (Tom Turini)

Given chlorpyrifos was banned by the Food and Drug Administration, alternative sugar beet insect pest management is needed. Findings from UCCE research projects conducted in Imperial County were demonstrated during field days, at the Fall Desert Crops Workshop, sugarbeet growers’ association meeting, California Association of Pest Control Advisers and Pesticide Applicators Professional Association seminars, and published in the Imperial Ag Brief. (Oli Bachie)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices that increased agriculture efficiency and profitability in vegetable and agronomy crops. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants gained knowledge of detection and control practices for invasive and endemic pests and diseases.**

* After field days on plant disease management in the Santa Cruz, Monterey, and San Benito County area, 75% participants gained new insights into disease management. The response rate for the post-event survey was 20%. (Yu-Chen Wang)
* As a result of attending a UCCE Small Farm Advisor’s workshops and seminars, growers’ knowledge about how to prevent, control, and mitigate pests and diseases increased:
  + Recruiting owls and raptors for pest management seminar: 53 organic small farmers increased their knowledge of using raptors for rodent management, and 43 organic small farmers intend to adopt one or more control strategies that were discussed.
  + Weed management on small farms/organic systems seminar: 39 organic small farmers increased their knowledge of weed management, and 32 intend to adopt one or more weed control strategies that were discussed.
  + Biology and management of thrips and diseases they spread seminar: 12 organic small farmers increased their knowledge of management of thrips, and seven intend to adopt one or more control strategies that were discussed.
  + Management of Soil-borne Plant Pathogens with Organic Amendments seminar: 30 organic small farmers increased their knowledge of soil borne disease management, and 17 intend to adopt one or more control strategies that were discussed.
  + How to Identify and Scout for Insects seminar: 40 organic small farmers increased their knowledge about identifying and scouting for insect pests, and 38 intend to adopt one or more scouting strategies that were discussed. (Aparna Gazula, Lucy Diekmann, Margaret Lloyd, Hung Doan)

**Participants adopted prevention and detection practices for invasive and endemic pests and diseases.**

* One broccoli grower with a 850-acres farm will switch from overhead irrigation to drip irrigation to mitigate the loss from Alternaria head rot. (Yu-Chen Wang)

**Participants adopted recommended treatment and management practices for invasive and endemic pests and diseases.**

* After participating in UCCE field trials, two sweet potato and one tomato grower purchased new finger weeders, a mechanical method of weed management, which saves time and costs for hand-weeding later in the season. (Scott Stoddard)
* UCCE work on disease management has generated information that is helping growers better manage rice diseases. Based on individual consultations, growers are adopting tolerant and resistant varieties. Fungicide guidelines developed by the UCCE Advisor have been adopted on 50% of planted acreage in California, which is about 250,000 acres. (Luis Espino)
* UCCE studies on blue aphid, alfalfa weevil, and mint root borer at the Intermountain REC brought about significant change in the management of these insects. For example, crop consultants and growers throughout Northern California and Southern Oregon switched from using wide spectrum pyrethroid insecticides to more targeted insecticides that were shown to provide better pest control while preserving natural predators. (Rob Wilson)
* Observations have shown that some growers have started to use Poncho Beta, a product that, through UCCE research, showed promising early-stage pest control, such as for flea beetle. (Oli Bachie)

**Science-based information was applied to integrated pest management policy and decision-making.**

* As a result of UCCE research on pests impacting cotton production, California Department of Pesticide Regulation granted an emergency exception for insecticidal management of *lygus* in cotton. (Ian Grettenberger)
* Data from the sweet potato nematicide trials was used by the registrant, Corteva AgriScience, to register their new Salibro nematicide on sweet potatoes. Federal Environmental Protection Agency (EPA) registration was granted in September 2023; California registration is expected in 2024. (Scott Stoddard)
* Results from UCCE research on armyworm was pivotal in obtaining the emergency registration of an effective insecticide in 2021 and 2022 and its full registration in 2023. The insecticide was used in 4,000-8,000 acres annually, allowing growers to prevent yield losses that can be as high as 25%. (Luis Espino)
* Research from the Intermountain REC produced California-specific data to enable seven new pesticide registrations in California. (Rob Wilson)

**Change in condition: Participants saved money.**

* After learning the results of nematicides trials and adopting recommendations, a medium-scale okra grower in Coachella, saved ˜$6,000 on 40 acres by withholding Velum. A 30-acre small-scale okra grower requested to have the soil tested before Velum treatments. After testing, the UCCE Advisor advised grower to not treat the fields, directly saving the grower $4,500 on Velum nematicide. (Philip Waisen)
* Growers adopted UCCE’s recommendation to request greenhouses apply the biofungicides to watermelon transplants on 795 acres of watermelons, potentially saving those growers up to $795,000. UCCE’s research found that this alternative to soil fumigation could save growers up to $1,000 per acre. They have also decided to expand the acreage of using biological fungicides to their other cucurbits in 2024 with a rough estimation of over 2,000 acres. (Zheng Wang)

**Change in condition: Reduced pest incidence.**

* A UCCE weedy rice field survey showed that measures taken to limit its spread are working; the area affected with weedy rice is limited to 3,000 acres. This number has decreased from 3,500 acres reported in 2021. Based on interactions with the industry, educational efforts have increased awareness of this problem among the industry, and weedy rice has stopped being a problem growers need to keep “secret”. (Luis Espino)
* The biocontrol insectary at the Intermountain REC was successful at establishing and rearing a robust population of *Tetrastichus julis*, a parasitoid wasp, at the REC and the surrounding area. As a result, cereal leaf beetle pest populations in Tulelake went from levels requiring insecticide treatment to very low levels from 2020-2023 eliminating the need for insecticide treatment in wheat. (Rob Wilson)
* White rot has rarely been reported over the last four years in Fresno or Kings counties and when it was reported, it was not at a level at which economic damage resulted. This is likely due to the sustained and scientifically sound method of rotation away from garlic for a minimum of three years with use of a fungicide applied at planting in fields with history of the disease. (Tom Turini)

The measured outcomes reported above improved the state’s ability to prevent, control, and mitigate pests and diseases and created new opportunities for economic sustainability. For example, according to the evidence collected by UCCE Advisors, field fumigation can cost more than $2,500 per acre with the risks of agriculture-related health issues. In these ways, UC ANR contributes to increased agricultural efficiency and profitability and the public value of promoting economic prosperity in California.

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

**Sustainable Food Systems**

**Issue**

California’s agricultural exports increased 7% percent between 2020 and 2021. The state's agricultural sector is vibrant and diverse, producing more than 400 commodities. For many of these specialty crops, California is often the nation's major producer. Although California already has the most diverse agriculture in the nation, the search for new opportunities responds to ongoing challenges and does not stop. 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 farmers and ranchers to continually innovate to stay abreast of market forces. Emerging technologies including robotics can provide new solutions to on-farm challenges. Small-scale and limited resource producers are more exposed to risks and susceptible to failure, thus needing different market opportunities and small-farm applications for new technologies.

**Methods**

UC ANR develops new scientific knowledge and extended science-based information that helps create new food products and market opportunities.

*New markets*

The UC Sustainable Agriculture Research and Education Program (UC SAREP) works on institutional purchasing and regional supply chains. Creating new market opportunities with large institutions, such as universities, hospitals, schools, and prisons, can play an important role in supporting the sustainability of local farms and food systems. The project team organized and facilitated biweekly Local Opportunities meetings attended by UC Davis Medical Center's Executive Chef and procurement managers to discuss their specific needs for cooking and processing priority specialty crops. (Gwenael Engelskirchen)

UC SAREP also continued work to promote food hubs, collaborating with a UCCE Regional Food Systems Advisor. Small-scale, beginning, and under-represented farmers need buyers for their products. Food hubs allow growers to achieve efficiencies and access markets that they would not be able to on their own. Food hubs are produce-holding facilities that allow for aggregation of the harvest from multiple growers prior to distribution to wholesalers, processors, retailers, restaurants, and consumers. To foster producer and food hub learning and networking about local/regional sales opportunities, UC SAREP and UCCE organized a convening in partnership with Valley Vision. There were 71 attendees, representing nonprofit/community groups, farmers, and food purchasers (institutional, wholesale, or food hubs), technical assistance providers, government or agency representatives, charitable or recovered food representatives. (Gwenael Engelskirchen and Olivia Henry)

A UCCE Agriculture and Food Systems Specialist at UC Berkeley has one project characterizing production practices and documenting changes over time, identifying key environmental, social and agronomic issues, and subsequently developing relevant research and extension programs for cannabis growers. A team wrote a policy-focused report based on collaborative research, funded by California's Department of Cannabis Control, entitled Cannabis Bans, Local Control, and the Effects and Efficacy of Proposition 64. The proposition passed in 2016 and legalized the use, sale, and cultivation of recreational cannabis in California for adults 21 and over. (Christy Getz)

*Ag tech*

A Viticulture Advisor in the Central Valley collaborates with manufacturers and developers during the product development stage so the products are ready for application in the field. Technologies are tested at UC Research and Extension Centers and grower sites to assess suitability and efficiency under different growing conditions. Five different products/equipment have been tested at six different sites over the past couple of years, including the Bloomfield yield estimation camera system. (Tian Tian)

*Crop variety development*

California potato growers rank potato variety development as their top research priority. Variety testing at Intermountain Research and Extension Center (IREC) is one of only two locations in California, and the only summer growing site evaluating new varieties for California’s 40,000-acre potato industry. Potato varieties differ significantly in their fertility, irrigation, seed spacing, and harvest needs. Field research projects at IREC looked at management of new varieties including evaluating the effect of harvest timing and irrigation on black dot tuber blemish on new specialty varieties, comparing new varieties skin appearance after commercial polishing, and evaluating differences in bruising susceptibility between Russet varieties, and how growers can alter harvest management to minimize bruising. (Rob Wilson)

A Vegetable Crops and Soils Advisor working in the Central Valley continued variety evaluation and development for sweet potatoes. There are about 22,000 acres of sweet potatoes in California. The state ranks third in the nation for acres planted in sweet potatoes and first in production yields per acre farmed. California is dependent on out-of-state breeders for improved varieties and special market niches, so these variety screening trials provide the California industry access to new germplasm and data showing the variety suitability to this growing environment. (Scott Stoddard)

As a result of UC ANR research and extension, participants utilized research-based information on emerging food economies and markets. Outcomes with specific indicators follow.

**Outcomes**

**Participants are trying out new market opportunities.**

* According to the evaluation of the local/regional sales opportunities convening, the buyers in attendance made a total of 54 new connections; the majority of these new connections were with food hubs (12), food banks (12), and schools (10). Food hubs are increasingly important sales channels for many small to medium-scale farmers, offering transportation efficiency and greater access to markets. (Gwenael Engelskirchen and Olivia Henry)
* The potato variety and management trials helped California growers adopt new potato varieties including Classic Russet, Canela Russet, and Reveille Russet. These new varieties offer higher yields, better pack-out revenue, or improved long-term storage compared to older varieties. The UCCE research helped producers avoid significant bruising of Classic Russet by altering harvest management practices from historic practices. Most recently, two potato growers altered their vine-kill timing using the UCCE results to minimize black dot tuber blemish when growing a new yellow potato. (Rob Wilson)
* Six varieties of sweet potato now represent about 70% of the total acreage in California (Covington, Murasaki-29, Bonita, Burgundy, Bellevue, and Vermillion). These new releases, since 2008, were all originally screened through the UCCE trials. They have improved yield, quality, and pest and disease resistance. In 2019, Louisiana State University sweet potato variety L-13-81 was selected for release in 2020 and named Vermillion. In addition, Bellevue is widely grown in Australia and Portugal. (Scott Stoddard)

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

* Bloomfield Robotics has utilized the six thousand ground-truthing data points provided by UCCE. This collaboration allowed the company to optimize the yield estimation algorithm. The camera system was commercialized in 2023 and two local growers have been beta users. (Tian Tian)
* Both the California Department of Cannabis Control and the Agricultural Labor Relations Board have noted the impact of UCCE recommendations on their thinking about how to move forward to address the myriad issues the sector is facing. Additionally, the report “Cannabis Bans, Local Control and the Effects and Efficacy of Proposition 64” was cited as research-based evidence that helped *kill* a bill (AB 1616), which would have provided more discretionary funds to rural police in counties that have banned cannabis cultivation. This work informed policy that improves the social, economic, and environmental sustainability of California’s cannabis sector. (Christy Getz)

**Change in condition: New market for local growers. NEW**

* The team on the CDFA Specialty Crop Block Grant funded project determined that the project’s activities successfully resulted in increased purchasing by UC Davis Medical Center of California grown fresh specialty crops by 25% (from $753,826 to $939,661) and of California grown fresh specialty crops within 250 miles of Sacramento by 377% (from $114,585 to $546,590, not including packers). Purchasing from small, local farms can produce positive economic and environmental impacts (Christensen et al., 2019; Pretty, 2001). The significant purchasing power of institutions can both stimulate local economies and influence healthy eating behaviors amongst consumers (Becot et al., 2016; Warsaw & Morales, 2022). In addition, with a shorter travel distance from farm to institution, locally-grown produce has the potential to retain more nutrients and yield better flavor than food imported from out-of-state or country (Martinez et al., 2010). (Gwenael Engelskirchen)

The measured outcomes reported above helped create new market opportunities, expanding revenue sources and strengthening local food systems and emerging food economies. In this way, UC ANR helps maintain the California food system's competitive edge and the state's role as a global leader in agriculture, contributing to the public value of promoting economic prosperity in California.

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# **SAFEGUARDING SUFFICIENT, SAFE, AND HEALTHY FOOD FOR ALL CALIFORNIANS**

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

**Sustainable Food Systems**

**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, communities, and public health. Furthermore, the Center for Disease Control and Prevention estimates that one in six people get sick from foodborne diseases each year, including 128,000 hospitalizations.

**Methods**

In partnership with communities and allied organizations, UC ANR conducts research to design and deliver educational programs promoting improvement in farm and food system food safety.

The UC ANR Small Farms Network serves as an information hub connecting small-scale farms to research and education resources, provided in multiple languages. The team develops and disseminates produce food safety resources, including connecting small-scale growers to certificate and non-certificate courses and financial assistance. An area of emphasis is working with beginning, immigrant, and refugee farmers to navigate food safety regulations.

To support food safety knowledge and regulatory compliance for small-scale, culturally diverse growers in California, the UC Cooperative Extension (UCCE) team engaged in multiple activities during 2023, serving a diverse audience including White, African American, Hispanic, Chinese, Korean, Hmong, Lu Mien, and Nepali growers. Content was delivered in languages relevant to these groups in many of the extension events. One-on-one technical assistance was provided to 108 growers across the state, and 456 growers attended workshops or webinars where food safety information was provided by the UCCE team. To comply with food safety regulatory requirements for on-farm production set forth by the Food Safety Modernization Act (FSMA) Produce Safety Rule (PSA), growers are required to attend a US Food and Drug Administration approved training course, the Produce Safety Alliance Grower course. (Reported by Erin DiCaprio; collaborators mentioned, Aparna Gazula, Ruth Dahlquist-Willard, Ramiro Lobo, Margaret Lloyd, Hung Doan, Paulina Hernandez, Ariana Reyes, Jacob Roberson, Marianna Castiaux, Pang Kue, Fam Fin Lee, Yurytzy Sanchez, Vong Moua)

As part of the network, a UCCE Specialist developed new content in response to the severe flooding events of early 2023, namely the web page “Produce Safety and Flood Resources” posted on the UC Small Farms Food Safety website and a new factsheet “Guidance and Resources for Growers to Assess Crop Safety After a Flood.” Upon request from the California Department of Food Agriculture (CDFA) Produce Safety Program, guidance on assessing risk after flooding was presented at a webinar attended by over 200 growers in early 2023. (Erin DiCaprio and Aparna Gazula).

On the Central Coast, a UCCE Small Farms Advisor facilitated 79 small-scale farmers from socially disadvantaged communities to attend PSA Grower Trainings, which help the farmers comply with necessary FSMA food safety regulations during audits by the California Department of Agriculture. Seventy-five farmers received one-on-one trainings on recordkeeping templates, forms, food safety plan templates, and other resources. (Aparna Gazula)

A Small Farms Advisor in the Central Valley organized and conducted a PSA grower training workshop. This training is required for at least one representative of every farming operation fully covered by FDA FSMA. The training was spread over two days to facilitate interactive demonstration activities and translation and discussion in Hmong, using Cornell University's approved curriculum. (Ruth Dahlquist-Willard)

In the Inland Empire of Southern California, the UCCE Small Farms Advisor learned through a workshop and needs assessment that 83 farmers were not aware of FSMA regulations, and requested training in Spanish and Korean, which UCCE is in the process of developing. As a result of the outreach, UCCE became the hotline for Korean farmers in the Inland Empire who will be undergoing FSMA inspection by the CDFA. For farmers who are aware of FSMA regulations, UCCE assisted three farmers with one-on-one local food safety assessments during individual farm visits, to help them prepare for upcoming audits. (Hung Doan)

In addition, the UC Sustainable Research and Education Programs (UC SAREP) team, including a UCCE Specialist in food safety at UC Davis, organized and led a workshop specifically on food safety best practices for harvesting, post-harvest handling, freezing, drying, and processing elderberries. The western native blue elderberry is native to California and well adapted to high heat and water constraints. There were 20 attendees and 19 additional people on the waiting list or registered but could not attend. Farmers in California are increasingly interested in hedgerow-planted elderberries along field edges as a strategy for increasing both ecological and economic returns; however, little published research exists on commercial management of blue elderberry. Sale of elderberry represents a significant market opportunity for California farmers; in a 2019 UC SAREP survey of elder buyers, 67% said they did not find enough supply, and 88% said they would “definitely” purchase California-grown elderberry were it available. (Gwenael Engelskirchen and Erin DiCaprio)

As a result of UC ANR research and education, participants learned about and adopted farm food safety behaviors. Outcomes with specific indicators follow.

**Outcomes**

**Participants learned and intended to adopt farm food safety behaviors.**

* Over the last year, the UCCE team engaged in delivering Produce Safety Alliance Grower courses, leading to 97 growers receiving the Association of Food and Drug Officials certificate of completion. (Erin DiCaprio)
* Twelve small-scale farmers, from socially disadvantaged communities, received certificates of completion, as a result of the PSA training. This is an essential requirement to be in compliance for FSMA inspections. They are prepared to display the PSA certificate in the event that their farm is selected for an inspection. (Ruth Dahlquist-Willard)
* PSA workshop evaluations showed 107 small farmers increased their knowledge of food safety, increased their awareness of FMSA requirements and pending inspections for small-scale farms, and intend to adopt on-farm practices to mitigate food safety risks. Intended actions resulting from this program include starting recording-keeping, conducting on-farm water testing, and writing a farm food safety plan. (Aparna Gazula)
* Seventy-nine participating small farms now have at least one staff on their farm that has completed the required FDA certified food safety training. (Aparna Gazula)
* After the elderberry food safety workshop, 19 participants indicated increased knowledge across eight content areas, including strategies for minimizing food safety risks during harvest, post-harvest and storage; strategies for minimizing food safety risks when making value-added products; and approaches to drying and destemming elderberries. When asked if they intended to make any changes to their operation based on something they learned at the workshop, one attendee responded, "Make my processing more consistent, cleaner and documented," and another responded, "adding sanitizer to batch water." Self-reported new concepts learned by attendees also included: being selective in harvesting of clean elderberry clusters, the steps and methods of maintaining water microbial quality when washing elderberry fruit, methods of preservation, and the science behind why drying or adding sugar reduces water activity and limits the potential of microbial growth in food. (Gwenael Engelskirchen and Erin DiCaprio)
* UC SAREP supported two California elderberry processors/handlers in completing a Preventive Controls Qualified Individual (PCQI) training. (Gwenael Engelskirchen and Erin Dicaprio)

**Science-based information was applied to farm food safety policy and decision-making.**

* As a result of UCCE education and training, farmers completed a CDFA Produce Safety Rule inspection with no findings. (Hung Doan)

The measured outcomes reported above demonstrate improved knowledge and skills around farm food safety practices that can decrease foodborne illness and highlight UC ANR's leadership in addressing natural events and environmental issues that impact food safety. In this way, UC ANR contributes 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 exports. The state faces social, regulatory, economic, and environmental challenges that affect our agricultural and food systems, communities, and overall public health. Furthermore, the Center for Disease Control and Prevention estimates that one in six people get sick from foodborne diseases each year, including 128,000 hospitalizations and 3,000 deaths.

**Methods**

UC ANR statewide programs conduct extension activities focused on improving individual and household food safety. UC Cooperative Extension (UCCE) academics provided oversight, leadership, and guidance for the implementation of the several statewide programs that deliver food safety education: UC 4-H Youth Development Program (UC 4-H) and Expanded Food and Nutrition Education Program (EFNEP). (UC 4-H, EFNEP)

As a result of UC ANR research and education, participants learned about and adopted individual and household food safety behaviors. Outcomes with specific indicators follow.

**Outcomes**

**Participants learned about home food safety practices.**

* Of 174 UC 4-H youth who responded to the statewide Healthy Living common measures survey, 79% reported knowing how to keep a cooking area clean to stop the spread of germs due to what they have learned from 4-H programming. (UC 4-H)

**Participants adopted home food safety practices.**

* EFNEP surveyed over 1,930 adult participants, and 84% showed improvements in one or more food safety practices, such as using safe methods to thaw frozen foods or using a meat thermometer, as a result of participating in the program. Out of 1,815 youth EFNEP participants surveyed, 57% of youth in kindergarten through grade 12 showed improvements in food safety skills and knowledge. (EFNEP) Local EFNEP outcomes include:
  + In Contra Costa and Alameda counties, a survey of 119 K-5th grade Youth EFNEP participants showed that 37% of Contra Costa County respondents and 45% of Alameda County respondents reported improvements in food safety practices. (Marisa Neelon)
  + In Contra Costa and Alameda counties, a survey of 231 EFNEP adult graduates showed that 70% and 76% of participants in each county respectively improved food safety skills such as washing hands and food preparation surfaces, and thawing foods properly. (Marisa Neelon)
  + In Los Angeles and Orange counties, 85% of adult EFNEP participants improved in one or more food safety practices and 63% of youth EFNEP participants used safe food handling practices more often or improved food safety knowledge. (Natalie Price)
  + In Sacramento County, 85% of EFNEP participants improved their food safety practices. (Marcel Horowitz)
* In Santa Barbara, after participating in the UC 4-H Student Nutrition Advisory Council, 95% of the youth surveyed reported they wash their hands frequently because of their participation. (Reported by: Shannon Klisch; collaborators mentioned: Mishelle Costa, Miguel Diaz, Kelly Hong, Abbi Marrs, Melissa Rorabough)

These measured outcomes demonstrate improved individual and household food safety practices that can decrease foodborne illness. In this way, UC ANR contributes to the public value of safeguarding sufficient, safe, and healthy food for all Californians.

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

**Healthy Families and Communities**

**Issue**

One out of ten Californians does not know where their next meal will come from. Of the 4.1 million Californians struggling with food insecurity, 1.2 million are children. Food insecurity for youth increases school absences and behavioral problems and reduces children's concentration and academic achievement. There is an ongoing need to increase participation in the CalFresh (SNAP) benefits program and connect families to additional resources such as the Women, Infants, and Children (WIC), USDA's Summer Food Service Program, local government aid programs, and the broader charitable food network.

**Methods**

In partnership with communities and allied organizations, UC ANR conducts research to design and deliver educational programs that promote individual and household food budget practices and overall food security.

The CalFresh Healthy Living, UC (CFHL, UC) State Office at UC Davis provided statewide oversight, leadership, and guidance for the CalFresh Healthy Living Program. UC Cooperative Extension (UCCE) academics and CFHL, UCCE supervisors offered local leadership and guidance in program implementation and evaluation. UCCE academics also provided oversight, leadership, and guidance for the Expanded Food and Nutrition Education Program (EFNEP) statewide program. (CFHL, UC, EFNEP)

UCCE in San Luis Obispo and Marin counties seek to increase food security by increasing access to healthy local food. In San Luis Obispo, a UCCE Academic convened a multi-sector working group (CalFresh at Farmers Market Work Group) to improve redemption of CalFresh at farmers markets and provided support for programs that increase CalFresh redemption, such as the Farmers Market Navigators program. In Marin, a UCCE Advisor piloted interventions to expand awareness about CalFresh and nutrition incentives at farmers markets, implemented marketing campaigns, and developed a Meat, Dairy, and Eggs Voucher Program. (Shannon Klisch and Julia Van Soelen Kim)

A UCCE Advisor in Marin County seeks to strengthen local and regional food systems and build community resilience at a regional scale across California North Coast counties from Marin to Del Norte. As one of partners in the North Coast Emergency Food System Partnership, the advisor works on projects to: (1) create additional market opportunities for local producers within emergency food supply chains to mitigate risk and maintain income during disasters; (2) build collective capacity to improve emergency food systems by creating a strong network of partners, developing emergency feeding plans, and inventorying local emergency food supply chain infrastructure; and (3) identify policy and practice recommendations to establish effective regional emergency food supply chains. (Reported by: Julia Van Soelen Kim; collaborator mentioned: Dorina Espinoza)

UCCE Advisors in Santa Clara County conducted stakeholder research and engaged over 70 nonprofits, businesses, government agencies, and existing food system collaboratives to develop the Santa Clara County Food System Workplan. The Workplan presented key findings, including a review of pandemic conditions, and offered goals, strategies, action steps, and proposed evaluation metrics to assess continued progress. To support the County of Santa Clara in its implementation of the Workplan goal addressing food insecurity, UCCE Advisors facilitated a Food Security Action Plan group from 2021-2022 and completed a needs assessment to determine levels of food insecurity among county residents. (Lucy Diekmann and Laura Vollmer)

UCCE Advisors in Santa Clara County offered a five-part professional development series, Building Equity in the Silicon Valley Food System, to 140 unique attendees from 35 organizations representing all parts of the food system. (Lucy Diekmann and Laura Vollmer)

As a result of UC ANR research and extension, changes were made that lead to improved food security. Outcomes with specific indicators follow.

**Outcomes**

**Participants learned how to increase food resources.**

* Participants in the Building Equity in the Silicon Valley Food System were surveyed about changes to their awareness, knowledge and skills as a result of participating in the workshop series. Respondents reported increased knowledge of equitable food systems (81%), the historical roots of inequity in land access and housing in Silicon Valley (81%), diverse cultural food traditions (80%), and strategies for promoting equity and community-led solutions (82%). Respondents (98%) indicated they would take action, or had already taken action, as a result of the series. Those actions included increased networking and collaboration, implementing values-based procurement, sharing learnings with others, including program participants and colleagues, and finally, willingness to advocate for systems-level change. (Lucy Diekmann and Laura Vollmer)

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

* A UC ANR Academic increased county elected officials’ support for farmers markets that accept CalFresh, leading a proclamation that recognizes San Luis Obispo Farmers Market Week across the county in 2023. The week increases the visibility of farmers markets to boost market attendance and showcase the health, environment, and economic benefits that farmers markets bring to local communities. (Reported by: Shannon Klisch; collaborators mentioned: Mishelle Costa, Kelly Hong, Rosa Vargas)
* As a result of the adoption of the Santa Clara County Food System Workplan, a number of actions have been taken, including: the hiring of a full-time Food System Program manager to implement the Workplan and improve food system coordination; and the allocation of $900,000 for a new grant program for food system resilience work and for funding food assistance providers. (Lucy Diekman and Laura Vollmer)
* After several natural disasters and weather events in the North Coast that included the 6.4 Humboldt earthquake in December of 2022, an atmospheric river in January 2023 and the Smith River Complex Fire in August 2023, the North Coast Emergency Food System Partnership leveraged partners’ relationships, knowledge, and capacity to respond to urgent food system needs. Over 50 individuals have contributed to a Virtual Rolodex that has been accessed during these climate and natural disasters. (Julia Van Soelen Kim)

**Change in condition: Participants improved food security.**

* In Contra Costa and Alameda counties, 231 post-survey results of adult EFNEP graduates showed that 42% and 51% of participants in each county respectively improved food security and reported having enough money to buy food and having enough food to eat. (Marisa Neelon)
* In Los Angeles and Orange counties, pre-/post- survey results of EFNEP participants showed that 60% and 50% of participants in each county, respectively, improved in at least one food security indicator. (Natalie Price)
* In Sacramento County, 53% of EFNEP participants reported that they were more food secure. (Marcel Horowitz)
* After participating in the *Plan, Shop, Save, Cook* curriculum, 34% of CFHL, UC adults who responded to a statewide survey reported being less likely to run out of food. (CHFL, UC and Marcel Horowitz)

**Change in condition: Improved community food security.**

* UC ANR Academics in San Luis Obispo and Marin contributed to increased food security in communities by providing support that improved usage of CalFresh and Market Match programs at farmers markets. In FFY 2023, farmers market attendees in San Luis Obispo made $232,957 of CalFresh and Market Match purchases, a 10.9% increase over the previous fiscal year and a 112% increase over Federal Fiscal Year 2021. In Marin County, CalFresh and Market Match distributions increased by 99% from 2020 to 2022. (Shannon Klisch and Julia Van Soelen Kim)

These measured outcomes showed learning and behavioral changes related to food resource management and informed decision-making that can lead to food policy changes at the local and state levels. They also demonstrate how UC's network of researchers and educators participate in cross-sector collaboration to address emerging food security issues. In this way, 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 security

**Sustainable Food Systems**

**Issue**

One out of ten Californians does not know where their next meal will come from. Of the four million Californians struggling with food insecurity, 1.2 million are children. Food insecurity is an issue in both urban and rural areas due to lack of availability of fresh produce and/or transportation issues.

**Methods**

UC Master Gardener volunteers provide the public with the knowledge and skills to increase their edible gardening success, reducing food loss and fostering the opportunity for garden grown fresh produce to be distributed in local communities. Science-based horticultural information is extended through educational workshops, demonstration gardens, phone advice, Farmer’s Market booths, social media, newsletters, websites, and individual contacts. (UC Master Gardener Program)

A UC Cooperative Extension (UCCE) Environmental Horticulture Advisor in the rural Eastern Sierra region of California works to strengthen the local food systems and tribal food sovereignty. Fourteen tribal members received assembled raised bed gardens and soil with training to begin growing their own garden at home, and nine non-tribal members also learned about soil health. Two garden managers received training and consultation on topics such as irrigation management and high tunnels. In addition, the advisor provided expertise to a collaborative project between the UC Master Gardeners and the City of Bishop, funded by a CalRecycle Urban Greening Grant. (Dustin Blakey)

The Vegetable Crops Advisor working in the Inland Empire of Southern California works with Torres Martinez Tribe to improve access to healthy food, knowledge of sustainable crop production, and food sovereignty. In collaboration with the tribe, the UCCE multidisciplinary team of nutrition and agriculture Advisors, with the support of a grant Advancing California Opportunities to Renew Native Health Systems, implemented several backyard garden projects. The projects included: 1) raised-bed vegetable gardens for six families, 2) citrus fruit tree planting for seven families, and 3) hosting planting events at the Tribal Senior Community Garden. During this reporting period, a backyard garden meeting was organized to guide participating tribal families on growing seasons and the types of crops expected to grow at different times of the year. Three talks were given on compost and transplant preparations for backyard gardening. The project outcomes and impacts were discussed with the California Rural Indian Health Board. (Philip Waisen)

As a result of UC ANR research and extension, changes were made that lead to improved food security. Outcomes with specific indicators follow.

**Outcomes**

**Participants learned how to increase food resources.**

* After hosting the ‘Backyard Garden Workshop’, the tribal members can now prepare transplants, and have a knowledge of seasonality and what vegetable crops to grow in different seasons. (Philip Waisen)

**Change in condition: Participants improved food security.**

* Of 769 members of the public who participated in UC Master Gardener volunteer-led public education events, 50% reported that they applied gardening practices that reduced food loss in a statewide follow-up survey. (UC Master Gardener Program)

**Change in condition: Improved community food security.**

* One hundred members of the public, who participated in UC Master Gardener volunteer-led educational activities with a focus on food gardening and who responded to the statewide survey, donated produce to community programs that distribute food to individuals in need of food assistance. (UC Master Gardener Program)
* The new backyard gardens for the Torres Martinez tribe supply healthy and organically grown fruits and leafy greens, and can reduce grocery spending. (Philip Waisen)
* With UCCE support, the Big Pine Pauite Tribe restarted their Food Sovereignty Garden project successfully after a multi-year hiatus. (Dustin Blakey)
* With UCCE support, the Bishop Community Garden renewed a long-term memorandum of understanding with the City of Bishop, along with significant funding ($133,000), to improve the facility, increasing garden plot access to low-income gardeners. (Dustin Blakey)

These measured outcomes showed learning and behavioral changes related to growing practices at home and community gardens. Research shows home gardens and community gardens increase access to fresh, locally produced fruits and vegetables. These efforts also demonstrate how UC's network of researchers and educators participate in cross-sector collaboration to address food security issues. In this way, UC ANR's efforts contribute to the public value of safeguarding sufficient, safe, and healthy food for all Californians.

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# **DEVELOPING A QUALIFIED WORKFORCE FOR CALIFORNIA**

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

**Sustainable Food Systems**

**Issue**

California requires a highly skilled workforce to remain 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. Technological advances have reduced manual labor in agriculture but increased the need for skilled labor. Projections for near-future retirements of people working in California's agricultural production, marketing, and post-harvest handling sectors indicate severe re-staffing needs. The California Agricultural Vision statement (2023) for the California Department of Food and Agriculture (CDFA) strongly recognizes the critical need to upskill the next generation of farmers and farmworkers. Landscape management professionals are also in need of training; California's landscaping services is a $9 billion industry.

**Methods**

UC ANR’s extensive network links campuses and communities across California to develop information and tools needed to train agricultural and landscape management professionals.

A UC Cooperative Extension (UCCE) Specialist in food safety at UC Davis is a lead instructor for the Food Safety Preventive Controls Alliance Preventive Controls Qualified Individual (PCQI) course. For processors that manufacture low-acid or acidified canned food products, additional training is required by the U.S. Food and Drug Administration, to ensure that processors of these high-risk foods control the risk of *Clostridium botulinum* in these products. A 4-day in-person training course that satisfies this training requirement, called Better Process Control School, was held in February 2023. (Reported by Erin DiCaprio; collaborator mentioned: Linda J. Harris)

A UCCE Agronomy Advisor’s work on nutrient management is primarily driven by current, complex environmental regulations pertaining to groundwater quality. He conducts applied research to improve nitrogen use efficiency of agronomic crop systems and increase precision of nitrogen fertilizer budgets for annual crop farmers. He extends information about how to improve nitrogen use efficiency and remain in compliance with current environmental regulatory requirements. He creates and updates study and testing material for certified crop advisers and growers working to prepare and certify grower nitrogen management reports. (Nick Clark)

The UCCE Specialty Crops and Horticulture Advisor on the North Coast is connecting beginning farmers with current research and best practices that would support their efficiency, profitability, and ecological sustainability. He developed and delivered a series of classes to beginning farmers with 23 participants. (Eddie Tanner)

As a result of UC ANR research and extension efforts, participants learned skills and adopted strategies to improve workforce competency.

**Outcomes**

**Participants learned agricultural production management competencies.**

* Of the 83 certified crop advisers who took a nitrogen management specialty license enhancement exam that certifies them to perform consulting and certification of regulated irrigation and nitrogen management plans and annual summary reports for growers in California, 86% passed. (Nick Clark)
* Assessments of 47 certified crop advisers who took nitrogen management specialty courses and exams, co-developed by the UCCE agronomy program, showed an improvement in pre-post-training knowledge by an average of 26% in seven critical categories related to irrigation water and agricultural nitrogen use efficiency management. (Nick Clark)
* After the beginning farmer classes, 100% of participants reported an increase in knowledge of the topics, aligning with the UC ANR public value of increased workforce retention and competency. (Eddie Tanner)

**Participants gained agricultural production competencies.**

* Of the 270 growers who utilized the curriculum and exam developed for them to self-certify their regulated reports on irrigation and nitrogen management plans, and annual use summaries, 80% passed the certifying exam which makes them legally allowed to self-certify their plans and reports. (Nick Clark)
* As a result of four PCQI courses, 72 individuals received the Association of Food and Drug Officials certificate of completion, which is required for food processors. This helps them implement food safety systems and certification is required for regulatory compliance. (Erin Dicaprio)
* As a result of the Better Process Control School, over 70 individuals in attendance received certificates of completion, required by the US Food and Drug Administration for processors that manufacture low-acid or acidified canned food products. (Erin Dicaprio and Linda J. Harris)

The measured outcomes reported above demonstrate gains in knowledge and cutting-edge skills that increase workforce retention and competency. A [2007 World Bank study](https://openknowledge.worldbank.org/handle/10986/5990) determined the effects of agricultural education and training on agricultural productivity, including enhanced worker productivity, increased grower abilities to choose prime combinations of inputs and outputs, and increased grower capacity to innovate and adopt new technologies. (Maria de la Fuente) Developing a more qualified agricultural production and landscape management workforce contributes to poverty reduction for smallholders and other marginalized groups, facilitating interaction with commercial markets. In this way, UC ANR contributes to increasing workforce competency and the public value of developing a qualified workforce in 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 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 in youth education and health promotion.

**Methods**

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.

UC Cooperative Extension (UCCE) academics provided oversight, leadership, and guidance for the statewide implementation of the UC 4-H Youth Development (UC 4-H) statewide program, which conducts research and extends new knowledge to youth development professionals. (UC 4-H)

A UCCE Youth Development Program Advisor partners with urban conservation education organizations to improve youth programming. The advisor trained staff to incorporate culturally responsive climate change education in their programs. (Sally Neas)

Nutrition Policy Institute (NPI) Academics partner with the California Department of Public Health and local health departments to evaluate CalFresh Healthy Living (CFHL) programs. Academics provide technical assistance, training, expertise, and other resources to local health departments (LHDs) to improve competencies when evaluating their activities, enabling local health departments to identify successes and areas for program growth and improvement. (Amanda Linares, Carolyn Rider and Miranda Westfall) During the pandemic, local health departments migrated nutrition and physical activity education from delivery in-person to delivery online. While LHDs focused on modifying interventions, NPI evaluators were busy adapting evaluation methodology for students learning outside the classroom. A key component of this evaluation involved measuring student eating and physical activity behavior using the Eating and Activity Tool for Students (EATS). Pre-COVID-19, a hardcopy survey was administered to students before and after annual CFHL interventions. In Fall 2020, NPI launched an online version of EATS and provided technical assistance to schools to support virtual administration. Survey questions were also added to capture the unique impact of school closures on students' eating and physical activity behaviors. (Amanda Linares)

As a result of UC ANR research and extension efforts, participants learned skills and adopted strategies to improve workforce competency.

**Outcomes**

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

* After attending a 4-H Cooking Academy training, 44 Expanded Learning staff grew in their skills facilitating youth education programs: 89% percent of staff felt confident teaching hands-on cooking activities to youth, 95% felt they knew how to utilize food safety techniques in their cooking lessons, and 92% felt comfortable teaching cooking and nutrition to youth. (Nicole Marshall-Wheeler)
* In a survey of 17 educators from SproutUp, a college student-run environmental education organization, 100% of respondents reported they understand and will apply aspects of an actionable environmental education training. (Sally Neas)

**Participants gained needs assessment and program evaluation competencies. NEW**

* In a survey of 17 LHD staff, 100% reported knowing how to get answers to their impact and outcome evaluation questions, and how to find the resources they need online. (Amanda Linares and Miranda Westfall)
* In a survey of 12 LHD staff, 92% reported knowing how to get answers to their questions about adult nutrition education evaluation, and 72% know how to find the resources they need online. (Amanda Linares and Miranda Westfall)
* In a survey of 32 LHD staff, 81% reported knowing how to get answers to their questions about program evaluation and reporting. (Miranda Westfall)
* After attending a live training on how and when to use a needs assessment for school districts, California Department of Public Health and LHD staff participated in a post-training survey. Of the 16 survey respondents, 94% reported that they were confident they could apply what they learned in their job and 88% were confident that they could apply what they learned to improving community health. (Carolyn Rider)
* In Federal Fiscal Year 2020-21, thanks to the technical assistance from NPI academics, LHD staff were able to quickly adapt to an online evaluation process after pandemic restrictions made in-person surveys difficult. They collected pre-/post- EATS data from 1,087 students in 47 CFHL intervention schools and 846 students from 17 comparison schools (schools where no programming occurred). The results showed that intervention students reported a greater increase in frequency of consumption of fruit (by 0.16 times/day) and vegetables (by 0.45 times/day) than comparison students. (Amanda Linares)
* In another evaluation, LHDs were able to collect pre-intervention data from 3,297 4th and 5th grade students from 67 CFHL-eligible schools via the online method. Most students were attending school exclusively by distance learning at the time of the survey (83%). Results from the evaluation showed that approximately one quarter of students had eaten at least one school meal the previous day (27%), with about 1 in 7 reporting they ate both breakfast and lunch (15%). Evaluators found that students who ate one or two school meals a day had significantly higher intakes of vegetables, whole fruits, and 100% fruit juice, compared to students who did not eat school meals. However, children who ate one school meal a day drank more fruit drinks (non-100% juice) and flavored milks than those who did not eat school meals. Furthermore, students who ate two school meals consumed more fruit drinks, flavored milks, and sports and energy drinks than those who did not eat school meals. These findings provided valuable information for local health departments and showed their improved evaluation competency. (Amanda Linares)

The measured outcomes reported above demonstrate changes in learning and improvements in participants’ professional skills. Youth development professionals and nutrition educators learned cutting-edge skills that increase workforce retention and competency. In this way, UC ANR contributes to increasing workforce competency and the public value of developing a qualified workforce in California.

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

**Sustainable Natural Ecosystems**

**Issue**

California requires a highly skilled workforce to remain 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 to equip the next generation of working landscapes professionals.

**Methods**

UC ANR’s extensive network links campuses and communities across California to develop information and tools needed to train working landscapes professionals.

UC ANR's Informatics and Geographic Information Systems (IGIS) continued to extend information about cutting-edge geospatial technology. While the primary audience of IGIS is internal UC ANR employees, their trainings also reached partner organizations, state and local governments, growers, and other public groups in California. Post-workshop surveys were sent to training participants, and 146 responses were received out of 403 attendees. (Sean Hogan)

A UC Cooperative Extension (UCCE) Advisor in Plumas and Sierra Counties and a UCCE Specialist at the UC Davis School of Veterinary Medicine hosted a Cattleman’s Clinic webinar series with over 330 attendees. This series was a continuation of a highly rated course offered every three years about livestock, rangeland management, and economics, and coincides with Beef Quality Assurance Certification terms. In 2021, this course pivoted to a webinar series due to the COVID-19 pandemic. (Tracy Schohr)

As a result of UC ANR research and extension efforts, participants learned skills and adopted strategies to improve workforce competency.

**Outcomes**

**Participants learned new, practical informatics and GIS technology.**

* Participants learned new subject matter IGIS workshop evaluations (n=146), which revealed that internal and external participants increased their knowledge of the geospatial technology and other subject matter. On a scale from 1 to 5, attendees self-reported an average rating of 1.7 on subject matter knowledge before the workshop and an average rating of 3.2 after the workshop. (Sean Hogan)

**Participants learned agricultural production management competencies.**

* Cattleman’s Clinic webinar participants increased their knowledge of beef quality assurance, beef carcass quality, parasites, and foothill abortion, as demonstrated by 61 attendees passing a post-webinar quiz. Furthermore, participants obtained industry-recognized Beef Quality Assurance certificates that can provide access to niche cattle markets and premium cattle prices. (Tracy Schohr)

The measured outcomes reported above demonstrate changes in learning and improvements in how participants work. Working landscapes professionals learned cutting-edge skills that increase workforce retention and competency. In this way, UC ANR contributes to increasing workforce competency and the public value of developing a qualified workforce in California.

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

**Sustainable Natural Ecosystems**

**Issue**

California requires a highly skilled workforce to remain 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 to equip the next generation of forest and climate workers.

**Methods**

UC ANR’s extensive network links campuses and communities across California to develop information and tools needed to train fire, forestry, natural resources, and climate professionals.

The UC ANR Fire Network was formalized in April 2023 and is a collection of UC Cooperative Extension (UCCE) Fire and Natural Resource Advisors, Specialists, and staff committed to delivering fire-related research, outreach, and support for communities across California. The network addresses five strategic goals: enhance use of prescribed fire to reduce fuels and restore ecosystem function; implement fuels reduction strategies to improve treatment efficacy and reduce ecosystem impacts; incorporate home hardening techniques to build and retrofit homes for improved wildfire resilience; incorporate defensible space standards to reduce “near home” fire vulnerabilities; and engage with local planners to support wildfire resilience and best management practices. Fire Network will build connections and workforce capacity among UC ANR scientists, practitioners, land management and regulatory agencies, policymakers, and communities to work toward fire resilience in California. This includes the California State-Certified Prescribed Fire Burn Boss (CARX) program, which builds capacity for prescribed and cultural fire practitioners to implement more prescribed fire on the ground. (Katie Low, Lenya Quinn-Davidson)

The UCCE Fire Network Academic Coordinator collaborated with other UCCE academics and community partners to deliver the Forestry and Natural Resources Career Mentorship Program, a statewide mentoring program aimed at training new members of the forestry and natural resources workforce. The program supported the professional development of 248 early-career professionals and students studying forestry and natural resources, particularly those who identify as women, nonbinary, Black, Indigenous, Latinx, Asian, Pacific Islander, or LGBTQIA. (Katie Low)

A UCCE Forestry Youth Education Academic Coordinator oversaw four separate week-long professional learning events for educators in Humboldt, Shasta, El Dorado, and Tuolumne counties. The goal of the institute is to support PreK-12 educators in becoming more literate in forestry and natural resource management concepts and associated career pathways. Sessions combined field-based learning opportunities and environmental education curriculum to certify educators in Project Learning Tree and Project Water Education Today. (Austin Roughton)

A UCCE Advisor was a collaborator in the Modoc Shared Stewardship, a partnership between the Modoc County Farm Bureau, Modoc County, Modoc National Forest, and UCCE to address the continual lack of qualified workforce in forest management that impacts the timely completion of forest projects important to Modoc clientele. The UCCE Advisor gathered collaborative resources to complete the human resources, job outreach and hiring, and on-the-ground training out of the UCCE Modoc office. (Laura Snell)

As a result of UC ANR research and extension efforts, participants learned skills and adopted strategies to improve workforce competency.

**Outcomes**

**Participants increased understanding of forestry and natural resources career opportunities.**

* At the end of the program year, Forestry and Natural Resources Career Mentorship Program students and early career professionals indicated that because of this program:
  + they learned about potential career paths; and
  + they were increasingly motivated and determined to pursue a career in forestry and natural resource management.
* In addition, at the end of the program year, professional mentors
  + recognized the value of the Diversity, Equity, Inclusion, and Justice (DEIJ) workshops the Program hosted, with one citing they “are essential for progressing forestry to a more inclusive profession.” (Katie Low)

**Participants increased capacity to deliver forestry curriculum to youth.**

* UCCE’s Forestry Institute for Teachers graduates (n=96) received three university-accredited continuing education units. These PreK-12 educators also applied their skills to develop and implement a forestry curriculum project in their respective classrooms to share core forestry concepts with their students. These curriculum projects center on civic engagement, workforce development, and increasing environmental literacy. As a result of UC ANR research and extension efforts, participants learned skills and adopted strategies to improve workforce competency. (Austin Roughton)

**Condition change: Increased qualified workforce in forestry and fire management.**

* Nearly 200 individuals were trained and hired to work on natural resources issues in Modoc County, due in part to UCCE’s role in the Modoc Shared Stewardship partnership. The number of individuals trained and hired increased by 40 compared to the previous year. The individuals logged over 70,000 hours in recent years and have provided rangeland monitoring, marked timber projects, completed archeology and wildlife surveys, treated noxious weeds, and accomplished National Environmental Policy Act compliance on 1.6 million acres of U.S. Forest Service land. (Laura Snell)
* Since 2022, about 30 professionals have become Certified Burn Bosses through CARX. This increases the number of available professionals for hire in conducting prescribed burns, which make working lands more resilient to wildfire. (Lenya Quinn-Davidson)

The measured outcomes reported above demonstrate increases in understanding of career opportunities and increased capacity of forestry and climate professionals. Participants learned cutting-edge skills that increase workforce retention and competency. In this way, UC ANR contributes to increasing workforce competency and the public value of developing a qualified workforce in California.

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

**Endemic and Invasive Pests and Diseases**

**Issue**

California requires a highly skilled workforce to remain a competitive, prosperous, and 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. Technological advances have reduced manual labor in agriculture but increased the need for skilled labor. Projections for near-future retirements of people working in California's agricultural production, marketing, and post-harvest handling sectors indicate severe re-staffing needs. The California Agricultural Vision statement (2017) of the California Department of Food and Agriculture (CDFA) strongly recognizes the critical need to equip the next generation of agricultural workers. Landscape management professionals are also in need of training; California's landscaping services is a $9 billion industry.

**Methods**

UC ANR’s extensive network links campuses and communities across California to develop and extend integrated pest management (IPM) information and tools to train farmers and pest management professionals.

A UCCE Specialist located at the UC ANR Kearney Agricultural Research and Extension Center (REC) promoted best practices for pesticide spray applications to enhance efficiency, effectiveness, and environmental sustainability of critical crop protection efforts against pests and diseases in the San Joaquin Valley, which has over 24 million acres of farm in operation. The Specialist organized and delivered the Airblast Sprayer Calibration Training, which involved classroom and field exercises focused on axial airblast spray applications directed to tree and vine canopies. It covered the basic steps and calculations involved in sprayer calibration, with practical follow up via hands-on demonstrations in the field. The DPR approved 3.5 hours of continuing education credits in ‘Other' category for qualifying participants. Sixteen participants were in attendance, including growers, applicators/operators, pest control advisors/certified crop advisors, scientists/researchers, and others. (Reported by Peter Larbi; collaborators mentioned: Abiodun Abioye, Sharon Asakawa, Daniel Cabrera)

The UCCE Specialist also organized and delivered the Citrus Spray Field Day with 3.5 hours of continuing education credits approved by the DPR for qualifying participants. There were 36 registrants and 16 participants in attendance, which included growers, applicators/operators, pest control advisors/certified crop advisors, regulators/policymakers, scientists/researchers, and others. (Reported by Peter Larbi; collaborators mentioned: Abiodun Abioye, Sharon Asakawa, Daniel Cabrera)

In addition, the UCCE Specialist at Kearney REC worked with a UCCE Orchard Systems Advisor to organize and deliver two Calibration Safety and Compliance Training events, covering pest management in perennial specialty crops. The 4.5-hour each training events were also in collaboration with the Almond Board of California (ABC), AgSafe Food and Farms (AgSafe), and the Western Agricultural Processors Association (WAPA). In total, over 53 participants, from Northern and Central California, attended the trainings. (Reported by Peter Larbi; collaborator mentioned: Franz Niederholzer)

Lastly, the UCCE Specialist delivered a presentation on “Spray deposition and drift in grape pest and disease control” at UC Grape Day, which was attended by 30 participants. (Peter Larbi)

A UC Cooperative Extension (UCCE) Urban Integrated Pest Management (IPM) Advisor shared science-based recommendations with pest management professionals within California's structural pest control industry to address pests that cause physical and emotional harm to humans, threaten homes and other structures, and pose nuisances, especially for drywood termites. (Reported by Andrew Sutherland; collaborators mentioned: Siavash Taravati, Vernard Lewis)

A UCCE Area IPM Advisor for San Luis Obispo, Santa Barbara, and Ventura Counties delivered the webinar series, “Pest Management in the Garden/ Landscape.” The series consists of eight (four in English and four in Spanish) 2-hour educational webinars respectively. These webinars provided landscape professionals continuing education units to renew their California Department of Pesticide Regulation Maintenance Gardener License, so that they may appropriately and safely implement effective pest management programs when needed. There are a total of 100-250 attendees each year for the series. (Christopher Greer)

Asian farmers in the San Francisco Bay Area face significant language and cultural barriers to obtaining and maintaining their pesticide applicator permits. For the past seven years, in collaboration with the Santa Clara County Agricultural Division, UCCE has coordinated annual workshops on topics related to pesticide safety, laws and regulations, and IPM. In 2023, UCCE offered a BACGA Continuing Education Workshop in Mandarin, which was attended by 60 Asian farmers. (Aparna Gazula)

Science for Citrus Health (SCH) is a cooperative effort of individuals across UC ANR, Florida, and Texas. SCH aims to reach citrus growers, the media, and the public with information on Huanglongbing (HLB), an economically devastating citrus disease worldwide. Government funding for addressing this problem is robust, but often growers, the media and the public do not know what those efforts are or what they are accomplishing. SCH sponsored seven webinars on a variety of topics of interest to citrus growers and researchers, one of which was presented in Spanish. Webinars provide about 30-40 min talks by experts and were attended by participants worldwide, from the U.S., Mexico, Spain, Peru, Ecuador, Argentina, Venezuela and Costa Rica. Each webinar attracted 150-250 attendees. (Peggy Lemaux)

A UCCE Area Citrus IPM Advisor for the San Joaquin Valley delivered seven in-person events, which included field days on citrus mealybug and California red scale as well as a workshop with a UCCE Advisor and UCCE Entomology Specialist focused on ants. All the outreach events provided continuing education units for Pest Control Advisor/Qualified Applicator licenses. Over the past two years, 457 participants attended the eight different events. (Reported by Sandipa Gautam; collaborators mentioned David Haviland and Mark Hoddle)

As a result of UC ANR research and extension efforts, participants learned skills and adopted strategies to improve workforce competency.

**Outcomes**

**Participants gained pest management competencies.**

* After participating in the Citrus Spray Field Day at Kearney REC. Overall, 93% reported gains in learning for the entire field day, showing that the training was very effective and provided participants with a great amount of learning. Nine participants obtained continuing education credits (CEUs) totaling 31.5 hours. (Peter Larbi)
* After the Airblast Sprayer Calibration Training, 100% of participants reported learning gains from the entire training. Twelve participants obtained CEUs totaling 42 hours. (Peter Larbi)
* In post-training surveys for both Calibration Safety and Compliance Trainings, 100% of respondents reported learning gains. Moreover, 100% of respondents from both events reported they intend to adopt practices learnt from my Sprayer Calibration Training section. (Peter Larbi)
* After listening to “Spray deposition and drift in grape pest and disease control” at UC Grape Day, post-event survey respondents (n=30) reported learning new information from the talk as follows: a little (23%), a moderate amount (40%), a lot (23%), and a great deal (14%). Participants commented on how helpful the presentation was, with one noting, “Interesting results. Similar to what we observe in our vineyard.” (Peter Larbi)
* Pest management professionals within California’s structural pest control industry attended presentations for continuing education credits on new monitoring and management strategies for drywood termites, with 100% demonstrating increased knowledge of termite biology and ecology, preventive tactics, monitoring tools and detection techniques, legal roles and responsibilities, and evaluation tactics. Several testimonials indicate accelerating behavior change within California's pest control industry. (Andrew Sutherland)
* Over 95% of the participants indicated they gained useful information from the “Pest Management in the Garden/ Landscape'' webinar series. The series provided landscape professionals continuing education units to renew their California Department of Pesticide Regulation Maintenance Gardener License and the tools and knowledge needed to practice ecological based IPM in urban areas. (Christopher Greer)
* After attending the Continuing Education Seminar and the Bay Area Chrysanthemum Growers Association (BACGA) Continuing Education Workshop, 122 farmers increased their knowledge about avoiding pesticide drift, farm labor contractor inspections, pesticide use and school notifications, online pesticide use reporting, the new invasive pest Spotted Lanternfly, and updates about proposed PAC licensing. All 122 farmers that attended the two trainings received 2.5 CEUs each. (Aparna Gazula)
* Polls taken after the presentations on topics related to the citrus industry indicated that more than 50% of attendees intended to implement at least one new practice they learned in the webinar. Many attendees, mostly from Califoirna, received CEUs, which are mandatory to maintain their professional license status. (Peggy Lemaux)
* After attending in-person events on citrus mealybug, California red scale, and ants for CEU credits, 65-90% attendees of field days and workshops reported knowledge gains and that they will use it for future pest management. (Sandipa Gautam)

The measured outcomes reported above demonstrate changes in learning and improvements in how participants work. Decision-makers and pest management managers learned cutting-edge skills that increase workforce retention and competency. In this way, UC ANR contributes to increasing workforce competency and the public value of developing a qualified workforce in California.

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

**Issue**

According to data from the United Nations, half of the world's population was under 25 years old in 2019. Just one year prior, 61% of U.S.-based Pew Research respondents stated that "significant changes" are needed in the American government's fundamental "design and structure" to make it work for current times. This global majority of young people must be prepared to provide leadership in a dynamic and changing world, with emerging issues such as climate change and increasingly complex political, social, and economic challenges.

**Methods**

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 Cooperative Extension (UCCE) academics provided oversight, leadership, and guidance for the statewide implementation of the UC 4-H Youth Development Program (UC 4-H). Program activities like 4-H Student Advisory Nutrition Councils (4-H SNAC Club) and Food Waste Busters empowered youth to take on leadership roles in research, teaching, and service-learning projects to improve their communities. (UC 4-H)

The UC 4-H On the Wild Side (OTWS) program is a field trip program that aims to enthuse and educate elementary school children about nature and the outdoors, and encourage community involvement and leadership skills in teenagers. Over several months, teen staff and adult volunteers orchestrate and deliver weekend camp programs to elementary-aged students. Teens receive training in environmental curricula and teach inquiry-based science, then design and deliver one to two weekend programs with up to 90 children at each session. In 2023, 18 teens delivered OTWS to 56 students from two elementary schools. (Marianne Bird) UC 4-H also conducted Youth Experiences in Science (YES) curriculum, training 67 teenagers and adult coaches to deliver the curriculum to 547 elementary school students across 19 Expanded Learning sites. (Marianne Bird)

As a result of UC ANR research and educational efforts, youth participants learned and applied scientific methods, leadership, presentation, and advocacy skills. Outcomes with specific indicators follow.

**Outcomes**

**Participants felt more confident in their leadership skills.**

* Youth who participated in a 4-H SNAC Club reported gaining leadership skills. Youth retrospectively rated their abilities as excellent, good, some, or no ability before and after the program. For all skills measured, there was an increase in good or excellent self-ratings after programming compared to before: I can lead group discussions (42% increase), I can work as a team member (16% increase), I can plan programs (26% increase) and I can teach others (28% increase). (Reported by: Shannon Klisch; collaborators mentioned: Mishelle Costa, Miguel Diaz, Kelly Hong, Abbi Marrs, Melissa Rorabough)
* Fourteen volunteers completed the 4-H Food Waste Busters project training and 78% reported that they are definitely more confident in leading the project. (Reported by: Marisa Neelon; collaborators mentioned: Dorina Espinoza, Yu Meng)
* A retrospective pre-post survey showed that teens delivering a 4-H day camp program grew in leadership skills, including speaking before a group, planning programs, and sharing their ideas with adults. (Marianne Bird)
* After completing the UC 4-H Epidemiology Project, youth reported not only improved health behaviors for themselves, but also reported being leaders in the health of their communities. Many of the young participants (62.5%) reported that they can definitely help control the spread of diseases and 71.9% could envision themselves getting involved in their local community to help slow the spread of disease. (Marcel Horowitz)
* In the Capitol Corridor area, 73% of UC 4-H youth reported they are more comfortable being a leader. (Marcel Horowitz)
* Retrospective pre-post surveys from YES teen teachers in Sacramento County indicated that they grew significantly in leadership skills such as speaking before a group, leading discussions, planning lessons, being part of a team, and teaching others. (Marianne Bird)

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

* Of the 18 OTWS teen teachers who delivered the program to elementary school youth, two-thirds grew in their ability to speak before a group, plan programs, lead discussions, teach, and organize their time. In addition, 87% of 4-H OTWS participants scored better in their understanding of fire ecology, water quality, tree physiology, compass use, and dynamics of animal populations. (Marianne Bird)

The measured outcomes reported above demonstrate 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

**Issue**

California requires a highly skilled workforce to remain competitive, prosperous, and an innovative global leader. According to the National Center of Education Statistics, California’s 85% graduation rate lagged slightly behind the national rate of 86% in 2019-20. Improved college readiness and access can contribute to the development of a qualified workforce for California and a robust and thriving state economy.

**Methods**

UC ANR’s youth and community development programs equip the next generation for college and successful careers.

UC Cooperative Extension (UCCE) academics provide oversight, leadership, and guidance for the statewide implementation of the UC 4-H Youth Development Program (UC 4-H), which reached nearly 57,695 youth and had over 6,415 adult volunteers that contributed nearly 660,930 hours to the program. Program activities empowered youth to take on leadership roles in research, teaching, and service-learning projects to improve their communities. (UC 4-H) A UCCE 4-H Youth Development Advisor supported a three-year 4-H National Mentoring Program, utilizing the 4-H Youth Futures: College within Reach curriculum. In three program cycles spanning from 2019 to 2023, 119 teenagers were mentored by 34 college students. (Steven Worker)

The agricultural education programming at South Coast Research and Extension Center (REC) began as a collaboration with the Orange County Farm Bureau under the GROW banner. Programming focused initially solely on Orange County high school youth enrolled in agriculture courses. UCCE Community Educators at South Coast REC have expanded the program to deliver agriculture education to high school youth enrolled in culinary arts and biosciences. Through the GROW Program Agriculture Career Pathways program, 303 high school students from 5 Orange County high schools attended 5 separate half-day field events at South Coast REC where they learned about agricultural research careers, careers closely linked to agriculture, planting and harvesting of crops, and how these crops are utilized in the culinary industry. GROW staff collaborated with emeritus 4-H Advisor, Fe Moncloa, to develop the activities into formal curriculum in order to better capture knowledge gains as well as the impact of the program on steering youth towards selecting a career in an agricultural-related field. (Darren Haver)

As a result of UC ANR research and educational efforts, youth participants demonstrated learning gains to better prepare them for college and careers. Outcomes with specific indicators follow.

**Outcomes**

**Participants had positive attitudes and learned information about preparing for college and careers.**

* The GROW agriculture career pathways program conducted a post-survey asking youth participants to describe their experience in the program. Following field days in May of 2023, 51% of the 104 attendees stated they were likely or highly likely to consider a career in agriculture. The long-term impact of the GROW program will be an overall increase in urban youth entering careers in ag-related fields. (Darren Haver)
* Twenty-nine 4-H youth statewide responded to the college and career readiness common measures survey and reported learning information to prepare them for college and a career as a result of what they learned at UC 4-H programs. All youth reported when choosing a career, it is important to be passionate about the work they do. Eighty-three percent of youth report that for the type of career they want, it is important to go to college. (UC 4-H)
* One hundred forty 4-H youth between the ages 9-18 responded to the science common measures survey about positive attitudes and aspirations toward science they may have gained in the 4-H program. (UC 4-H) Specific outcomes include:
  + 86% of youth reported liking science.
  + 73% of youth reported liking a job that involves using science.
  + 65% of youth reported interest in studying science after high school.
* Youth who participated in a 4-H Embryology program reported statistically significant increases in their love for science and knowledge of how a chicken develops over time. (Matthew Rodriguez)

**Participants adopted science and teaching skills to prepare them for college and careers.**

* One hundred forty 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 (87%), trying new things to see how they will work (87%), looking at how things are the same or different (81%), and comparing how different things work (78%). (UC 4-H)

**Participants are more prepared for college and careers.**

* After participating in the 4-H Youth Futures: College within Reach curriculum, over 90% of participants have graduated high school, with almost all enrolled in post-secondary education. Additionally, younger students who were in 8th to 10th grade are now progressing successfully through their junior and senior years, on track to graduate. (Steven Worker)

These measured outcomes demonstrated knowledge and skills learned and positive attitudes related to science, college, and careers, which are a 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 - In Youth Development**

**Issue**

California requires a highly skilled workforce to remain competitive, prosperous, and an innovative global leader. Active participation in volunteerism and civic engagement not only fosters skills and confidence among individuals to make them more employable, but also cultivates strong community bonds. These connections inspire individuals to invest in their communities, promoting prosperity and enhancing the overall quality of life.

**Methods**

The UC 4-H Youth Development Program (UC 4-H) delivers educational programs that increase civic engagement. For example, Student Nutrition Advisory Councils (SNAC Clubs), On the Wild Side (OTWS), and Water Wizards are UC 4-H programs that empower youth to take on leadership roles in research, teaching, and service-learning projects to improve their communities. UC 4-H reached nearly 57,695 youth participating in clubs, afterschool programs, and camps, who were involved in projects around civic engagement, healthy lifestyles, science, engineering and technology. Civic engagement projects included four focus areas: community engagement, service, civic education, and personal development. Over 6,415 adult volunteers contributed over 660,930 hours to the program. (UC 4-H)

As a result of UC ANR research and educational efforts, participants demonstrated increased civic engagement. Outcomes with specific indicators follow.

**Outcomes**

**Participants had positive attitudes and gained skills for civic engagement.**

* One hundred forty-eight 4-H youth responded to the Civic Engagement common measures survey about what they may have learned at 4-H. Ninety-seven percent of the youth reported that they like to help people in their community, and 74% feel a responsibility to help their community. (UC 4-H)
* Youth who participated in the 4-H SNAC Club reported gaining skills related to civic engagement: 91% of youth surveyed agreed or strongly agreed with the statement, “I gained skills through serving my community that will help me in the future,” and 88% agreed or strongly agreed, “I am more confident in helping others.” (Reported by: Shannon Klisch; collaborators mentioned: Mishelle Costa, Abbi Marrs)
* In Alameda and Sacramento counties, 61% of students grew in their knowledge about water as a result of participating in the UC 4-H Water Wizards program, increasing their understanding of community water issues. In Sacramento County, 88% of students could name at least one water issue in their community. (Marianne Bird and Sally Neas)
* In Sacramento County, 83% of teens delivering a 4-H day camp strongly agreed they had made an important contribution to their community. (Marianne Bird)
* In the Capitol Corridor area, 67% of UC 4-H youth feel a responsibility to help their community. (Marcel Horowitz)

**Participants engaged in community service.**

* Of the 148 4-H youth who responded to the Civic Engagement common measures survey about what they may have gained through 4-H, 80% reported they had done a community service project, and 61% said they look for ways to help when they learn about a problem in the community. (UC 4-H)
* Of the 18 OTWS teen teachers who delivered the program to elementary school youth, 93% agreed or strongly agreed that they felt they had made a significant contribution to their community as a result of the project. (Marianne Bird)

**Participants used less water.**

* In Sacramento County, 35% of students reported using less water as a result of participating in the UC 4-H Water Wizards program. (Marianne Bird)
* In Glenn County, 75% of UC 4-H Water Wizards participants reported using less water following the program. The most commonly reported action for water reduction was taking shorter showers (50%). (Nicole Marshall-Wheeler)

These measured outcomes demonstrated learning and behavior changes related to civic engagement. Research shows civic engagement outcomes can lead to employability, emotional connection to communities, and a more qualified workforce. UC ANR’s youth development programs equip the next generation to be active participants in their communities, contributing to a robust and thriving state economy.

Condition Change: UC ANR contributed to increased civic engagement

**Healthy Families and Communities - In Nutrition**

**Issue**

California requires a highly skilled workforce to remain competitive, prosperous, and an innovative global leader. Volunteering and civic engagement can develop skills and confidence that make individuals employable and create attachments to communities that encourage people to invest, spend, hire, and promote the quality of life in their community.

**Methods**

UC ANR delivers educational programs that increase civic engagement. This includes UC-managed volunteers and individuals from other organizations. (EFNEP; UC Master Food Preserver)

CFHL, UC worked with over 190 youth leaders statewide to lead direct education activities about nutrition, physical activity, and health across 10 counties. Over 800 youth statewide were also involved with shaping Policy, Systems, and Environmental (PSE) changes in their communities across 15 counties through participation in activities such as Youth-led Participatory Action Research Projects (YPAR). (CFHL, UC)

As a result of UC ANR research and educational efforts, participants demonstrated increased civic engagement. Outcomes with specific indicators follow.

**Outcomes**

**Participants had positive attitudes and gained skills for civic engagement.**

* After participating in the YPAR projects with CFHL, UC, 130 youth responded to a follow-up survey saying that they could “Yes, probably” (40%) or “Yes, definitely” (40%) make a difference in their community. (CFHL, UC)

**Participants engaged in community service.**

* Over 2,271 volunteers donated 33,797 hours across three statewide programs.
  + 1,661 CFHL, UC volunteers donated over 24,760hours towards nutrition and physical activity education. (CFHL, UC)
  + 213 EFNEP volunteers donated over 1,450 hours towards assisting in nutrition extension programming (EFNEP)
  + 492 UC Master Food Preserver volunteers donated over 20,960 hours towards food preservation classes and demonstrations. (UC Master Food Preserver) A local example follows:
    - A UCCE Advisor administers the Intermountain Food Preservers Program which covers Siskiyou, Modoc, Lassen, Sierra, and Plumas Counties, which grew to 21 volunteers who participate in outreach across the five-county area reaching over 1,000 people annually through fairs, famer’s markets, workshops, and classes. (Laura Snell)

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. UC ANR’s youth development programs equip the next generation to be active participants in their communities, contributing to a robust and thriving state economy.

Condition Change: UC ANR contributed to increased civic engagement

**Sustainable Natural Ecosystems**

**Issue**

California requires a highly skilled workforce to remain competitive, prosperous, and an innovative global leader. Volunteering and civic engagement can develop skills and confidence that make individuals employable and create attachments to communities that encourage people to invest, spend, hire, and promote the quality of life in their community.

**Methods**UC ANR delivers educational programs that increase civic engagement. This includes UC-managed volunteers and individuals from other organizations.

The UC Environmental Stewards Program conducts activities and training to introduce Californians to the wonders of our unique ecology and engage the public in the study and stewardship of California’s natural communities. It aims to increase knowledge, skills, identity, and self-efficacy related to California's natural history and environmental issues, increase public participation and civic engagement in environmental education, and enhance citizen science, climate adaptation, and planning toward environmental and climate justice. Each year, the program co-develops, delivers, and evaluates instructor trainings to partner organizations, who then extend the Environmental Stewards and Climate Stewards certification courses. (Greg Ira)

As a result of UC ANR research and educational efforts, participants demonstrated increased civic engagement. Outcomes with specific indicators follow.

**Outcomes**

**Participants improved environmental stewardship capacity**

* Based on course evaluations from Environmental Stewardship courses, participants self-reported improving their capacity to do volunteer service (93%) and intention to volunteer more (60%) in the coming year. (Greg Ira)

**Participants engaged in community service.**

* The number of Environmental Stewards alumni recording volunteer hours has grown to 1,155 individuals participating in naturalist-related civic engagement. In 2023, Environmental Stewards volunteers donated a record high of over 59 thousand hours engaging in participatory science, land, and water stewardship, environmental justice, and education and interpretation activities. (Greg Ira)

These measured outcomes demonstrated behavior change related to civic engagement. Research shows civic engagement outcomes can lead to employability, emotional connection to communities, and a more qualified workforce; thus, contributing to a robust and thriving state economy.

Condition Change: UC ANR contributed to increased civic engagement

**Sustainable Food Systems**

**Issue**

California requires a highly skilled workforce to remain competitive, prosperous, and an innovative global leader. Volunteering and civic engagement can develop skills and confidence that make individuals employable and create attachments to communities that encourage people to invest, spend, hire, and promote the quality of life in their community.

**Methods**

The UC Master Gardener Program welcomes members of the public to apply to the program where they receive a minimum of 50 hours of training over the course of 16 weeks. The UC Master Gardeners receive education and certification, and in exchange are required to volunteer a minimum of 50 hours in the first year and 25 hours each subsequent year. UC Master Gardeners must complete a minimum of 12 hours of continuing education per year, starting their second year. (UC Master Gardener Program)

**Outcomes**

**Participants engaged in community service.**

* Over 5,876 Master Gardener volunteers provided 478,176 hours of public service in 50 of California’s 58 counties, by extending research-based information on environmental horticulture to help the public grow home, community, and school gardens more sustainably. (UC Master Gardener Program)

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; thus, contributing to a robust and thriving state economy.

# **DEVELOPING AN INCLUSIVE AND EQUITABLE SOCIETY**

## 

## Condition Change: UC ANR contributed to improved living and working conditions for California's food system and farmworkers

**Sustainable Food Systems**

**Issue**

In 2021 there were 21.1 million full- and part-time jobs related to the agricultural and food sectors – 19.5% of total U.S. employment (Economic Research Service). Migrant and seasonal farmworkers are a vital component of those jobs, yet they continue to live in poverty with poor health indicators and limited access to health care services. Farm labor conditions are intricately entwined with farmworker quality of life, farm profitability, and the socioeconomic vitality of agricultural communities. For example, recent labor shortfalls have reached as high as 20% in California, resulting in $3 billion in lost production. Agriculture is one of the most hazardous industries for workers. In 2020, there were 11,880 injuries that required days away from work ([National Institute for Occupational Safety and Health](https://www.cdc.gov/niosh/index.htm)).

**Methods**

UC ANR continues research and extension efforts to improve conditions for workers in California’s food system.

A UCCE Viticulture Advisor continued collaborative work with the Napa Valley Farmworker Foundation to use the unique agriculture-specific workplace assessment tool they developed which queries workers and provides direct feedback to employers. Feedback allows employers to address issues of communication, team cohesion, supervision, safety, and compensation. Acting on the feedback can improve managers. This tool supports improved agricultural working conditions and increased employment stability. (Monica Cooper)

A UCCE Small Farms Advisor and team in Santa Clara County continued to identify or develop research-based information for protecting food system and farm workers. This included developing and delivering a farmworker training in Mandarin, with five Asian farmworkers attending. In addition, to five Asian and Hispanic farms in the region, they provided one-on-one technical assistance to comply with farmworker requirements. (Aparna Gazula)

A UCCE Specialist working on social justice in agriculture at UC Berkeley conducts research on the health of agricultural workers, with a focus on long term health, the ability to access high quality health care, and the ability of the workforce to meet the changing demands of the industry. The specialist shared research findings in a report to the California Department of Public Health. (Christy Getz)

CalFresh Healthy Living, UC in Kern County (CFHL, UCCE Kern) partnered with Community Action Partnership of San Luis Obispo (CAPSLO), which has five migrant Head Start centers in the county. CAPSLO provides no-cost childcare and preschool services to low-income families whose primary occupation is agricultural production and harvesting. Nineteen Head Start teachers were trained on *Coordinated Approach to Child Health Early Childhood Education* (CATCH ECE) by the CFHL, UCCE Kern County Supervisor to increase nutrition and physical activity knowledge. CFHL, UCCE Kern conducted youth and adult nutrition education at the centers. Over 125 preschool children participated in evidence-based lessons utilizing CATCH ECE and *Go, Glow, Grow* to introduce nutritious foods and tastings, share how foods keep them healthy, and promote physical activity. Over 130 parents also received evidence-based education during the evenings to accommodate work schedules from *Plan, Shop, Save, and Cook* (PSSC) and *Healthy, Happy Families* tolearn how to read the nutrition facts label, save money on food, and how to start healthy habits with their children. Parents also learned how to incorporate physical activity in their everyday family routine. (Andra Nicoli and Beatriz Rojas)

As a result of UC ANR research and extension efforts, participants learned skills and informed policies to improve food system and farmworker conditions.

**Outcomes**

**Participants reported learning gains that are intended to lead to improved farmworker outcomes.**

* Sixty growers and a grower cooperative pesticide vendor for whom English is a second language learned about insecticide active ingredients that are labeled for use on Asian leafy vegetables grown in greenhouse production systems. Thus avoiding using products that are not labeled for Asian leafy vegetables and greenhouse production systems, and avoiding fines for misusing pesticides. (Aparna Gazula)
* After participating in multiple food tastings (36 surveys capturing 393 responses), 85% of preschoolers reported a willingness to eat the sampled nutritious foods again which helps promote the purchase of healthy foods when perishability and waste is a concern for parents stretching their money to feed their families. (CFHL, UC, Andra Nicoli and Beatriz Rojas)
* Twenty parents who received the PSSC lesson on understanding food labels completed an “Intent to Change” survey. Of the 16 respondents who did not use the “Nutrition Facts” label prior to the lesson, 81% reported that they will use the nutrition facts on the food label to choose foods the next time they go shopping. A Head Start center director shared the benefits of educating staff, children, and parents: “I like how teachers and children are physically active with CATCH. The nutrition sessions given to the parents also make it more impactful for the whole family.” (CFHL, UC, Andra Nicoli and Beatriz Rojas)

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

* Through sharing of evidence-based research on the health of agricultural workers, UCCE contributed to a decision by the California state government to expand Medi-Cal coverage to undocumented adults. (Christy Getz)

**Change in condition: Improved working conditions for farmworkers.**

* Using the workplace assessment tool, 85 of the 331 surveyed farmworkers in Napa County over two consecutive growing seasons (2022 and 2023), 53% reported that between 2022 and 2023, their employers addressed issues that were raised in the survey, such as adjustments to compensation and communication between workers and managers. In addition, 28.2% of employers consulted with their employees after the survey to discuss and resolve issues. (Monica Cooper)

The measured outcomes reported above demonstrate changes to improve the 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 developing an inclusive and equitable society.These efforts also benefit the food system through workforce retention, improved safety, and product quality.

## Condition Change: UC ANR contributes 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 is 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 college preparation. California continues to be challenged by social, health, and economic inequities.

**Methods**

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 UC ANR resources. UC ANR academics live and work in communities building trust and credibility to solve local problems together through research, outreach, and education.

A UCCE Specialist at UC Berkeley partners with Tribes to examine tribal sovereignty in land use. The specialist held a “Strengthening Tribal-Agency Partnerships'' webinar to address challenges Tribes and agencies face in land use permitting on tribal lands, as well as concerns about the impact of cannabis grows on tribal cultural resources. Thirty-six people attended, including government agency representatives, students (including Tribal students), Tribal government representatives, Tribal attorneys, and UC ANR personnel. (Jennifer Sowerwine)

A UCCE Specialist at UC Berkeley increases opportunities for cultural competency professional development for UC ANR personnel. The specialist participated in a panel at the UC ANR Statewide Conference and shared best practices for outreach with Native communities with over 100 participants. (Jennifer Sowerwine)

A UCCE 4-H Youth Development Advisor extended knowledge to educators to improve their ability to provide youth with culturally relevant programming. The advisor co-planned a six-session online workshop series titled, “Latino Youth Development,” reaching 25 4-H professionals nationwide. (Steven Worker)

A UCCE Small Farms Advisor conducted research and outreach programs dedicated to ensuring the sustainability and viability of organic farms. In 2023, the advisor served on the Sustainable Pest Management workgroup for the California Department of Pesticide Regulation’s “Accelerating Sustainable Pest Management: A Roadmap for CA,” and represented the needs and interests of both underserved farmers and organic growers, diversified and small-scale. (Margaret Lloyd)

As a result of UC ANR’s multipronged efforts to better reach underserved audiences, program staff gained cultural competency skills, and UC ANR increased engagement with diverse communities across California. Outcomes with specific indicators follow.

**Outcomes**

**Participants gain cultural competency skills in their work. NEW**

* After attending the “Strengthening Tribal-agency partnerships” webinar, all 9 respondents to the question “how much did you learn” indicated they learned something. Eight respondents indicated they felt more confident in their ability to engage in consultation and resource protection and nine reported they were more likely to engage in consultation and resource protection. (Jennifer Sowerwine)
* After a workshop on Latino Youth Development, post-workshop evaluations revealed that 82% of participants found the course beneficial to their roles within 4-H, and improved understanding how community partnerships and program elements influence Latino youth engagement. (Steven Worker)

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

* After attending a panel at the UC ANR Statewide Conference, 44 participants responded to an evaluation survey. As a result of attending the panel, 73% said they had greater confidence in reaching out to Tribes and 68% said they learned something. (Jennifer Sowerwine)

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

* As a result of a UCCE Advisor’s participation in the workgroup on Sustainable Pest Management, the California Department of Pesticide Regulations included the needs and interests of underserved farmers and organic growers (diversified and small-scale) in a new guiding document, “Accelerating Sustainable Pest Management: A Roadmap for CA.” Their inclusion in the roadmap increases the resiliency and viability of these farmers in the future. (Margaret Lloyd)

These measured outcomes demonstrate how UC ANR has strengthened its internal capacity to do effective outreach to diverse audiences to have participants better reflect the state's diversity. 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 Haas Institute of Fair and Equitable Society finds California ranking in the top quarter amongst the states for inclusiveness. However, the state dropped from fifth to twelfth in the nation between 2018 and 2020, indicating there is still much work to do.

Condition Change: UC ANR contributes to increased diversity, inclusiveness, and cultural competency in California's workplaces.

**Sustainable Food Systems**

**Issue**

In California, over 8% of producers with day-to-day decision-making input on farms and ranches are producers of color or identify as multi-racial and 12% identify as Hispanic (National Agricultural Statistics Service 2017). Statewide, the farms run by farmers of color are smaller, make less money, and receive less government support than their white-operated counterparts, including access to extension services (National Agricultural Statistics Service 2007, 2012). A 2017-2018 survey conducted by the California Farmer Justice Collaborative revealed that they more often draw upon family and community networks rather than professional extension providers. Many extension personnel in California do not share the cultural and social histories of these producers of color, and therefore would benefit from learning new skills and strategies for building successful professional relationships with these producers. (Sonja Brodt)

Similarly, national data indicates that Master Gardener volunteers are overwhelmingly white, female-identified, college-educated, affluent, employed outside of the home, or retired. (Dorn et.al. 2018; Schrock et.al. 2000; Takle 2015; Strong and Harder 2010). While we do not currently have data specific to the UC Master Gardener Program, incomplete data from 2015 indicates that the volunteer population in California is in line with national trends, meaning that it does not reflect the diversity of California residents and gardeners. To truly achieve the program’s mission to extend research-based horticulture, sustainable landscaping, and integrated pest management information, it must improve outreach to communities historically underinvested by Extension, and increase the cultural competency and awareness of personnel and volunteers.

**Methods**

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 UC ANR resources. UC ANR academics live and work in communities building trust and credibility to solve local problems together through research, outreach, and education.

With funding from the Department of Pesticide Regulation, the UCCE Small Farms Advisor in Capitol Corridor continued to deliver an extension IPM program for Hmong and Iu Mien farmers, immigrants from Southeast Asia who predominantly grow conventionally managed strawberries, vegetables, and flowers in Sacramento. Language and cultural barriers have prevented these farmers from integrating into and receiving resources standard for California farmers. Participation in the program increased from approximately 110 to 132 in 2023. (Margaret Lloyd)

As a result of UC ANR’s multipronged efforts to better reach underserved audiences, program staff gained cultural competency skills, and UC ANR increased engagement with diverse communities across California. Outcomes with specific indicators follow.

**Outcomes**

**Change in condition: The agriculture industry is more inclusive.**

* Hmong and Iu-Mienh farmers working with the UCCE Capitol Corridor small farms IPM program are more connected to financial and technical resources, and ultimately more economically stable and resilient.
  + Over $317,000 has been awarded to 40 farms, from diverse funding sources including the California Department of Food and Agriculture and the Natural Resources Conservation Service,
  + 70,000 plants representing new varieties with improved disease resistance have gone out to farms,
  + 3270 linear feet of native hedgerows were planted across four farms, and

265 tons of compost delivered onto 17 farms.

* + A compost spreader was built specifically for small scale farms, improving growers’ ability to spread compost on a farm, which is a major barrier to adopting the use of compost on-farm.
  + Observations during field trips to farms showed that, with more economic resources, Hmong and Iu-Mienh farmers can transition to experimenting with or adopting practices that support IPM, such as purchasing mechanical weeding implements, paying for water for a hedgerow establishment, purchasing compost, purchasing personal protective equipment that is more expensive but provides better safety, correct nozzles for the job and replacing them when necessary, and using lower risk pesticides that may be more expensive. (Margaret Lloyd)

These measured outcomes demonstrate how UC ANR has strengthened its internal capacity to do effective outreach to diverse audiences and have participants better reflect the state's diversity. 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 Haas Institute of Fair and Equitable Society finds California ranking in the top quarter amongst the states for inclusiveness. However, the state dropped from fifth to twelfth in the nation between 2018 and 2020, indicating there is still much work to do.

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# **PROMOTING HEALTHY PEOPLE AND COMMUNITIES**

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

**Healthy Families and Communities - In Nutrition**

**Issue**

California has the largest population of any state in the U.S. and is home to over 39 million people. California’s large population creates pressure on community resources and presents numerous challenges to health and safety, including for chronic disease prevention. According to the CDC, more than three million Californians suffer from diabetes and over eight million suffer from heart disease, leading to an estimated $50 billion in healthcare costs. Poor nutrition and lack of physical activity are major risk factors for the development of chronic diseases.

**Methods**

In partnership with communities and allied organizations, UC ANR produces new knowledge, tools, programs, and policy-relevant research that result in healthy living for individuals.

The CalFresh Healthy Living, UC (CFHL, UC) State Office at UC Davis provides statewide oversight, leadership, and guidance for the CalFresh Healthy Living Program. UC Cooperative Extension (UCCE) academics and CFHL, UCCE supervisors offer local leadership and guidance in program implementation and evaluation. CFHL, UC, and UCCE offices throughout the state offer nutrition education aligned with policy systems and environmental change initiatives to generate sustainable healthy outcomes in communities. Partnering with SNAP-Ed funded and non-funded organizations furthers local engagement and impact. CFHL, UC delivered nutrition education programs to over 89,500 youth and adults, and 3,400 food tastings with over 66,700 students and 2,200 adults. CFHL, UC supports implementation of policy, systems, and environmental changes that work together to promote nutrition and physical activity practices, and improve health outcomes for CFHL, UC participants. (CFHL, UC)

CFHL, UCCE in Santa Barbara County partnered with Santa Maria Recreation and Parks (SM R&P) to promote a *Teens Love Cooking* series to middle school and high school-aged youth throughout the city of Santa Maria. Additionally, SM R&P provided access to a full commercial kitchen, kitchenware, and storage space for program materials. With the support of a SM R&P staff member, UCCE staff met with students for two hours, twice a week over three weeks to teach various nutrition and cooking topics, including knife safety, how to follow a recipe, and how to cook a healthy meal using MyPlate as a guide. Additionally, participants put into practice what they learned by preparing recipes from the *Cooking for Health Academy* curriculum. (Kelly Hong)

CFHL, UCCE in the Butte Cluster and UC Master Gardeners, kicked off their second annual “Great Tomato Challenge” in 2022, a social media contest for Community Housing Improvement Program (CHIP). The goal of the “Great Tomato Challenge” event is to promote container gardening at apartment complexes through a *Fresh from the Garden* workshop and social media contest. The 1.5 hour Fresh from the Garden curriculum workshops took place at 5 CHIP sites, having been advertised in English, Spanish, and Hmong language flyers. (Veronica Van Cleave-Hunt)

UCCE academics provide oversight, leadership, and guidance for the statewide implementation of the Expanded Food and Nutrition Education Program (EFNEP) statewide. This program serves adults with income less than 185% of the federal poverty level and youth that attend Title 1 schools in which 50% or more of the students qualify/receive free or reduced-price lunch or live in households that receive food assistance. EFNEP delivered evidence-based curricula to over 9,620 youth and adults. (EFNEP)

UCCE academics provide oversight, leadership, and guidance for the statewide implementation of the UC 4-H Youth Development Program (UC 4-H). UC 4-H provided hands-on, experiential learning opportunities about healthy lifestyles with programs like 4-H Student Advisory Nutrition Councils (4-H SNAC Club) and participation from over 57,695 youth. (UC 4-H) For example, the *Cooking Academy* series, which provides youth development guidance for a teens-as-teachers approach for healthy eating and food preparation techniques to be delivered to younger youth in the community. (Marianne Bird) 4-H Mindful Mechanics helps teens learn practices that can maintain and improve mental health, and other projects educate youth on communicable disease prevention. (Marcel Horowitz)

A UCCE Specialist at UC Berkeley studies the impacts of a nutrition and culinary course for college students. Transitioning from parental care to college life, many students lack skills to procure food and cook their meals, which may result in a suboptimal diet. To address this, UC Berkeley campus created a course to improve their dietary intake, meal preparation behaviors, food security and stress, and the specialist evaluated its impact. (Susana Matias)

A UCCE Advisor authored an award-winning nutrition and fitness education curriculum, EatFit. The curriculum was taught to 646 EFNEP and 821 CFHL, UC youth in FY23. (Marcel Horowitz)

As a result of UC ANR research and extension, participants learned about and adopted strategies to improve individual health and wellness. Outcomes with specific indicators follow.

**Outcomes**

**Participants gained knowledge about, changed attitudes toward, or intended to adopt healthy eating practices.**

* Over 1000 CFHL, UC participants statewide responded to a survey about their experience with the *Plan, Shop, Save, Cook* or *Making Every Dollar Count* curricula, with 51% reporting more frequently thinking about healthy food choices when deciding what to feed their family. (CFHL, UC)
* Students who participated in CFHL, UC food tastings reported being more willing to eat the food again (70%) and being more willing to ask for the food at home (64%). (CFHL, UC)
* In Sacramento County, follow-up surveys of 4-H Cooking Academy teen participants showed that 88% plan to eat the recommended amount of fruits and vegetables, 75% know how to follow a recipe to make something to eat, 67% plan to prepare healthy foods or snacks with their family, 59% indicated they learned more about healthy food choices, and 83% have given their family ideas for healthy meals or snacks. (Marianne Bird)
* After completing a nutrition and culinary course, a pre-/post-test survey of college students showed an increase in their self-confidence about consuming more fruits, vegetables and whole grains, and about cooking their own meals. (Susana Matias)
* Eighteen participants completed an "Intent to Change" survey after participating in the *Fresh from the Garden* workshop. Of the seven respondents who reported not eating “more than 1 kind of vegetable each day” over the past week, all seven indicated they intended to eat “more than 1 kind of vegetable each day” more often within the next week. One participant wrote, “This workshop helps my family to be healthier.” Gardening has a role in promoting greater vegetable intake and variety among families with low income, which improves overall health. (Veronica Van Cleave-Hunt)
* At the end of the *Teens Love Cooking* class series, youth completed the “What Did You Learn” open-ended qualitative survey, which asks about changes in knowledge and behaviors. Ten youth responded to the survey, and for the question related to learning, the theme of improved knife skills and safety was reported most frequently, followed by reports related to increased nutrition knowledge, and increased knowledge of healthy food preparation. When asked about one thing that they do differently because of these classes, students responded with the theme of comfortability using a knife and preparing nutritious foods. (Kelly Hong)

**Participants adopted healthy eating practices.**

* EFNEP surveyed over 1,930 adult participants, and 98% reported improvements in their diet quality, including eating more red and orange vegetables (59%), eating more dark green vegetables (58%), and eating fruit more often each day (55%). Out of 1,815 youth EFNEP participants surveyed, 87% reported improvements in their diet quality, including eating more vegetables (40% of 3rd-5th graders, 48% of 6th-8th graders, and 38% of 9th-12th graders) and eating more fruit (33% of 3rd-5th graders, 47% of 6th-8th graders, and 34% of 9th-12th graders). (EFNEP) Local highlights follow:
  + In Contra Costa and Alameda counties, a survey of 119 K-5th grade students showed that 78% of Contra Costa County respondents and 59% of Alameda County respondents reported improvements in healthy food choices. (Marisa Neelon)
  + In Contra Costa and Alameda counties, post-survey results of 231 adult EFNEP graduates showed that 95% and 97% of participants in each county respectively improved diet quality (eating more fruits and vegetables daily, drinking less soda and sugary drinks, and cooking dinner at home more often). (Marisa Neelon)
  + In Los Angeles and Orange counties, pre/post-surveys of adult EFNEP participants showed that 95% and 99% of participants in each county, respectively, improved in one or more diet quality indicators. (Natalie Price)
  + In Los Angeles County, 89% of youth EFNEP participants improved their ability to choose food according to USDA recommendations. (Natalie Price)
  + In Sacramento County, 99% of EFNEP participants improved their diet quality, with 81% reporting they ate more vegetables. (Marcel Horowitz)
* In a statewide survey of 546 adult CFHL, UC participants’ diet, many reported making improvements in several healthy eating practices, such as drinking less soda (36%), eating more cups of fruits and vegetables in a day (67%), and using the nutrition facts label (54%), while over 1,000 adults surveyed about food resource management used MyPlate to make food choices more often (65%) after participating in CFHL, UC education. A statewide survey of 1,500 youth CFHL, UC participants showed that 43% of youth ate vegetables more times yesterday, 41% ate fruit more times, and 47% drank sugar sweetened beverages fewer times after participating in CFHL, UC education. (CFHL, UC) Local highlights follow:
  + Out of 133 fourth grade participants of CFHL, UCCE programming in Santa Barbara County, 37% reported an increase in vegetable consumption, 35% increased fruit consumption, and there was a statistically significant decrease in consumption of sweetened beverages. (Reported by: Shannon Klisch; collaborators mentioned: Mishelle Costa, Miguel Diaz, Kelly Hong, Abbi Marrs, Melissa Rorabough)
  + Evaluation of the *UP4it* curriculum showed 48% of students decreased their frequency of sugary drink consumption and 43% and 50% increased their frequency of eating fruits and vegetables, respectively. (CFHL, UC & Marcel Horowitz)
  + After participating in the virtual *Happy Healthy Families* curriculum, 96 parents evaluated by the statewide CFHL, UC program showed significant improvement in nine of ten parenting skills related to feeding children: sitting and eating together, consistent snack times, not warning children “no treat” if they don’t eat, caregivers eating vegetables in front of children, preparation of one liked food, consistent dinner time, not reminding children to continue eating, not skipping meals, and reintroducing previously unliked food. (CFHL, UC & Marcel Horowitz)
  + Over 40 adults who participated in the CFHL, UC’s *Fresh from the Garden* workshops learned how to harvest, store, and prepare fresh tomatoes. (Veronica Van Cleave-Hunt)
  + Youth who received instruction from the *EatFit* curriculum reported drinking sugar-sweetened beverages fewer times the previous day in a pre-post survey following the lessons. (Marcel Horowitz) For example, CFHL, UCCE in Contra Costa reported that of 232 students who completed a pre-post questionnaire, 49% reported a reduction in the number of times they drank sugar-sweetened beverages the previous day. Additionally, 36% reported eating fruit more times and 36% reported eating vegetables more times the previous day after participating in *EatFit*. (CFHL, UC and Eli Isreal Figueroa)
* Youth who participated in the UC 4-H SNAC Club reported adopting healthy eating practices. Forty-three youth surveyed agreed or strongly agreed because of participating in this program, “I learned cooking skills” (95%), “I use cooking skills to prepare food at home” (82%), “My family has purchased healthier foods” (88%), and “My family prepared healthier foods” (86%). (Reported by: Shannon Klisch; collaborators mentioned: Mishelle Costa, Melissa Rorabough, Miguel Diaz, Abbi Marrs, Kelly Hong)
* After completing a nutrition and culinary course, college students (n=51) reported a significant increase in the number of cups of fruits consumed, an increase in frequency of cooking their meals and a decrease in the frequency of skipping meals compared to a control group of students who did not take the class (n=81). (Susana Matias)

**Participants gained knowledge about and changed attitudes toward healthy lifestyle practices.**

* UC 4-H youth who participated in a vaccine and COVID-19 reduction educational activity reported several improvements in their knowledge and attitudes around disease prevention. Ninety-seven percent of youth agreed that germs get into their body through their mouth; 96% of youth reported that washing hands helps prevent germs from getting inside them; 91% of youth reported that staying further away from people helps to prevent them from getting sick; 88% indicated that vaccines help to keep them from getting sick; 87% believed that opening up windows and doors helps to get germs out of rooms; and 80% reported that wearing masks helps them from getting sick. (Marcel Horowitz)

**Participants adopted healthy lifestyle and decision-making practices.**

* EFNEP surveyed over 1,930 adult participants, and 84% reported increasing their physical activity. Sixty-five percent of adults made small changes to be active more often and 53% increased the number of days they exercised for at least 30 minutes. Out of 1,815 youth EFNEP participants surveyed, 58% reported increasing their physical activity. Thirty-six percent of 3rd through 5th graders, 42% of 6th through 8th graders, and 37% of 9th through 12th graders increased the number of days they were active for at least 60 minutes. (EFNEP) Local highlights follow:
  + In Contra Costa and Alameda counties, a survey of 119 K-5th grades showed that 49% of Contra Costa County respondents and 45% of Alameda County respondents reported improvements in physical activity. (Marisa Neelon)
  + In Contra Costa and Alameda counties, post-survey results of 231 adult EFNEP graduates showed that 79% and 75% of participants in each county respectively improved physical activity practices such as exercising for at least 30 minutes more often and strengthening muscles. (Marisa Neelon)
  + In Los Angeles County, 65% of 932 youth EFNEP participants improved their physical activity practices. (Natalie Price)
* In a statewide survey of 546 adult CFHL, UC participants, many reported making improvements in several healthy lifestyle practices, such as increasing the number of days in which they were physically active for at least 30 minutes (57%) and making small changes to be more physically active (54%) after participating in CFHL, UC education. (CFHL, UC) Specific examples follow:
  + In a survey of 552 CHFL, UC youth who participated in the *UP4it* curriculum, 48% improved the number of days they participated in moderate and vigorous physical activity. (Marcel Horowitz)
  + One hundred seven fourth grade participants of CFHL, UCCE programming in Santa Barbara County reported an increase in the number of days per week they got more than 60 minutes of physical activity (52%). (Reported by: Shannon Klisch; collaborators mentioned: Mishelle Costa, Miguel Diaz, Kelly Hong, Abbi Marrs, Melissa Rorabough)
  + Out of 232 youth in Contra Costa County who received instruction from the *EatFit* curriculum, 37% reported an increase in the number of days they were physically active for 60 minutes or more the previous week. (CFHL, UC & Eli Isreal Figueroa)
* After completing the UC 4-H Epidemiology Project, youth reported that they were more likely to wash their hands before food preparation (78.1%), after sneezing or coughing (56.2%), and after shopping in a public space (87.5%). The majority (84.4%) of youth also reported that they were more likely to wear a face mask when out in public, compared to before the project. When youth were asked what they learned from the project, one youth stated, “I learned why masks work, I learned how hand sanitizer works, and I learned how I can help my community.” (Marcel Horowitz)

The measured outcomes reported above lead to improved health for Californians where they live, learn, work, and play. Furthermore, longitudinal studies of EFNEP graduates indicate that they maintain positive behavior change 2-6 months after completing the program (Dollahite, 2014; Koszewski, 2011; Swindle, 2007). Healthy habits can prevent or reduce the detrimental effects of chronic disease, and for every dollar spent on California EFNEP, there is a savings of $8.34 in healthcare costs (California EFNEP Impact Report, 2018). Collectively these efforts contribute to the public value of promoting healthy people and communities.

Condition Change: UC ANR contributed to improved health for all

**Sustainable Food Systems**

**Issue**

California has the largest population of any state in the U.S. and is home to over 39 million people. California’s large population creates pressure on community resources and presents numerous challenges to health and safety, including for chronic disease prevention. According to the Center for Disease Control, more than three million Californians suffer from diabetes and over eight million suffer from heart disease, leading to an estimated $50 billion in healthcare costs. Poor nutrition and lack of physical activity are major risk factors for the development of chronic diseases. The average American diet, particularly for low-income families, is deficient in fresh produce in comparison to USDA dietary guidelines.

**Methods**

The statewide implementation of the UC Master Gardener Program leverages a network of program coordinators, academics, county directors, and volunteers working together to provide science-based information to the public on food gardening through outreach and education. (UC Master Gardener Program)

As a result of UC ANR research and extension, participants learned about and adopted strategies to improve individual health and wellness. Outcomes with specific indicators follow.

**Outcomes**

**Participants adopted edible gardening practices.**

* Participants of public education events led by UC Master Gardener volunteers responded to a 2023 statewide survey and 67% of 778 volunteers reported starting or improving the growing of edible plants and 55% of 766 volunteers expanded varieties of edible plants grown. (UC Master Gardener Program)
* Also, 979 reported applying what they learned to 1,071,303 square feet of food gardens. These behaviors are correlated with increased consumption of fruits and vegetables. (UC Master Gardener Program)

**Participants spent more time gardening and outdoors.**

* 63% of 1,994 respondents spent more time gardening and outdoors, which is associated with improved individual emotional and physical health. (UC Master Gardener Program)
* Over 650 participants of UC Master Gardener volunteer-led educational programs reported in a statewide survey that they started or improved practices on 1,549,929 square feet of home gardens in California. (UC Master Gardener Program)

The measured outcomes reported above lead to improved health for Californians by increasing the quality and quantity of fresh, locally produced fruits and vegetables. In addition, spending more time gardening and outdoors improves both physical and mental/emotional health. Gardening is considered a moderate to high intensity exercise. According to the Center for Disease Control and Prevention, you can burn up to 300 calories during just one hour of light gardening and yard work. The National Institutes of Health recommends 30-45 minutes of gardening three to four times per week as an excellent healthy living strategy. In addition, research with students has demonstrated that just 30 minutes spent in nature after completing a stressful task improves their mood. The students who were studied exhibited lower levels of cortisol, the stress hormone. Collective improvements to individual community members' health 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 - In Nutrition**

**Issue**

California has the largest population of any state in the U.S. and is home to over 39 million people. California’s large population creates pressure on community resources and presents numerous challenges to health and safety, including for chronic disease prevention. According to the CDC, more than three million Californians suffer from diabetes and over eight million suffer from heart disease, leading to an estimated $50 billion in healthcare costs. Public health experts agree that poor nutrition, lack of physical activity, school, community, home environments, income level, and education are factors in the development of chronic diseases.

**Methods**

In partnership with communities and allied organizations, UC ANR produces new knowledge, tools, programs, and policy-relevant research that contribute to healthy communities.

The CalFresh Healthy Living, University of California (CFHL, UC) State Office at UC Davis provides statewide oversight, leadership, and guidance for the CalFresh Healthy Living Program. University of California Cooperative Extension (UCCE) academics and CFHL, UCCE supervisors offer local leadership and guidance in program implementation and evaluation. UCCE academics provided oversight, leadership, and guidance in educational programs and policy, systems, and environmental (PSE) interventions delivered statewide through CFHL, UC. Programs such as Edible Gardens were conducted to increase healthy choices, food-based gardening, and quality physical activity in early childhood centers, schools, and community environments. (CFHL, UC)

A Nutrition Policy Institute (NPI) academic provides leadership through the coordination of the National Drinking Water Alliance (NDWA) that conducts research and advocacy to improve access to safe and appealing drinking water and reduce consumption of sugar-sweetened beverages. The academic shared data-driven information and best practices on drinking water with stakeholders, government agencies, and elected officials at the local, state, and national level. (Christina Hecht)

NPI academics provided evidence-based research, recommendations and testimony to state elected officials and state departments in support of effective nutrition and physical activity policies and guidance. (Christina Hecht, Janice Kao, Amanda Linares, Suzanne Rauzon, Carolyn Rider, Miranda Westfall; collaborators mentioned: Hannah Thompson)

A UCCE Advisor in Marin County led Food Policy Council meetings with local government officials, including the Marin County Board of Supervisors, and over 40 food system leaders to co-create food policies and improve local food systems for the county. (Julia Van Soelen Kim)

Over the course of many years, an NPI Academic led the development of the UC Healthy Vending Guidelines and implementation toolkit, as part of the UC Global Food Initiative, and worked with UC campus partners to promote and adopt the guidelines. (Janice Kao)

An NPI academic provided public health nutrition expertise, sitting on the City of Berkeley Sugar-Sweetened Beverage Tax Product Panel of Experts. The commission makes recommendations on how and to what extent the City should establish and/or fund programs to reduce the consumption of sugar-sweetened beverages in Berkeley and to address the effects of such consumption. (Janice Kao)

As a result of UC ANR research and extension, participants learned about and adopted strategies to improve community health and wellness. Outcomes with specific indicators follow.

**Outcomes**

**Partners adopted community-level changes that contribute to improved community health and wellness.**

* CFHL, UC reported statewide Policy, Systems, and Environment (PSE) changes at 377 SNAP-Ed sites, contributing to improved community health and wellness for more than 137,900 people. For example, 163 program sites in 22 counties made at least one physical activity-related PSE change; more than half of these sites improved the quality and/or number of opportunities for structured physical activity. (CFHL, UC) Local highlight follows:
  + CFHL, UCCE in Santa Clara, San Mateo, and San Francisco counties supported 99 PSE changes at 57 sites, including increasing access to opportunities to engage in structured physical activity, improving quality of structured physical activity, revitalizing school and childcare gardens, supporting improvements to the school meal program, and promoting fruits and vegetables through cafeteria tastings coordinated with food services teams. (Laura Vollmer)
* CFHL, UC sites statewide adopted or enhanced edible gardening and food access strategies, including new or expanded edible gardens at 134 sites, providing opportunities for the community to work in an edible garden at 95 sites, initiating or expanding use of garden produce for meals and snacks at 58 sites, initiating or expanding a mechanism for distributing seedlings and/or other materials to families or communities for home gardening at 24 sites, initiating or expanding farm-to-table use of fresh or local produce at 8 sites, and developing new or improved policies related to edible gardens at 4 sites. (CFHL, UC) Local highlight follows:
  + CFHL, UCCE in Fresno, Madera, Tulare, and King counties supported the adoption or maintenance of 136 PSE changes across 48 partner sites and organizations, with school cafeteria improvement efforts and edible garden-related PSEs as the most common PSE efforts implemented. (Irene Padasas)

**Science-based information was applied to community health and wellness policy and decision-making at local, state, and national levels.**

* NPI undertook policy engagement activities related to improving drinking water safety, access, education, and promotion in the US through sharing data-driven information and best practices and informing policy at federal and state-level agencies. These policy engagement activities included making recommendations to the White House Conference on Hunger, Nutrition, and Health, which contributed to the US Food and Drug Administration’s decision to commit to reducing added sugars in the American diet. (Christina Hecht)
* California elected officials utilized NPI academics’ expertise to support the passage of SB 348, a bill that includes a limit on added sugars in school meals and instructs the California Department of Education to investigate and define an adequate time for students to eat school meals. (Christina Hecht)
* The California Department of Public Health decided to implement recommendations from NPI’s breastfeeding assessment report, including strategies for better access to lactation support, improved lactation workplace accommodations, improved breastfeeding education, and increased diversity of lactation consultants to reduce disparities and barriers to breastfeeding in California. (Suzanne Rauzon)
* As a result of the Marin Food Policy Council’s efforts, the county has improved local and regional food system policies, systems, and environments that support increased access to healthy food, expanded food justice, and sustainable agriculture. For example, the Council created a Policy Platform on Older Adult Nutrition and a State Policy Strategy on Older Adult Nutrition to meet the needs of older adults in Marin County. (Julia Van Soelen Kim)
* UC adopted a new section into the UC Sustainable Practices Policy, under the Health and Wellbeing Policy Area. The new section incorporates provisions that set targets for percentage of beverage and food in vending machines that meet the UC Healthy Vending Guidelines, and also cover the marketing of healthy vending items. It sets a goal for UC suppliers that operate or maintain vending machines on UC locations to ensure 50% of the beverages and 35% of snacks meet the UC Healthy Vending Guidelines. The percentages increase to 60% and 40%, respectively, in 2027. (Janice Kao)
* The City of Berkeley Sugar-Sweetened Beverage Tax Product Panel of Experts recommended funding of eight proposals, all of which were unanimously approved by the Berkeley City Council. The goals of the proposals are to improve access to water; increase knowledge and awareness of the health risks of consuming sugary drinks; change preferences for water or other non-sugary drinks; decrease consumption of sugary drinks; and implement policy, systems and environmental changes to reduce sugar-sweetened beverage consumption. (Janice Kao)
* NPI Academics contributed to research that supported the passage of SB 291, a law that will improve opportunities for students to engage in physical activity, play, and peer social interactions. K-8 public schools in California will increase their time spent in both structured physical activity and free play. Additionally, students will no longer be restricted from recess for academic or behavioral reasons, a practice that disproportionately affects low-income and under-resourced students. (Janice Kao, Amanda Linares, Carolyn Rider, Miranda Westfall)
* A UCCE Academic contributed to improved programmatic guidance for state and local agencies implementing CalFresh Healthy Living programs. The academic provided research expertise to a statewide curriculum workgroup and ensured that nutrition and physical activity curricula offered by the program were evidence-based and implemented with fidelity. Additionally, the academic led a statewide curriculum needs assessment that led to implementation of new training and resources to fill identified gaps. (Carolyn Rider)

The measured outcomes reported above demonstrate learning, action, and policy changes that can improve community health and wellness. 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

Endemic and Invasive Pests and Diseases

**Issue**

Pests, such as bed bugs, cockroaches, human lice, and fleas, pose significant challenges to community health. Many of these species have developed insecticide resistance and can spread diseases and unsanitary situations. Integrated Pest Management (IPM) programs for pests impacting community health have the potential to increase pest control efficacy, decrease number of insecticide applications, decrease potential for insecticide exposure, and thus increase community well-being, as well as increase economic viability for the pest control industry and its stakeholders. Urban pests impacting community health are of particular concern to schools, child care centers, landlords, tenants, businesses, and property managers. It is critical that housing professionals, school districts, child care centers, and pest control professionals understand the legal roles and responsibilities associated with providing pest management in residential and care settings.

**Methods**

In partnership with communities, UC ANR produces new knowledge, tools, programs, and policy-relevant research that contribute to healthy communities by preventing and managing urban pests, especially those that impact the physical and mental wellbeing of humans.

A UC Cooperative Extension (UCCE) and Agricultural Experiment Station collaboration evaluated the relative efficacy and cost of IPM strategies and tactics and develop new management tools and techniques, increasing adoption of and demand for IPM services for bed bugs, cockroaches, fleas, rodents, ants, and other urban pests. Research findings have included significant decreases in pest infestations, which may bring immediate relief to those who live, work, and study at demonstration sites. For example, bed bug demonstration sites typically include 50 to 100 residential units, each housing one to four residents, many of whom have experienced barriers to accessing safe and healthy housing due to age, ability, income, or other factors. Research has demonstrated effective new monitoring and management strategies for use in multi-unit housing environments and schools and child care environments. Science-based recommendations are shared with pest management professionals within California's structural pest control industry to address pests that cause physical and emotional harm to humans, threaten homes and other structures, and pose nuisances. Various methods have been used, including peer-reviewed publications, newsletter and trade magazine articles, presentations, hands-on workshops, web sites, social media interactions, and individual consultations. (Reported by Andrew Sutherland; collaborators mentioned: Siavash Taravati, Dong-Hwan Choe, Vernard Lewis)

A UCCE Specialist at UC Riverside (UCR) maintained a leading role in organizing the UCR Urban Pest Management Conference. This long-standing annual meeting, 2011 to present, is well attended by pest management professionals throughout California and the Southwest United States, providing an ideal setting to communicate updates on scientific research and regulations to those who can immediately utilize the information. In 2023 there were 114 attendees from the pest management industry, research laboratories, state regulatory agencies, and chemical manufacturing. (Dong-Hwan Choe)

A UCCE Advisor and other UC IPM affiliates offer monthly free webinars aimed at the general public covering basic IPM topics, including urban IPM and control of pests that impact community health. Live attendance for each urban pest webinar has ranged from 50 to 620. All webinars are recorded, edited, and posted on YouTube with closed captioning for ADA accessibility. The webinars, both live and recorded, have received 43,635 views since 2021 and will continue to provide education to California’s increasing urban population. (Karey Windbiel-Rojas)

As a result of UC ANR research and extension, participants learned about and adopted pest management strategies to improve community health and wellness. Outcomes with specific indicators follow.

**Outcomes**

**Participants learned integrated pest management strategies to maintain public health.**

* Among program participants, 75% reported increases in knowledge regarding bed bug biology and ecology, preventive tactics, monitoring tools and detection techniques, legal roles and responsibilities, and evaluation tactics. (Andrew Sutherland)
* A UCCE Advisor reported that 96% of participants in online and in-person programming on IPM for schools and child care environments increased their knowledge about the Healthy Schools Act, the legal roles and responsibilities associated with providing IPM services to schools and child care centers, specific IPM strategies and tactics, and specific evaluation tactics. (Andrew Sutherland)
* A UCCE Advisor reported that 75% of participants, including housing management professionals, residents, municipal housing providers, and pest management professionals, increased their knowledge about legal roles and responsibilities associated with pest management in rental housing environments, specific pest biology and ecology, pest preventive tactics, monitoring and detection techniques, and specific IPM strategies and tactics. (Andrew Sutherland)
* A UCCE Advisor reported that 72% of participants in online and in-person courses and presentations on IPM strategies and tactics in urban and residential environments increased their knowledge about pest biology and ecology, pest preventive tactics, monitoring and detection techniques, and specific IPM strategies and tactics. (Andrew Sutherland)
* The post-event survey findings, after the 2023 UCR Urban Pest Management Conference, indicated 86 participants intend to apply at least one thing they learned about urban pest management. (Dong-Hwan Choe)
* Evaluations of UC IPM’s live webinars covering urban pests show that on average, 54% of attendees said they would implement practices they learned immediately, and 35% said they would within 6 months. When asked whether they would share the information they learned with others, 88% said ‘yes’. (Karey Windbiel-Rojas)

**Participants adopted integrated pest management strategies to maintain public health.**

* Observations suggest that urban IPM program participants and clientele, both those who have received technical assistance and those who participated in online and in-person courses, have changed their behavior by increasing preventive and nonchemical control tactics and by decreasing unnecessary pesticide applications after receiving UCCE technical assistance. (Andrew Sutherland)
  + Three housing providers increased preventive and nonchemical control tactics and decreased unnecessary pesticide applications. (Andrew Sutherland)
  + Changes in clientele behavior have also been observed, including increases in bed bug monitoring services offered, increases in preventive and nonchemical control services offered, and decreases in substandard bed bug contracting. (Andrew Sutherland)
  + Changes in clientele behavior have also been observed, including increased offering of cockroach monitoring services and baiting services provided, and a decrease in spray programs for cockroaches. At least two medium-sized regional pest control operators, each serving multiple states and employing hundreds of technicians, had incorporated UCCE recommendations into their protocols. Several testimonials and media products indicate accelerating behavior change within California's pest control industry with regards to cockroach baiting, especially for peridomestic species. (Andrew Sutherland)

**Change in condition: Reduced pest incidence.**

* All 15 single-family homes serviced by five pest control operator companies that had adopted new monitoring and management strategies for subterranean termites experienced significant reduction in termite incidence. (Andrew Sutherland)
* Significant decreases in bed bug incidence (100% reduction in individual cases, up to 88% reduction property-wide) and infestation severity (up to 99% reduction in individual cases) was reported at demonstration sites, directly improving living conditions for residents in over 130 units. (Andrew Sutherland)
* Significant reductions in cockroach density was reported:up to 99% reductions at two public school districts and three housing sites. (Andrew Sutherland)

The measured outcomes reported above demonstrate learning, action, and policy changes that can improve community health and wellness by reducing exposures to urban pests while also limiting exposure to pesticides. 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 environment

**Issue**

There are documented health benefits of spending time in nature. Yet, a 2019 landscape and urban planning study found inequities in access to urban vegetation in communities that are more ethnically, racially diverse, and have lower income levels. 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 many negative health consequences.

**Methods**

UCCE academics provided leadership and science-based information for the statewide implementation of the UC Master Gardener Program. Volunteers delivered public education workshops on sustainable landscaping and edible gardening. (UC Master Gardener Program)

As a result of UCCE research and extension efforts, participants learned and applied sustainable landscape and edible gardening practices, which increased access to positive built and natural environments. See condition change outcome below.

**Outcomes**

**Change in condition: Improved positive built and natural environments.**

* Eighty participants of UC Master Gardener volunteer-led educational programs reported in a statewide survey that they applied practices to 294,233 square feet of school and community gardens. Gardening interventions have the potential benefit to the broader community. A 2016 nationwide study found that living near greenery may help you live longer due to less air pollution, more physical activity, more social engagement, and most significantly better mental health as measured by a lower prevalence of depression. (UC Master Gardener)

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. According to the Center for Disease Control and Prevention, you can burn up to 300 calories during just one hour of light gardening and yard work. In addition, research with students has demonstrated that just 30 minutes spent in nature after completing a stressful task improves their mood. The students who were studied exhibited lower levels of cortisol, the stress hormone. Collectively these efforts contribute to the public value of promoting healthy people and communities.

# 

# **PROTECTING CALIFORNIA’S NATURAL RESOURCES**

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

**Issue**

Public and private land in California is managed for a wide variety of uses. Challenges include loss of productive working landscapes, tree loss, human and wildlife conflicts, protecting water quality, living in fire-prone areas, and a better understanding of ecosystem services. Research and extension are needed to help residents and land managers balance the social, economic, and ecological benefits of land management.

**Methods**

UC ANR activities focus on management strategies concerning livestock, wildlife, and land maintenance.

A UC Cooperative Extension (UCCE) Specialist’s lab at the UC Berkeley location continued to lead community-based projects related to Sudden Oak Death (SOD), including SOD Blitzs. Over 400 residents per year volunteer to help with detecting the disease and producing detailed local maps of disease distribution, identifying areas for proactive management. In 2023, SOD Blitz volunteers conducted 28 blitzes in 28 communities from the Oregon border to Santa Barbara County, surveyed more than 10,000 trees, and sampled approximately 2,000 to be tested at UC Berkeley. The map can be used to identify areas where the infestation may be mild enough to justify proactive management. A questionnaire was sent to users of the databases and maps to understand the impact of SOD BLITZ, including property owners, professionals, and property managers. (Matteo Garbelotto)

The specialist’s lab also ramped up the diagnostic services on novel and unprecedented large-scale mortality for large landowners, including the San Francisco Public Utility Commission, East Bay Regional Parks, California State Parks, National Parks, Golden Gate Park, MidPen Open Space, and for UCCE advisors working on these large-scale issues in various counties in Northern California. This large effort has resulted in the diagnosis of new diseases affecting up to 90% of certain tree species over hundreds of thousands of acres. In the last two years, the lab identified 13 first reports of new diseases in California. (Matteo Garbelotto)

Salinization problems occur on a high proportion of agricultural land in the San Joaquin Valley. A UCCE Nut Crops Advisor continued work on salinity issues. She delivered nine talks on diagnosing and treating soil and water salinity water problems, including at the Advances in Pistachio Water Management Workshop that drew over 150 attendees. Another co-organized, hands-on workshop, with over 100 attendees, assisted growers with understanding how to calculate irrigation schedules, and to use soil and water reports to choose appropriate amendments and calculate application rates for pistachios under saline conditions. (Mae Culumber)

UCCE Advisors continued long-term research and extension efforts on blue oak, which are keystone species in many oak woodlands. Projects aim to develop a monitoring program that a) is widely accessible, considering cost, time, and technical expertise; and b) correlates oak conditions to management actions under varying climatic and site conditions. One collaborative ecological monitoring program occurred on two plots in Fresno County and culminated in a Blue Oak Field Day. (Reported by Rebecca Ozeran; collaborators mentioned: Julie Finzel, Devii Rao)

A UCCE Advisor in the San Francisco Bay Area conducted research and extension to ranchers on carnivore ecology and available nonlethal tools to protect livestock. The advisor co-organized a workshop on livestock guardian dogs for livestock owners. (Carolyn Whitesell)

A UCCE Sustainable Agriculture Coordinator, Student Assistant, and Watershed Management Advisor and County Director in Marin County delivered a professional development series to 21 county department staff to improve their understanding of and interactions with the agricultural community. The UCCE Team facilitated policy engagement discussions and field trips about agricultural diversification with the series participants. (David Lewis)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices that improved land management. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants intend to adopt land management changes.**

* After the 2023 Blue Oak Field Day, participants indicated that they intend to begin monitoring oaks that they care about. Many participants shared that they are excited to try using game cameras to collect information about their oaks after learning how simple they can be to set up. Furthermore, a participant invited one of the UCCE Advisors to share an overview of management protocols with tribal leaders in Placer County. The advisor has been told that they are adapting some of UCCE’s ideas into monitoring that will incorporate cultural burning as an oak management practice. (Rebecca Ozeran)
* After UCCE’s livestock guardian dog workshop, all six of the attendees who filled out the post-workshop survey said they had learned something new and five said they would be implementing something new in their operation as a result of what they learned. (Carolyn Whitesell)
* Salinity workshop attendees (n=100) responded to a post-meeting survey and reported the likelihood of adopting these practices in the future as 4.5 on a scale of 5. The positive feedback suggests that UCCE outreach education hands-on workshops are promoting the improved management and use of land condition change. (Mae Culumber)

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

* Northern California agencies’ tree management actions were informed by research as a result of utilizing UCCE’s tree disease diagnostic services for large-scale mortality. Most commonly, the agencies received findings that led to the elimination of exotic trees in sites where they are no longer appropriate. This returns the land to more natural ecosystems but with an eye to solutions that may survive the ongoing climate change. (Matteo Garbelotto)
* Marin County staff developed 28 process and policy recommendations to improve support of agricultural diversification projects after completing UCCE’s professional development series. They also developed a precedent-setting Agriculture Chapter in the Marin Climate Action Plan 2030, which has become a model for other California county plans. (David Lewis)

**Change in condition: Trees saved. NEW**

* Sixty-four land managers received treatment options and technical assistance in 2023 from SOD Blitz volunteers. The volunteers reported that they were able to protect 6,678 trees over 715 acres with an average success rate of 88% and at an average cost of $56 per tree. The combined value of oaks protected in 2022 and 2023 is estimated at over $12 million. (Matteo Garbelotto)

The measured outcomes reported above demonstrate how UC ANR has contributed to improvements in land management policies and practices that can maximize the benefits that managed lands provide. In this way, UC ANR contributes to the public value of protecting California’s natural resources.

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

**Issue**

More than 90% of Californians breathe unhealthy air sometime during the year. Air pollution causes premature deaths per year, as well as asthma attacks, emergency room visits, and lost school and work days each year. Since 2003, California Department of Pesticide Regulation (CDPR) has documented hundreds of acute illnesses caused by accidental fumigant exposure to agricultural workers and people living near fumigated fields.(Joji Muramoto) According to the CDPR, sources of air pollution include vehicle exhaust and pesticides. California has been at the forefront of developing ways to mitigate air pollutant concentrations and the impacts of existing air pollution. The California Department of Food and Agriculture and CDPR’s Pest Management roadmap aims to eliminate high-risk pesticides by 2050. This roadmap was published in 2023 and is anticipated to include fumigants, which are toxic air contaminants.

**Methods**

UC ANR partners with public, governmental, and private groups to extend new knowledge and develop agricultural management and composting practices to improve air quality.

One University of California Cooperative Extension (UCCE) Specialist and his colleagues at the UC Santa Cruz continued to conduct on-farm research trials on organic strawberries and develop pest management alternatives to fumigants, which are toxic air contaminants. This included an economic analysis that examined soil health management practices, particularly the practice of anaerobic soil disinfestation as one alternative to fumigants. Three on-farm strawberry trials in central coastal California demonstrated that cover crops could be used as a partial carbon source, thus reducing the costs of this practice and offering more options in doing anaerobic soil disinfestation for growers. Findings were shared with industry clientele via blogs, presentations, and journal articles. (Joji Muramoto)

A UCCE Digital Agriculture Specialist at UC Davis and collaborators developed and validated the effectiveness of an innovative spray backstop system. The system was designed to address the issue of pesticide drift, an air quality issue. A series of tests were conducted in young almond orchards. The sprayer was operated at a 3.2 km/h speed to simulate real-world conditions. One of the most noteworthy aspects of this innovation is that it managed to reduce drift without compromising the effectiveness of the pesticide application. (Ali Pourreza)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices that improved air quality. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants adopt recommended management practices.**

* Organic strawberry growers in the state began implementing anaerobic soil disinfestation (ASD) at a commercial scale after UC Santa Cruz and UCCE’s research demonstrated that this practice could provide a comparable yield without fumigants. In 2023, 5,287 acres of organic strawberries were grown in California, representing 13% of total strawberry acreage in the state. Almost all increased acreages in organic strawberries since 2014 were due to increased acreage of organic strawberries with ASD. Relatedly, organic strawberries with ASD acreage increased by 702 acres. This means ASD contributed to 213,000 pounds reduction of total fumigant as active ingredients, mitigating the health risks from toxic air contaminants. (Joji Muramoto)
* Young almond orchard growers who participated in UCCE’s study experienced the benefits of the spray backstop system: The system successfully reduced the drift potential by 78% without compromising the pesticide effectiveness for optimal growth and yield. Reduced drift means fewer chemicals in the air, contributing to improved air quality. This outcome has wide-ranging implications for human health and climate change. (Ali Pourreza)

The measured outcomes reported above demonstrate improved knowledge and adoption of non-fumigant pest control practices that reduce air contaminants.Many more non-fumigant tools to control pests and diseases are needed, especially to reach CDFA and CDPR’s sustainability goals by 2050. According to CDPR, the average pounds of total fumigant active ingredients used on strawberries per year between 2019 and 2022 is 9,368,685 lbs/year. (Joji Muramoto) In these ways, UC ANR contributes to improved air quality and the public value of promoting healthy communities.

## 

## Condition Change: UC ANR contributed to the protection and conservation of soil quality

**Issue**

Soil health is essential for productive agricultural lands. Critical issues that require solutions in California include addressing salinity and nutrients in the soil. Healthy soils can lead to reduced greenhouse gas (GHG) emissions, improvements in crop yields, drought and flood tolerance, and better air and water quality. Soil health can be improved through farm management that increases soil organic matter. Proper understanding and care of soil are essential for a healthy and abundant food supply for Californians.

**Methods**

UC ANR develops research projects and extends information throughout the state to better understand management strategies, including cover cropping, to build soil health.

A UC Cooperative Extension (UCCE) collaboration with Agricultural Experiment Station (AES) faculty at UC Davis has worked to evaluate and demonstrate several soil-building techniques, including reduced tillage, cover cropping, and organic matter amendments. Outputs have included field days and extension materials. (Reported by Brenna Agerter; collaborators mentioned: Jeff Mitchell, Amelie Gaudin)

UC Sustainable Agriculture Research and Education Program (UC SAREP) delivered the workshop, "Building on Farmer Experience to Increase Cover Crops Adoption," to 305 farmers/ranchers, 36 extension professionals, 43 agricultural non-profit staff, 26 agricultural service providers, 27 researchers, and 15 public agency staff through events and broad communications of outputs. Specifically, three in-person cover crop tours covering six experienced cover crop growers' operations reached a total of 68 attendees, including 25 who identified as farmers or ranchers. (Sonja Brodt)

A UCCE Small Farms Advisor on the Central Coast facilitated farmers from socially disadvantaged communities in applying for grants. For the County of Santa Clara Agricultural Resilience Incentive (ARI) Program Grant Opportunity, two workshops in English and Mandarin were held with 55 growers attending. UCCE provided one-on-one technical assistance to 63 farmers from socially disadvantaged communities. Forty-one farmers (30 small-scale socially disadvantaged farmers) in Santa Clara County were able to submit ARI grant applications, requesting funds totaling $632,343. In addition, she held a seminar on the use of biofumigant crops for managing soilborne diseases, soil health, and nutrients in vegetable production that had 75 organic small farmers attendees. (Aparna Gazula)

A UCCE Vegetable Crops Advisor in Imperial and Riverside counties conducted collaborative research and extension on cover crops to identify and promote soil conservation practices. Applied research projects were conducted with small growers in the region, which is known to have sandy loam soils with poor water-holding capacity. Furthermore, growers in the region tend to fallow vegetable fields in the summer, which exposes the soil to high temperatures, depletes soil’s organic matter, and reduces its ability to perform ecosystem functions like decomposition and mineralization. UCCE’s projects addressed this challenge by evaluating cover crops like Sudan grass and brown mustard that are known to improve soil health. (Philip Waisen)

The UCCE Specialty Crops and Horticulture Advisor on the North Coast is building relationships with producers in this region, both established and beginning, and connecting them with current research and best practices that would support their efficiency, profitability, and ecological sustainability. He provided one-on-one consultations about cover cropping and soil analysis in addition to a field day workshop on organic nitrogen management with 38 participants. (Eddie Tanner)

A collaborative project between the UC ANR Intermountain Research & Extension Center’s Director and a UCCE Specialist in Nutrient Management at UC Davis investigated amendments and cover crops to improve soil health and fertilization in organic potato production. The studies were designed to learn more about organic fertilizers and soil mineralization and help growers better understand the benefits and pitfalls of using amendments and cover crops for fertilization and soil health. The organic fertilizer studies involved multiple small plot studies and a 10-acre demonstration study with multiple collaborators to showcase the effects of the most promising amendment and cover crop treatments in a multi-year crop rotation. (Rob Wilson)

The UCCE Delta Crops Advisor continued to evaluate the impacts on soil quality from deficit-irrigated alfalfa. Research findings have relevance for drought management strategies because the deficit treatments serve as a proxy for drought and demonstrate how water use prioritization in a changing climate may impact soil quality. Furthermore, she is well-connected with state agencies that oversee and support projects in the Delta. Through involvement with the Delta Drought Response Pilot Program, she advocated that soil health practices accompany water conservation practices. (Michelle Leinfelder-Miles)

As a result of UC ANR research, outreach, and education, growers learned and adopted practices to improve soil quality and conservation practices. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants learned about or intended to adopt recommended soil management practices.**

* Participants who responded to UC SAREP’s workshop surveys indicated the following outcomes:
  + 14 will begin growing cover crops to build soil health next year, on approximately 1,290 acres.
  + 3 reported they would probably begin integrating livestock grazing into cropping systems the next year, on approximately 209 acres.
  + 14 extension and technical service providers said they would utilize aspects of the tours in their own educational programming with clientele in the next year.
  + 40 attendees said their level of knowledge about growing cover crops in orchards and vineyards increased as a result of the tours.
  + 14 indicated that their knowledge of grazing cover crops in orchards and vineyards increased. (Sonja Brodt)
* As a result of the Use of Biofumigant Crops for Managing Soilborne Diseases, Soil Health, Nutrients in Vegetable Production seminar, 28 small farmers increased their knowledge of cover crops, soil amendments, and their impacts on soil health. Twenty-three farmers indicated that they would adopt one or more practices discussed during the workshop. (Aparna Gazula, Lucy Diekmann, Margaret Lloyd, Hung Doan)
* Of the 12 participants who completed the evaluation survey after the organic nitrogen management workshop, 92% reported that their knowledge of the topic greatly or somewhat improved. (Eddie Tanner)

**Participants adopted recommended soil health management practices.**

* As a result of UCCE’s technical assistance, 12 Santa Clara County ARI grant recipient farmers successfully implemented healthy soil practices on their farm that resulted in sequestering 1,994 metric tons of estimated CO2 Equivalents sequestered each year. This is the equivalent of removing 434 cars from the road each year. (Aparna Gazula)
* Two California tomato processors are now providing small incentives for their growers to implement soil health practices, where they have not in the past. With these incentives, greater adoption of these practices has been observed. In addition, even growers who are not receiving the incentives have increased their rate of adoption. Two growers, one tomato and one potato, who are new to cover cropping have been helped by UCCE to address technical challenges and evaluate whether their own goals were achieved. (Brenna Agerter)
* Small growers adopted cover cropping on 65 acres in the southern desert valley to substitute previous practices of fallowing during the summer. Specifically:
  + Brown mustard cover crop was planted on 50 acres by a big pepper grower and by a small okra grower on 6 acres.
  + A small okra grower planted 9 acres of Sudan grass cover crop for nematode, soil health, and nutrient management.
  + These growers are expected to cut back on water, fertilizer, and pesticide inputs due to previous local research demonstrating Sudan grass builds organic matter in low desert conditions. Increased organic matter would stabilize pH, and moisture, and support microbial activity. Sudan grass and brown mustard are expected to provide biofumigation benefits for root-knot nematode management. (Philip Waisen)
* As a result of the North Coast Specialty Crops and Horticulture Advisor’s individual clientele advising, two growers reported the adoption of a novel cover cropping strategy leading to a 15% and 30% increase in their cover cropped acreage. Additionally, four growers conducted soil analysis for the first time. (Eddie Tanner)
* The UCCE organic potato production studies helped growers more accurately estimate amendment application rates, reducing input costs and preventing nitrate losses in the environment. By the end of the project, over 80% of Tulelake potato producers were regularly monitoring plant available nutrients in soil and adopting specific organic fertilizer recommendations. (Rob Wilson)

**Science-based information was applied to soil and water management decision-making.**

* The Delta Drought Response Pilot Program was informed by UCCE’s alfalfa deficit irrigation project. The result was requiring the funded deficit irrigation practices to be partnered with soil health practices like cover cropping or reduced tillage. These practices occurred on over 24,000 acres during 2022-23. (Michelle Leinfelder-Miles)

The measured outcomes reported above demonstrate that growers learned and intend to adopt healthy soil practices. UC ANR has contributed to improvements in decision-making and potential technologies that will have the potential to improve soil health. For example, [2019 research by the California Natural Resources Agency](https://www.energy.ca.gov/sites/default/files/2019-11/Agriculture_CCCA4-CNRA-2018-002_ADA.pdf) confirmed that applying compost to rangeland can increase carbon storage by about 2.1 tons compared to untreated rangeland. UCCE’s recommendations to apply compost to working landscapes potentially increase carbon storage, which improves soil quality, structure and water-holding capacity, and nutrient cycling.Through these efforts, UC ANR contributes to the public value 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, forests, built and wooden structures, school and childcare, and urban environments. The spread of invasive pests has increased in recent decades, linked to global travel, produce trade, and climate change. In 2020, the California Department of Pesticide Regulation identified that California used over 215 million pounds of pesticides. Pesticides are often used to control weeds, insects, and other pests. However, when used incorrectly, they can cause environmental problems. Growers, land managers, forestry, residents, and pest control experts need pest management tools and strategies that minimize the impact on natural pest enemies and pollinators, the potential for water and soil quality problems, the impact on aquatic invertebrates, and endangered species.

**Methods**

UC ANR partners with public, governmental, and private groups to develop and extend new knowledge about integrated pest management (IPM) for growers, land managers, and pest control professionals.

*Agriculture*

A UCCE Entomology Specialist at UC Riverside focused research and extension efforts on the biological control of Asian citrus psyllid (ACP), a serious pest of citrus that spreads a citrus killing bacterium, *Candidatus* *Liberbacter asiaticus* (*C*Las), the causative agent of the lethal citrus disease, huanglongbing (HLB). ACP, native to the Indian subcontinent, established in California sometime around 2008. Natural enemies imported into California were sourced from Punjab Pakistan and approved for release by USDA-APHIS in 2011. *C*Las was detected in southern California citrus in 2012. Since 2010, more than 22 million parasitoids have been mass reared and released in California in cooperation with the CDFA. Establishment of parasitoids has been confirmed at 95% of release sites, parasitoids have spread up to eight miles from initial release sites without human assistance, and ACP densities have declined by more than 70% in California citrus. Consequently, there have been no devastating HLB outbreaks. Six ACP biological control workshops/meetings were conducted in 2022-2023 along with numerous talks at industry meetings. These events were very well attended and reached an estimated 453 end users, in person and online via zoom. (Mark Hoddle)

A UCCE Advisor in Southern California conducted research and extension on invasive pests. Over 800 participants attended 10 presentations and six meetings on topics such as Mexfly and African tulip trees. The UCCE Advisor provided treatment recommendations and determinations to San Diego County Ag Weights and Measures 29 times, including for five A-rated pests. (Eric Middleton)

A UCCE Advisor conducted applied research projects to address pest management issues of major nut crop pests such as navel orangeworm. Starting in 2016, the advisor conducted over ten mating disruption trials in walnuts and almonds. Through several collaborative studies with others, the work has proven that mating disruption can reduce crop damage by about 50%. The results have been extended through collaborations with California Department of Pesticide Regulation, Almond Board of California, California Walnut Board & Commission to increase the adoption of mating disruption. Multiple commodity boards, private pest control industries, and other local and state agencies funded these projects. Several UC, Almond Board of California, non-profits, Community Alliance with Family Farmers, and USDA researchers have collaborated on these projects. Over the last several years, the UC extension advisors in the team altogether disseminated the information to over 20,000 growers and pest control advisers, via over 50 different meetings (Reported by Jhalendra Rijal; collaborators mentioned: David Haviland, Sudan Gyawaly)

*Landscapes*

A UCCE Advisor at the Intermountain REC and a UCCE Specialist at UC Davis continued to research management of medusahead, invasive winter annual grasses impacting wildlands and rangelands in California, to improve habitat for sage grouse in Northeast California. Dry annual grasses threaten sage grouse habitat by increasing and replacing fire regimes in sagebrush ecosystems and crowding out desirable plants grouse use as forage. (Reported by Rob Wilson; collaborator mentioned: Joseph DiTomaso)

A Livestock and Natural Resources UCCE Advisor in Lassen County initiated a multi-stakeholder partnership in 2001, which continues to be an active and effective means of managing and enhancing the broad expanse of sagebrush rangelands in the county. Together, they conduct hands-on, collaborative, participatory, rangeland restoration projects in an adaptive management framework. UCCE created extension documents providing grazing management guidance after wildfire and practical control strategies for the weed western juniper to support on-the-ground management. (David Lile)

A UCCE Advisor conducted two studies related to controlling vegetation around structures and roadsides for safety and fire prevention purposes. The first investigated the potential effect of two unregistered herbicides compared to products currently on the market. A second study was implemented between July 2022 and April 2023 where three timing of application were investigated in larger replicated plots to control problematic kochia on the roadways in Modoc County. Preliminary results from the Modoc County trial were shared with the road department in a report, which contracts with the Modoc Agricultural Department, and during site visits to visualize the effects. Results were also presented at the Intermountain Research and Extension Center (REC) Field Day. Further testing is being undertaken to determine if the problematic kochai populations are herbicide resistant. (Thomas Getts)

*Forestry*

A UCCE Specialist at UC Berkeley delivered research-based information to stakeholders in real time is pivotal when dealing with emergent invasive diseases with dynamic host and geographic ranges. Heterobasidion Root Disease (HRD) is a major problem in coniferous forests in California and worldwide and contributes to high mortality, which, in turn, affects bark beetle outbreaks and wildfires. Stump treatment is a major solution, but the chemicals used are being phased out due to human health concerns. The biocontrol *Phlebiopsis gigantea* is a valid alternative but the commercial product, ROTSTOP, is based on Eastern US strains. In response to a request by the US Forest Service (USFS), the UCCE Specialist and collaborators investigated whether it would be safe to use the ROTSTOP in western forests. (Matteo Garbelotto)

In 2023, a UCCE Specialist’s lab at UC Berkeley completed ongoing studies on Sudden Oak Death and on soilborne Phytophthoras. The lab was among the first to show that soilborne Phytophthoras introduced in restoration areas are now spreading into adjacent ecosystems and killing native plant species outside the areas. The lab also completed research on how to produce clean plant stock. Outputs of the research included workshops, extension and research publications. (Matteo Garbelotto)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices that led to the increased ecological sustainability of agriculture, landscapes, and forestry. Research and activities that resulted in outcomes with specific measured indicators follow.

**Outcomes**

**Participants learned or intended to adopt pest management practices, including IPM strategies.**

* After attending presentations and meetings on invasive pests, Southern California participants learned new information and intend to adopt IPM strategies. Across all extension events, 145 participants responded to post-event surveys, with 100% that they learned something from the event, 99.3% that they would implement something from the event in the future. (Eric Middleton)
* Attendees of the ACP biological control workshops and meetings reported, through an online polling system, increased knowledge on presented materials by 49-55%. (Mark Hoddle)

**Participants adopted recommended pest management techniques.**

* A [recent study](https://doi.org/10.1093/jipm/pmad014) reported that mating disruption for navel orangeworm has been adopted by 16%, 25% and 58% of walnut, almond and pistachio growers, respectively. When UCCE research on mating description for navel orangeworms started in 2016, less than 5% of growers had adopted the technique. (Jhalendra Rijal)

**Science-based information was applied to integrated pest management policy and decision-making.**

* After seeing the results of UCCE’s trial, the Modoc Agricultural Department changed their application timing from the summer, to the fall for their roadside treatments in 2023. They also changed to a combination of herbicides that was providing much more effective control of the kochia, than the mix they had been using the previous three years. They will be implementing these changes on hundreds of miles of roadways in the country over the coming years due to the information generated in this trial. (Thomas Getts)
* The San Diego County Ag Weights and Measures adopted recommendations from UCCE. The impact of these recommendations has been to allow clientele to bring in imports without having to ship them back or destroy them, has reduced pesticide use when treatment is necessary, and has helped prevent invasive pests from spreading the state. (Eric Middleton)
* After receiving the study findings on the genetic variation of the ROTSTOP, the commercial biocontrol product used to manage HRD, the US Forest Service put a moratorium on the use of ROTSTOP on all Western National Forests. (Matteo Garbelotto)
* The results of research on managing medusahead informed regulatory weed management plans. The Clearlake National Wildlife Refuge incorporated research results in a 500+ acre medusahead management plan. The Weed Management in Natural Areas handbook sold over 2000 copies, and several state agencies adopted the handbook guidelines in their weed management programs. (Rob Wilson)
* National Parks, Mid Pen Open Space, and San Francisco Public Utilities Commission have adopted UCCE’s recommendations to prevent Sudden Oak Death and soilborne Phytophthoras through their habitat restoration, including putting prescriptions in place to achieve clean operations. (Matteo Garbelotto)

**Change in condition: Reduced pest incidence.**

* Since the inception of the UCCE promoted classical biological control program in 2010, and over 10 years from the initial *C*Las detection in Los Angeles County, ACP pest populations have declined, on average, by about 70% in California. Only about 6,000 citrus trees have succumbed to HLB, a miniscule fraction of the total number of trees present in southern California. After more than 15 years, ACP-*C*Las is still largely limited to urban areas and there have not been major outbreaks of ACP-*C*Las in commercial citrus production areas. Overall, the long-term viability of commercial citrus production is now far more likely given the highly reduced threat posed by ACP-*C*Las. Additionally, homeowners with backyard citrus have also benefited from the ACP biocontrol program as urban citrus will now continue to thrive and will not be killed by ACP-*C*Las. (Mark Hoddle)

**Change in condition: Rangeland restored.**

* Between 2021-2023, UCCE contributed to building clientele capacity in Lassen County, resulting in the following changes:
  + over 15,000 acres of the weed western juniper have been removed,
  + 4,000 acres of range seedings or beneficial shrub planting completed,
  + 7,000 acres of annual grass treated,
  + 5 spring developments completed,
  + over a miles of stream restoration,
  + a conservative estimate of increasing the pace of work by about 3-4 times. (David Lile)

The measured outcomes reported above improved the state’s ability to prevent, control, and mitigate pests and diseases. IPM programs contributed to decreased the use of certain pesticides and reduced the health and environmental risks associated. According to CDPR’s 2021 Pesticide Use Report, ten-year trends include a 17% reduction in carcinogens, 40% reduction in cholinesterase inhibitors (neurotoxins), 18% reduction in fumigants (biocides), 81% in potential groundwater contaminants, 58% reduction in reproductive toxins, and 22% reduction in toxic air contaminants. (Jim Farrar) In these ways, UC ANR contributes to the increased ecological sustainability of agriculture, forestry, and diverse landscapes and the public value of protecting California’s natural resources, helping California realize the many benefits of its rich and diverse natural resources.

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

Sustainable Natural Ecosystems

**Issue**

Nearly 33% of California’s land is covered by forest, which provides clean air and water, carbon sequestration, and habitat for plants and wildlife. There is a critical need for landowners and managers to understand how to implement a variety of forest management practices that allow for the restoration and conservation of these services. Identifying ecosystem restoration and management practices is needed for California’s plants, wildlife, and other natural resources to continue to thrive.

**Methods**

UC ANR partners with public, governmental, and private groups to develop and extend new knowledge to forest managers to help them increase the ecological sustainability of their forests.

UC Cooperative Extension (UCCE) Advisors and an Academic Coordinator continued to deliver the Forest Stewardship workshop across the state as part of the Forest Stewardship Education Initiative which began in 2020. The goal is to extend recommended actions to private landowners to help them increase their forests’ resilience to wildfire and climate change. 117 people completed one of five nine-week workshop series this year held in Napa, Trinity, Solano-Sacramento, Santa Clara-Santa Cruz, and San Bernardino Counties. (Kim Ingram and Susie Kocher)

UCCE modeled a new post-fire workshops series after the successful forest stewardship workshop series in 2022. The post-fire workshops are being held across the state where landowners were affected by wildfires between 2019 and 2021. The goal was to help landowners learn about practices important for forest restoration. Four seven-week-long workshop series were held last year enrolling 125 landowners affected by recent wildfires in Plumas, El Dorado, Alpine, Madera, Fresno, Napa, and Siskiyou Counties. (Katie Reidy and Susie Kocher)

A UCCE team supported comprehensive regulatory reform through a decade of research that culminated in the development of new permitting pathways for oak woodland restoration via changes in regulations before the California Board of Forestry and Fire Protection and policy through Assembly Bill 1958 and Senate Bill 901. This allowed landowners to use a California Environmental Quality Act permit process to carry out forest management in an effort to restore oak woodlands. UC ANR’s research provided the evidence for the policy and regulatory changes. (Yana Valachovic)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices for forest management. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants learned strategies for forest stewardship.**

* Forest Stewardship workshop participants who responded to a survey (n=41) indicated interest across the range of management activities that forest landowners can take, attitudes and perceptions increased positively for each: (pre-workshop to post-workshop, 'very or definitely' interested)
  + Prescribed fire: 42% to 66%
  + Fuels reduction: 65% to 98%
  + Tree thinning: 40% to 88%
  + Timber harvest: 15% to 41%
  + Forest inventory on property: 12% to 83%
  + Forest management plan: 29% to 92% (Kim Ingram, Susie Kocher)
* Post-fire workshop participants who responded to a survey (N=35) reported on their intention to use practices for reestablishing forests on their property. Intentions increased positively for each: (pre-workshop to post-workshop, 'likely or extremely likely' to engage in restoration activities)
  + Remove hazard trees: 63% to 83%
  + Remove dead trees and biomass: 63% to 83%
  + Use erosion control measures: 63% to 80%
  + Control post-fire invasive weeds: 60% to 83%
  + Control competing vegetation: 46% to 77%
  + Reforest after wildfire: 46% to 66%
* Manage resprouting trees: 29% to 34%. (Susie Kocher and Katie Reidy)

**Participants adopted recommended practices for forest management.**

* Since 2020, the number of Forest workshop participants who adopted UCCE’s recommended practice of completing a free initial site visit by a Registered Professional Forester increased to 79, which is up from 64 last year. These forest landowners manage over 8,631 acres of forestland in California. This practice leads to the development of a forest management plan and implementation of forest management activities, potentially improving overall forest health and resiliency, and reducing the negative effects of wildfire. Thirty-eight percent continue to have an ongoing, professional relationship with the resource professional. (Kim Ingram, Susie Kocher)
* UCCE conducted interviews with a subset of forest stewardship participants (N=40) who have had their initial site visits about their progress towards plan development, obtaining funding, and forest management. Post-workshop, 20% had an existing plan that was updated and 45% had developed a plan or are close to finalizing a plan. Top 5 management activities include thinning, burn piles, defensible space work, road work, and invasive species removal. Twenty-one applied for and received cost-share funding. (Kim Ingram, Susie Kocher)
* Oak restoration is becoming a mainstream practice, as demonstrated by landowners utilizing over 70 permits to restore oak woodlands across the state. This number has increased from seven permits reported in 2018, when UCCE’s research and policy engagement activities contributed to the passing of California Assembly Bill 1958 (Wood, 2016). (Yana Valachovic)

The measured outcomes reported above demonstrate how UC ANR supports the implementation of forest management and restoration practices and policy. Increased ecological sustainability of forests 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 increased ecological sustainability of agriculture, landscapes, and forestry

Sustainable Natural Ecosystems

## 

**Issue**

Rangelands are the largest land use in California at over 62.9 million acres and account for over 50% of the state. Range provides clean air, carbon sequestration, clean water, and habitat for plants and wildlife. It is imperative to support the $1 billion in ecosystem services that rangelands provide across the state. Issues of most concern include drought, climate change, catastrophic wildfires, and the threat of urban sprawl. (Scott Oneto) There is a critical need for landowners and managers to understand the impacts of a variety of different management practices, including the restoration and conservation of these services. Identifying ecosystem restoration methods and ecosystem management practices is needed for California’s plants, wildlife, and other natural resources to continue to thrive.

**Methods**

UC ANR leads collaborative research and extension efforts and supports the development of new policies to increase the ecological sustainability of rangelands.

A UCCE Specialist at the UC Berkeley location developed the California Rancher Sustainability Analysis tool in collaboration with UCCE Advisors. The tool provides ranchers with a self-assessment of their ranching practices and one-click access to science-based information on ranch management guidelines that protect valuable natural resources. (Reported by William Tietje; collaborated mentions: Royce Larsen, Rebecca Ozeran)

A UCCE Advisor continued research with collaborative ranchers and land managers on grazing summer mustard. The goal of this research is to influence national and state parks to consider grazing at sites where it has previously been excluded and improve management and ecological sustainability of landscapes. (Devii Rao)

A UCCE Advisor continued research and extension in the conservation of biological diversity and social sustainability in San Francisco Bay Area working rangelands, where nearly one-third of all federally-listed threatened and endangered species in California are found (97 species). Science-based knowledge of grazing and rangeland management was developed and extended via workshops and publications to rangeland managers and livestock producers to support species conservation, mitigate threats to biological conservation, restore livestock ponds, support compost application, and address concerns from livestock grazing including climate impacts. (Sheila Barry)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices that led to the increased ecological sustainability of rangeland. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants adopted recommended practices for range management.**

* Ranchers have utilized the California Rancher Sustainability Analysis Tool to have informed discussions about ranch management and resource sustainability with employees, as observed through conversations with the UCCE team. (William Tietje)
* Interviews with four ranchers reveal that ranchers have experimented with grazing summer mustard and in some cases have had success grazing at fairly high stocking densities when the plants are bolting. (Devii Rao)

**Change in condition: Rangeland restored.**

* Preliminary results of mustard grazing research at Pinnacles National Park are showing success: after two years of data collection, grazed plots consistently have lower cover of summer mustard than ungrazed plots. (Devii Rao)
* As a result of UCCE’s research on grazing and management for conservation of San Francisco Bay Area endangered species habitat, grazing management practices are supporting habitat for endangered butterflies, reptiles, amphibians, birds, and flowering plants across over 200,000 acres in San Mateo, Santa Clara, Alameda, and Contra Costa counties. (Sheila Barry)

The range management measured outcomes reported above demonstrate how UC ANR supports the implementation of rangeland restoration practices and policy and regulation. Increased ecological sustainability of range 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 increased ecological sustainability of agriculture, landscapes, and forestry

Sustainable Food Systems

**Issue**

California’s growing population of over 40 million people raises environmental concerns for the state’s urban landscapes and urban-rural interfaces, such as effects on pollinator populations, green waste, and water quality and quantity issues. There is an opportunity to improve landscape management industry practices. For example, changes in fertilizer and pesticide applications can reduce negative impacts on the environment, especially surface water contamination. There is also the opportunity to conserve water, given 50% of residential water consumption statewide is applied to landscapes.

**Methods**

UC ANR translates research into actionable landscape management strategies and extends science-based information about environmental horticulture.

The UC Master Gardener Program has volunteers in 50 counties serving 55 counties by research-based information on environmental horticulture to help the public grow home, community, and school gardens more sustainably. Over 5,876 Master Gardeners volunteered 478,176 hours. (UC Master Gardener Program)

In 2023 the Agriculture Order for Waste Discharge Requirements for the California Regional Water Quality Control Board, Los Angeles Region was set to expire. To educate growers on the Administrative Draft of General Waste Discharge Requirements for Discharges from Irrigated Agricultural Lands, the UCCE Environmental Horticulture Advisor organized a workshop in which 10 growers were in attendance. There were follow-up meetings and conversations with the Los Angeles Irrigated Lands Group and the Los Angeles Regional Water Board to help inform the plan update. (Christopher Shogren)

As a result of UC ANR research and extension, participants learned and adopted sustainable landscaping and gardening practices. Outcomes with specific indicators follow.

**Outcomes**

**Participants 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 enhanced pollinator-friendly gardens; for example, 70% (of 415 respondents) started or improved their use of plants that attract and support pollinators, and 49% (of 403 respondents) 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 781,592 square feet of pollinator habitat. This improves yields from home food gardens and supports local agriculture productivity.
* Used recommended green waste reduction practices; for example 58% (of 388 respondents) started or improved using finished compost as a soil amendment. This recycles organic matter and contributes to less green waste in landfills.
* Adopted improved landscape water use efficiency practices; for example, 66% (of 638 respondents) started or improved using mulch, and 62% (of 631 respondents) started or improved the practice of selecting low water-use plants. In addition, participants reported removing 142,047 square feet of turf. These practices reduce landscape water use.
* Adopted integrated pest management practices; for example, 75% (of 440 respondents) started or improved monitoring for pests or diseases, and 58% (of 438 respondents) started or improved the practice of removing or not introducing invasive plants. These practices slow the spread and protect natural and managed ecosystems. (UC Master Gardener Program)

**Science-based information was applied to ornamental and edible landscapes policy and decision-making.**

* The language in the Irrigation and Nutrient Management Plan and Report was revised to define realistic expectations and plans for the nursery industry, based on stakeholder conversations and feedback. This UCCE effort informed the update of the General Waste Discharge Requirements for Discharges from Irrigated Agricultural Lands at the Los Angeles Regional Waterboard Meeting in September 2023. (Christopher Shogren)

Together the measured outcomes reported above demonstrate that because of UC ANR’s efforts, some landscapes are now more ecologically sustainable – supporting pollinators, reducing and reusing green waste otherwise going to landfills, protecting water quality, and saving water. UCCE research estimates that implementing best management practices for irrigating landscapes could save between 1.3 million to 2.9 million acre-feet of water per year in California. (Janet Hartin) In this way, UC ANR contributes to the public value of protecting California’s natural resources.

## 

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

**Issue**

Poor water quality can result from a variety of point and nonpoint sources of pollution such as land development, land-use practices, or pollutants and sediment in runoff from stormwater in urban and agricultural sites. Inefficient irrigation systems can lead to large volumes of subsurface water drainage, increasing the leaching of nitrates into water. When nitrate in a public water supply reaches or exceeds 45 mg/l standards, costly measures are required to remove it. In California, multiple areas have elevated nitrate contamination levels in groundwater, including the San Joaquin Valley, Santa Ana Valley, and Salinas basins. Water quality regulations for irrigated lands in California require that growers monitor water use and nutrient discharges to limit the movement of fertilizers into groundwater and surface water. In addition to managing agricultural lands, protecting water quality from rangelands is also a significant concern as surface runoff and groundwater on rangelands provide essential municipal water sources for regional communities.

**Methods**

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.

A UC Cooperative Extension Specialist (UCCE) at the UC Davis location built on a long line of collaborative research with UCCE academics, Agriculture Experiment Station (AES) faculty, ranchers, and resource agencies to develop science-based recommendations for optimizing rangeland livestock production, watershed management, and biodiversity. The researchers led some of the most comprehensive rangeland water quality surveys, given that much of the state’s water resources pass through or are stored on rangelands, with approximately 50% of these lands managed by public agencies. (Leslie Roche)

A UCCE Advisor in the Eastern Sierra region continued to bring water quality expertise in regional water quality planning for the impaired Bishop Creek watershed. UCCE provided technical service and led a planning process that included partner agency and local rancher input. The result was a Vision Plan for the Lahontan Regional Water Board that proposed an alternative to the current regulatory framework. (Dustin Blakey)

A UCCE Research Specialist based at UC ANR’s South Coast Research and Extension Center increased collaboration with Orange County’s Stormwater Public Education sub-committee. This included working with UC Master Gardeners to extend educational materials and best management practices for the Orange County Watershed’s Overwatering is Out Campaign at the county fair. (Natalie Levy)

A UCCE Advisor continued research and extension efforts to protect water quality and address waste discharge requirements for agricultural drainage water within drains in the Imperial and Coachella Valleys, nutrient total maximum daily loads for the Salton Sea, and groundwater and surface water resources in San Diego County. The advisor conducted nutrient and irrigation practices research on desert carrot production with the goal of improving water quality in the region. Findings were shared through extension articles, educational materials, and policy engagement activities with local land coalitions. (Ali Montazar)

The advisor also conducted collaborative research on salinity and drainage in 300 acres of alfalfa fields, 350 acres of onion fields, 300 acres of date palms, and 100 acres of carrot fields in the Imperial, Palo Verde, and Coachella Valleys. Findings were presented to the agriculture industry as well as local irrigation and water advisory groups. (Ali Montazar)

UCCE continued efforts to adapt CropManage for the low desert crops to address Salton Sea water quality concerns. CropManage is an online irrigation and nutrient management decision support tool that fills a gap in providing accurate information to achieve full economic gains in a sustainable, water quality approach. UCCE conducted outreach activities and provided equipment to encourage local growers to use this tool. (Ali Montazar)

*Irrigated Lands Regulatory Program (ILRP)*

UCCE conducts several nitrogen-related research and extension projects to address new groundwater regulations, including the ILRP, which aims to protect groundwater quality and require farmers, ranchers, and land managers to report total nitrogen applications and other data to regional water quality coalitions. Clientele must report the volume of irrigation water applied, the nitrate concentration of the irrigation water applied, list the crop types and acres harvested, pounds of nitrogen applied from fertilizers to each crop type, and pounds of nitrogen content of compost or amendments applied to the soil or land. UCCE extended research findings via field tours and policy engagement with local agencies, including the Central Valley Regional Board and Sierra Valley Groundwater District. (Reported by Tracy Schohr; collaborators mentioned: Kenneth Tate, Tina Saitone)

In Santa Clara County, UCCE assisted small and medium-sized growers, processors, and marketers of vegetable and specialty crops, and public and private agencies by providing one-on-one technical assistance, developing educational materials in multiple languages, and delivering on-farm workshops and trainings. Compliance with current ILRP reporting requirements is extremely difficult for small-scale diversified farming systems with crops, such as Asian specialty vegetables, and may also have economic consequences. However, the farmers growing Asian leafy vegetables lack the information needed to complete this form accurately, as there are no nitrogen fertilizer recommendations or nitrogen uptake data for most of their crops. Also, complying with the proposed ILRP regulations is challenging for these growers due to language and cultural barriers. (Aparna Gazula)

A UCCE Advisor conducted research to develop knowledge of nutrient management in commercial tree crop orchards. This research provided critical data to meet ILRP guidelines on nitrogen export rates, seasonality of nitrogen demand, and differences between cultivars for more and newer crops. Findings included identification of best management practices, such as fertilizer application in an orchard should be based on expected yield estimated at flowering and fruit set followed by analysis of leaves to diagnose any deficiency. Findings were shared with the tree crop industry and California commodity boards. (Douglas Amaral)

As a result of UC ANR research and extension, participants learned and adopted practices that improve water quality. Outcomes with specific indicators follow.

**Outcomes**

**Participants learned about and intended to adopt recommended management practices for preserving water quality.**

* Eighteen Orange County residents signed a behavioral commitment to the Overwatering is Out campaign after receiving UCCE best management practices information.As these campaigns continue to be implemented more broadly across the county this effort can lead to improved water quality by increasing the adoption of practices that better prevent water pollution. (Natalie Levy)

**Participants adopted recommended management practices for preserving water quality.**

* Eight growers in the Imperial Valley modified their salt leaching practices following UCCE’s recommendations from the salinity and drainage research. (Ali Montazar)
* CropManage was used by three cooperating growers involved in a UCCE lettuce study on nearly 250 acres. Growers who adapted the CropManage in lettuce fields with sandy soils (140 acres) found a considerable reduction in water (an average of 0.9 ac-ft/ac) and nitrogen fertilizer (120 lbs. N/ac) compared with the standard practices. Adopting water and nutrient management practices is vital for addressing water quality concerns in the low desert region. (Ali Montazar)
* Forty socially disadvantaged Asian farmers utilized UCCE’s IRLP one-on-one technical assistance to complete their Total Nitrogen Applied reports. Additionally, medium-sized growers changed nitrogen management behaviors for what is reported to the ILRP, as observed during one-on-one consultations and interviews of 40 small farmers in the region. Improving nitrogen management will minimize over and under-fertilization. This reduces nitrogen leaching, thereby improving water quality and reducing excess costs. Additionally, the farmers avoided fines of up to $40,000 for non-compliance. (Aparna Gazula)

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

* Both state and federal actions on rangeland water quality planning including the National Forest Plan Revision and the statewide Grazing Regulatory Action Project were informed by UCCE’s rangeland livestock production and water quality research findings. Furthermore, the findings demonstrated that rangeland livestock production, provisioning of clean water, and biodiversity can be compatible goals. (Leslie Roche)
* As a result of UCCE’s technical assistance and planning efforts, the Lahontan Region Water Board staff adopted and began implementing the Vision Plan. The plan reduces the regulatory hurdles needed for local cattle producers, by implementing a voluntary plan to improve water quality. If successful, Bishop Creek water quality will improve and will be de-listed as impaired by the Environmental Protection Agency. (Dustin Blakey)
* The Imperial Valley Irrigated Land Coalition and Coachella Valley Irrigated Land Coalition adapted the nitrogen removal carrot crop coefficient developed by UCCE’s carrot study and transformed these data into the quotient N applied/N removed, which is reported along with the applied N to the Colorado River Basin Regional Water Board. (Ali Montazar)
* The Imperial Irrigation District utilized findings of UCCE’s salinity and drainage study to comply with their On-farm Efficiency Conservation Program. (Ali Montazar)
* California Commodity Boards, including pistachio, cherry, and citrus, utilized UCCE’s nutrient management research findings to inform standard practices for the tree crop industry (pistachio, cherry, citrus, etc.). Growers who apply these ILRP practices will be able to increase their nutrient use efficiency from around 50% up to 80%. This potentially saves on fertilizer costs, preserves the environment, and ensures high productivity. (Douglas Amaral)
* The Central Valley Regional Water Board utilized UCCE’s irrigated pasture practices groundwater quality research findings to propose an exemption of the Feather River Watershed from the ILRP. The exemption was finalized in 2023 and translates to $57,000 annual cost savings and a projected 1,000-hour reduction in paperwork for clientele currently regulated under the program, while protecting water quality. (Tracy Schohr)
* The Sierra Valley Groundwater District utilized UCCE research and expertise to inform their 500+ page Management Plan, which will guide district management and research for the next 5 years. Research findings directly influenced eliminating the proposal for unnecessary testing that would have cost landowners in the district thousands of dollars annually. (Tracy Schohr)

The improved practices reported above enable managers to reduce pollutants, leading to more environmentally sustainable farming and ranching. By reducing pollutants such as nitrates from fertilizers, pesticides, and animal waste that run off or leach from agricultural, rangelands, and landscapes into water supplies, UC ANR helps preserve water quality. Thus, UC ANR contributes to the public value of protecting California’s Natural Resources.

## 

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

**Issue**

More than nine million acres of farmland in California are irrigated, representing roughly 80% of all water used for businesses and homes. The state faces challenges to meet its water demands. As the state’s population expands and agricultural water uses are curtailed to meet new sustainable groundwater management guidelines, there can be 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 the urban sector in and around homes to meet increasing demands. For example, UCCE research (Janet Hartin) indicates that poor irrigation practices lead to a 50% or greater loss of applied water in large commercial settings. This loss is likely higher in residential landscapes irrigated by homeowners. Since Californians, on average, use [50-60 gallons of water a day for outdoor purposes](https://pacinst.org/wp-content/uploads/2020/06/PI_Water_Use_Trends_June_2020.pdf), an estimated 15-30 gallons of water per day could be conserved through improved irrigation practices by homeowners.

**Methods**

UC ANR conducts research projects throughout the state to identify more efficient water practices and extends them to growers, managers, decision-makers, and the public to transform how Californians use water.

A UC Cooperative Extension (UCCE) Advisor conducted applied research and extension activities in irrigation efficiency in San Diego County, where virtually no surface or groundwater water is available and improving irrigation efficiency is essential to maintain nursery and floriculture industry profitability and regulatory compliance. Educational presentations and YouTube videos in English and Spanish reached clientele, including growers, production managers, local agencies, and non-profit organization staff. (Gerry Spinelli)

A UCCE Advisor continued water use efficiency research with collaborative growers in the Imperial and Coachella Valleys. This included assessing the viability of subsurface drip irrigation versus the most common practices of furrow and sprinkler irrigation in 34 commercial desert vegetable crop fields as well as at UC ANR’s Desert Research and Extension Center. In another project, the advisor assessed optimal deficit irrigation strategies for alfalfa in 16 commercial fields in the Palo Verde and Imperial Valleys. The advisor also conducted irrigation research on six commercial date palms in the low desert. Findings were disseminated to the agriculture industry and partner organizations via technical guidelines, articles, grower meetings, and workshops. (Ali Montazar)

UCCE Advisors collaborated on an avocado irrigation project in San Diego, Riverside, Ventura, and Orange counties. This included surveying 61 orchards, conducting extensive field measurements, and developing and disseminating irrigation tools and information to avocado growers and stakeholders. (Reported by Ali Montazar; collaborators mentioned: Ben Faber, Dennis Corwin)

A UCCE Irrigation and Water Resources Advisor offered clientele a weekly Evapotranspiration (ET) Report which details weekly crop-water use for the bulk of crops grown in the region and is offered in collaboration with the California Department of Water Resources. The ET Report goes out weekly to nearly 200 clients throughout the Sacramento Valley. In addition to distributing the updated report each week from roughly March to October, the advisor offered programming on the benefits of utilizing the reports. (Curt Pierce)

The Specialty Crops and Horticulture Advisor working on the North Coast worked with the Yurok tribe and presented at a workshop organized by the California Rural Indian Health Board. (Eddie Tanner)

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

*CropManage*

A UCCE Advisor in Santa Clara, San Benito, and Santa Cruz counties delivered two CropManage workshops about nutrient and irrigation management as well as a seminar called, Tools and Approaches for Assessing and Improving Irrigation Efficiency on the Farm. Participants included small organic farmers. (Reported by Aparna Gazula; collaborator mentioned: Michael Cahn)

A UCCE Vegetable Crops Advisor continued to provide clientele with tools like CropManage, which has been adapted with UCCE watermelon and processing tomato research to address how irrigation water should be allocated. Growers’ reliance and confidence in CropManage continues to grow rapidly as a decision-support tool for sustainable irrigation management under complex climatic and production situations. (Zheng Wang)

*State Water Efficiency and Enhancement Program (SWEEP)*

UCCE provides trainings and technical assistance to support farmers' understanding of the requirements of and submitting SWEEP grants, which assist growers in implementing practices that improve soil health and water-use efficiency. (Climate Smart Agriculture Program, Hope Zabronsky) As a technical provider for the SWEEP Pilot program, UCCE provided technical assistance to many growers in the desert. (Ali Montazar)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices that improved water use efficiency. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants learned and intended to adopt water use efficiency strategies.**

* End-of-session survey responses from San Diego nursery and floriculture clientele indicate that 76% of participants plan to adopt the tools that UCCE presented about irrigation management, pressure optimization, irrigation management for potted ornamentals and pumps fundamentals and that 86% of participants increased their skills “a lot” or “hugely”. (Gerry Spinelli)
* As a result of the two CropManage workshops, 39 out of 71 growers increased their knowledge of irrigation management, nutrient management, and how irrigation and nitrogen management affect each other. Additionally, 39 growers intend to use CropManage decision support tool to manage their farm’s irrigation and nutrient management practices. (Michael Cahn, Aparna Gazula)
* As a result of the Tools and Approaches for Assessing and Improving Irrigation Efficiency on the Farm seminar, 33 out of 64 organic small farmers increased their knowledge about the tools and how to use them for improving on-farm irrigation system efficiency. Twenty-four organic small farmers indicated that they would adopt 1 or more irrigation efficiency practices discussed during the workshop on their farm. (Michael Cahn, Aparna Gazula, Lucy Diekmann, Margaret Lloyd, Hung Doan)

**Participants adopted recommended irrigation or other water and soil management practices.**

* As a result of UCCE’s technical assistance, 68 farmers and ranchers in 33 counties have received over $7.3M in SWEEP-funded water efficiency projects yielding 4,430 MT/CO2 reduced per year and 30,450 gallons of water saved annually. The program supports the adoption and installation of efficient pumps with variable frequency drives, soil moisture

sensors, electronic weather stations linked to irrigation controllers, evapotranspiration-based irrigation scheduling, drip irrigation systems, and low-pressure irrigation systems among others. (Climate Smart Agriculture Program, Hope Zabronsky)

* After attending UCCE programs and receiving weekly ET reports, several Sacramento Valley growers reported having finally adopted the practice of managing irrigations based on plant-water status readings from pressure chamber devices. Furthermore, subscriptions to the ET report have grown. (Curt Pierce)
* UCCE work with the Yurok tribe Food Village led to the installation of a micro-irrigation system that will reduce their water use by roughly 40%. (Eddie Tanner)

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

* Local irrigation districts in the desert region utilized UCCE’s drip study information to comply with their On-farm Water Conservation Programs. Additionally, the information developed by UCCE’s alfalfa deficit irrigation study was considered as a guideline by Imperial County Farm Bureau and two local irrigation districts to develop incentive programs for growers who adapt deficit irrigation as a water conservation tool in alfalfa, bermudagrass, and kleingrass fields in the Imperial and Palo Verde Valleys. (Ali Montazar)
* As a result of UCCE’s outreach activities of the new SWEEP Pilot Program for the Southern Desert Region, CDFA awarded 18 projects for more than $3 million in funds in the past two years, which is a significant achievement for UCCE and the low desert region. (Ali Montazar)

**Change in condition: Water saved.**

* Watermelon growers shared that they followed UCCE’s recommendations made by CropManage in response to the excessive precipitation in the early season. Only 24 inches of irrigation were applied in 2023, which is an almost 50% reduction of total applied water without a yield drop compared to the previous average amount under drier years. Furthermore, the impacted acreage of watermelons in the northern San Joaquin Valley that uses CropManage for irrigation decision support increased from zero before 2021 to 400 acres in 2023. (Zheng Wang)
* Fifteen collaborative desert vegetable growers (nearly 60,000 acres) conserved water and nitrogen as a result of adopting subsurface drip irrigation and following UCCE’s management recommendations. Specifically:
  + Lettuce growers conserved an average of 0.7 c-ft/ac water on a total of 1,100 acres and reduced N fertilizer application by 14% as a result of adopting drip irrigation and following UCCE’s management recommendations.
  + Onion growers in the desert region who collaborated with UCCE and adopted drip irrigation conserved an average of 2.6 ac-ft/ac water on a total of 400 acres and enhanced N-use efficiency by 53%.
  + Spinach growers who adopted drip irrigation in spinach increased water use efficiency by nearly 12%. As a result of applying less fertilizer and water for food safety and downy mildew control, these growers also reduced fertilizer costs and water treatment costs by $160 and $310 per acre, respectively. (Ali Montazar)
* As a result of adopting UCCE’s irrigation management guidelines in date palms, 10 cooperating growers in Southern California conserved an average of 15% reduced annual water usage. (Ali Montazar)
* Alfalfa growers in the desert region who collaborated in UCCE’s deficit irrigation study conserved an average of 1 ac-ft/ac following the proposed practices without sacrificing much yield (4-6%). Furthermore, eight alfalfa growers have already adopted deficit irrigation guidelines on about 1,000 acres while the acreage is expected to increase significantly from the summer 2024 considering the incentives developed by the local districts to encourage growers. This practice could provide a notable water conservation potential not just to the low desert region but to the whole Colorado River Basin (approximately 1.3 million ac-ft). (Ali Montazar)
* In Southern California, seven avocado growers who adopted UCCE’s avocado irrigation guidelines reported an average of 13% in water savings and a $940 water cost reduction per acre. Furthermore, 33 avocado growers have already adopted the findings of this project to conserve water and reduce production costs.(Ali Montazar)
* 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 32 million gallons to date. This number increased from 27 million gallons reported in 2018. The program extends water supplies to the consumer without raising rates and is more cost-effective than alternatives such as desalination. (Steven Swain)

These water use efficiency outcomes reported above demonstrate how Californians better understand and adopt water use efficiency measures. Ultimately, improved water management will increase water cost savings, reduce water usage, benefit the end-user, and reduce groundwater over-pumping in California. For example, it was estimated in 2019 that California growers could save approximately $147 billion gallons of water per year by using California Irrigation Management Information System (CIMIS) weather data to inform more efficient water practices (Zilberman, et al., 2019).Thus, UC ANR contributes to the public value of protecting California's Natural Resources.

## Condition Change: UC ANR contributed to increased water supply security

**Issue**

California's climate has the largest precipitation and streamflow variability in the contiguous United States. 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. Many groundwater basins have seen significant reductions in groundwater levels over time, which is increasingly problematic in the face of climate change. This trend, coupled with a growing urban population, requires more efficient management of water resources. (Ellen Bruno) The Sustainable Groundwater Management Act (SGMA) in California will require that pumping be reduced to bring recharge and extraction of groundwater back into parity. Failure of water users to achieve targets could lead to court adjudication, further limiting pumping and potentially the amount of land that can be farmed. Identifying new ways to ensure and secure a safe water supply is essential to California's health and prosperity.

Another issue is access to safe drinking water. It is estimated that more than 19 million people in the country receive drinking water from systems with health-based violations. Unsafe water is received disproportionately by low-income, indigenous, and rural communities, and communities of color (Dobbins, Fencl, 2021).

**Methods**

UC ANR extends new knowledge using both in-person and virtual methods to increase understanding of groundwater resources and conservation.

A UC Cooperative Extension (UCCE) Specialist developed a public data interface on local management decisions to assist policymakers and practitioners working to implement the SGMA. In collaboration with students, information was collected on proposed demand management strategies from all 118 Groundwater Sustainability Plans that have been submitted to the state for approval. The researchers tracked their progress and approval status, explained what policies were being proposed, and assessed the potential economic implications of each. The SGMA Demand Management Action Database, which makes available hand-collected data on groundwater management strategies proposed across California, is available at https://SGMA-DMAD.com. (Ellen Bruno)

Two UCCE Specialists at UC Berkeley organized a researcher-practitioner workshop called “SGMA in 2023”. Despite this California landmark groundwater reform law passing almost ten years ago, there's still a long road to achieving groundwater sustainability in California. This event was a culmination of the partnerships and experience the specialists have gained over the past five years and served as a needs assessment for future research and extension work. The goal of this convening was to strengthen partnerships between the research community and groundwater stakeholders on social and economic issues of groundwater management and advance a collaborative research and extension agenda to meet the state's emergent groundwater management needs. The event brought together roughly 60 practitioners, community-based organizations, farmers, water managers, county-based extension advisors, academic researchers, policy experts, and representatives from state agencies and several environmental organizations. The participants had thoughtful cross-disciplinary conversations throughout the day and identified seven key areas for focused collaboration. The convening's takeaways were published in a UC ANR blog from the California Institute of Water Resources, The Confluence. (Ellen Bruno and Kristin Dobbin)

A UCCE Soil Resource Specialist located at UC Davis continued to develop decision support tools to guide land and water resource management, including the Agricultural Groundwater Banking Index. This tool is a foundational data element for ongoing research across the state for flood managed aquifer recharge on agricultural landscapes. Clientele include growers, ranchers, consultants, agencies, and the general public. (Anthony O’Geen)

A UCCE Advisor conducted research in Northern California on irrigated pasture lands and rangeland watersheds. Research findings were shared via policy engagement activities, including policy briefs that engaged the Biggs West Gridley Water District in Butte County. (Tracy Schohr)

UCCE continued to be the research partner on the French Meadows Project, which is west of Lake Tahoe. Research goals are to provide adaptive management of natural resources, especially in forested watersheds, which face widespread threats from overgrowth, drought, pests, and wildfires. The advisor conducted ongoing, participatory research and capacity building with forest restoration implementations with government agencies, non-governmental organizations, associations, and natural resource management groups. (Safeeq Khan)

The UCCE Delta Crops Advisor has a rice program that addresses water supply reliability, economic profitability, and soil quality for Delta farmers and all Californians who rely on the Delta for water. Research shows that the flooded rice system can stave off soil carbon loss from organic soils by reducing carbon oxidation, thereby accreting 0.02-0.8 cm of soil per year (Deverel et al., 2016; Hatala et al., 2012). UCCE program activities are informing the Delta Conservancy’s Nature Based Solutions Program, which incentivizes rice cultivation by cost-sharing the land conversion with growers. (Michelle Leinfelder-Miles)

A UCCE Advisor in Marin and Sonoma Counties provided drought response and relief technical information and worked with county, state, and national agencies in policy engagement activities. (David Lewis)

A UCCE Water Justice Specialist at UC Berkeley also created and released a dataset on California Community Water System institutional types and shared this information with decision-makers and stakeholders. Leveraging this new data combined with other publicly available information, the specialist conducted several open-source data analyses and helped members of the environmental justice organization, Leadership Counsel for Justice and Accountability, interpret the results. (Kristin Dobbin)

As a result of UC ANR research and education, participants and decision-makers increased understanding and capacity to change behaviors and policies that will increase water supply security. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants increased understanding of water resources in California.**

* The “SGMA in 2023” workshop post-event survey had a 50% response rate and 96% of respondents agreed with the statement "I learned something new.” Additionally, 86% agreed that "This workshop will influence my future work on this subject.'' Feedback was overwhelmingly positive, with several requests to host another similar event in the future. (Ellen Bruno and Kristin Dobbin)

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

* Several policymakers and practitioners utilized the SGMA Demand Management Action Database and website as observed through follow-up conversations with UCCE. (Ellen Bruno)
* UCCE’s Ground Water Banking Index decision support tool was utilized by 41 different users over the past year. UCCE delivered 60 gigabytes of information used to identify which soil landscapes are ideally suited and safe for flood managed aquifer recharge on agricultural landscapes. After this tool was developed, this recharge practice has become part of groundwater basin plans and policies led by CDFA and the Department of Water Resources. (Anthony O’Geen)
* The Delta Conservancy’s Nature Based Solutions Program has incentivized 9,000 acres for future rice conversion. Since the advisor started working on rice about ten years ago, 7,000 acres have been converted. Therefore, with augmentation approaching 16,000 acres, there is the potential to accrete 320-12,800 cm/year of soil across the Delta, which will help stabilize levees and water supply. (Michelle Leinfelder-Miles)

**Science-based research applied to water access policy.**

* An example of UCCE research translating to policy is with the Biggs West Gridley Water District, redefining their drought water supply allocation based on a UCCE Advisor’s policy brief. The policy brief described how the district discriminated against irrigated pasture producers. Changing policies resulted in 140% more water for 1,150 acres of irrigated pasture in the district. Based on UCCE cost studies, this change in policy for clientele is valued at $54,000 annually in drought years. (Tracy Schohr)
* Sonoma and Marin Counties utilized UCCE information to inform Drought and Water Shortage Risk Mitigation plans, which have the potential to increase safe water supply. These plans comply with California Senate Bill 522 which is about Drought Planning for Small Water Suppliers and Rural Communities. (David Lewis)
* Staff from Leadership Counsel for Justice and Accountability utilized UCCE-developed dataset and analyses to inform talking points as they advocated for and against bills under consideration in the legislative session. Specifically, the analyses helped shed light on the disparate performance of mobile home park and mutual water company water systems and develop potential policy solutions to increase access to safe drinking water. (Kristin Dobbin)

**Change in condition: Forested watersheds restored.**

* UCCE’s continued engagement with the French Meadows watershed restoration project resulted in 870 acres of forest restored in the past season using thinning and mastication. It also resulted in 500 acres of prescribed burns. This restored land contributes to increased water security as forested watersheds are a critical natural resource. In California, forested watersheds cover one-third of the state and serve as the water tower for the environment and millions of people. (Safeeq Khan)

The measured outcomes reported above strengthened understanding of water supply and helped improve the actions taken to ensure a stable water supply to meet California's demand. UC ANR supports communities as they develop groundwater management plans to bring pumping and recharge into balance by 2042 to comply with the state's Sustainable Groundwater Management Act. UC ANR also supports communities as they develop plans to improve equitable access to safe water. Thus, UC ANR contributes to the public value of protecting California's natural resources.

# **BUILDING CLIMATE RESILIENT COMMUNITIES AND ECOSYSTEMS**

## 

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

Sustainable Food Systems

**Issue**

Increasingly extreme and erratic weather patterns caused by climate change threaten crop yields and farm profits across the state. Ranchers must continue to adapt to climate stressors, such as increased temperatures and occurrences of drought, and can aid in reducing climate change through their ranching practices. In particular, the development and adoption of alternative manure management practices that reduce greenhouse gas emissions from dairy and livestock operations are needed.

**Methods**

UC ANR collaborates with agencies, land managers, and communities that have been impacted by catastrophic fires, droughts, heat waves, and urban heat islands. Science-based information is provided to aid in wildfire response, recovery, and prevention efforts and develop improved practices.

Since 2019, UC ANR’s Climate Smart Agriculture (CSA) team has supported 12 dairy and livestock operations in five counties through the Alternative Manure Management Program (AMMP), with $7.4M in funding from the California Department of Food and Agriculture. The program supports the adoption of pasture-based management, alternative manure treatment and storage, and solid separation or conversion from flush-to-scrape practices that contribute to significant reductions in greenhouse gas emissions and operation costs for producers. Clientele continue to receive support from UC Cooperative Extension (UCCE) in the implementation of climate-smart projects. (Hope Zabronsky)

UCCE Dairy Advisors work collaboratively with UC ANR’s CSA effort. For example, the UCCE Dairy Advisor working in Marin and Sonoma Counties received $480,000 in Technical Assistance funding from CDFA to assist 20 dairy producers in applying for AMMP through onsite consultations. To showcase successful implementation, an AMMP demonstration project, a collaboration with California Dairy Research Foundation and UC ANR, created five producer videos from completed projects across the state. The team developed seven technical bulletins for applicable AMMP climate smart practices. (Reported by: Randi Black; collaborators mentioned: Betsy Karle and Amanda Charles)

Another UCCE Dairy Advisor, and County Director, in Glenn County worked with Climate Smart Agriculture educators to provide vital assistance to meet the state’s climate goals to increase carbon sinks and lower overall greenhouse gas emissions on dairies and throughout the agriculture industry. Data and resources from past projects to evaluate sampling methods for dairy nutrient management and water quality protection were published in two ANR 8000 series publications. (Betsy Karle)

Counties across the state are implementing agriculture passport (Ag Pass or Livestock Pass) programs that permit conditional access into evacuation areas to perform specific agricultural tasks. A UCCE Livestock and Natural Resources Advisor in rural Northern California worked with colleagues and emergency service personnel on the development of 10 county livestock and Ag disaster pass programs across the state, providing technical support, speaking at local meetings, and co-hosting an annual statewide seminar for hundreds of emergency service personnel. Her expertise on disaster preparedness and the Ag Pass program has been shared internationally in British Columbia, Vietnam, and Australia. (Tracy Schohr)

As a result of UC ANR research and extension, participants learned and adopted practices that lead to improved preparedness and resilience to climate change and extreme weather.  Outcomes with specific measured indicators follow.

**Outcomes**

**Participants adopted climate-resilient strategies.**

* Nine dairies that received UCCE technical assistance were successfully awarded grants totaling $5.7 million to reduce GHG emissions by 19,764 MTCO2e over five years, or the equivalent of 50,655,979 miles driven by an average gas-powered vehicle. As dairies see neighbors implementing climate smart agricultural practices and receiving incentives for those practices, producers grow more apt to adopt these technologies, amplifying the initial impact. More dairies now produce compost using implemented technology either for bedding, reducing imported materials costs and environmental impact, or to apply on land, sequestering more carbon. This work increases resilience to extreme weather and climate change through increased dollars awarded to and projects implemented for climate resilience, as well as increases agricultural efficiency and profitability through reducing offsite input costs. (Randi Black)
* One Glenn County dairy implemented a manure separator project and is now saving $13,000 annually on fertilizer costs and has improved the manure nutrient distribution on their farm, protecting water quality in the county. Technologies that separate manure mitigate manure storage emissions by reducing the quantity of carbon stored anaerobically. (Betsy Karle)

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

* As a result of UCCE’s dedicated effort, the Plumas-Sierra Ag Pass program was approved. After multiple county administration personnel changes and the Dixie Fire, it was a feat! These programs develop protocols for livestock producers to care, feed, water, and medicate animals that have sheltered in place in evacuated areas. The livestock Ag Pass will provide a formal process of allowing producers access to restricted or closed areas during an emergency to care for their animals. (Tracy Schohr)

**Change in condition: Reduced greenhouse gases.**

* Since 2019, the AMMP projects supported by the UC ANR Climate Smart Agriculture Team have contributed to over 20,600 MT/CO2 reduced per year, the equivalent of removing more than 4,584 gasoline-powered passenger vehicles driven per year. (Hope Zabronsky)

The measured outcomes reported above demonstrate participants learning about and developing new management paradigms to address the challenges of a changing climate on agriculture and food systems. Adopting new strategies and policies informed by UC ANR’s science-based research will help increase animal agricultural resiliency. In these ways, UC ANR contributes to building climate-resilient communities and ecosystems.

## 

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

Sustainable Food Systems

**Issue**

Increasingly extreme and erratic weather patterns caused by climate change threaten crop yields and farm profits across the state. Growers must continue to adapt to climate stressors, such as increased temperatures and occurrences of drought, and can aid in reducing climate change through their farming practices. In addition, urban heat islands (UHIs) resulting from climate change and the built environment pose significant health and ecosystem risks. Currently, over 95 percent of Californians live in urban areas and are directly impacted by UHIs. Identifying climate resilient landscape tree species that are drought, heat, and pest resistant is important since the shade of a single well-placed landscape tree can reduce the temperature of impervious surfaces such as asphalt by 700 F in inland and desert cities, and surrounding air temperatures under and beyond the tree canopy by 6-100 degrees F in spring and summer.

**Methods**

UC ANR collaborates with agencies, land managers, and communities that have been impacted by catastrophic fires, droughts, heat waves, and urban heat islands. Science-based information is provided to aid in recovery and prevention efforts and develop improved practices.

*Climate Smart Agriculture Program*

In partnership with the California Department of Food and Agriculture, the UC ANR

Climate Smart Agriculture Educator team has provided hands-on assistance to over

1,785 farmers and ranchers through grant application assistance, project

implementation support, and education on climate smart agriculture adoption at 146

workshops and field days. Translation services are offered in English, Spanish,

Mandarin, Hmong, Cantonese, Punjabi, and lu-Mienh. Since 2019, clientele in 33

counties were able to receive 430 funded projects from three state programs: Healthy

Soils (HSP) Program, State Water Efficiency and Enhancement (SWEEP) Program,

and Alternative Manure Management Program (AMMP). Clientele continue to receive

support from UC Cooperative Extension (UCCE) in the implementation of climatesmart

Projects. (Hope Zabronsky)

The UCCE Specialist in climate adaptation in agriculture at UC Merced is the lead principal investigator on a highly collaborative $1.5 million project to develop multifaceted pathways to climate-smart agriculture through integrated participatory program development and delivery. This is one of six projects funded by USDA NIFA's $9 million investment to expand adoption of climate-smart practices. He also supervised a statewide needs assessment survey and conducted workshops and educational presentations. His co-authored study from Nature Sustainability had over 150 media coverages in the past year. (Tapan Pathak)

A UCCE Academic Coordinator organized and evaluated a regional climate-smart agriculture workshop for farmers and ranchers in collaboration with several UCCE academics and partners. Presentations were delivered by nine speakers about climate-agriculture science related to tree nut production. Participants included growers and technical service providers including Certified Crop Advisors, Pest Control Advisors, academics, and conservation personnel. (Reported by Samuel Ikendi; collaborators mentioned: Caddi Bergren, Mae Culumber, Phoebe Gordon, Tapan Pathak, Jhalendra Rijal, Scott Stoddard, Daniele Zaccaria, Cameron Zuber)

*Whole orchard recycling*

A UCCE Pomology Advisor and County Director for San Joaquin County in California’s Central Valley continued extending results about the air and soil quality benefits of whole orchard recycling. For the past two decades, the advisor’s research focused on questions related to whole orchard recycling (WOR): when an orchard reaches the end of its productive life, could the bulk and mass of a whole orchard be shredded and returned to the soil, could growers cultivate that ground, would the next generation trees be able to grow, would there be disease, and what would WOR do to soil carbon, organic matter, or the carbon to nitrogen ratio?

The cost is $1,000 per acre of orchard to recycle, which is more expensive than options like biomass cogeneration, but biomass facilities have become less available. (Brent Holtz)

The UCCE Nut Crops Advisor in neighboring Fresno County continued related work. Regional surveys documented differences in carbon storage and changes to overall soil health in different soil types and climate regimes in WOR replanted orchards. Replicated trials have been established throughout the Central Valley, with each location replanted to almonds. Soils are analyzed for net changes in chemical, biological and physical indicators, to capture changes over time resulting from the different orchard treatments. Two locations have detailed monitoring of criteria GHG pollutants, including CO2, N2O, and methane (CH4), using static chambers and a mobile gas-analyzer unit. Multiple publications and Extension activities disseminate results. A field day was conducted which emphasized the utility of several hands-on tools to implement and evaluate soil and water conservation practices in replanted orchards after WOR. (Mae Culumber)

*Climate resilient landscapes*

A UCCE Research Specialist continues to be a collaborator on a multi-state Climate Ready Landscape Plants (CRLP) project, which evaluates promising low-water-use plants. She managed deficit irrigation fields at the South Coast Research and Extension Center, data collection, analysis, and disseminating findings to industry clientele. One of the partner institutions created an extensive western regional landscape evaluation network and standardized evaluation in six different climates and soil types. (Natalie Levy)

A UCCE Environmental Horticulture Advisor continues to co-lead a UC/United States Forest Service research project to identify climate-ready landscape tree species at University of California Riverside. She also provided information on recommended species and long-term care of climate-ready landscape trees to over 1,500 city planners and managers; landscape architects, arborists, city foresters and landscapers; and citizens groups at live and virtual workshops, conferences, and seminars. The Advisor also continued to provide training to UCCE Master Gardeners who, through the “Trees for Tomorrow” tree education and tree distribution program provided an additional 750 trees to residents of low shade neighborhoods in hot inland and desert cities bringing the total number of trees provided since 2020 to over 1,700. (Janet Hartin)

Due to the impact of climate change, farmers requested more information on specialty crops production, selected for their low water requirements and adaptability to hot and cold weather. A UCCE Small Farms Advisor working in the Inland Empire of Southern California organized and delivered six workshops with 166 total participants. The focus was to help farmers grow specialty crops, and included the importance of soil health in water conservation. (Hung Doan)

As a result of UC ANR research and extension, participants learned and adopted practices that lead to improved preparedness and resilience to climate change and extreme weather.  Outcomes with specific measured indicators follow.

**Outcomes**

**Participants gained understanding of and intend to use strategies to respond to climate change and extreme weather.**

* Participants of the climate-smart tree nut production workshop reported a statistically significant change in knowledge from a mean of 2.88 to 4.12, reflecting a 1.24-point knowledge gain after the workshop which moved participants from “minimal” to “adequate” knowledge. Growers reported larger learning gains regarding the effects of chills on orchards, optimal power supply, and winter cover crops, technical service provider participants reported larger learning gains regarding climate change trends and nutrient management. (Samuel Ikendi)
* After a Climate Smart Agriculture (CSA) event for nut growers, 78.6% of 30 attendees gained knowledge of climate smart agriculture practices and other aspects of climate change and agriculture. (Tapan Pathak)
* As a result of the CRLP project, 84 new, drought-tolerant specialty plants and seeds were introduced to consumers. Of the 48,863 consumers or wholesale buyers reached, 69 reported an intention to access/produce/prepare/preserve specialty crops. This project increases awareness, access, and competitiveness of the low-water use specialty crop landscape plants examined in this study. (Natalie Levy)
* A post-evaluation survey found 92 out of 166 farmers expressed their intent (intend to/already) to incorporate more organic matter, increase mulch usage, and plant additional cover crops. Additionally, farmers are transitioning to drip irrigation, moving away from high water-demand crops like pistachios, and favoring climate-ready specialty crops such as garlic, pomegranates, and indoor mushroom production. (Hung Doan)
* The post-meeting survey for the orchard recycling and soil health field day found among the 30 attendees surveyed, 85% greatly increased their understanding about the impact of the practice on soil properties, 72% said they learned a great deal about how to implement orchard recycling, and 64% indicated greatly increased their understanding of nutrient and irrigation best management practices associated with WOR. (Mae Culumber)

**Participants adopted climate-resilient strategies.**

* As a result of the HSP, SWEEP, and AMMP grant funded projects, with almost $39M awarded since 2019, farmers and ranchers implemented science-based climate-smart practices that support climate change mitigation by reducing greenhouse gas emissions and sequestering carbon, and promoted climate change adaptation by increasing on-farm resilience. The focus has been on adopting practices that build healthy soils, increase water use efficiency, and improve manure management. (Hope Zabronsky)

**Science-based information was applied to fire and climate-resilient policy and decision-making.**

* Informed by the study co-authored by UCCE in Nature Sustainability, the Gila River Indian Community signed an agreement to put solar panels over a stretch of irrigation canal on its land south of Phoenix. (Tapan Pathak)

**Change in condition: Reduced greenhouse gases.**

* Provided with UCCE expertise and leadership, whole orchard recycling (WOR) has significantly reduced air pollution and increased soil carbon and organic matter, by replacing open field or co-generation burning. Since 2018, when the San Joaquin Valley Air Pollution Control District (SJVUAPCD) began funding WOR at $600-900 per acre: 3,019 growers (projects) received $137 million in funding and 162,775 acres have been recycled (2023 report). As a result, 4.5 million tons of agricultural biomass were diverted from burning, resulting in the reduction of 8,791 tons of nitrogen oxides (NOx), 16,212 tons of particulate matter (PM), and 13,702 tons of volatile organic carbons (VOC). Open field burning in the San Joaquin Valley has dropped from an average of one million tons annually to only 125,000 tons in 2022. (Brent Holtz)
* Through assisting awardees in the adoption of practices such as cover cropping, installing solar panels, and installing dairy manure solid separator systems, the Climate Smart Agriculture program has collectively supported growers in reducing 115,394 MT/CO2 per year, as measured by California Air and Resources Board (CARB) Greenhouse Gas Emission Reduction Tool ([SWEEP GHG Calculator on CDFA's website](https://www.cdfa.ca.gov/oefi/sweep/)), and the [HSP Comet planner tool](http://comet-planner-cdfahsp.com/). Furthermore, [research shows](https://www.cdfa.ca.gov/oefi/healthysoils/docs/CompostApplicationRate_WhitePaper.pdf) that Healthy Soils Program practices such as compost application increases the amount of organic matter in the soil, amongst numerous other benefits such as increasing the water and nutrient retention capacity of soils, providing a reservoir of nutrients for plants, improving aeration, improving water infiltration, reducing soil erosion, and supporting the abundance and diversity of soil organisms, which can improve plant health. Compost application is just one fundable practice farmers can implement to help reduce greenhouse gasses on their operation. (Hope Zabronsky)

**Change in condition: More climate resilient urban landscapes. NEW for this Extension Program**

* The Environmental Horticulture Advisor’s presentations on climate-ready trees that emphasized the high return on the initial investment of trees ($2.23 returned for every $1 invested) influenced the planting of over 8,000 trees in over 200 public places in Southern California, enhancing tree canopy and cooling urban heat islands. Benefits also include lower air conditioning costs/greater energy conservation, reduced air pollution, increased water quality, enhanced habitat and pollinators, and carbon sequestration. (Janet Hartin)
* The same Advisor’s leadership over the “Trees for Tomorrow” UC Master Gardener tree education and tree give-away program is estimated to reduce air conditioning costs of tree recipients by 25% and provide vital shade as trees mature. ([McPherson, et al, 2004, pg. 80](https://www.fs.usda.gov/psw/topics/urban_forestry/products/001_cufr542_72dpiDsrtSWCommTreeGd04.pdf)) (Janet Hartin)

The measured outcomes reported above demonstrate participants learning about and developing new management paradigms to address the challenges of a changing climate on agriculture and food systems. Adopting new strategies and policies informed by UC ANR’s science-based research will help increase agricultural resiliency. In these ways, UC ANR contributes to 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 - In the Environmental Stewards Program

**Issue**

The associated effects of climate change are increasing the risk of extreme weather events that negatively impact California’s ecosystems and communities. Because of our changing climate, rangelands, forests, peri-urban, and urban areas are experiencing the effects of intense wildfires, persistent droughts, and urban heat islands. Land managers and communities need effective response and adaptation strategies to prepare to deal with the growing risks.

**Methods**

UC ANR collaborates with agencies, land managers, and communities to deliver science-based climate-related extension programs.

The UC Environmental Stewards Program conducts activities and training to introduce Californians to the wonders of our unique ecology and engage the public in the study and stewardship of California’s natural communities. It aims to increase knowledge, skills, identity, and self-efficacy related to California’s natural history and environmental issues, increase public participation and civic engagement in environmental education, and enhance citizen science, climate adaptation, and planning toward environmental and climate justice. Each year, the program delivers and evaluates instructor trainings to partner organizations, who then extend the trainings. (Greg Ira) The statewide program also maintains and delivers Climate Stewards trainings to partners and monitors evaluation results of participants. Climate Stewards is a hybrid, flipped classroom, adult education curriculum that improves climate change literacy and civic engagement for community and ecosystem resilience. Partners include community-based organizations, state agencies, and higher education institutions. (Sarah Mae Nelson)

As a result of UC ANR research and extension, participants learned and adopted practices that lead to improved preparedness and resilience to climate change and extreme weather.  Outcomes with specific measured indicators follow.

**Outcomes**

**Change in condition: Climate resilient land.**

* Climate Stewards participants (623) who were either certified or completed a community college course in the first three years of the program potentially reduced carbon emissions by 1,782 of CO2 this year, which is up from 1,143 reported last year. This has been extrapolated from research by Cordero et al. (2020), which indicates that focused climate education can result in individual carbon emissions reduction by up to 2.86 tons of CO2 per year. (Greg Ira, Sarah Mae Nelson)

The measured outcomes reported above demonstrate participants learning about and developing new climate change strategies to address the challenges of a changing climate. Adopting mitigation strategies informed by UC ANR’s science-based research will help increase the resiliency of working landscapes and decrease the impact of climate change. In these ways, UC ANR contributes to 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 - In Forestry & Fire

**Issue**

The associated effects of climate change are increasing the risk of extreme weather events that negatively impact California’s ecosystems and communities. Because of our changing climate, rangelands, forests, peri-urban, and urban areas are experiencing the effects of intense wildfires. During 2020, one of the most devastating years in California fire history, over four million acres burned, and over 10,000 structures were damaged or destroyed. Since 2017, 50,000 structures have been lost to wildfire in the state. Land managers and communities need effective response and adaptation strategies to prepare to deal with the growing risks. Communities need to be better prepared to mitigate the growing risks of hazards from fires.

**Methods**

UC ANR collaborates with agencies, land managers, and communities that have been impacted by catastrophic fires, droughts, heat waves, and urban heat islands. Science-based information is provided to aid in recovery and prevention efforts and develop improved practices.

The UC ANR Fire Network was formalized in April 2023 and is a statewide team of UC Cooperative Extension (UCCE) Fire and Natural Resource Advisors, Specialists, and staff committed to delivering fire-related research, outreach, and support for communities across California. The network addresses five strategic goals: enhance use of prescribed fire to reduce fuels and restore ecosystem function; implement fuels reduction strategies to improve treatment efficacy and reduce ecosystem impacts; incorporate home hardening techniques to build and retrofit homes for improved wildfire resilience; incorporate defensible space standards to reduce “near home” fire vulnerabilities; and engage with local planners to support wildfire resilience and best management practices. UC ANR's statewide Fire Network will build connections and capacity among UC ANR scientists, practitioners, land management and regulatory agencies, policymakers, and communities to work toward fire resilience in California.

The UCCE Fire Academic Coordinator hosted a preparing for prescribed fire workshop with the Placer and Nevada Resource Conservation Districts to address knowledge gaps regarding the safe and legal use of prescribed fire to reduce fuels on private lands. The coordinator also collaborated with two UCCE Forestry Advisors to deliver four pile burning workshops to 68 landowners and four wildfire preparedness events to 140 residents in Placer, Nevada, and Yuba counties. (Reported by Katie Low; collaborators mentioned: Ricky Satomi, Yana Valachovic)

A UCCE Advisor continued to expand the capacity of the Central Coast Prescribed Burn Association to increase climate resilience and ecological sustainability of range resources. This included providing training and technical assistance to conduct burns as well as managing consultant contracts and CAL FIRE grants. (Devii Rao)

One UCCE Fire Advisor partnered with the Yosemite Gateway Prescribed Burn Cooperative and engaged 70 community members and local partners in community meetings discussing the benefits of prescribed burning and working with prescribed burn associations. (Alison Deak)

A UCCE Advisor in Plumas, Sierra, and Lassen Counties continued to deliver wildfire preparedness information and assist seven local communities in completing assessments for Firewise USA, a national certification in partnership with CAL FIRE and fire safe councils to empower communities to perform outreach and mitigation actions. The advisor also developed a geospatial reporting tool to support Firewise communities and map volunteer investments. (Ryan Tompkins)

Another UCCE Fire Advisor conducted 43 extension activities on home hardening and defensible space in the form of webinars, virtual workshops, in-person presentations, and participation at community events to engage populations with different demographics and interests. The activities were attended by over 1,000 participants. (Luca Carmignani)

A UCCE Forestry and Pyrosilviculture Specialist at UC Berkeley conducted research and extension work related to the understanding and management of giant sequoia in California. This involved conducting studies within and outside of native giant sequoia groves, working with federal scientists, and advising/collaborating with non-governmental organizations on giant sequoia issues. (Rob York)

Several UCCE Advisors conducted a long-term, grazing for fuels reduction project. The team analyzed how much forage/fine fuels cattle consume and how that affects fire behavior and fire safety. Findings about prescribed grazing practices were published in the California Agriculture journal and shared in policy engagement activities. (Reported by Sheila Barry; collaborators mentioned: Devii Rao, Theresa Becchetti)

A UC Cooperative Extension (UCCE) Livestock and Natural Resources Advisor collaborated with local resource conservation districts, local ranchers, and CALFIRE on a prescribed fire demonstration. This project helped establish relationships between ranchers, local agencies, and fire professionals and demonstrated the opportunity for using fire to improve rangeland productivity. (Dan Macon)

As a result of UC ANR research and extension, participants learned and adopted practices that lead to improved preparedness and resilience to climate change and extreme weather.  Outcomes with specific measured indicators follow.

**Outcomes**

**Participants gained skills and understanding of strategies to respond to climate change and extreme weather.**

* Of 75 attendees, 29 filled out the evaluation survey for a weeklong prescribed burn Training Exchange (TREX) workshop and reported the following as a result of attending UCCE’s workshop:
  + 93% agreed or strongly agreed with the statement, "My knowledge regarding prescribed fire has increased as a result of the TREX.”
  + 97% agreed or strongly agreed with the statement, "I will incorporate this information into my job or share with my community within the year."
  + The following quote demonstrates how the TREX is impacting the community, "This TREX was my first time ever lighting a broadcast burn. This experience, and our firing patterns exercise, made me a lot more comfortable explaining prescribed fire to community members and championing it as a management tool and community building experience."
  + One more quote shows how the TREX is influencing local organizations, "My agency does not [have] a lot of institutional knowledge around prescribed fire. TREX allows me to gain knowledge about leadership, firing techniques, …and logistics that I can bring back and teach to others." (Devii Rao)
* Home hardening and defensible space extension participants who responded to post-presentation surveys (n=31) indicated they will use the content again in the future (84%). Empowering residents and communities in reducing their fire risk will help decrease the number of structures and livelihood losses in future fires. (Luca Carmignani)
* The UCCE Fire Academic Coordinator utilized surveys to collect the following extension participant learning outcomes:
  + 50% of 41 preparing for prescribed fire workshop participants, indicated they were more likely to implement prescribed fire on their property than before the workshop.
  + 93% of the regional pile burn workshop participants indicated they learned how to safely burn piles and 25% of participants identifying as new property owners with no previous experience burning piles indicated they are more likely to do so to reduce fuels.
  + 90% of Placer and Nevada county residents who participated in the wildfire preparedness events indicated they left the workshops with a better idea of how to prepare for wildfire and 35% were more likely to retrofit their homes or implement a defensible space strategy. (Katie Low)

**Participants adopted climate-resilient strategies.**

* Another 20 communities are utilizing UCCE’s Firewise tool as a result of expanding the program to Sonoma County. Annually, community volunteers donated around 27,000 to 31,000 hours, which equate to a $1.2-1.5 million community investment in wildfire preparedness actions to reduce fuels and improve home resistance to wildfires across seven California counties. This data was measured by UCCE’s Firewise tool, which was used by the National Fire Protection Association. (Ryan Tompkins)

**Science-based information was applied to fire and climate-resilient policy and decision-making.**

* The local community values the Central Coast Prescribed Burn Association (PBA) and TREX workshops, as demonstrated by organizations’ decisions to commit to sustaining UCCE’s efforts. The Resource Conservation District of Monterey County (RCDMC) applied for and received funding from the California Coastal Conservancy to keep the association going for two years after CAL FIRE grants end. RCDMC will take the lead on working with the PBA to help them become their own entity. (Devii Rao)
* The U.S. Forest Service’s decision to conduct an emergency response treatment was informed in part by UCCE’s sequoia research findings, which were extended by the specialist’s position statement on behalf of the Society of American Foresters. (Rob York)
* Nevada County agencies, local clientele, and UCCE’s collaborative efforts resulted in the implementation of the first summer-season prescribed fire for range improvement in Nevada County in the last 20 years. (Dan Macon)

**Change in condition: Climate resilient land.**

* Two prescribed burns were conducted by the Central Coast PBA as a result of UCCE technical assistance and training efforts. (Devii Rao)
* The Yosemite Gateway Prescribed Burn Cooperative adopted fuels reduction strategies and utilized UCCE expertise, resulting in:
  + 23 acres broadcast burned; and
  + 4.1 acres pile burned. (Alison Deak)

**Change in condition: Reduced greenhouse gas emissions.**

* UCCE research on the Central Coast found a net decrease in CO2 equivalent emitted on grazed land that burned. Ungrazed grasslands that burn emit more CO2 equivalent and PM 2.5 pollution. The higher the PM 2.5 levels in the air, the worse the Air Quality Index (AQI) will be. This change in condition builds upon outcomes reported in previous years describing UCCE research and policy engagement activities that led to clientele adoption of prescribed grazing. Sustaining livestock grazing in California helps meet climate and public safety goals. (Sheila Barry)

The measured outcomes reported above demonstrate participants learning about and developing new management paradigms to address the challenges of a changing climate.

Adopting mitigation strategies and new policies informed by UC ANR’s science-based research will help increase forest, rangeland, and community resiliency and decrease the impact of fires and droughts. For example,prescribed burning is estimated to reduce carbon dioxide and particulate matter emissions in forested ecosystems by approximately 18-25% when compared to a wildfire of the same size (Wiedinmyer and Hurteau 2010) (Devii Rao). According to CAL FIRE, the total acreage burned by wildfire in 2023 continued to fall well below the 5-year average; less than 350,000 acres burned in 2023 versus the 5-year average of 2,300,000+ acres.

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

Healthy Families and Communities

**Issue**

The effects of climate change in California include more severe and lengthy droughts, warmer temperatures that contribute to the increasing number of wildfires, bigger storms, and coastal erosion due to rising sea levels. The associated effects of climate change negatively impact California’s communities and ecosystems. Communities must continue to mitigate climate stressors, including methane, a greenhouse gas with global warming potential approximately 25 times higher than carbon dioxide. The decomposition of green material in landfills produces methane. Recent state legislation, such as the California SB 1383 Short-Lived Climate Pollutants Bill, focuses on diverting all forms of organic waste, including food waste, from landfill disposal in order to eliminate greenhouse gas emissions such as methane. (Sheila Barry)

**Methods**

UC ANR collaborates with communities to mitigate climate stressors. Science-based information is provided to aid in climate policy implementation and develop improved practices.

UCCE Santa Clara County’s Composting Education Program focuses on diverting waste and truck trips to landfills, potentially reducing air pollution. The program targets residential areas by providing free workshops throughout Santa Clara County to educate and promote home composting. In 2022, composting outreach reached over 20,000 residents of Santa Clara County at 85 different events. Master Composter volunteers donated 1,450 hours delivering education, helping schools start their own composting systems, and developing a community composting demonstration site. (Sheila Barry)

As a result of UC ANR research and extension, community members learned and adopted practices that lead to improved resilience to climate change.  Outcomes with specific measured indicators follow.

**Outcomes**

**Participants adopted composting practices.**

* Home composting workshop attendees who responded to a three-month post-workshop survey reported the following:
  + Attendees from the 2022 workshops composted at home an estimated 73.6 tons of organic waste, which includes 8.7 tons of food waste. By doing so, attendees alone saved 3.17 metric tons of CO2 from being emitted, the equivalent emissions of 7,869 miles by the average gasoline-powered car.
  + Since the 2015 workshops, attendees composted at home a cumulative total of 7,723 tons of organic waste and 918 tons of food waste. Tons diverted from the landfill can also reduce the number of truck trips to the landfill, contributing to improved air quality (Andersen et al., 2012). (Sheila Barry)

The measured outcomes reported above demonstrate participants adopting practices to address climate stressors. Adopting mitigation strategies informed by UC ANR’s science-based research will help increase the resiliency of communities and decrease the impact of climate change. In these ways, UC ANR contributes to building climate-resilient communities and ecosystems.