**UC ANR IMPACT STORIES 2021-2022**

**Table of Contents**

[PROMOTING ECONOMIC PROSPERITY IN CALIFORNIA 2](#_Toc136614452)

[Condition Change: UC ANR contributed to improved individual and household financial stability. 2](#_Toc136614453)

[Condition Change: UC ANR contributed to enhanced community economic development 4](#_Toc136614454)

[Condition Change: UC ANR contributed to improved animal management, productivity and efficiency 7](#_Toc136614455)

[Condition Change: UC ANR contributed to increased agricultural and forestry efficiency and profitability 13](#_Toc136614456)

[Condition Change: UC ANR contributed to increased emerging food economies and markets 28](#_Toc136614457)

[SAFEGUARDING SUFFICIENT, SAFE, AND HEALTHY FOOD FOR ALL CALIFORNIANS 31](#_Toc136614458)

[Condition Change: UC ANR contributed to improved food safety 31](#_Toc136614459)

[Condition Change: UC ANR contributed to improved food security 34](#_Toc136614460)

[DEVELOPING A QUALIFIED WORKFORCE FOR CALIFORNIA 40](#_Toc136614461)

[Condition Change: UC ANR contributed to increased workforce retention and competency 40](#_Toc136614462)

[Condition Change: UC ANR contributed to increased effective public leaders 48](#_Toc136614463)

[Condition Change: UC ANR contributed to improved college readiness and access 51](#_Toc136614464)

[Condition Change: UC ANR contributed to increased civic engagement 53](#_Toc136614465)

[DEVELOPING AN INCLUSIVE AND EQUITABLE SOCIETY 60](#_Toc136614466)

[Condition Change: UC ANR contributed to improved living and working conditions for California's food system and farmworkers 60](#_Toc136614467)

[Condition Change: UC ANR contributes to increased diversity, inclusiveness, and cultural competency in California's workplaces. 62](#_Toc136614468)

[PROMOTING HEALTHY PEOPLE AND COMMUNITIES 68](#_Toc136614469)

[Condition Change: UC ANR contributed to improved health for all 68](#_Toc136614470)

[Condition Change: UC ANR contributed to improved health for all 71](#_Toc136614471)

[Condition Change: UC ANR contributed to improved community health and wellness 73](#_Toc136614472)

[Condition Change: UC ANR contributed to improved access to positive built and natural environment 76](#_Toc136614473)

[PROTECTING CALIFORNIA’S NATURAL RESOURCES 78](#_Toc136614474)

[Condition Change: UC ANR contributed to improved management and use of land 78](#_Toc136614475)

[Condition Change: UC ANR contributed to improved air quality 81](#_Toc136614476)

[Condition Change: UC ANR contributed to the protection and conservation of soil quality 82](#_Toc136614477)

[Condition Change: UC ANR contributed to increased ecological sustainability of agriculture, landscapes, and forestry 85](#_Toc136614478)

[Condition Change: UC ANR contributed to improved water quality 96](#_Toc136614479)

[Condition Change: UC ANR contributed to improved water use efficiency 100](#_Toc136614480)

[Condition Change: UC ANR contributed to increased water supply security 105](#_Toc136614481)

[BUILDING CLIMATE RESILIENT COMMUNITIES AND ECOSYSTEMS 107](#_Toc136614482)

[Condition Change: UC ANR contributed to increased preparedness and resilience to extreme weather and climate change 107](#_Toc136614483)

**Note: Some condition changes have more than one story given the amount measured outcomes data, and are thus split by UC ANR Strategic Initiatives.**

# PROMOTING ECONOMIC PROSPERITY IN CALIFORNIA

##

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

**Issue**

Three years in, the COVID-19 pandemic continues to disrupt Americans’ economic livelihoods. In the early part of the pandemic, cascading shutdowns and pandemic-related conditions led to layoffs and lost wages. By April 2020, unemployment had reached 14.7%. As the job market recovered, unemployment slowly improved and reached historically low levels (4% or less in 2022). However, inflation has been historically high, between 6% and 9% in 2022, curbing the buying power of American consumers. 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 *Eating Smart Being Active* (ESBA), are designed to help adult participants gain the tools needed to take control of their money by teaching families food buying/budgeting skills and food resource management techniques. (CFHL, UC and EFNEP)

To understand the long-term impacts of participation in the UC 4-H Youth Development program (UC 4-H), UCCE Advisors studied how 4-H experiences shaped early adult outcomes. UCCE surveyed young and emerging adult alumni (ages 18-34) about their economic stability, health and well-being, and community involvement. (Nicole Marshall-Wheeler and Steven Worker)

UCCE Advisors in the Bay Area, Northern California, and Southern California develop programs to combat food waste and improve food resource management. The UC 4-H Food Waste Busters Project was developed as an 8-session training that culminated in capstone presentations. (Reported by Marisa Neelon; collaborators mentioned: Dorina Espinoza, Yu Meng)

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

**Outcomes**

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

* Fourteen 4-H youth from across California in 3rd to 5th grade participated in the live zoom sessions of the 4-H Food Waste Busters Project to learn about ways to reduce food waste. Participants reported positive changes they or their families made because of participation, including eating leftovers more frequently, cooking smaller portions to waste less food, and avoiding buying food unnecessarily. (Reported by Marisa Neelon; collaborators mentioned: Dorina Espinoza and Yu Meng)

**Participants improved food resource management practices.**

* After participating in CFHL, UC education, a statewide survey of 742 adult participants showed that 89% of participants reported improvements in at least one food resource management skill, such as comparing unit prices (61%) and shopping with a list (62%). (Lyn Brock and CFHL, UC)
* In Contra Costa County, a survey of 539 K-8th grade students who participated in Youth EFNEP programming showed that 41% of respondents reported improvements in food resource management skills. (Marisa Neelon)
* In Alameda and Contra Costa counties, 277 out of 509 parents graduated from the ESBA series. Post-survey results show that 92% of participants in Alameda County and 91% in Contra Costa County improved food management skills such as planning meals before shopping, making a shopping list, comparing food prices, and checking for foods on hand. (Marisa Neelon)
* After participating in the 4-H Food Waste Busters Food Project, participants reported positive changes they or their family made because of their participation, including eating leftovers more frequently, cooking smaller portions to waste less food, and buying less food unnecessarily. (Reported by Marisa Neelon; collaborators mentioned: Dorina Espinoza and Yu Meng)

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

* EFNEP graduates statewide averaged a $33.58 savings in their monthly grocery budget, which is a $400 savings a year per family. After completing EFNEP classes, the number of participants reporting they were unable to afford balanced meals decreased from 90% to 33%. (EFNEP) Local highlight follows:
	+ After attending the ESBA series from EFNEP, families in Alameda County saved an average of $5 per month on food costs, and Contra Costa County families saved an average of $21 per month on food costs. (Marisa Neelon)

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. 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 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 sectors to identify opportunities for economic development through innovation and entrepreneurship while also fostering environmental and social sustainability.

UC Cooperative Extension (UCCE) Specialist at UC Riverside is also the director of the California Citrus Clonal Protection Program (CCPP). This was the first program of its kind in the world with roots in the 1933 discovery of the first citrus virus by Dr. H. S. Fawcett, who was part of the Citrus Experiment Station established in 1907 at UC Riverside. CCPP provides a safe mechanism for introduction into the state of citrus varieties through methods such as in vitro variety therapy and disease diagnostics to propagate healthy citrus trees for the growing California citrus industry and all Californians. (Georgios Vidalakis)

A UCCE Livestock and Natural Resources Advisor in the Sierra Foothills developed business planning and economic analysis tools, including profit calculators and decision support tools, specific to targeted grazing businesses. Unlike conventional livestock production enterprises, these businesses emphasize providing a service rather than optimizing livestock reproduction and weight gain, requiring a shift in producer focus. The tools enable producers to analyze potential costs with a focus on establishing a profitable and sustainable fee structure. The information helps potential clients of these businesses understand how targeted grazing may or may not meet their specific vegetation management needs. (Dan Macon)

UCCE in the Sierra Foothills also works to support new farming businesses. Twenty-eight new and beginning farmers participated in three different business courses: Start a Farm, Beginning Farming Academy, and Growing Citrus Production. These courses included guidance and requirements for starting an agricultural business, learning to assess resources and conduct market research, and an introduction to basic farm economics and key regulations. (Cindy Fake and Dan Macon)

The UCCE Small Farms Team provided bilingual outreach and technical assistance in Chinese, Hmong, Spanish, and English to support farmers in applying for economic relief grants. Grants included: 1) the Coronavirus Food Assistance Program (CFAP) 2 from USDA; and 2) the California Underserved and Small Producers (CUSP) program from the California Department of Food and Agriculture (CDFA), both for COVID-19 economic relief and drought relief funding. (Ruth Dalhquist-Willard and Aparna Gazula)

To address challenges small agricultural producers face in the larger San Francisco Bay Area, a UCCE Small Farms Advisor and her team developed educational materials to help their operations be competitive and sustainable, covering topics such as organic seedling production, managing Mycorrhizas, and using biostimulants.(Reported by Aparna Gazula; collaborators mentioned: Lucy Diekmann and Margaret Lloyd)

UCCE continues to be the research partner on the French Meadows Project, which is west of Lake Tahoe, and conducts ongoing forest restoration implementations with government agencies, non-governmental organizations, associations, and natural resource management groups. (Safeeq Khan)

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 learned or planned to utilize innovation and entrepreneurial strategies.**

* The eight prospective farmers and ranchers who participated in the 2022 “Start a farm” class reported a:
	+ 140% increase in knowledge of agricultural rules and regulations,
	+ 100% increase in knowledge of business practices, and
	+ 58% increase in understanding of economic principles. (Cindy Fake and Dan Macon)
* At the end of the courses for new and beginning farmers, each participant identified key actions needed to start their farm businesses within a year, which contributes to the viability of small-scale foothill farming and increased profits for farm families.
	+ 100% of respondents planned to conduct market research and analyze start-up costs for their operation;
	+ 93% planned to develop a budget for an enterprise;
	+ 89% planned to network with other farmers and analyze their capital purchase costs and benefits; and
	+ 81% planned to develop a recordkeeping system for their operation. (Cindy Fake and Dan Macon)
* As a result of the Organic Seedling Production seminar, 28 organic, small-scale farmers increased their knowledge, and 24 indicated that they would adopt one or more practices discussed during the workshop on their farm. (Aparna Gazula)
* As a result of the Building Capacity for Bigger Potential of Crop Biostimulants among Organic Small Farms seminar, 15 organic, small-scale farmers increased their knowledge of biostimulants, and 11 indicated that they would adopt one or more practices discussed during the workshop on their farm. (Aparna Gazula)
* As a result of the Managing Mycorrhizal Fungi in Your Soil seminar, 25 organic, small-scale farmers increased their knowledge of biostimulants, and 18 indicated that they would adopt one or more practices discussed during the workshop on their farm. (Aparna Gazula)

**Participants implemented innovation and entrepreneurial strategies.**

* From the 34 new citrus varieties that completed therapy and testing during this reporting period, seven varieties were introduced by large California citrus producers that invested $70,000 towards the cost of the introduction. This means that the California citrus industry believes that seven varieties have commercial potential. Thousands of agricultural jobs will be maintained or created in the next few years as these varieties are propagated, grown in the field, and come to production. (Georgios Vidalakis)
* In 2022, local landowners/managers utilized targeted grazing services to manage vegetation on more than 7,000 acres in the Sierra Foothills region. (Dan Macon)
* The technical assistance provided by the Small Farms Team in Santa Clara County to 46 farmers from socially disadvantaged communities resulted in 38 farmers getting $101,000 in grant funds from the California Underserved and Small Producers Program. (Aparna Gazula)
* The technical assistance provided by UCCE in Fresno County to 38 farmers from socially disadvantaged communities resulted in 32 of those farmers getting funded for a total amount of over $450,000 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)

**Change in condition: Jobs created.**

* UCCE’s continued engagement with research, education, advocacy, and fundraising related to the French Meadows watershed restoration project resulted in 6,000 acres, up from 4,500 acres reported last year, of forest restoration of federal and private land. In the previous season alone, this all-hand partnership generated 1 million board feet of timber to the local mill and economy, restored miles of roadways and culverts to reduce sedimentation, and provided jobs to local contractors. During year 4 of operations, the French Meadows Project employed 5 different vendors for a total of 15 individual workers dedicated to the project. (Safeeq Khan)

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**

California’s total livestock receipts are over $12.1 billion (2021). It remains the largest dairy-producing state, accounting for about 18% of the nation’s dairy product receipts (2020), and dairy is the state’s top-producing commodity. Ranchers and dairy producers face many management and production challenges, like drought, water, and air quality regulations, and invasive species, as they strive to maintain their competitive edge. Although livestock 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, including conserving aquatic species and managing stress in sustainable aquaculture.

**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) Specialist located at UC Davis working on animal biotechnology continued to lead the eXtension beef genetics/genomics community of practice, which aims to meet beef producers and Extension educators’ needs in beef genetics programming. Reductions in beef genetics Extension specialists and outreach funding in the US led a group of beef genetics Extension faculty in Kentucky, Kansas, Missouri, Tennessee and California to coordinate their efforts and develop the national Extension program called eBEEF. Together they utilize four platforms for outreach: Beef Improvement Federation, National Beef Cattle Evaluation Consortium, the National Cattlemen’s Beef Association education program, and the eBEEF.org website. The UCCE Specialist manages all aspects of the eBEEF eXtension beef genetics/genomics [community of practice website](https://ebeef.ucdavis.edu/), and maintains a [UC website](http://animalbiotech.ucdavis.edu) which averages approximately 2,000 visits monthly and a [faculty blog](http://biobeef.faculty.ucdavis.edu). Materials provided through eBEEF include the publication of a 2021 revised version of the Beef Cattle Beef Sire Selection Manual that was produced and distributed to cattle producers throughout the nation. (Alison Van Eenennaam)

The UCCE Aquaculture Specialist at UC Davis continues work on his fish slaughter and animal welfare program. Working with collaborators, he continued to expand slaughter technology to all sturgeon and paddlefish caviar farms across the US and provided hands-on demonstrations to the two commercial sturgeon producers in Idaho. They also conducted demonstrations and provided training of percussion stunning and provided guidance and support around fish welfare at the U.S. Fish and Wildlife’s Coleman National Fish Hatchery, which is the largest salmon hatchery in the nation. (Jackson Gross)

UC ANR conducted research and delivered educational information to dairy producers on management practices that support environmental stewardship. UC ANR continues as an important partner in the California Dairy Quality Assurance Program (CDQAP), working in collaboration with USDA Natural Resource Conservation Service, California Department of Food and Agriculture and dairy industry partners (Western United Dairies, Milk Producers Council, California Dairy Campaign), amongst others. The CDQAP partnership conducts quarterly meetings to bring industry, government agencies, and academia together to assess needs and plan outreach needs related to sustainability. Technical support is provided to dairy producers. (Reported by Deanne Meyer; collaborators mentioned: Caddie Bergren, Randi Black, Amanda Charles, Nicholas Clark, Jennifer Heguy, Betsy Karle, David Lewis, Lizzeth Mendoza, Jeff Stackhouse)

To address identified needs of small acreage livestock operators, UCCE Livestock and Natural Resources Advisors statewide collaborated to organize a 7-part webinar series focusing on common management issues, which had 113 attendees registered. The series helped to further identify specific needs for these small acreage landowners with livestock, which is informing the further development of a website to bring together the available resources to answer many of the common questions asked. (Reported by Brook Latack; collaborators mentioned: Rebecca Ozeran, Julie Finzel, Devii Rao, and Theresa Becchetti)

A UCCE Livestock and Natural Resources Advisor in the Sierra Foothills collaborated with experienced ranchers and UCCE Specialists to expand hands-on workshops and field days, in particular with a focus on workforce development to train ranch employees. This UCCE Advisor also developed a curriculum and led the Cattle and Sheep Grazing School, the first multi species grazing school in California, that provided cross-species training in managing irrigated pasture and annual rangeland. (Dan Macon)

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.**

* The small acreage livestock management webinar series increased knowledge and confidence. For example, before the presentation on pasture forage nutrition, 33% of attendees felt not comfortable at all or slightly uncomfortable understanding the nutritional needs of their livestock on their property, and after the presentation, 100% of the audience indicated that they feel slightly more comfortable (75%) or a lot more comfortable (25%) in understanding the nutritional needs of the livestock on their property. In the poultry and pig sessions of the series, 89% and 75% of participants, respectively, reported knowing more about raising poultry or pigs than they did before attending the webinars. From the sheep and goat sessions, 100% of participants responded they learned a lot of new information, and 33% of participants were very interested in adopting electronic identification to help manage their flocks as a result of learning about their uses. (Brook Latack)
* Based on pre- and post-workshop evaluations for the ranching training in the Sierra Foothills, 100% of the 12 producers and employees reported increased knowledge of low-stress livestock handling, animal health practices, and grazing management systems. In addition, more than 80% increased their knowledge of managed grazing and intended to use this knowledge in their own ranching operations or in their work providing technical assistance to ranchers. (Dan Macon)

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

* Post-workshop evaluations have demonstrated that up to 80% of the 61 participants have adopted animal health practices that will likely lead to a reduction in antibiotic use in their operations. (Dan Macon)
* Coleman National Fish Hatchery adopted the improved fish slaughter technology which increases fish welfare for over 50,000 salmon, as well as reduces workplace injuries and increases equity in the workforce. (Jackson Gross)

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

* The eBEEF national Extension program made contributions to the Beef Improvement Federation Guidelines for Uniform Beef Improvement Programs. These guidelines are used by cattle breeders throughout the nation to standardize performance recording and to select and improve beef cattle genetics. (Alison Van Eenennaam)
* Dairies acquired the California Dairy Quality Assurance Program’s environmental stewardship certification. This results in a 50% fee reduction for water quality fees. The actual value to producers exceeded $3,200,000 in 2022. (Deanne Meyer)

The above 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 Food Systems**

**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 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 livestock operations.

A UC Cooperative Extension (UCCE) Livestock and Natural Resources Advisor helped livestock industry clientele address increasing levels of water quality and quantity state regulations, including the Irrigated Lands Regulatory Program and Sustainable Groundwater Management Act. (Laura Snell and David Lile)

UCCE Advisors continue their long-term forage production studies. A UCCE Advisor evaluated both the quantity and quality of livestock forage on rangeland and extended findings through policy engagement activities. These results are presented each year to the USDA Farm Service Agency and Agricultural Commissioners in Monterey, San Luis Obispo and Santa Barbara Counties to help determine drought impacts. (Royce Larsen) Another UCCE Advisor clips forage production each year at three ranches in San Benito County and writes a letter to the Farm Service Agency as well as blog posts for clientele to share the results and to help FSA determine if it is a drought year. (Devii Rao)

UCCE Advisors implemented a weed management project focusing on outreach to people managing livestock on small acreages. Two workshops, two presentations, and a website about weed management on small acreages were delivered to clientele. (Reported by Devii Rao; collaborators mentioned: Theresa Becchetti, Julie Finzel, Brooke Latack, Rebecca Ozeran)

A UCCE Advisor organized the San Benito Weed Management Area’s Annual Rancher seminar. This included pivoting to a virtual format while still allowing ranchers to get their Department of Pesticide Regulations continuing education credits. (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.**

* Before watching the weed management presentations at one livestock small acreage workshop, participants were asked, “How confident are you that you can choose an appropriate weed management tool?” Responses were as follows: not confident at all (5), a little confident (8), very confident (1). After the presentations, all 14 respondents said they were more confident than before. (Devii Rao)
* Rancher Seminar participants were asked when they would incorporate what they learned. Out of 30 responses, 21 people (70%) said they would incorporate information they learned at the workshop within six months. In general, this would potentially lead to more effective weed management and increase ecological sustainability of rangelands. (Devii Rao)

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

* The San Luis Obispo County Agriculture Commissioner, the Department of Agriculture/Weights and Measures, the Farm Service Agency, and the local agriculture industry utilized UCCE science-based information on grass growth loss percentages to accurately assess impacts and streamline processes, ultimately leading to federal assistance for cattle ranchers who have suffered losses due to severe drought conditions. “The continuing drought in multiple contiguous counties has necessitated new USDA resources. Mr. Larsen has provided the data to help our field offices receive resources and programs for our customers.” – County Executive Director, Monterey/Santa Cruz/San Mateo Farm Service Agency. (Royce Larsen)
* The forage production monitoring project provided Farm Services Agency data to manage their Non-Insured Crop Disaster Assistance Program, which is rangeland crop insurance. Roughly 40 ranches in San Benito and Santa Cruz counties participate in this program and get a financial payout during drought years. This contributes tocommunity economic development by increasing rancher income through improved forage production and livestock feeding/supplementation programs, in addition to facilitating insurance payments during particularly poor forage years. (Devii Rao)

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

* About 30 Goose Lake irrigators started saving about $20,000 annually in water quality monitoring fees due to UCCE support. The Goose Lake irrigated lands sub-coalition received an exemption the state’s irrigated lands regulatory program after the sub-coalition worked with UCCE for many years and demonstrated that the vast majority of irrigators in Modoc County grow grass, alfalfa, and hay, which are forage crops with very low risk for water quality issues. UCCE also demonstrated that best practices were already being implemented in the county and the value of ecosystem services such as storing carbon, filtering water, and providing wildlife habitat. The Central Valley Water Quality Board voted to extend the invitation to other similar basins to pursue this same exemption. (Laura Snell)

The above 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.

A UC Cooperative Extension Specialist (UCCE) in agronomy and bioenergy at UC Davis completed work on a project with funding from California Department of Pesticide Regulation to identify alternative to the use of chlorpyrifos in sugarbeet production in California and improve overall integrated pest management. The research was conducted at the UC Desert Research and Extension Center and in grower-cooperators fields, and involved frequent contact with the cooperating growers and Pest Control Advisers. Results were recently reported to the American Society of Sugar Beet Technologies biennial meeting. (Steve Kaffka)

Another UCCE Specialist in agronomy at UC Davis co-led, with the Public Policy Institute of California, a recently published study that assessed the feasibility of winter cropping systems in low rainfall areas of the state where increasing fallow land is expected in coming decades. They were able to construct models thatquantify multi-season outcomes of the interactive effects of irrigation quantities, sowing date, and harvested product on crop feasibility, productivity and associated water productivity across the San Joaquin Valley. (Reported by Mark Lundy; collaborator mentioned: Cameron Pittelkow)

He also helped organize two virtual events and three field days. Activities included demonstrations of how to use the Nitrogen fertilizer management tools they developed, presenting their results from statewide small grain variety evaluations, and roundtable discussions of UCCE’s work related to cropping system adaptation in the face of increasing water scarcity. Aggregate attendance at these events was more than 200 individuals and included growers, industry professionals, policymakers, agronomists, and other researchers. (Reported by Mark Lundy; collaborators mentioned: Nick Clark, Sarah Light, Konrad Mathesius, Giuliano Galdi, Tom Getts, Michelle Leinfelder-Miles)

A collaborative research project between UCCE Advisors and Specialists evaluated practices to improve nitrogen fertilizer management in wheat using soil testing and handheld, proximal sensing devices to monitor plant nitrogen status to inform real-time decision-making. Research was conducted among a statewide network of sites and at the Delta site specifically, findings demonstrated a 0.5 percent increase in grain protein, and fertilizer nitrogen accounted for only 40% of the nitrogen removed in the harvested crop, which means that crop quality improved without over-applying nitrogen. (Reported by Michelle Leinfelder-Miles; collaborators mentioned: Nick Clark, Sarah Light, Konrad Mathesius, Giuliano Galdi, Tom Getts, Mark Lundy)

In the Sierra Foothills, UCCE conducts on-farm workshops to teach practical knowledge and skills for horticultural productivity. (Cindy Fake) Also in the Sierra Foothills, UCCE offered “So you want to start a farm or ranch?” workshop and a 2-day Beginning Farming Academy, with a focus on providing aspiring farmers and ranchers with the economic analysis, business management, and market analysis tools necessary to turn a ranch dream into reality. (Dan Macon and Cindy Fake)

Grafting is an ancient production tool widely recognized to improve fruiting vegetable yield, enhance disease resistance, and tolerate nutrient and water deficiency; however, grafted watermelons had not been effectively tested in California. A UCCE Vegetable Crops Advisor conducted the third-year field experiment 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. In addition, he implemented a new watermelon rootstock variety trial to inform choosing rootstocks calibrated by production needs. Findings were disseminated to the cooperative growers and broader stakeholders through a field day, variety trial tour, and newsletter. (Zheng Wang)

An UCCE Agronomy Advisor led a series of seven presentations on improving nitrogen use efficiency in wheat with Pest Control Advisers, Certified Crop Advisers (CCAs), soil scientists, and other crop consultants throughout the major wheat-growing regions of California. UCCE is looking to leverage a developed webtool as part of a win-win service agreement that CCAs could integrate into their nitrogen management recommendations rather than training all growers individually, and in this way achieve improved nitrogen fertilizer use efficiency on a broader scale more quickly and with less effort. While the focus has been on a train-the-trainer approach growers are of course still welcome and encouraged to attend all these UCCE talks. (Reported by Konrad Mathesius; collaborators mentioned: Nick Clark, Giuliano Galdi, Thomas Getts, Michelle Leinfelder-Miles, Sarah Light, Mark Lundy)

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.**

* As a result of UCCE workshops offered in the Sierra Foothills:
	+ 152 specialty crop producers learned about soil and plant health and implemented one or more new soil management, water conservation, or pest management “best practices” on their farms, which increase organic matter, build healthier soil, and conserve water, as well as mitigating climate-change-induced plant stress.
	+ Of the 16 growers who attended a workshop on managing grapevine stress, 88% of survey respondents stated the intention to change or adopt one or more new practices, including mulching vine rows, winter/spring irrigation when rainfall is inadequate, and adjusting irrigation based on weather. UCCE research shows that mulch can mitigate canopy temperature fluctuations, reducing damage to fruit from heat and water stress.
	+ The 12 participants in the Growing Citrus course reported increasing their knowledge of citrus production and orchard management by 100%; citrus varieties and eco-requirements by 83%; and citrus pest management by 67%.
	+ After another citrus workshop nine growers learned about the benefits of using mulch to mitigate tree stress: 78% planned to mulch their orchards and 67% planned to monitor soil moisture under mulch and adjust irrigation appropriately. UCCE research has shown that mulch can reduce water use by 25 to 30%. (Cindy Fake)
* Forty-four Certified Crop Advisers and growers reported increased knowledge about various aspects of nitrogen management in small grains. Of the attendees, 96% reported an increase in general N-management knowledge. Together, growers and CCAs who attended the meetings manage over 41,000 acres of small grains throughout California. (Konrad Mathesius)
* Results from surveys of agronomy extension efforts indicated that the educational content improved knowledge and that behavioral change was likely to result. For example, based on surveys conducted after three events related to improved nitrogen management practices in small grain crops, 19 respondents indicated a 48% increase in knowledge about the topics discussed and were on average ‘very likely’ to utilize the information in their future work. (Mark Lundy)

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

* Growers in the Imperial Valley have widely adopted the use of seed treatments instead of chlorpyrifos or other insecticides, which is one of the low-risk strategies identified and extended through the UCCE effort. (Steve Kaffka)
* Growers' adoption of grafted watermelon continued to increase. The gross planting area of grafted watermelons in California increased from less than 250 acres in 2018 to over 2,000 acres in 2022, and this number is estimated to exceed 2,200 in 2023. On average, growers 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 net income through growing grafted watermelons increased 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)

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

* The new agronomic models have enabled rapid response, and provided well-founded, high-resolution answers to pertinent agronomic questions and are informing policy discussion surrounding land and water use. (Mark Lundy)

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

* While the Census of Agriculture reports that just 25% of the farming operations in Placer and Nevada Counties are profitable, 86% of the participants in our farm business planning short course generate a profit and pay themselves a salary as business owners. (Dan Macon)
* Measured outcomes from employing recommended nitrogen use efficiency practices included 28% higher yields and $40/acre of fertilizer cost savings, averaged across participants, and higher crop nitrogen recovery compared to the grower standard practice. (Michelle Leinfelder-Miles)

The above 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**

**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 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 California’s population increases, crop production must increase to meet the greater food demands despite lagging resources for detection. 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) the university’s best information on managing pests using safe and effective techniques and strategies that protect people and the environment.

UCCE Advisors and one UCCE Specialist located at UC Davis conduct nearly all of the efficacy, crop safety, and residue research trials for the Interregional Research Project No. 4 (IR-4 program) in California. UCCE takes the lead on the residue trials at the UC Davis campus farm and has conducted trials at Kearney and Desert Research and Extension Centers (RECs). Many UCCE Advisors conduct pest management efficacy trials for specific crops around the state and a few UCCE Advisors conduct pesticide crop safety trials. (Reported by Jim Farrar; collaborator mentioned: Brad Hanson)

UC IPM updated how online resources are delivered to improve reach. This update resulted in an increase in visits to the UC IPM website. The UC IPM website went from 2.2 million users and three million sessions in 2020 to 2.5 million users and 3.3 million sessions in 2022. The program also delivered new online courses and evaluated clientele behavior changes. (Tunyalee Martin)

A UCCE Advisor in Southern California 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. The UCCE Advisor also collaborated with state and San Diego County regulatory agencies to provide recommendations for treatment and to be kept in the loop for any invasive pests that they detect. (Eric Middleton)

Another UCCE Advisor provided practical, science-based solutions to the nursery and cut flower community in San Diego County regarding rodent management issues. One grower experienced mice damaging significant amounts of bulbs used to grow blooming plants. Another grower had mice chewing irrigation lines used to provide water to cut flowers. Without the correct pesticide or appropriate application method, pesticide use can be highly inflated. (Niamh Quinn)

A UCCE Advisor is an active supporter and founding member of the [Sonoma County Winegrape Pest and Disease Control District Coalition (SCPCDC)](https://sonomacountypcd.org/%20and%20ucanr.edu/scpcd), which is a group of local grape industry professionals, growers, PCAs, and the Agricultural Commissioner. Learning from UCCE successes in other counties, policy engagement activities were conducted with the goal of having a pest control district in Sonoma County. (Cindy Kron)

UCCE conducted research and extension activities to address the insect vector of Grapevine Red Blotch Virus (GRBV) using a model to time management of ground cover to disrupt three cornered alfalfa hopper life cycles in GRBV-affected areas. Findings have been published in a journal article and growers can access the UC IPM website to use a free online calculator to calculate degree days accumulated. Use of the model was evaluated at the annual North Coast IPM seminar. (Cindy Kron)

UCCE cohosted a virtual Walnut Day webinar, reaching 282 attendees on the first day and 295 on the second day. Topics included monitoring for the walnut husk fly, a top research priority of the 957.7 million dollar walnut industry. (Cindy Kron)

Another UCCE Advisor focused on the effect of cucumber beetles on fresh market melons. Research progress was disseminated in the UCCE Vegetable Crops Newsletter, reports, and presentations to the CA Melon Research Board, and to grower and pest control adviser cooperators via the CA Association of PCAs magazine. (Amber Vinchesi-Vahl)

A former UCCE Advisor developed the [new IPM paradigm in 2019](https://academic.oup.com/jipm/article/10/1/12/5480541) that incorporated social and economic aspects of crop production in addition to various pest management options and other influencing factors. The model was translated into multiple languages and extended via invited talks, journal publications, and symposia to farmers, crop care professionals, and agricultural input industries. (Surendra Dara)

As a result of UC ANR research, outreach, and education, participants learned and adopted 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.**

* Results from a post-seminar survey of the virtual Walnut Day webinar indicated that 98% of 251 participants agreed that the pest and disease sessions covered a practice that they would plan to apply. (Cindy Kron)

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

* Three to six months after taking an online course, UC IPM participants responded they made different pest management choices (n=22), made better or timed applications (n=22), timed their monitoring (n=17), used IPM tools (n=15), and used prevention practices (n=4). (Tunyalee Martin)
* The model to time management of ground cover to disrupt the insect vector of GRBV was used on about 1,166 acres in 2022. There was a 389% increase in the number of attendees that used the model in 2022 and the number that plan to use the model to time ground cover management in 2023 (n=152). UCCE’s validation research in five grape regions has shown that the model is able to accurately predict the window of time before adult emergence. (Cindy Kron)
* Survey results (n=45) showed that 93.3% of clientele would use information from the social and economic IPM model or have used it to improve their farming operations. The model has been or would be used on 33,703 acres with a realized or expected savings or additional returns of $1.79 million. (Surendra Dara)

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

* Treatment recommendations were utilized by San Diego County Agriculture Weights and Measures nine times in the past several months for invasive pests intercepted on imports entering the area. The County was previously unable to provide the owner of the imports with recommendations for treatment. As a result of UCCE’s recommendations, the owners of the imports are now able to either destroy, ship back, or treat their stock in a timely manner. The recommendations provided reduced pesticide use when treatment is necessary (e.g. treating with hot water instead), and has helped prevent invasive pests from spreading in Southern California. (Eric Middleton)
* Grape industry clientele decided to sign petitions, representing 15,000 acres, as a result of UCCE and the SCPCDC’s policy engagement efforts to establish a pest control district in the county. This is 75% of the acreage needed for the Agricultural Commissioner to move forward with the petition. If established, a pest control district is expected to bring in about $300,000 annually in assessment fees that would go towards board-approved trapping for and inspection of invasive species, educational outreach, and research programs. (Cindy Kron)

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

* UCCE's technical assistance provided to the San Diego County nursery and cut flower growers prevented significant crop loss. One grower estimated that the information on rodent management prevented $50,000 a year in crop loss, while the other estimated that their crop yield increased by 5% due to improved crop uniformity and height because rodents were no longer damaging drip. Both growers reported significant cost reductions in labor. One grower has saved over $20,000 in labor costs due to a significant reduction in the amount of pesticide applied. The 90% reduction in pesticide applied not only saved the grower money on the labor needed to apply the product, but approximately $30,000 reduction in cost because less pesticide needed to be purchased. The other grower saved approximately $3,100 on the labor needed to repair drip irrigation that was being damaged by rodents. (Niamh Quinn)
* The Regional Field Coordinator for the Western Region IR-4 program stated that there are about 90-100 research trials conducted in CA each year and UCCE does more than 90% of them. IR-4 is a specialty crops program and California produces 43.7% of the $8.97 billion value of U.S. specialty crops. Thus, UCCE Advisors and a UCCE Specialist working in collaboration with the national IR-4 program contributed to an increase of $3.92 billion in gross domestic product (GDP). (Jim Farrar)

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) For example, a UCCE chemical research trial for cucumber beetles identified that adding a feeding stimulant and using one quarter of the standard insecticide treatments performed equally as well as the standard treatment alone. One insecticide spray for cucumber beetle control costs roughly $25/acre. In the Sacramento Valley, insecticides are typically applied every 10-14 days. With the addition of the feeding stimulant which costs $5/acre, and a reduction in insecticide rate by one quarter, the cost of control per acre is reduced from $30 to $11.25. When adopted, this new IPM strategy to control cucumber beetles could save a grower up to $2,500 on a 100-acre field. (Amber Vinchesi-Vahl) 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**

**Issue**

Pests, diseases, and invasive plants decrease California’s agriculture efficiency and profitability. Eight to ten exotic arthropods are introduced to California annually, with nearly 20% developing into invasive pests. (Monica Cooper) In agricultural systems, pests and diseases reduce yields, render 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 UC Cooperative Extension (UCCE) Specialist located at UC Davis conducted human-wildlife conflict resolution research and extension. Trials were conducted to determine the effectiveness of elevated bait stations and traps for large scale roof rats, a pest in citrus orchards. This led to the development of an IPM program to compare the efficacy and cost effectiveness of this program to a bait station only management program. Final results were shared with California citrus growers, including through an Extension presentation attended by 157 clientele. (Roger Baldwin)

A UCCE Specialist located at UC Davis continued research in the identification and control of plant pathogens affecting the fruit and nut crops. Project topics included the detection and management of fungal canker diseases in almond and sweet cherry. Research trials were conducted with collaborating growers and at UC ANR’s Kearney Agricultural Research and Extension Center. Findings were shared with clientele, who include representatives of commodity boards, agrochemical and biocontrol companies, growers, fieldworkers, Pest Control Advisers (PCAs), field workers, and CDFA. (Florent Trouillas)

One UC Riverside UCCE Specialist is the director of the California Citrus Clonal Protection Program (CCPP), which provides a safe mechanism for statewide introduction of different citrus varieties from any citrus-growing area of the world for research, variety improvement, or use by the commercial industry and citrus enthusiasts. (Georgios Vidalakis)

A UCCE Advisor continued viticulture research in emerging horticultural pest and disease management. Extension activities, demonstration trials, and collaborations generated original, timely, readily available detection tools and evidence-based management strategies. Advocacy of policy decisions and public programs further optimized resource allocation and supported the adoption of sustainable agricultural production practices. Clientele testimonial regarding the UCCE Advisor’s role in providing accurate diagnosis and proper intervention: "I have sent this to a lot of people and no one has been able to identify the issue so clearly...I am very impressed." (Monica Cooper)

A UCCE Orchard Systems Advisor in the Sacramento Valley region continued research and extension in walnut blight, a disease that spreads in rain events during bloom and can directly reduce yield by over half. This disease is particularly important to address now as the region has experienced high rainfall while the industry faces low crop prices and record high costs of production. Promising practices, such as new spray materials that can be rotated, have been extended to clientele via popular press publications, podcasts, the UC Walnut Short Course, and other educational presentations. (Luke Milliron)

 A UCCE Advisor delivered a seminar focused on identifying and managing critical pests in Placer County, which was attended by 44 farmers, landscapers, and municipal landscape managers. (Cindy Fake)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices that increased agriculture efficiency and profitability. 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.**

* Participants of the citrus roof rat IPM presentation indicated they had gained new knowledge on rat management in agriculture (97%) and only 9% of attendees indicated they would not use at least one proposed technique in the future. (Roger Baldwin)
* Over 88% of farmers, landscapers, and municipal landscape manager participants (39 of 44) were able to identify the damage or threat caused by four key pests (Bagrada bug, Brown Marmorated Stink Bug, Leaf-footed Bug, and Asian Citrus Psyllid) and 84% were also able to identify these insects and the 3-cornered Alfalfa Hopper, which vectors Red Blotch disease in grapevines. (Cindy Fake)
* Growers and PCAs have shared that UCCE presentations and writing on walnut blight have been helpful in their understanding of the latest information on the disease. During these tenuous times in the walnut industry, growers being prepared for a potentially devastating threat like a bad blight infection, could save their operation. These outcomes demonstrate a boost in the resilience of walnut growers in the walnut blight affected region:
	+ Before one presentation half of survey respondents noted having only a “slight” or “not at all” understanding of the latest on managing walnut blight. After the presentation, only two responses noted a “slight” understanding, and the remaining 22 noted “moderate” or “comprehensive” knowledge.
	+ At another small webinar presentation, all seven survey responses reported learning something useful.
	+ After a grower presentation, eight attendees noted that a specific walnut blight management practice was the thing they were most likely to adopt in their operation after the meeting.(Luke Milliron)
* Twenty growers who attended demonstration field days shared intent to adopt the use of UCCE-developed agar-based baits to manage Argentine ants, building upon an outcome previously reported: widespread adoption of a polyacrylamide bait for Argentine ants in agricultural production systems. However, the carrier (polyacrylamide) is a synthetic substance, so use of the bait was not permitted in organic production. (Monica Cooper)

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

* During 2022, the CCPP’s budwood system registered 2,022 new users for a total of 9,787 overall users. Over 870 users placed 1,182 orders for 43,972 buds of 337 different citrus varieties.Therefore, this project not only has achieved measurable behavior change but has also reduced the risk of people smuggling desirable citrus varieties into California. (Georgios Vidalakis)
* Napa growers utilized disease testing for over 6,000 samples of the red blotch pathogen on grapevines and adopted loop mediated isothermal amplification (LAMP assay) with support from UCCE. 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)

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

* Nursery professionals who collaborated with UCCE have broadly adopted recommendations to improve the quality of sweet cherry planting stocks in California, as observed by UCCE. Recommendations included preventing the introduction of plant pathogenic fungi in orchards by applying Vintec® at grafting wounds. It was reported last year that UCCE research helped register Vintec®, and research since then has confirmed that application at grafting wounds reduced infection in trees by up to 80%. (Florent Trouillas)
* The number of growers adopting UCCE-recommended practices for organic leafhopper management in vineyards increased from two to 2021 to at least seven in 2022. Pioneer practices include adoption of crop oil sprays to target young instar leafhopper nymphs in the spring. UCCE observed widespread acceptance in industry sentiment and there are limited biological control and other options to reduce leafhopper feeding damage. (Monica Cooper)

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

* UCCE’s recently developed primers to detect almond canker pathogens were shared with diagnostic laboratories in California and are currently being used to support diagnosis efforts in many fruit and nut crops. This includes 22 primers or molecular markers and reduces typical processing time for the diagnosis of suspected canker pathogens to about 24 hours, compared to the 3-week time previously required. (Florent Trouillas)

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. 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**

**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 UC Davis UC Cooperative Extension (UCCE) Specialist continued research on Verticillium wilt, a fungus which poses a grave threat to the $1.5 billion lettuce industry in California. Comparative genome analyses were conducted to confirm that a new *V. dahliae* race 3 is present in California. Historically, the fungus from lettuce and other hosts belonged to either race 1 or race 2. Findings were shared with clientele including the California Leafy Greens Research Board, growers, seed industry, and several allied industries. (Krishna Subbarao)

A UCCE Advisor and a UCR researcher collaborated on field trials to evaluate a variety of Asian yardlong bean with resistance to aphids. Results from the 2022 production season showed lower aphid pressure and damage in lines with two introduced genes conferring aphid resistance. Findings were disseminated at a field day at the Kearney Agricultural Research and Extension (KARE) Center attended by 29 farmers, who were introduced to the long bean breeding program and field evaluation trials with translation in Hmong. (Ruth Dahlquist-Willard)

A UCCE Advisor conducted organic heirloom tomato research to identify rootstocks that, under disease conditions, provided economically viable disease protection. However, under non-disease conditions, the yield benefits are unpredictable and may not justify the high cost. The UCCE Advisor also evaluated four organic pesticide treatments on management of thrips in tomato to address gaps in research comparing the efficacy of organic products. The results identified three treatment options. Findings were disseminated via targeted events for industry, growers, and small-scale farmers. (Margaret Lloyd)

UCCE Advisors conducted research and extension on management tools for cucumber beetles, which damage melons, cucumbers, pumpkins, watermelons and squash. The research led to the identification of the plants which are housing cucumber beetles in the winter, two effective organic pesticides, and a pheromone lure to attract more beetles to fatal sticky traps. Findings were shared via trade journals. (Margaret Lloyd)

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. (Reported by Aparna Gazula; collaborators mentioned: Lucy Diekmann, Margaret Lloyd)

A UCCE Agronomy Advisor in the Sacramento Valley continued work on issues associated with the invasive, herbicide-resistant annual grass known as Italian ryegrass. The UCCE Advisor addressed this priority concern among grain growers despite having limited weed science expertise and limited expertise in the UCCE network to leverage. Promising research related to Italian ryegrass seed shatter rates indicated that proven IPM methods from other areas of the world should also work well in California conditions. These findings as well as those from local herbicide and tillage trials were extended to clientele via nearly a dozen webinars and presentations, as well as through blog posts and other publications. (Konrad Mathesius)

A UCCE Advisor continued research on BLH and BCTV, a damaging insect and disease affecting processing tomato growers in the northern San Joaquin Valley and lower Sacramento Valley. There were nineteen sites monitoring BLH population dynamics and BCTV incidence in Stanislaus County, covering a total of 3,200 acres of processing tomato fields. Samples of BLH and infested tomato plants have been collected from 37 monitored tomato fields. Findings were shared with the tomato industry in research meetings and pest classes. (Zheng Wang) The 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 biologically derived preventative fungicides can diversify soil beneficial microbial communities, avoid hazardous by-products, reduce leaching to groundwater systems, minimize volatilization, and control soil-borne fungal pathogens. Encouraging results from a commercial grafted watermelon field trial were shared in a California Association of Pest Control Advisers [magazine article](https://capca.com/publication/adviser-magazine-december-2022/). (Zheng Wang)

As a result of UC ANR research, outreach, and education, participants learned and adopted 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.**

* After the KARE field day activities, 18 farmers reported in surveys that they were interested in experimenting with the new varieties on their farms in summer 2023. Farmers requested supplies of seeds to plant a total acreage of 21.8 acres of the new varieties, including 8.65 acres (dark green), 10.325 acres (light green), and 2.85 acres (purple). UC Riverside will provide the seeds to farmers free of charge for experimentation. (Ruth Dahlquist-Willard)
* Seedbank Management and Physical Weed Control Strategies for Small-scale Vegetable Farmers Seminar post-survey results: 31 organic small farmers increased their knowledge on weed management, and 17 organic small farmers intend to adopt one or more weed seedbank and weed control strategies that were discussed. (Aparna Gazula)
* Classic Biocontrol for the Spotted Wing Drosophila seminar post-survey results: 25 organic small farmers increased their knowledge of biological pest management, and 18 intend to adopt one or more control strategies that were discussed. (Aparna Gazula)
* Growers reported increased likelihood of implementing seven major herbicide resistance management techniques in small grains. Based on post-meeting surveys, they also indicated knowledge gains in:
	+ Treating weeds with different herbicide modes of action: (33% increase)
	+ Treating a field during the fallow period (54% increase)
	+ Exploring Harvest Weed Seed Control options (56% increase)
	+ All of the above will contribute to reducing the spread of herbicide resistance and maintaining better control of invasive, herbicide-resistant weeds like Italian ryegrass in the future. (Konrad Mathesius)

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

* Central Coast organic heirloom tomato growers with soilborne diseases increased uptake of grafted plants while those without soilborne diseases abandoned grafting, which is an observed result of UCCE’s research and extension efforts. These efforts also advanced breeding efforts of “hybrid heirlooms”—hybrid varieties with more heirloom genetics, as a cheaper alternative to grafting. (Margaret Lloyd)

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

* Tomato growers are utilizing organic pesticide treatments recommended by UCCE research to inform their thrip management plans, as observed by UCCE. Growers have already started to share materials for 2023 trials with UCCE for continued collaborative research. (Margaret Lloyd)

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

* Lettuce breeding programs for Verticillium wilt resistance are utilizing UCCE’s research and will begin accounting for resistance against a newly identified race of the pathogen in California. (Krishna Subbarao)
* Growers reported that UCCE’s research is directly informing cucumber beetle pest management strategies. These strategies have the potential to save them money, yield and effort by comparison to otherwise ineffective strategies. (Margaret Lloyd)

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

* Processing tomato growers adopted UCCE’s recommendations of replanting early in the season to reduce the chance of BLH feeding and BCTV infection. Some fields prevented up to $1050 losses per acre (up from $900 reported by growers last year) compared to growers' other fields that were not replanted.(Zheng Wang)
* Growers adopted UCCE’s recommendation to request greenhouses to apply the biofungicides to watermelon transplants for the 2023 season on 792 acres of watermelons), potentially saving those growers up to $792,000. UCCE’s research found that this alternative to soil fumigation could save growers up to $1,000 per acre. (Zheng Wang)

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. Adopting UCCE’s recommendation to apply biofungicides to watermelons when transplants are still in the greenhouses saves watermelon growers up to $1,000 per acre with additional benefits of environmental and water resource protections compared with the application of fumigants to non-grafted fields. (Zheng Wang) 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

**Issue**

California is the nation's largest agricultural producer and exporter. The state's agricultural sector is vibrant and diverse, producing more than 400 commodities. For many of these specialty crops, California is often 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. Small-scale and limited resource producers are more exposed to risks and susceptible to failure, thus needing different market opportunities. In addition, aquaculture is expanding in California like elsewhere. In 2018, worldwide farmed seafood exceeded that produced from wild-caught fisheries.

**Methods**

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

A UC Cooperative Extension Specialist in Agricultural and Resource Economics at UC Davis worked with scientists across the UC ANR network, growers, and industry representatives to continue developing cost and return studies. During 2022, six new cost and returns studies were published online and were downloaded over 1,000 times by a total of 792 users. During this time period, all cost studies, including prior published studies, were downloaded 38,384 times by a total of 18,594 users. (Brittney Goodrich)

A UCCE Vegetable Crops Advisor worked on potato and UC ANR scientists tested varieties and played key roles in introducing new varieties that are responding to food and marketing needs, including various nut crops in the Central Valley. During the past year, data was collected from novel plant materials bred from more than a dozen scientifically designed pistachio trials with private cooperating growers and at the UC ANR West Side Research and Extension Center. (Craig Kallsen) A very well attended field day was held for a Central Valley regional almond variety trial, displaying more than a dozen cultivars that have been recently released or are under development. Part of the role of serving as a third-party evaluator of new cultivars and communicating the results is to temper interest, given that new cultivars can fail once they are planted more widely and exposed to more environments and management practices. This can be a particular risk for small growers who may only have one or two orchards on which they rely. (Phoebe Gordon) carrot variety trials, also in the Central Valley. She continued to offer an annual potato field day and hosted the Annual Potato Growers Meeting, attended by growers, breeders, and the private industry, to present the results from the variety trial as well as other potato trials. She also works with the Organic Seed Alliance, and other researchers from various universities, on a project “Carrot Improvement for Organic Agriculture” which develops and evaluates carrots with improved disease and nematode resistance and enhanced nutrition and flavor. She handles the coordination of the USDA National Carrot Winter Nursery at the UC ANR Desert Research Extension Center (DREC) in Imperial County. She also participated in the annual DREC field day after the harvest of variety trials for growers and breeders to see and evaluate carrot varieties in the field. Results are also presented at the Annual Carrot Research Symposium every year. (Jaspreet Sidhu)

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.**

* A new pistachio cultivar named “UC West Side” was released from the UC ANR breeding program to the pistachio industry, which is an improved pollenizer compared to the existing industry standard which has demonstrated problems with the Central Valley's increasingly warming winters. (Craig Kallsen)
* One new almond cultivar that was bred by USDA and was evaluated by UC ANR personnel was released and has been picked up by several nurseries. There is a lot of industry interest in this cultivar due to early promising results. (Phoebe Gordon)
* Two potato cultivars “Primabelle” and “Salinero” have been adopted by local growers and in 2022 Salinero comprised roughly 20% of the total production by one of the big growers in the area. The trials also provide confidence to growers that the varieties have been trialed in their area and are locally adapted, with improved yields and quality and improved resistance to common pests and diseases, contributing to the increased agriculture efficiency and profitability. (Jaspreet Sidhu)
* The Carrot Improvement for Organic Agriculture (CIOA) project along with Organic Seed Alliance released three varieties, two red R6220, R6636, and a yellow cultivar Y1246 in the last two years. Another carrot variety ‘Carnelian’ developed as part of CIOA is now commercially available from High Mowing Organic Seed. These variety trials allow organic growers to select varieties better suited for the region and maintain high productivity and carrot quality. (Jaspreet Sidhu)

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

* UC ANR cost and returns studies are used by members of California's agricultural industry to evaluate loans, inform farm production and financial management decisions, among a number of other uses. USDA agencies, including the Natural Resources Conservation Service and Farm Service Agency, use the cost and returns studies to determine loan rates and reimbursement rates for conservation programs like the Environmental Quality Incentives Program. The USDA Risk Management Agency uses the cost and returns studies to determine indemnities and premium rates for federal crop insurance policies. The California Department of Food and Agriculture also regularly uses the cost and returns studies, for example, see various Office of Pesticide Consultation and Analysis reports (Brittney Goodrich)

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.

# 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.

A UC Cooperative Extension (UCCE) Specialist in food safety located at UC Davis collaborated with scientists at Oregon State to develop and deliver a webinar to 100 scientists and policy experts from the Food and Drug Administration (FDA), as part of the FDA’s Center for Food Safety and Applied Nutrition Regulatory Research lecture series. They explained past, current and proposed research in survival of pathogens in curing onions and during postharvest handling through to final preparation. (Linda Harris)

UCCE Fresno County organized and conducted a Produce Safety Alliance (PSA) grower training workshop. This training is required for at least one representative of every farming operation fully covered by the Food Safety Modernization Act (FSMA). The training was spread over two days to facilitate interactive demonstration activities and translation and discussion in Hmong, using Cornell University's PSA-approved curriculum. (Ruth Dahlquist-Willard)

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.**

* Fourteen small-scale, socially disadvantaged farmers who attended the PSA training received certificates of completion, an essential requirement to be in compliance for FSMA inspections and are prepared to display the PSA certificate in the event that their farm is selected for an inspection. (Ruth Dahlquist-Willard)

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

* UCCE expertise, along with other diverse stakeholder input, was incorporated into the updated, second edition of the Commodity Specific Food Safety Guidelines for the Dry Bulb Onion Supply Chain (July 2022). The document provides science-based, recommended food safety practices for dry bulb onion production that are intended to minimize microbiological hazards. (Linda Harris)

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 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 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), CalFresh Healthy Living, University of California (CFHL, UC), Expanded Food and Nutrition Education Program (EFNEP), and UC Master Food Preserver Program (MFP). (UC 4-H, CFHL, UC, EFNEP, and MFP) For example, UC 4-H provides hands-on, experiential learning opportunities about healthy lifestyles with programs like 4-H Student Advisory Nutrition Councils (4-H SNAC Club) that have participation from over 486 youth. UC 4-H also conducts the Cooking Academy series, which provides youth development guidance for a teens-as-teachers approach for healthy eating and food preparation techniques that are delivered to other youth in the community. (UC 4-H)

A UCCE Food Safety Specialist located at UC Davis worked with collaborators to investigate the food safety implications of soaking nuts, a popular practice commercially and at home. Outbreaks of foodborne illness linked to consumption of soaked seeds or nuts or their products have been recognized in recent years. UCCE used surveys and analysis of blogs and videos to identify both the reasons for soaking nuts and the common practices employed. Foodborne pathogens were able to multiply in nuts soaked at certain temperatures. In collaboration with Purdue University, a webinar was provided for health educators and extension specialists in addressing food safety concerns related to soaking tree nuts. A total of 57 educators or food safety educators participated. Research related to this topic was presented by graduate students at the International Association for Food Protection annual meeting to 85 volunteers with the UC Master Food Preserver Program and to 50 students and faculty at Rutgers University. (Linda Harris)

A UC ANR Academic Coordinator works on the development and implementation of food safety training courses. The Academic Coordinator led a course for nutrition educators titled *Food Safety for Classroom and Other Food Activities,* which covers food safety considerations for recipe demonstrations and garden nutrition education. Seventy-three nutrition educators participated in the training and completed the course. (Lyn Brock)

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.**

* 4-H youth (310) statewide responded to the Healthy Living common measures survey, and 79% of youth reported knowing how to keep a cooking area clean to stop the spreading of germs due to what they may have learned at 4-H. (UC 4-H)
* Participants in the food safety webinar on concerns related to soaking tree nuts were presented with pre and post webinar surveys. Most (97%) reported learning new information, and 80% indicated that they would apply what they learned the next time they were handling nuts and seeds and that they would pass the information they had learned in the webinar to educate others. (Linda Harris)

**Participants adopted home food safety practices.**

* EFNEP surveyed over 1,650 participants, and 82% of adult participants showed improvement in one or more food safety practices, such as thawing frozen food at room temperature less often or using a meat thermometer, as a result of participating in the program. Out of 1,374 youth EFNEP participants, 51% to 57% of youth in grades 3 through 12 showed improvement in food safety skills and knowledge. (EFNEP) Local EFNEP outcomes include:
	+ In Alameda and Contra Costa counties, a survey of 579 K-8th grades who participated in Youth EFNEP programming showed that 49% of Contra Costa County respondents and 50% of Alameda County respondents reported improvements in food safety. (Marisa Neelon)
	+ In Alameda and Contra Costa counties, 277 out of 509 parents graduated from the EFNEP’s *Eating Smart Being Active* series. Survey results show that 72% and 64% 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 Sacramento County, teens delivered UC 4-H’s Virtual Cooking Academy series every other week for 12 weeks to elementary-aged students attending 10 Expanded Learning programs in Elk Grove Unified School District. Follow-up surveys showed that 57% of student participants used safe food handling practices more often or gained knowledge of these practices, 33% improved at putting cold foods back in the refrigerator, and 26% improved at washing fruits and vegetables. (Marianne Bird)
* Forty nutrition educators who participated in the *Food Safety for Classroom and Other Food Activities* course responded to a post-training survey. Participants reported that they planned to make at least one change in their food safety practices (82%) as a result of the training. The two most commonly reported planned changes in food safety practices were hand washing and garden food safety practices. (Lyn Brock)
* Youth who participated in the 4-H SNAC Club reported adopting better food safety practices. Of 25 youth surveyed, all reported they wash their hands frequently because of their participation. (Reported by Shannon Klisch; collaborators mentioned: Abbi Marrs and Mishelle Petit)

The above 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 3.6 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, 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.

UC ANR's statewide programs provide academic oversight and local implementation of the Expanded Food and Nutrition Education Program (EFNEP), CalFresh Healthy Living, UC (CFHL, UC), and the Master Food Preserver Program (MFP). EFNEP and CFHL, UC use evidence-based curricula to deliver direct education on food security to participants across California. CFHL, UC also works to enhance local capacity to develop school and community gardens. MFP trains volunteers to deliver food preservation and safety trainings so that participants can learn how to maximize food resources. (CFHL, UC, EFNEP, and MFP)

UCCE in San Luis Obispo and Santa Barbara counties seek to increase food security by increasing access to healthy local food. UCCE 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. (Shannon Klisch and Katherine Soule)

UCCE Advisors in Marin, Humboldt, Del Norte, Sonoma and Napa counties have created the North Coast Emergency Food Network and worked with community partners to bolster the local community’s preparedness for food insecurity during emergencies. (Dorina Espinoza and Julia Van Soelen Kim)

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.**

* In the North Coast, attendees of nine virtual Master Food Preserver demonstrations completed demonstration evaluations. The number of participants reporting “a lot” of knowledge of the demonstration topic increased by 50% after the demonstration and many reported they would try to use the food preservation and cooking techniques featured in the demonstrations. (Dorina Espinoza)

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

* As a result of UCCE’s partnership with community organizations and local governments, emergency food response was included in Sonoma County’s Recovery and Resiliency Framework. The county issued a County Request for Proposals for Emergency Food Providers, which was leveraged during the pandemic and 2023 winter storms and floods. (Julia Van Soelen Kim)
* Government agencies in the North Coast utilized a UCCE Advisor’s expertise to develop a 3-year plan for the creation of a centralized food hub, form the Emergency Food System Committee for Humboldt and Del Norte counties, and initiate the integration of emergency food systems into the County Offices of Emergency’s emergency plans. (Dorina Espinoza)
* A UC ANR Academic worked to increase county elected officials’ awareness of and support for farmers markets that accept CalFresh, leading to the creation of a proclamation recognizing Farmers Market Week across the county in August 2022. Celebrated nationally, 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: Kelly Hong, Mishelle Petit, and Rosa Vargas)

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

* In Alameda and Contra Costa counties, 277 out of 509 parents graduated from the *Eating Smart Being Active* series. Post-survey results show that 46% and 49% 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)
* Adult participants of CFHL, UCCE’s nutrition education in San Mateo and Santa Clara counties reported running out of food less often. One Santa Clara participant stated, “After taking these classes I have started to use MyPlate to make food choices along with comparing unit prices before buying food.” (Laura Vollmer)

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

* UCCE Advisors in San Luis Obispo County contributed to increased food security in communities by providing support that improved usage of Farmers Market EBT and Market Match programs. From the start of the programs in 2017 to 2021, purchase of local produce using healthy food incentive programs increased 397% for CalFresh and Market Match. (Shannon Klisch and Katherine Soule)
* After UCCE San Luis Obispo started convening Farmers Markets Work Group, UCCE San Luis Obispo worked with community partners and the local government to increase the number of local farmers markets and farm stands that accept CalFresh from nine sites to twelve sites. Additionally, there has been a 50-57% annual increase in CalFresh and Market Match redemption. This increase has generated $338,000 in direct income to local farmers and farmers markets in the last two years and over $600,000 since the collaborative work began. (Reported by Shannon Klisch; collaborators mentioned: Kelly Hong, Mishelle Petit, and Rosa Vargas)
* UCCE engaged Promotores in the Farmers Market Navigators program to increase the number of CalFresh customers by 165% and increase the total CalFresh and Market Match redeemed at farmers market by 171% compared to the same months of the prior year. (Reported by Shannon Klisch; collaborators mentioned: Mishelle Petit and Rosa Vargas)
* CFHL, UCCE in San Luis Obispo and Santa Barbara worked with extenders, schoolteachers, and staff at partnering school sites to harvest over 2,400 pounds of produce from school gardens. Produce was donated to school meal programs and local food pantries. (Reported by Shannon Klisch; collaborators mentioned: Miguel Diaz, Kelly Hong, Abbi Marrs, Mishelle Petit, Betsy Plascencia, Melissa Rorabough, and Rosa Vargas)

The measured outcomes reported above show 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 that address food security issues. Other outcomes indicate improvements in individual, family, and community food security. 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. COVID-related economic challenges continued to exacerbate food insecurity.

**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, social media, newsletters, websites, and individual contacts. (UC Master Gardener Program)

A UC Cooperative Extension (UCCE) effort in the San Francisco Bay Area region fosters urban agriculture viability. Eight workshops were conducted for producers on topics such as ground squirrel management, microgreens, backyard and pastured poultry, orchard management, and organic production. These workshops brought content experts from UC and elsewhere to teach urban, small, and specialty crop farmers about pest, nutrient, weed, and water management, among other topics. The 2022 Organic Production Series was attended by 545 farmers. (Lucy Diekmann)

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)

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.**

* Post-workshop evaluation surveys of the 2022 Organic Production Series were completed by 207 participants, and 92% reported increasing their knowledge of production topics and 69% intended to adopt one or more production practices. This new knowledge about urban agriculture and local food production can help contribute to food security, access to healthy foods, and community resilience. (Lucy Diekmann)

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

* Monthly meetings of the Food Security Action Group brought together County and City staff and food assistance providers in Santa Clara County to help prioritize strategies for addressing food needs as federal pandemic funding ended. This process resulted in a shared definition of “at-risk-for food insecurity,” spurred greater coordination among City and County staff, informed Board requests for additional action to address food insecurity, and made information about finding food assistance more accessible for county residents.  (Lucy Diekman and Laura Vollmer)

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

* 54% of 677 members of the public who participated in UC Master Gardener volunteer-led public education events 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.**

* Eighty members of the public, who participated in UC Master Gardener volunteer-led educational activities 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 measured outcomes reported above showed learning and behavioral changes related togrowing practices that contribute to increased community access to fresh produce.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.

#

# 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 (2017) of 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 information and tools needed to train agricultural and landscape management professionals.

A UC Cooperative Extension (UCCE) Specialist located at UC Davis developed the UC Master Beekeeper Program, which provides science-based education on beekeeping to a variety of interested clientele groups: general public, educators, youth, beekeepers, growers, pesticide applicators, etc. The program has several levels of mastery: apprentice, journey, and master level. In 2022, they have added a more general-public friendly level: Honey Bee Ambassador. Participants at all levels can take any of the number of different workshops/courses available and they must pass the corresponding level exam to move up in the program. To achieve the Master level, participants must complete an approved project and present it to the program’s panel. The main goal of the program is to support better beekeeping management to ensure healthy colonies to safeguard the safety and security of the food supply, as well as educate others about what they can do to help support honey bee and other pollinator health. (Reported by Elina Nino; collaborators mentioned: Wendy Mather, Kian Nikzad, Karine Pouliquen, Leah Taylor.)

A UCCE Nut Crops Advisor continues collaborating with the CDFA Fertilizer Research and Education Program (FREP). For the past several years, she has been the UC Nitrogen Course Instructor and, more recently, part of the exam writing committee member for Next Generation Nitrogen Management Training for Certified Crop Advisors. She contributed to the production of irrigation training modules for the study curriculum and development of Certified Crop Advisers (CCA) exams for the California Nitrogen Management Specialty certification. At least 155 CCAs who utilized the video training modules and other preparation materials took the CCA nitrogen management exam by mid-2022. (Mae Culumber)

Certified Crop Advisers (CCAs) are responsible for advising many growers and managing nitrogen application to a large number of acres. The curriculum for the Next Generation Nitrogen Management Training for CCAs was developed by UCCE Academics to help CCAs better advise growers on optimizing nitrogen application for all cropping systems. Various UCCE Advisors and Specialists were instructors for the course and others worked to develop exam questions for the certification program. (Sarah Light and Doug Parker)

Two UCCE Advisors working in environmental horticulture, including urban forestry, have been leading the Western Chapter of the International Society of Arboriculture’s education committee. They continued to plan a webinar series and hosted many sessions. The program has had almost 1000 attendees and provides Continuing Education Units. (Reported by: Jim Downer; collaborator mentioned: Igor Lacan) Igor had this outcome last year

UCCE developed the Green Landscaper curriculum in Spanish for training landscapers and workers in the landscape maintenance sector. (Maria de la Fuente)

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.**

* In 2022, 83 participants had an 86% pass rate to receive the California Nitrogen Specialty Credential. Since UCCE began working on this, close to 100% of the 225 growers responding to surveys have indicated an increase or slight increase in applied learning which can lead to the adoption of best management practices. (Mae Culumber)
* Since the project started, the Nitrogen Management Training for Certified Crop Advisers had a pass rate of 86% for 83 participants. (Sarah Light)
* During 2022, the UC Master Beekeeper Program certified 110 participants at all levels. Eleven participants obtained their Master level certification by completing independent projects. Some examples of those projects are: Starting own Commercial Beekeeping Business; Starting up a Queen Rearing Program within a beekeeping business; Developing a Children's Pollinator Education organization; and Developing Guidelines for Bee Removal Businesses. (Elina Nino)

**Participants gained landscape management competencies.**

* As a result of the sustainable landscape training offered in Spanish, 24 Hispanic participants were awarded a certificate of completion, increasing their professional competencies in this area. (Maria de la Fuente)
* Around 60 arborists received 92 hours of continuing education units to retain and renew their certification, granted by the International Society of Arboriculture. (Jim Downer)

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 obesity prevention, two areas where California ranks among the worst in the country.

**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) For example, UC 4-H hosted the 2022 California Camping Conference in Pollock Pines, where UCCE Advisors and community partners held workshops for volunteers, teen leaders, and professional 4-H staff. Topics included planning for emergencies, creating and implementing Covid protocols, creating welcoming and inclusive camp environments (including for LGBTQ+ youth), implementing STEM programming at camp, and learning about the power of the counselor-camper relationships. (Marianne Bird) UC 4-H also conducted Youth Experiences in Science (YES) training sessions for 55 Expanded Learning program staff in Chino and Fontana. Expanded Learning programs serve more than a half-million youth every day in before and after school programs, summer programs, and intersession learning programs and provide an opportunity to engage children in the process of exploration and learning. (Marianne Bird)

A UC ANR Academic provided the ServSafe® Food Handler Course to 73 nutrition educators. (Lyn Brock)

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.**

* Participants of the 2022 California Camping Conference strongly agreed that the information learned at the conference would improve the quality of their camp. All 68 participants reported that the conference gave them new ideas to implement at their camps and that the conference was a good investment of their time. In a retrospective survey, participants reported significant growth in knowledge about camp regulations and policies, best practices in program development and delivery, and resources available to support them in their camp leadership role. (Marianne Bird)
* Retrospective pre-post surveys from YES educators in Sacramento County indicate Expanded Learning staff grew significantly in their skills facilitating science education. Specifically, Expanding Learning staff improved their understanding of how to teach science to young children, how inquiry relates to science, and what was expected in their role teaching the YES project. All of the respondents reported that they enjoyed the YES training and 95% reported feeling prepared and confident in their role teaching YES. (Marianne Bird)
* All 73 nutrition educators who participated in the ServSafe® Food Handler Course completed the course and received the ServSafe® Food Handler certification on their first attempt. (Lyn Brock)

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 forest and climate workers.

**Methods**

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

The UC California Naturalist 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 natural history and environmental issues, increase public participation and civic engagement in environmental education, and enhance participatory 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 California Naturalist and Climate Stewards trainings. (Gregory Ira) The California Naturalist program’s Climate Stewards Academic Coordinator also modified the Climate Stewards course to fit the needs of the California Climate Action Corps Fellows. From March to August 2022, two pilot courses were delivered to a total of 50 CCAC Fellows in the 2021-22 Cohort. (Sarah Mae Nelson)

UCCE Advisor was a collaborator in the Modoc Shared Stewardship, a partnership between the Modoc County Farm Bureau (MCFB), Modoc County, Modoc National Forest (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 gained climate career competencies.**

* Among the California Climate Action Corps 2022 Cohort, 21 participants (72% of respondents) reported that the program improved their capacity to do their current work and 14 participants (48% of respondents) reported that the program improved their capacity toward work they would like to do in the future. (Sarah Mae Nelson)

**Participants increased capacity to deliver natural resources courses with fidelity to course requirements.**

* Of the 1103 California Naturalist participants trained, 940 were certified. From the perspective of California Naturalist train-the-trainer participants, evaluation results from an instructor training showed that 93% agreed with the statement: “training increased my knowledge of how to deliver an effective course.” Participants in courses offered by the trained instructors who completed an end-of-course survey continued to show statistically significant gains in participants' sense of self-efficacy and agency in responding to climate-related issues as well as gains in climate communication skills. (Greg Ira)

**Change in condition: Increased qualified workforce in forest management.**

* Nearly 100 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. Furthermore, 15 of the individuals became full-time federal employees, providing an economic benefit to the county. Employees have provided rangeland monitoring, marked timber projects, completed archeology and wildlife surveys, treated noxious weeds, accomplished National Environmental Policy Act (NEPA) compliance and more. This program also employs students, giving them experience for when they graduate and recent retirees who can provide institutional knowledge to the next generation of land managers. (Laura Snell)

The measured outcomes reported above demonstrate changes in learning and improvements in how participants work. Decision-makers, climate professionals, and forest 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 workforce retention and competency

**Endemic and Invasive Pests and Diseases**

**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 (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.

Asian farmers in the region 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, UC Cooperative Extension (UCCE) has coordinated annual workshops on topics related to pesticide safety, laws and regulations, and integrated pest management. (Aparna Gazula)

A UCCE Advisor resumed research and extension programs that benefit the olive industry in the North Coast, which has had a gap in UCCE expertise since 2016. The UCCE Advisor brought researchers to growers by launching the first annual North Coast Olive Field Day in 2022, which included research tables covering olive fruit flies and diseases, canopy management, alternate bearing and irrigation. Licensed attendees were offered continuing education units for renewing certificates and licenses to apply pesticides. The event reached the venue’s maximum occupancy of 65 attendees and provided attendees with intentional dialogue opportunities to establish relationships with fellow industry members and build a stronger cohesive olive industry in the North Coast. (Cindy Kron)

A UCCE Specialist located at the UC ANR Kearney Agricultural Research & Extension Center 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 UCCE Specialist developed *CitrusSprayEx* Windows-based application and *Airblast Spray Advisor* web app, which are decision support tools for planning and evaluating airblast spray applications. These tools were extended to clientele, including growers, pesticide applicators and sprayer operators, pest control advisors, certified crop advisors, and policy makers via airblast spray application webinars. UCCE offered continuing education units to webinar participants. (Peter Larbi)

Over the last few years, UCCE academics developed a [free online course on invasive shothole borers](http://www.ishb.org/), a pest that puts one third of southern California urban trees at risk of being killed. The course delivered information on the biology and impact of invasive shothole borers, how to identify the signs and symptoms of an infestation, and best management practices. It provided one hour of continuing education units to 351 green industry professionals in 2022. (Beatriz Nobua-Berhmann)

UCCE delivered innovative classes to address grapevine leafroll-associated viruses that cause economic impacts as high as $45 to $91 thousand per acre in Sonoma and Napa Counties. The viruses are vectored by mealybugs, which are guarded by ants, so the classes focused on ant management and included portable microscopes and ants collected from the field, as well as hosting an ant taxonomist to guide attendees through using the key and show photos of what each ant feature listed in the key looks like. Continuing education units were offered to grape industry clientele and other extension outputs included industry magazine articles. (Cindy Kron)

A UCCE Advisor continued extension work with the structural pest control industry, which is an $8.6 billion industry in the U.S. Clientele include pest management and application professionals, Pest Control Advisers, housing professionals, public schools, and municipalities. As one example, the advisor delivered an online workshop titled “Controlling ants around the home” and collected outcomes via post-talk surveys. (Siavash Taravati)

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.**

* Annually around 70 growers in Santa Clara received continuing education credits from UCCE, successfully renewed their pesticide permits for the past seven years, and are legally able to apply pesticides to manage pest issues in their crops. (Aparna Gazula)
* Participants of the olive field day who responded to a post-survey (n=32) indicated that they planned to implement knowledge gained from attending the field day (100%). Attendee testimonial: I found the day’s structure, your selected topics, and the structural guiding of attendees to make “socializing connection” an enormously important and overlooked aspect of similar events I’ve attended. (Cindy Kron)
* In post-workshop surveys, respondents universally highlighted their increased knowledge on the management of emerging tree pests and expressed their intentions to apply the best management practices they’d learned in these trainings. The online course is routinely used as a baseline training for professionals who are starting their jobs or have no experience with invasive shothole borers. Since launched in July 2019, 982 users completed the course and passed the final exam. (Beatriz Nobua-Berhmann)
* Sonoma and Napa participants of UCCE’s ant classes received continuing education units and in a post-survey (n=49) reported that they gained new knowledge about vineyard ants (100%) and plan to implement knowledge gained into their IPM programs (92%). Knowing how to accurately identify species of ants will allow for applications of ant baits that are effective, reduced mealybug damage and virus spread in vineyards, reduced amount of ineffective pesticides applied and their effects on the environment, and reduced costs of labor and materials from not applying ineffective baits. (Cindy Kron)
* All of 350 survey-takers who participated in the “controlling ants around the home” online workshop stated that they learned something new and 99.7% of them stated that they will implement some of the IPM practices they learned from the workshop in the future. Adoption of IPM has the potential to maximize pest control efficacy while minimizing the environmental side effects. (Siavash Taravati)
* Most of the 250 participants of UCCE’s airblast spray application webinars received continuing education credits for their qualified pesticide applicator certification with 52% being very likely or somewhat likely to adopt the new *Airblast Spray Advisor* web app and 39% being very likely or somewhat likely to adopt the initial *CitrusSprayEx* expert system. These decision support tools have the potential to improve spray application effectiveness, profitability, and environmental stewardship. (Peter Larbi)

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. The COVID-19 pandemic has also posed serious challenges to global, national, and local leaders and highlighted the importance of community leadership and resilience.

**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) empowered youth to take on leadership roles in research, teaching, and service-learning projects to improve their communities. (UC 4-H)

To understand the long-term impacts of the UC 4-H Youth Development program, UCCE 4-H academics studied how 4-H experiences shaped early adult outcomes. UCCE surveyed young and emerging adult alumni (ages 18-34) about their economic stability, health and wellbeing, and community involvement. (Reported by Nicole Marshall-Wheeler and Steven Worker; collaborators mentioned: Anne Iaccopucci and Roshan Nayak)

UC 4-H conducts an annual Public Speaking Confidence Study. While 4-H has a robust public speaking program, what influences youth's communication confidence has yet to be explored. The statewide study took place in 2020, 2021 and 2022, and explored what 4-H members report as their communication confidence and the role that UC 4-H has played in building that confidence. (Reported by: Nicole Marshall-Wheeler and Steven Worker; collaborators mentioned: Yu Meng and Roshan Nayak)

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. OTWS in Sacramento County has returned to in-person programming after two years of virtual delivery due to COVID. Over several months, teen staff and adult volunteers orchestrate and deliver weekend camp programs to 4th, 5th, and 6th grade 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 2022, ten teens and eight adult volunteers delivered OTWS to 86 students from three elementary schools. (Marianne Bird)

A UC 4-H Youth Development Advisor in Santa Clara County works to address the gap of Latinxs employed in STEM careers by leveraging the Teens as Science Teachers program. The program uses a civic engagement strategy where teens teach and mentor youth in their communities and serve as camp counselors. A collaboration with ANR program staff from CalFresh Healthy Living, UCCE, UC Master Gardener Program, California Naturalists, and Project Learning Tree ensured a variety of environmental educational experiences for teen teachers and camp participants. (Reported by Fe Moncloa; collaborators mentioned: Susan Weaver)

In Contra Costa County, five teen leaders participated in 27 weekly virtual meetings for 41 hours of education on a Youth Participatory Action and Research (YPAR) curriculum. The teens also learned about health inequities caused by the social determinants of health in preparation for choosing an issue they will work on during the school year. (Marisa Neelon)

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.**

* Six hundred ninety-five UC 4-H alumni who responded to the 4-H Alumni Study survey reported the program helped them develop their leadership skills (93%) and boosted their confidence in public speaking (88%). (Nicole Marshall-Wheeler and Steven Worker)
* 4-H youth who participated in the 4-H Public Speaking Confidence Study reported growing their public speaking skills at 4-H Club meetings (67%) and Presentation Days (64%). 4-H members report higher levels of confidence in public speaking the more years they have participated in 4-H, even when controlling for age. On average, 4-H members reported 89% public speaking confidence compared to a comparable sample of college students reporting 75% confidence. Findings also showed a positive correlation between public speaking confidence of 4-H youth and ratings given by external evaluators on the youth’s 4-H presentations. (Nicole Marshall-Wheeler and Steven Worker)
* The 41 youth who attended 4-H Officer Training in Colusa and Glenn counties reported they better understood their officer duties after attending the training, felt more prepared to successfully complete those duties, and felt more connected to their fellow 4-H officers. Additionally, 98% of participants reported feeling excited to be a 4-H club officer and hold a leadership role after attending Officer Training. (Nicole Marshall-Wheeler)
* Youth who participated in the 4-H SNAC Club reported gaining leadership skills. Youth rated their abilities as excellent, good, some, or no ability before and after the program, retrospectively. For all skills measured, there was an increase in good or excellent self-ratings after programming compared to before: I can lead group discussions (43% increase), I can work as a team member (23% increase), I can plan programs (41% increase) and I can teach others (46% increase). (Reported by Shannon Klisch; collaborators mentioned: Abbi Marrs, Mishelle Petit and Rosa Vargas)
* In Contra Costa County, a cohort of five YPAR teen leaders reported an increase in their ability to share research findings in a meaningful way to adults and decision-makers in their school and community (80% increase). (Marisa Neelon)

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

* Over 353 4-H youth responded to the universal positive youth development common measures survey and reported having leadership skills, including respecting others’ ideas (98%) and being comfortable working in a group (91%) as a result of what they may have learned at 4-H. (UC 4-H)
* Empirical evidence showed thirteen 4-H teen teachers learned to serve as camp counselors, teach four different environmental education curricula, and conduct focus groups with younger youth. Additionally, post-pre surveys of 4-H teen teachers demonstrated an increase in leadership skills and sense of belonging. (Fe Moncloa)
* Pre- and post-surveys from teen teachers delivering the OTWS program indicated they grew in leadership skills. Half of the teen teachers reported they grew in their ability to speak before a group, organize their time, lead discussions, teach, or share their opinions with adults. Additionally, 37% of teen teachers said they had grown in their ability to work as a team member and plan programs. (Marianne Bird)
* All of the OTWS teen teachers who delivered the program to elementary school youth agreed or strongly agreed that they felt they had made a significant contribution to their community as a result of the project. In addition, 62% of 4-H On the Wild Side participants scored better in their understanding of watersheds, characteristics of a lake with good water quality, and the concept that wildlife and humans share the same environment. (Marianne Bird)

The measured outcomes reported above demonstrate that leadership skills were learned and applied for the benefit of local California communities. Research findings published in the 2018 Health Education & Behavior journal indicate that involvement in YPAR such as the projects described above can lead to positive leadership, academic, and career outcomes. 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 46,632 youth and had over 5,776 adult volunteers contributing nearly 693,120 hours. Program activities empowered youth to take on leadership roles in research, teaching, and service-learning projects to improve their communities. (UC 4-H)

To understand the long-term impacts of the UC 4-H, UCCE 4-H Youth Development Academics studied how 4-H experiences shaped early adult outcomes. UCCE surveyed young and emerging adult alumni (ages 18-34) about their economic stability, health and wellbeing, and community involvement. (Nicole Marshall-Wheeler and Steven Worker)

UCCE helps improve scientific literacy in young people. A UCCE Advisor in Marin led the planning of a North Bay Science Discovery Day with exhibits from 52 organizations and nearly 6,000 attendees. The event, held at the Sonoma County Fairgrounds, was designed to spark young people's wonder and curiosity for science, technology, engineering, and mathematics (STEM). (Steven Worker)

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.**

* Ninety-five 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 resulting from what they may have learned at 4-H. (UC 4-H)
	+ 84% of youth reported when choosing a career, it is important to be passionate about the work they do
	+ 78% of youth report that for the type of career they want, it is important to go to college
* Three hundred thirty-one 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 learned in the 4-H program. (UC 4-H)
	+ 88% of youth reported liking science
	+ 73% of youth reported liking a job that involves using science
	+ 71% of youth reported interest in studying science after high school
* Youth who responded to a survey at the North Bay Science Discovery Day reported an increase in their fascination and enjoyment in STEM (71%). Additionally, 79% reported that they would seek out more STEM information and 64% said they would go to other out-of-school time STEM activities. (Steven Worker)

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

* Three hundred thirty-one 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 (89%), trying new things to see how they will work (90%), looking at how things are the same or different (83%), and comparing how different things work (81%). (UC 4-H)
* Ninety-five 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 resulting from what they may have learned at 4-H. Youth reported having intrapersonal professionalism skills such as it being important to arrive on time for work (96%), be trusted by an employer (100%), do their job well (100%), show respect for others (98%), and have a professional image on social media (71%). (UC 4-H)
* Six hundred ninety-five UC 4-H alumni who responded to the 4-H Alumni Study survey reported the program helped them succeed in their careers later in life (84%). (Nicole Marshall-Wheeler)

The measured outcomes reported above demonstrate 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. 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**

Programs like UC 4-H Youth Development Program (UC 4-H) and CalFresh Healthy Living, UC (CFHL, UC) deliver educational programs that increase civic engagement. Program activities like Youth-led Participatory Action Research (YPAR), Student Nutrition Action/Advisory Councils (SNAC Clubs), and 4-H On the Wild Side (OTWS) empowered youth to take on leadership roles in research, teaching, and service-learning projects to improve their communities. (UC 4-H, CFHL, UC) UC 4-H reached nearly 46,632 youth participating in clubs, afterschool programs, and camps, who were involved in projects around civic engagement, healthy lifestyles, and science, engineering and technology. Civic engagement projects included four focus areas: community engagement, service, civic education, and personal development. Over 5,776 adult volunteers contributed over 693,120 hours. (UC 4-H)

UCCE provided 4-H Water Wizards training sessions to school teachers and program staff in afterschool programs who delivered the project to youth in Alameda, Yuba, and Sacramento Counties. The program included experiential learning and civic engagement training prior to project implementation. The teachers led the project over 12 weeks and gave participating youth a pre- and post-test to measure their water knowledge. (Marianne Bird and Nicole Marshall-Wheeler)

To understand the long-term impacts of the UC 4-H Youth Development program, UCCE 4-H Youth Development Academics studied how 4-H experiences shaped early adult outcomes. UCCE surveyed young and emerging adult alumni (ages 18-34) about their economic stability, health and wellbeing, and community involvement. (Nicole Marshall-Wheeler and Steven Worker)

**Outcomes**

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

* One hundred ninety-seven 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 81% 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. Twenty-five youth surveyed agreed or strongly agreed with the statements, “I gained skills through serving my community that will help me in the future” (100%), and “I am more confident in helping others” (79%). (Reported by Shannon Klisch; collaborators mentioned: Abbi Marrs, Mishelle Petit, and Rosa Vargas)

**Participants engaged in community service.**

* Of the 197 4-H youth who responded to the Civic Engagement common measures survey about what they may have gained through 4-H, 73% reported they had done a community service project, and 73% said they look for ways to help when they learn about a problem in the community. (UC 4-H)
* Findings from the 4-H Alumni Study showed that the UC 4-H program helped foster a sense of responsibility in 4-H Youth that lasted into adulthood. A survey of 695 UC 4-H alumni showed that alumni volunteer 73 hours more than the general population. UC 4-H alumni reported volunteering 130 hours annually compared to the general population's 57 hours annually. Alumni also scored significantly higher than the general US population on indicators related to community involvement. For example, 65% of 4-H alumni always vote, compared to 57% of the general population. (Nicole Marshall-Wheeler and Steven Worker)
* Teen teachers who responded to pre- and post-surveys about the OTWS program indicated that they felt they had made a significant contribution to their community as a result of the project. (Marianne Bird)

**Participants saved water.**

* In Sacramento County, 34% of students reported using less water as a result of the UC 4-H Water Wizards program. (Marianne Bird)
* In Yuba County, 76% 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)

The measured outcomes reported above 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

**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. (CalFresh Healthy Living, UC; EFNEP; UC Master Food Preserver)

In Contra Costa County, five Youth-led Participatory Action Research (YPAR) teen leaders participated in 27 weekly virtual meetings for 41 hours of education on a YPAR curriculum. The teens also learned about health inequities caused by the social determinants of health in preparation for choosing an issue they will work on during the school year. (Marisa Neelon)

CFHL, UC worked with over 30 youth leaders statewide to lead direct education activities about nutrition, physical activity, and health across 13 counties. Over 850 youth statewide were also involved with shaping Policy, Systems, and Environmental (PSE) changes in their communities through participation in activities such as YPAR and Student Nutrition Advisory/Action Councils. (CFHL, UC)

**Outcomes**

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

* After participating in the YPAR projects with CFHL, UC, 108 youth responded to a follow-up survey saying that they could “Yes, probably” (40%) or “Yes, definitely” (45%) make a difference in their community. (CFHL, UC)
* In Contra Costa County, a cohort of five YPAR teen leaders reported an increase to in wanting to make a difference in their school or community (60% increase), knowing where and how to gather valuable data on making their school or community a healthier place (80% increase), understanding how their surrounding affects their health (60% increase), and seeing themselves as part of a youth community that can solve their concerns (60% increase). (Marisa Neelon)

**Participants engaged in community service.**

* Over 2,271 volunteers donated 33,797 hours across three statewide programs.
	+ 1,634 CFHL, UC volunteers donated over 15,313 hours towards nutrition and physical activity education. (CFHL, UC)
	+ 248 EFNEP volunteers donated over 1,851 hours towards assisting in nutrition extension programming (EFNEP)
	+ 389 UC Master Food Preserver volunteers donated over 16,633 hours towards food preservation classes and demonstrations. (UC Master Food Preserver).

The measured outcomes reported above 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 California Naturalist 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 California Naturalist and Climate Stewards certification courses. (Greg Ira)

A UC Cooperative Extension (UCCE) Specialist located at UC Davis developed the UC Master Beekeeper Program, which provides science-based education on bee keeping to a variety of interested clientele groups: general public, educators, youth, beekeepers, growers, pesticide applicators, etc. The program has several levels of mastery: apprentice, journey, and master level. In 2022, they have added a more general-public friendly level: Honey Bee Ambassador. Participants at all levels can take any of the number of different workshops/courses available and they must pass the corresponding level exam to move up in the program. To achieve the Master level, participants must complete an approved project and present it to the program’s panel. The main goal of the program is to support better beekeeping management to ensure healthy colonies to safeguard the safety and security of the food supply, as well as educate others about what they can do to help support honey bee and other pollinator health. (Elina Nino)

**Outcomes**

**Participants engaged in community service.**

* The number of California Naturalist course alumni recording volunteer hours has grown to 948, a nearly 55% increase in three years, participating in naturalist-related civic engagement. In 2022, California Naturalist volunteers donated over 57 thousand hours engaging in participatory science, land, and water stewardship, environmental justice, and education and interpretation activities. (Greg Ira)
* A crucial premise of the program is volunteerism provided by the program members who provide additional education opportunities in their communities. With 400 active members, the volunteers have provided 3,216 contact volunteer hours reaching thousands of community members to educate them about the importance of pollinators to continued food supply. Perhaps the biggest event where volunteers extend educational information to the general public is the California Honey Festival which has an estimated 30,000 attendees in 2022. (Elina Nino)

The measured outcomes reported above 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 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 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 provides members of the public who apply and are accepted into the program with 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 6,170 Master Gardener volunteers provided 377,890 hours of public service in 52 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)

The above measured outcome demonstrates 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.

#

#

# 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)). Farmworker communities were hard hit by the pandemic; crowded living and working conditions, low wages, and fear of deportation all contribute to high rates of COVID-19.

**Methods**

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

UC Cooperative Extension (UCCE) Dairy Advisors worked with a group of UCCE Specialists located at UC Davis School of Veterinary Medicine to investigate the application of the Community of Practice model as a professional development strategy for farm workers. Each farm represents a separate case study. They concluded the project on two dairies and are looking for more. The findings will be extended through an American Dairy Science Association meeting and UCCE Dairy newsletters. (Reported by Daniela Bruno and Betsy Karle; collaborators mentioned: Roselle Busch, Martin Smith)

A UCCE Viticulture Advisor continued collaborative work with the Napa Valley Farmworker Foundation to develop a unique agriculture-specific workplace assessment tool that 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 her team in Santa Clara County continued to identify or develop research-based information for protecting food system and farm workers. This included creating a How to Protect Oneself From Risks When Working in an Agricultural Operation PowerPoint presentation and New Fieldworker Training Requirements PowerPoint presentation. Educational materials were developed in Chinese, English, and Spanish and extended via inclusiveness workshops, and technical assistance. (Aparna Gazula)

A UCCE Specialist working on social justice in agriculture at UC Berkeley conducts evaluation research on social certification in agriculture. The researcher works with the Equitable Food Initiative (EFI) in its continuous improvement process to strengthen its social certification and workforce development program. EFI’s primary goal is to improve the working conditions of farmworkers in California and beyond. (Christy Getz)

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-seven growers and a grower cooperative pesticide dealership 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. (Aparna Gazula)

**Farmworkers had learning gains intended to improve working conditions.**

* The community of practice approach empowered dairy employees to bring their experiences and knowledge to the table to make decisions on the dairy. Facilitating the development of the communities of practice promoted peer-based learning and improved antimicrobial drug use practices on the farm. Farmworkers were able to openly discuss challenges and potential solutions, increasing engagement and reducing protocol drift. (Betsy Karle)

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

* EFI has implemented an additional evaluation-based recommendation from a 2017 UCCE report to streamline its audit process with other IPM audits and become the only certification that meets retailer requirements for social responsibility, food safety, pest management, and pollinator health in a single audit. By helping to lessen auditing burden, this streamlining will enable more farms to become certified, thus improving conditions for farmworkers on more farms. (Christy Getz)

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

* Thirteen forward-thinking Napa Valley grape growers sought feedback from 311 farmworkers. Of the participating employers, seven responded to a follow-up survey and 100% found the survey very useful, and they used the feedback from their workers in various ways: 50% made adjustments to compensation, 63% adjusted communication between workers and managers. In addition, 100% reported results to managers and 43% reported results to workers. After the worker survey, they observed changes among their teams, including higher morale (57%), greater motivation (57%), and lower turnover and absenteeism (29%). Vineyard management companies used the results internally, as well as externally in budget conversations with their clients. (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 4-H Youth Development Program in the San Francisco Bay Area continued work to address the gap of Latinxs employed in STEM careers by leveraging the Teens as Science Teachers program. The program uses a civic engagement strategy where teens teach and mentor youth in their communities and serve as camp counselors. A collaboration with ANR program staff from CalFresh Healthy Living, UCCE, UC Master Gardener Program, California Naturalists, and Project Learning Tree ensured a variety of environmental educational experiences for teen teachers and camp participants. (Reported by Fe Moncloa; collaborators mentioned: Susan Weaver)

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**

**UC ANR better engages communities historically underrepresented in its programs.**

* As a result of UCCE Santa Clara County integrating more equity and Latinx youth development practices into extension programs, they were better able to engage Latinx youth and families. Thirteen immigrant teens learned to serve as camp counselors and teach four different environmental education curricula to camp participants, which included 34 Latinx children. Post-pre surveys of 4-H teen teachers demonstrated an increased interest in STEM. In addition, 80 Latinx family members participated in the camp’s family night BBQ and engaged in STEM activities. (Fe Moncloa)

The measured outcome reported above demonstrates 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, reinforcing 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. (Marisa Coyne)

**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.

UC SAREP led a project to educate extension professionals about the needs, challenges, and strategies for engaging with clientele in communities of color in California. Six 1.5-hour webinars were conducted covering topics ranging from building relationships with agricultural communities of color, to respecting different knowledge systems, to rectifying racial inequities in land access. Speakers included a range of experts, from farmers of color and leaders of tribal-serving organizations and other nonprofits, to UCCE and NRCS extension professionals. Two focused on indigenous and farmer of color perspectives on sustainable agriculture, with 40 and 42 attendees respectively, and two focused on racial disparities in farmland ownership, with 42 attendees, and innovative approaches to land sovereignty and tenure had 26 attendees. [Webinar recordings](https://youtube.com/playlist?list=PLLjlfxpbNglZnj700E62ZB4Gn4UoKAsYv) were posted to UC ANR’s Youtube Channel. (Sonja Brodt)

UCCE collaborated with underserved farmers in the Capitol Corridor, including approximately 200 Hmong (pronounced “mohng”) and Iu Mien (pronounced “yew me-en”) farmers, immigrants from Southeast Asia, who predominantly grow conventionally managed strawberries, vegetables and flowers. Language and cultural barriers have prevented these farmers from integrating into and receiving resources standard for California farmers. The UCCE Advisor worked with the Department of Pesticide Regulation to fund an integrated pest management (IPM) extension program for Hmong and Iu Mien farmers in Sacramento. The funding was used to hire two staff persons, a Hmong and Iu Mien speaker, to develop a culturally targeted outreach program. They conducted many on-farm visits and workshops, educating growers about soil health, pesticide safety, and regulatory compliance. As a result, the UCCE Advisor increased reach from zero to 30 Hmong farmers and doubled the reach to Iu Mien farmers to 80+. Also critical to building enfranchisement of these communities, the UCCE Advisor brought representation of the needs of the Iu Mien strawberry farmers to the industry. This resulted in a collaboration with the UC Strawberry Breeding Program. New, flavorful varieties bred with improved yield and disease resistance were distributed to the Iu Mien farmers. (Margaret Lloyd)

A UCCE Advisor to the UC Master Garden Program of Santa Clara County initiated, designed, and led a hybrid Initial Training in 2022 to address barriers to broad participation in the Santa Clara County Master Gardener Program. The training combined weekly Zoom lectures with outdoor, in-person meetings to do hands-on activities. It also incorporated content on engaging diverse communities and intercultural competence. The class of 2022 showed promising results for increasing access to the program: 67% of trainees reported that an evening and weekend class schedule increased access and that they would not have been able to participate otherwise. (Reported by Lucy Diekmann; collaborator mentioned: Katherine Uhde)

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**

**UC ANR better engages communities historically underrepresented in its programs.**

* Members of this class are already engaged in outreach to diverse communities: e.g., they started a monthly workshop series in partnership with an urban farm and are planning to highlight different cultural organizations at the annual spring garden market and fair. Because of the efforts to increase access, it is anticipated that the Master Gardener Program of Santa Clara County will better engage historically underrepresented communities in their programming and outreach. (Lucy Diekmann)
* In response to the evaluation surveys for the UC SAREP webinars, 48 indicated gaining increased awareness of the topics and learning new knowledge, 17 learned new skills, and 39 changed their opinions and/or attitudes about the topics. The importance of investing time in building relationships with people of color in the context of one's work was particularly mentioned by respondents as something they learned. (Sonja Brodt)

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

* Farmers who worked with UCCE to receive disbursements of state funds for minority and underserved clientele increased their capacity to be stewards of the environment. Specific outcomes below demonstrate the impact of intentional efforts to be inclusive via a culturally targeted outreach program:
	+ Growers in one year built 1660 feet of native hedgerows that recruit beneficial insects for pest management.
	+ UCCE motivated 11 farms to use compost for the first time which increases plant and soil health, and reduces pesticide use. These practices, which shift a farm to become more sustainable, cost money. While the initial investment can be recouped, it's often not realized for years. Many farmers cannot afford this, even if they would like to make the change. Our grant funded those initial supply costs.
	+ Beyond the Department of Pesticide Regulation grant, 38 farmers utilized UCCE’s expertise to receive over $200,000 in financial assistance from two California Department of Food and Agriculture programs.
	+ Two farmers collaborated with UCCE to establish major contracts with the Natural Resources Conservation Service for high tunnels and new tractors that reduce air pollution.
	+ Fourteen Iu Mien/Hmong farmers who received direct UCCE technical assistance became compliant with county-based agricultural regulations. Numerous others received guidance from UCCE and pursued compliance independently. Regulatory compliance can increase the safety practices on the farm reducing injury or environmental harm, but it also prevents farmers from being fined or put out of business.
	+ 16 farmers safely and legally sell jam from their farm stand due to a partnership with a UCCE Advisor and the Master Food Preservers. In just one month, one farmer participant began selling his jam after receiving training on preservation.
	+ As a result of UCCE’s food safety training and outreach, farmers have been observed changing the way they harvest, clean, and prepare their produce. This is setting them up for legal and safe marketing of fresh produce.
	+ Iu Mien farmers are now accessing competitive strawberry varieties and are able to produce higher yielding and healthier plants, reducing pesticide use. Furthermore, the needs of this cliente group are included in a $6.2 million grant focused on California strawberry production. (Margaret Lloyd)

The measured outcomes reported above 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.

#

#

#

# PROMOTING HEALTHY PEOPLE AND COMMUNITIES

##

## 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 3 million Californians suffer from diabetes and over 8 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 58,000 youth and adults, and 1,400 food tastings with over 24,000 students. 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)

A UC ANR Advisor in Alameda County partnered with 28 preschools in Oakland Unified School District to conduct education on nutrition, wellness, and physical activity and help support policy, system, and environmental changes. Sixty-six Early Childhood (EC) teacher extenders used the Happy Healthy Family Curriculum (six lessons) to reach 1545 children under five years old with nutrition and wellness classroom activities. (Mary Blackburn)

UCCE academics provide oversight, leadership, and guidance for the statewide implementation of the Expanded Food and Nutrition Education Program (EFNEP) statewide programs. These programs serve 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 Eating Smart Being Active (ESBA) and other programs to over 8,109 youth and adults. (EFNEP)

**Outcomes**

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

* Over 700 CFHL, UC participants statewide responded to a survey about their experience with the *Plan, Shop, Save, Cook* or *Making Every Dollar Count* curricula, with 55% 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 at school (71%) and being more willing to ask for the food at home (65%). (CFHL, UC)

**Participants adopted healthy eating practices.**

* EFNEP surveyed over 1,660 adult participants, and 98% reported improvements in their diet quality, including eating more red and orange vegetables (64%), eating more dark green vegetables (61%), and eating fruit more often each day (54%). Out of 1,779 youth EFNEP participants, 83% reported improvements in their diet quality, including eating more vegetables (35% of 3rd-8th graders and 44% of 9th-12th graders) and eating more fruit (34% of 3rd-8th graders and 37% of 9th-12th graders). (EFNEP) Local highlights follow:
	+ In Alameda and Contra Costa counties a survey of 579 K-8th grade students showed that 86% of Contra Costa County respondents and 55% of Alameda County respondents reported improvements in healthy food choices. Teachers observed that students who participated in EFNEP programming choose less sugary snacks and beverages and drink more water. (Marisa Neelon)
	+ In Alameda and Contra Costa counties, 277 out of 509 parents graduated from the ESBA series. Post-survey results show that 98% 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 a statewide survey of 375 adult CFHL, UC participants, many reported making improvements in several healthy eating practices, such as drinking less soda (44%) and eating more cups of fruits and vegetables in a day (71%) after participating in CFHL, UC education. (Lyn Brock and CFHL, UC) Local highlights follow:
	+ CFHL, UCCE in Santa Barbara County hosted a virtual Family Cook Night. Parent attendees of the class reported in pre-/post-surveys that they would make changes related to avoiding the use of food as a reward (66%) and would offer food again to kids after they reject it the first few times (92%). (Reported by Shannon Klisch; collaborators mentioned: Miguel Diaz, Kelly Hong, Mishelle Petit, Betsy Plascencia, Melissa Rorabough, and Rosa Vargas)
	+ Fourth grade participants of CFHL, UCCE programming in Santa Barbara reported an increase in vegetable (33%) and fruit consumption (35%). (Reported by Shannon Klisch; collaborators mentioned: Miguel Diaz, Mishelle Petit, Betsy Plascencia, and Rosa Vargas)
* Youth who participated in the UC 4-H SNAC Club reported adopting healthy eating practices. Twenty-five youth surveyed agreed or strongly agreed because of participating in this program, “I use cooking skills to prepare food at home” (76%), and “My family has purchased healthier foods” (92%). (Reported by Shannon Klisch; collaborators mentioned: Abbi Marrs, Mishelle Petit, and Rosa Vargas)
* In Alameda County, 48 teacher extenders of the Happy Healthy Family Curriculum reported the following observations of children’s behavior changes compared to the beginning of the year and found: 63% of students bring fruit as snacks, 52% more eat fruit and vegetables in the cafeteria, 92% will try new food, and more students are eating breakfast (88%). Pre- and post-surveys by the children indicated increases in fruit and vegetable intake (52%) and reductions in consumption of sugary drinks (26%). (Mary Blackburn)

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

* EFNEP surveyed over 1,650 adult participants, and 85% reported increasing their physical activity. Sixty-seven percent of adults made small changes to be active more often and 63% increased the number of days they exercised for at least 30 minutes. Out of 1,765 youth EFNEP participants, 55% reported increasing their physical activity. Thirty-nine percent of 3rd thru 8th graders and 34% of 9th through 12th graders increased the number of days they were active or at least 60 minutes. (EFNEP) Local highlights follow:
	+ In Alameda and Contra Costa counties, a survey of 579 K-8th grades showed that 62% of Contra Costa County respondents and 28% of Alameda County respondents reported improvements in physical activity. (Marisa Neelon)
	+ In Alameda and Contra Costa counties, 277 out of 509 parents graduated from the ESBA series. Post-survey results show that 70% 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 Alameda County, pre- and post-surveys by children who participated in the Happy Health Family Curriculum indicated increases in physical activity (42%), and muscle strengthening activities (19%). (Mary Blackburn)
* In a statewide survey of 375 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 (59%) and making small changes to be more physically active (63%) after participating in CFHL, UC education. (CFHL, UC)
* 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 (72%). (Reported by Shannon Klisch; collaborators mentioned: Miguel Diaz, Mishelle Petit, Betsy Plascencia, and Rosa Vargas)

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

**Healthy Families and Communities - In Youth Development**

**Issue**

California’s rapid population growth increases pressure on community resources and presents numerous challenges to health and safety. Adult and childhood obesity is a public health crisis for the state and nation, resulting in many negative health consequences. According to the Centers for Disease Control (CDC) Behavioral Health Risk Surveillance System, 64% of California’s adults are overweight or obese, and obesity in California’s adult population has increased over 15% between 2015-2020. The CDC’s Youth Risk Behavior Survey also indicates that 30% of California’s high school-aged youth are either overweight or obese. Childhood obesity alone is estimated to cost the nation $14 billion per year.

**Methods**

UCCE academics provide oversight, leadership, and guidance for the statewide implementation of the University of California 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 46,632 youth. (UC 4-H) This includes 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)

To understand the long-term impacts of UC 4-H, UCCE 4-H Youth Development Academics studied how 4-H experiences shaped early adult outcomes. UCCE surveyed young and emerging adult alumni (ages 18-34) about their health and well-being, as well as community involvement and economic stability. (Nicole Marshall-Wheeler and Steven Worker)

**Outcomes**

**Participants adopted healthy eating practices.**

* In Sacramento County, teens delivered the 4-H Virtual Cooking Academy to elementary-aged students attending 10 different Expanded Learning programs in Elk Grove Unified School District. Follow-up surveys showed that 80% of youth improved their abilities to choose foods according to Federal Dietary Guidelines, 33% improved in their responses on drinking less soda or fruit flavored drinks and eating more fruit as a snack. (Marianne Bird)

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

* Findings from the 4-H Alumni Study showed that the UC 4-H alumni scored significantly higher than the general US population on indicators related to health and well-being. (Nicole Marshall-Wheeler and Steven Worker)

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

Condition Change: UC ANR contributed to improved 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 CDC, more than 3 million Californians suffer from diabetes and over 8 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)

**Outcomes**

**Participants adopted edible gardening practices.**

* Participants of public education events led by UC Master Gardener volunteers responded to a 2022 statewide survey and 73% (of 689) reported starting or improving the growing of edible plants and 60% (of 675) expanded varieties of edible plants grown.

Also, 992 reported applying what they learned to 400,274 square feet of food gardens. These behaviors are correlated with increased consumption of fruits and vegetables.

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

* 63% of 1,375 respondents spent more time gardening and outdoors, which is associated with improved individual emotional and physical health. (UC Master Gardener Program)
* Over 598 participants of UC Master Gardener volunteer-led educational programs reported in a statewide survey that they started or improved practices on 1,472,355 square feet of home gardens in California. (UC Master Gardener Program)

The measured outcomes reported above lead to improved health for Californians. Health is improved 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 3 million Californians suffer from diabetes and over 8 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 Coordinated Approach to Child Health (CATCH) and Gardens were conducted to increase healthy choices, food-based gardening, and quality physical activity in early childhood centers, schools, and community environments. (CFHL, UC)

One NPI Academic led two studies, one in California and one involving multiple states, to determine if WIC participants would prefer changes to the WIC food packages, specifically, an increase in the WIC cash value benefit (CVB) for fruits and vegetables. In response to COVID-19, the CVB was increased nationally on a temporary basis. NPI collected qualitative and quantitative data from WIC participants in California and five other states to understand the impacts of this change. NPI also led the publication of several reports demonstrating that the COVID-related pivot to virtual WIC interactions were viewed favorably by both WIC staff and WIC participants, and both participants and staff want these changes to be made permanent, and shared these findings with national organizations and government agencies. (Lorrene Ritchie)

NPI academics provided 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. Academics 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)

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. (Lucy Diekmann and Laura Vollmer)

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 286 SNAP-Ed sites, contributing to improved community health and wellness for more than 108,000 people. For example, 111 program sites in 19 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 highlights follow:
	+ CFHL, UCCE in Santa Clara, San Mateo, and San Francisco counties supported 83 policy, system, and environmental changes at 67 sites. The most common strategies were improving or increasing structured physical activity, providing fruit and vegetable taste tests, and improving practices related to healthy choices in school meals. For example, UCCE in San Mateo and Santa Clara counties provided more opportunities for structured physical activity during recess in schools using the CATCH curriculum. Principals at the schools observed increased participation in physical activity during recess, and appreciated that the games were more cooperative than competitive. (Laura Vollmer)
* CFHL, UC sites statewide adopted or enhanced edible gardening and food access strategies, including new or expanded edible gardens at 86 sites, initiating or expanding a mechanism for distributing seedlings and/or other materials to families or communities for home gardening at 28 sites, initiating or expanding use of garden produce for meals and snacks at 30 sites, providing opportunities for the community to work in an edible garden at 68 sites, and initiating or expanding farm-to-table use of fresh or local produce at 9 sites. (CFHL, UC)

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

* A UC ANR Academic was invited to present findings of research on pandemic-related changes to WIC to state and federal departments that administer WIC. One finding showing that WIC staff and participants want virtual nutrition education options to continue post-pandemic was well-received. The USDA and states are using the findings to inform WIC program improvements and virtual nutrition education is increasingly being utilized with WIC populations. (Lorrene Ritchie)
* Findings from NPI’s research on WIC’s CVB demonstrated that WIC participants have a strong preference for the increased CVB amount, and that the CVB increase translated into higher fruit and vegetable intakes by young children on WIC in the multi-state study. NPI shared these findings, which were recognized by the Nutrition and Obesity Policy Research and Evaluation Network as being the most influential research for informing policy and cited by the USDA in their recommendation to permanently increase the WIC CVB. (Lorrene Ritchie)
* 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 contributed to the passage of a bill that improved drinking water access and promotion in California schools (CA AB 2638), and included submission of recommendations to the 2022 White House Conference on Hunger, Nutrition, and Health to support drinking water and decrease sugary drink consumption. (Christina Hecht)
* UCCE Advisors collaborated with county partners to develop the Santa Clara County Food System Workplan in 2021. As a result of this collaboration, they identified 7 overarching goals and 36 recommendations to guide County food system efforts, and proposed measures for evaluating progress on the Workplan. In 2022, through the efforts of the UCCE Advisors, County departments and local organizations, 4 recommendations were completed and 17 were partially implemented. Early achievements included the adoption of the Good Food Purchasing Program for County jails and hospitals. (Lucy Diekman and Laura Vollmer)

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 access to positive built and natural environment

Extension Program: Plant Production; Title: Improving 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 environmentally friendly and edible gardening for members of the public interested in and working to build new and sustain existing school and community gardens. (UC Master Gardener Program)

As a result of UCCE research and extension efforts, participants learned about the environment and increased access to positive built environments. Outcomes with specific indicators follow.

**Outcomes**

**Participants expand and sustain school and community gardens.**

* Seventy-two participants of UC Master Gardener volunteer-led educational programs reported in a statewide survey that they applied practices 101,705 square feet of school and community gardens. 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. Gardening interventions also have the potential benefit to the broader community. (UC Master Gardener)

The above measured outcome demonstrates 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. 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. 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 land managers and owners balance the social, economic, and ecological benefits.

**Methods**

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

A UC Cooperative Extension (UCCE) Small Farms Advisor responded to the needs of growers, managers, and groundskeepers for science-based information that sustain economic vitality while protecting environmental quality in agricultural areas, open spaces, and parkland. Specifically, information was shared about ground-burrowing rodents are a significant pest species. (Aparna Gazula)

UCCE Advisors designed a monitoring project for blue oak, which are keystone species in many oak woodlands, with input from ranchers, agency personnel, and UC oak experts. Three research plots were established in fall 2021 and oak growth, vigor, mortality rates, and regeneration rates will be monitored for at least 10 years. The first year’s data was shared at the 2022 Oak Symposium. The project aims 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. (Reported by Rebecca Ozeran; collaborators mentioned: Julie Finzel, Devii Rao)

A UCCE Advisor was invited by the California Department of Fish and Wildlife to serve on a committee to develop direct compensation and pay-for-presence programs for ranchers impacted by Gray Wolves in California. UCCE’s participation in their statewide committee helped inform these two programs. (Dan Macon)

A UCCE Advisor in the San Francisco Bay Area delivered presentations on wildlife and worked directly with various agencies, agricultural producers and residents to foster an enhanced understanding of how to minimize conflict with wildlife and how to differentiate what is expected vs. concerning wildlife behavior. Clientele include government agencies, agricultural producers, and residents in urban and suburban areas. (Carolyn Whitesell)

A UCCE Advisor and Project Scientist conducted a research project to develop a bioeconomic model to assess the costs and benefits of invasive shothole borers management in California. One-third of southern California urban trees are at risk of being attacked and killed by invasive shothole borers. Infestation data was provided from a UCCE monitoring project at OC Parks and from a statewide UCCE trapping program. The results of the analyses have been used to inform policymakers, such as the inter-agency Invasive Species Council of California, and the public on the costs of invasive species, or the benefits of investments in better management. (Karen Jetter and Beatriz Nobua-Behrmann)

A UCCE Advisor created awareness of emerging tree pests problems at a statewide level by working collaboratively with staff and advisors from other UCCE offices and state and federal agencies to design state-wide management strategies for emerging tree pests. Invasive tree pests are one of the biggest threats to the integrity of the urban forest in Southern California. Some species, like the goldspotted oak borer and the invasive shothole borer beetles, have infested and killed thousands of trees in urban landscapes and adjacent natural areas and have the potential to cause more damage if left unchecked. The UCCE Advisor is also leading a four-year research project evaluating the effectiveness of several pesticides, including an organic option, or the control of goldspotted oak borer in coast live oaks. This invasive beetle is currently one of the biggest threats to the integrity of oak forests in Southern California and has already infested and killed thousands of trees. This project started in 2022 and is a collaboration with colleagues from CalFire, UC ANR, and US Forest Service and is funded by the Orange County Fire Authority. (Beatriz Nobua-Berhmann)

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.**

* Oak Symposium participants, including individuals and agency personnel, expressed interest in replicating UCCE’s methodology across California Oak woodlands after receiving the first year of findings from UCCE’s 10-year research project on blue oak. (Rebecca Ozeran)

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

* Largely through UCCE’s previous and ongoing efforts, sheep producers in northern California are eligible to participate in the Gray Wolves compensation programs. (Dan Macon)
* As a result of UCCE’s outreach efforts, several of the County parks, including Martial Cottle Park, have adopted recommended IPM practices for managing ground burrowing rodents. Rodents can be major vectors of disease, cause crop and forage loss, and can cause significant damage to infrastructure such as irrigation systems. (Aparna Gazula)
* The Santa Clara County Ad Hoc Wildlife Group utilized information provided by UCCE and other partners in creating an unofficial coyote response plan to be used by members of the group when faced with certain coyote conflict situations. Additionally, a local San Mateo County rancher utilized UCCE expertise to catch a mountain lion caught in a local rancher’s son's classroom at Pescadero High School and the Villages Retirement Community in San Jose experienced marked improvement over the last year in terms of coyote incidents, after extensive technical assistance from UCCE. These outcomes contribute to a reduced number of livestock and pets lost and increased human-wildlife coexistence. (Carolyn Whitesell)
* The California Invasive Species Advisory Committee utilized UCCE’s model about the economic benefits of establishing a monitoring program as a basis to support the allocation of state funding to continue and expand the statewide invasive shothole borers monitoring program during 2023. (Beatriz Nobua-Berhmann)
* California Invasive Species Advisory Committee utilized information UCCE shared and collected from 41 different stakeholder organizations to create the strategic initiative to control invasive shothole borers in California that sets priorities for the appropriation of $5 million awarded by the state to develop a cohesive strategy to control invasive shothole borers and prevent economic losses and further damages to landscapes. The implementation of this action plan resulted in:
	+ A statewide monitoring program that defined the current extension of the infestation and identified priority areas for management,
	+ A significant increase in outreach activities targeted towards diverse audiences, many of which will be led by UCCE, and
	+ The successful completion of six research projects (two with UCCE participation) that allowed the development of improved management practices. (Beatriz Nobua-Berhmann)

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

* Over 400 trees were treated in the first year of a four-year UCCE research project on the control of goldspotted oak borer in coast live oaks. Overall, this project will help improve management of oak woodlands and protect one of California’s most-cherished native trees from invasive pests. (Beatriz Nobua-Berhmann)

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. California’s San Joaquin Valley is home to 10% of the state’s population and has some of the most polluted air in the United States. This pollution causes 1,300 premature deaths per year, as well as asthma attacks, emergency room visits, and lost school and work days costing valley residents $11 billion each year. California has been at the forefront of developing ways to mitigate air pollutant concentrations and the impacts of existing air pollution.

**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.

A UC Cooperative Extension (UCCE) advisor conducted research and extension on whole orchard recycling, a more common practice in recent years due to the closure of many biomass power generation plants and air quality regulations that restrict growers’ ability to manage biomass by burning. A research site consisted of an approximately 30 acres block with different replicated treatments and investigated the viability of whole orchard recycling in walnut orchard systems after the practice had already been deemed a best practice in almonds. Findings were shared in consultation with collaborating walnut growers. (Mohamed Nouri)

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.**

* Three collaborating walnut growers in the San Joaquin Valley adopted whole orchard recycling and changed their management practices following UCCE’s consultation. Additionally, many other growers expressed a desire to adopt this practice in the future.(Mohamed Nouri)

The measured outcome reported above demonstrate improved knowledge and adoption of a variety of practices and policies that reduce air contaminants. 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 monitor and understand soil composition, impacts from agricultural uses, and improved management strategies to conserve soil.

A UCCE Specialist located at UC Davis continued to improve the interactive, online soil survey app called SoilWeb by expanding the number of maps in the soil properties app and enhancing the interactivity so that users can easily change among tools to understand information better. The app intends to provide easy and rapid access to soil survey information and the spatial extent and analysis of common soil survey attributes. Clientele include growers, ranchers, consultants, agencies, and the general public. (Anthony O’Geen)

A UCCE Specialist located at UC Davis continued research in the identification and control of plant pathogens affecting fruit and nut crops. Research trials with collaborative growers included prevention strategies for soilborne diseases of pistachio. Findings were shared with clientele, who include representatives of commodity boards, agrochemical and biocontrol companies, growers, fieldworkers, Pest Control Advisers, field workers, and CDFA. (Florent Trouillas)

There is increasing interest in soil quality and nutrient management, particularly as growers face greater regulations such as the Sustainable Groundwater Management Act, Central Valley Salinity Alternatives for Long-Term Sustainability, and Irrigated Lands Regulatory Program. UC Cooperative Extension (UCCE) is working on a research and extension program on soils and nutrients. UCCE organized and moderated a cover crop field day at UC Kearney Research and Extension Center (KARE) which demonstrated different cover crop mixes, planting methods, and termination methods like tillage versus mowing. It was attended by 20 people including growers and government employees. (Reported by Joy Hollingsworth; collaborator mentioned: Jessie Kanter)

UCCE Advisors collaborated to ​​evaluate soil health, nutrient management, and soil-water dynamics in alfalfa after green-waste compost application. The project was influenced by the passage of CA Assembly Bill 1826, which requires local jurisdictions to divert organic wastes away from landfills, but the amount of compost generated would likely exceed what can be used in urban areas. Because alfalfa is a perennial crop where growers do not apply nitrogen fertilizer over the four-year (or more) stand, it holds great potential for being on the receiving end of green-waste compost. UCCE’s findings included improved soil carbon and nitrogen storage without increasing greenhouse gas emissions, which were shared with alfalfa growers. These results indicate that soil microbes are activated by the compost amendment, they improve nutrient cycling for future crops in the rotation, but this does not appear to result in higher greenhouse gas emissions. (Reported by Michelle Leinfelder-Miles; collaborator mentioned: Rachael Long)

In another project, the UCCE Advisor evaluated the impacts on soil quality from deficit-irrigated alfalfa. During the 2015 drought year, growers in the California Delta engaged in a voluntary agreement with the State Water Resources Control Board Office of the Delta Watermaster to cut back surface water diversions by 25 percent, to conserve water for other statewide uses. This project found that deficit irrigation strategies come with trade-offs. For example, some levels of deficit have minimal impact on alfalfa yield but have a more profound impact on soil biological functioning and salinity. These 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. (Michelle Leinfelder-Miles)

A UCCE Small Farms Advisor in Santa Clara County continued to identify and develop research-based information for soil-borne diseases in organic farming. Clientele include small-scale, organic growers. Educational materials were developed in Chinese, English, and Spanish and extended via workshops and technical assistance. (Aparna Gazula)

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

**Outcomes**

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

* After the KARE field day, five attendees filled out a post-meeting survey. Of those, 80% said that they learned something that they intend to use in the next 12 months. This information helps growers choose the best management practices for their land, which will lead to improved soil health, as well as air and water quality. (Joy Hollingsworth)
* As a result of Delta grower outreach, 12 out of 12 growers reported learning useful information from UCCE about compost management in alfalfa that they intended to use in the next 12 months. (Michelle Leinfelder-Miles)
* Learning outcomes from the alfalfa deficit irrigation project included 44 growers learning new information from UCCE about soil health and 29 learning information that they could employ in the next 12 months. (Michelle Leinfelder-Miles)
* Ten organic small farmers who attended UCCE’s Management of Fusarium Wilt and other Soilborne Fungal Diseases in Santa Clara County increased their knowledge of soil-borne disease management and nine intend to adopt one or more control strategies that were discussed.(Aparna Gazula)

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

* UCCE’s recommendation of the use of the Platinum tolerant rootstock for sustainable management of Phytophthora diseases of pistachio also has become a customary practice in the industry and has solved problems in areas at risk for these soilborne diseases, based on growers' feedback. Additionally, research findings attracted nurseries, which are now marketing Platinum among their rootstock inventory as a superior rootstock for soil-borne disease management. (Florent Trouillas)

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

* The SoilWeb app was utilized by clientele as observed by a median number of 6,000 requests in 2022 tracked by Google Maps. An analysis of Google Analytics with National Land Cover Data classes indicates SoilWeb has been applied to a wide variety of land applications including open water, wetlands, rangelands, grasslands, forest, urban land, and cropland. (Anthony O’Geen)

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 tonnes 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, 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. Research and extension are conducted at the Agriculture Experiment Station locations and in the field through the UC Cooperative Extension (UCCE).

*UC IPM Program*

A UCCE Advisor and Specialist continued to conduct Interregional Research Project No. 4 (IR-4) projects on olive fruit flies. IR-4, established by USDA, facilitates the registration of pesticides on high-value but low-acreage specialty crops by funding research that tests a pesticide’s efficacy and residue. In 2020, UCCE tested one pesticide at three rates, a second pesticide, an industry standard, and an untreated control. Promising results are being used in pesticide registration activities, described in the outcomes section below. (Cindy Kron)

A UCCE Advisor conducted research and extension on IPM in areas where IPM practices are not being used or are being used less frequently in a wide range of crops, systems, and pests present in Southern California. Several hundred growers and Pest Control Advisers (PCAs) attended monthly seminars and presentations, including at an Organic Agriculture meeting, and about 30 in seminars on agave mite and thrips management. (Eric Middleton)

*Agricultural production*

A UCCE Specialist started Science for Citrus Health (SCH) in 2015 to spread in lay language information about research aimed at understanding and combating HLB. SCH is now a cooperative effort with individuals from California, Florida and Texas, involving many activities such as 45 two-page snapshots on research efforts, podcasts, and a PowerPoint slide set disseminated through websites, social media, webinars, and citrus meetings. Another effort involves translating citrus information and Snapshots into Spanish to reach growers and workers in the citrus industry. (Peggy G. Lemaux)

One UCCE Specialist located at UC Riverside evaluated citrus production under protective screens. Studies at the UC ANR Lindcove Research and Extension Center (REC) are comparing the performance of a range of mainstream citrus varieties under standard field operation and under a protective screen designed to exclude the invasive insect and its pathogenic bacterium causing citrus Huanglongbing disease. Environmental parameters, tree physiology, horticultural data, yield and fruit quality, pests and pathogen pressure in addition to the cost benefit analysis are being assessed for growing citrus under prototective screens. (Philippe Rolshausen)

A UCCE Specialist located at UC Riverside continued research in the identification and control of plant pathogens affecting the fruit and nut crops. Project topics included the detection and management of canker diseases in almond and fungicides for Phytophthora diseases of pistachio. Research trials were conducted with collaborating growers and at UC ANR’s Kearney Agricultural REC. Findings were shared with clientele, who include representatives of commodity boards, agrochemical and biocontrol companies, growers, fieldworkers, PCAs, and CDFA. (Florent Trouillas)

A collaborative team that included a UCCE Specialist located at UC Davis, two UCCE Advisors, local PCAs and other researchers identified the cause of sudden vine collapse which began in 2011 with growers reporting large patches of unexplained grapevine mortality within a very short timeframe. Extensive field surveys and sampling between 2019-2022 determined that the cause of sudden vine collapse was a combination of three viruses vectored by mealybugs. Findings were shared with the funder, the Lodi Winegrap Commission, and grape growers. (Reported by Akif Eskalen; collaborators mentioned: Mark Battany, Larry Bettiga, Neil McRoberts) Another collaborative grape research program included annual field fungicide trials to evaluate the efficacy of various treatments, such as synthetic materials, oils, and bio-fungicides, to control powdery mildew, Botrytis bunch rot, sour rot, and pear scab diseases. My research program runs annual field fungicide trials to evaluate the efficacy of various treatments (e.g., synthetic materials, oils, and bio-fungicides) to control powdery mildew, Botrytis bunch rot, sour rot of grapevine, and pear scab diseases. (Akif Eskalen)

A UCCE Advisor in Placer and Nevada Counties continued to provide pest management education to horticultural crop producers, farm managers, and prospective growers. This service is critical to the area as there are no professional, licensed PCAs serving specialty crop commodities in these counties. Many new techniques and low-toxicity pesticides are available, but IPM requires a high level of knowledge as well as careful monitoring. Specific methods included training farmers and coordinating the release of parasitic Aphytis wasps to control California red scale instead of applying pesticides, and hands-on workshops to fruit growers. Over the last two decades, more than 1,100 clientele have participated in hands-on pest management workshops. (Cindy Fake)

A UCCE continued research and extension in rice for a developing Delta industry. This included conducting herbicide and insecticide trials. (Reported by Michelle Leinfelder-Miles; collaborators mentioned: ; collaborators mentioned: Luis Espino, Whitney Brim-DeForest, Ian Grettenberger, Kassim Al-Khatib)

A UCCE Orchard Systems Advisor in the San Joaquin Valley conducted a huge outreach and education effort about Western X-disease, a cherry disease that was once prominent in the 1970s and has recently reoccurred in Pacific Northwest cherry orchards with significant outbreaks. Many educational presentations, one-on-one/group consultations, and published newsletters/articles were provided to raise awareness among CA cherry growers and nurserymen about the epidemiology, symptomology, management and introduction risks of cherry X-disease and other diseases in California. (Mohamed Nouri)

A 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 western juniper to support on-the-ground management. (David Lile)

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 Integrated Pest Management strategies.**

* Post-meeting polls from UC ANR's Science for Citrus Health webinars indicated that more than 50% of attendees would implement at least one new practice they learned at the session, including application of particle film screens to control for ACP. Research from the University of Florida has shown this practice has the potential to reduce ACP populations by more than 80% compared to monthly insecticide treatments. (Peggy G. Lemaux)
* As a result of citrus research, UCCE has observed an increased interest by the industry in commercial use of screened structures to grow citrus in the context of the invasive disease Huanglongbing.(Philippe Rolshausen)
* Southern California growers and Pest Control Advisers learned new information and intent to adopt integrated pest management strategies:
	+ At the Organic Agriculture meeting, participants (n=67) answered: 58% Strongly Agree; 35% Agree; 8% Undecided to the question “I gained new knowledge from the workshop speakers, presentations and information shared: IPM Presentation”.
	+ For the agave mite management seminars (n= about 30), when asked “Did you learn new information?”, 91% responded “Yes” and 9% responded “Somewhat”. When asked “Will you implement the information you learned?” 64% responded “Yes”, 27% “Somewhat”, and only 9% “No”.
	+ For the thrips management workshop (n= about 30), when asked “Did you learn new information?”, 82% responded “Yes” and 18% responded “Somewhat”. When asked “Will you implement the information you learned?” 80% responded “Yes” and 20% responded “Somewhat”. (Eric Middleton)

**Participants adopted recommended pest management techniques.**

* Since 2005, 22.9 million Aphytis wasps have been released in 64 small-scale foothill citrus orchards, covering a total of 2,677 acres. As a result, approximately 22,808 pounds of carbaryl (carbamate pesticide) and 47,851 gallons of horticultural oil were not applied to these orchards. Growers also saved about 7,361,750 million gallons (22.6 acre-feet) of water. Over 90% of Placer County citrus growers now release Aphytis to control California red scale and it has become standard practice in foothill citrus. (Cindy Fake)
* Department of Pesticide Regulation records from 2001 to 2019 show significant decreases in the use of broad-spectrum pesticides and pesticides of concern for water quality in Placer and Nevada Counties. UCCE programs contributed to reducing organophosphate use: diazinon use declined by 99.8%, phosmet by 99.0%, and chlorpyriphos by 97.2% (before it was removed from use). Mancozeb, a fungicide that disrupts soil biota, also declined by 98.5% in the same period. The widespread use of mulch under orchard trees helped reduce glyphosate herbicide use by 69.5%. (Cindy Fake)
* Grape growers are now using their resources to control the grapevine mealybug, which UCCE research from 2019-2022 determined is the vector of viruses that lead to sudden vine collapse. This issue has been causing some growers to remove entire vineyards since 2011. (Akif Eskalen)
* Pest Control Advisers and grape growers use [published data](https://ucanr.edu/sites/eskalenlab/files/316471.pdf) from UCCE’s collaborative field fungicide trials to make decisions each year on which treatment and what combination of treatments to use to protect their crops and minimize the effects of pesticide resistance. (Akif Eskalen)

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

* UCCE research allowed the registration of one additional biocontrol product to be used in almonds for the management of canker diseases. The biological control product BotryStop® WP, initially launched as a biological control agent for Botrytis and Xanthomonas, received a label expansion allowing its use for pruning wound protection against almond canker diseases. The availability of additional biological control products to protect almond trees helps enhance the sustainability of almond production systems, which align with the current objectives of the Almond Board of California. (Florent Trouillas)
* Data from UCCE’s field and greenhouse assays permitted the registration of Orondis as a new, highly efficacious fungicide for use against Phytophthora diseases of pistachio. This fungicide can be applied through the irrigation system, a process called chemigation, thus eliminating the risks of fungicide drift as compared to other currently registered products. (Florent Trouillas)
* UCCE’s olive fruit fly pesticide research findings were utilized by the company that formulated Sivanto in the registration paperwork for the Environmental Protection Agency. Sivanto, which has a different mode of action than the currently registered pesticides on olive, showed efficacy from UCCE’s study and passed subsequent residue trials, and once approved, will be available for growers to rotate modes of action and help prevent pesticide resistance from occurring in olive fruit fly populations. (Cindy Kron)
* UCCE’s rice research contributed to two reduced-risk pesticides, one insecticide and one herbicide, receiving full registration with the CA Department of Pesticide Regulation, with anticipated impacts of enhanced economic prosperity in Delta rice systems and protected natural resources. (Michelle Leinfelder-Miles)

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

* In 2020, a collaborating grower utilized UCCE expertise to quickly diagnose an outbreak of X-disease in Sacramento County and adopt immediate management/abatement to avoid disease spread to neighboring cherry orchards. The potential harm a resurgence of this pathogen could do in California is immense, and the California cherry industry needs all types of efforts to help manage/prevent this disease before it spreads again. Many other cherry growers clientele, especially the new generation of farmers, shared that they are following UCCE advice in spraying for insect vectors. (Mohamed Nouri)

**Change in condition: Rangeland restored.**

* Clientele have increased the pace of juniper control to over 5,000 acres per year after successfully removing over 5,000 acres during phase one, which was reported last year. Additionally, numerous springs and seasonal riparian areas have been restored, and rangeland plantings and seedings completed during collaborative projects with UCCE in 2022. (David Lile)

The measured outcomes reported above improved the state’s ability to prevent, control, and mitigate pests and diseases. IPM programs decreased the use of certain pesticides and reduced the health and environmental risks associated with them according to research by Farrar et al. (2016) who assessed and concluded that pesticide risk from consuming food is low, risk of harm from pesticides in the air is low, and risk of harm from pesticides in surface water is decreasing. (Tunyalee Martin) The California Department of Pesticide Regulation reported pesticide use decreased between 2020 and 2021 by 11.5% or 24.8 million pounds. In these ways, UC ANR contributes to the increased ecological sustainability of agriculture, forestry, and urban landscapes and the public value of protecting California’s natural resources, helping California realize the many benefits of 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, carbon sequestration, clean water, and habitat for plants and wildlife. 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 partners with public, governmental, and private groups to develop and extend new knowledge forest managers to increase the ecological sustainability of forests.

UC Cooperative Extension (UCCE) Advisors and an Academic Coordinator continued to deliver Forest Stewardship workshops to extend recommended actions to private landowners to improve the resilience of their forests. Six nine-week workshops were conducted in 2022 in Siskiyou, San Diego, Placer-Nevada, Lassen-Modoc, Lake, and Amador-Calaveras Counties. UCCE continues to track workshop participants who adopt the recommendation to schedule site visits with a Registered Professional Forester since these workshops began in 2020. (Kim Ingram and Susie Kocher)

UCCE’s research on operational resilience in western US frequent-fire forests compared forests from 1911 to 2011. As a result of the research, forest managers now have a quantified resilience metric with well-defined, discrete ecological thresholds to design, implement, and measure the temporal efficacy of forest restoration projects in terms of resilience to drought, wildfires, and insects and disease. Findings were extended through management recommendations and policy considerations to local clientele, statewide webinars, an invited presentation to the state Board of Forestry, research briefs, and articles. The research was recognized by the chief of the Forest Service, Bloomberg news, and is driving new considerations and approaches in California Forest management. (Ryan Tompkins)

In response to the 2021 Dixie Fire, a UCCE advisor co-developed the concept proposal for the Plumas Emergency Forest Restoration Team and secured $11.3 million of funding to the resource conservation district to provide technical and funding assistance to non-industrial private forest landowners and tribal partners impacted by the 2020 and 2021 wildfires in Plumas County. This program removes dead trees, mitigates fuels, and plants trees for fire-impacted landowners. The program has over 220 landowners totaling over 5,000 acres signed up thus far. (Ryan Tompkins)

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

**Outcomes**

**Participants learned strategies for forest stewardship.**

* Forest Stewardship workshop participants who responded to a survey (n=48) 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: 47% to 79%
	+ Fuels reduction: 80% to 100%
	+ Tree thinning: 66% to 92%
	+ Timber harvest: 19% to 29%
	+ Reforestation: 35% to 68%
	+ Forest inventory on property: 10% to 76%
	+ Forest management plan: 21% to 88% (Kim Ingram)

**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 64, which is up from 29 last year. These forest landowners manage over 7,400 acres of forestland in California. This action 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. (Kim Ingram and Susie Kocher)

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

* UCCE’s science-based information and resilience metrics were used in the Post-Dixie Fire Restoration Assessment that provided restoration recommendations for over one million acres of public and private lands; for wildlife habitat modeling in the Sierra Nevada Forest Resilience Project; and by National Forest managers in their landscape-level forest restoration project design. The resilience metric informed new rules proposed for group selection harvest on private lands and the state Board of Forestry is interested in how it pertains to ongoing efforts to revise forest stocking requirements in the forest practice rules. (Ryan Tompkins)

**Condition change: Forests restored.**

* In the first year after the fire, the program accomplished 680 acres of dead tree removal, including restoration activities on Tasmam Koyom (Maidu tribal property), with plans to plant 870 acres in spring 2023. (Ryan Tompkins)

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 wildfire, 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 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 learned and intended to adopt recommended practices for range management.**

* Participants of UCCE’s livestock pond and restoration workshop responded to a survey (n=52) and indicated increased knowledge of livestock ponds and restoration (96%) and intention to apply the information to their work or decision-making around livestock ponds and restoration (83%). (Sheila Barry)
* Forty-five participants of the Central Coast Rangeland Coalition Workshop on compost and rangeland (attended by 115 land managers and ranchers) responded to an evaluation and 92% shared that they increased their knowledge of compost application on rangeland as a climate-smart strategy. Nearly one third stated that they would apply this information to their work or decision-making on compost use on rangeland. (Sheila Barry)
* Post-survey respondents of the Central Coast Rangeland Coalition workshop on adaptive grazing management and carbon on rangeland soils (attended by 125 participants) reported increased knowledge of grazing's role in carbon sequestration on rangeland (69%) and stated that they would use information from the workshop to improve grazing management for carbon sequestration (80%). (Sheila Barry)

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

* A survey with 95 respondents found long-term benefits of the Central Coast Rangeland Coalition meetings over the past 12 years. Over 85% of the respondents had applied information they learned at workshops to improve the sustainability of rangelands in the San Francisco Bay Area and Central Coast. Participants acquired skills and information on rangeland water quality, rangeland monitoring, grazing to improve habitat, conservation strategies including easements, and rangeland economics. (Sheila Barry)

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

* UCCE’s species conservation research was used in the development and support of AB 434 (2022) --access to public lands, and grazing leases. The data set informed the management of conservation lands in San Diego and San Mateo counties, supporting grazing management on over 11,000 acres. (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 45 counties serving 52 counties by research-based information on environmental horticulture to help the public grow home, community, and school gardens more sustainably. The program successfully adapted to the COVID-19 pandemic with strategies such as making the help desk completely remote, offering classes and plant clinics online, expanding and maintaining demonstration gardens as allowed by public health orders, creating an online system for plant sales, and increasing the use of social media to share science-based gardening information. Over 6,170 Master Gardeners volunteered 377,890 hours. (UC Master Gardener Program)

A UC Cooperative Extension (UCCE) Advisor with expertise in horticulture continues to teach sustainable gardening practices in the Eastern Sierra region. He worked with the Mammoth Community Water District to assist Homeowner Associations to plan for turf removal. Updated plant lists with turf alternatives were posted on websites and three on-site consultations were conducted. (Dustin Blakey)

A UCCE Urban Agriculture and Food Systems Advisor worked in collaboration with the UCCE Compost Education Program, a partnership with the Cities and County of Santa Clara, to expand community composting at the compost demonstration site. To extend information about community composting and build relationships among community composters, she coordinated a series of meetings to bring together urban agriculture organizations engaged in or interested in pursuing community composting. There have been three workshops and engaged 48 total volunteers over 19 community workdays. (Reported by Lucy Diekmann; collaborators mentioned: Cole Smith, Maya Shydlowski, Jenel Vincze, and Ariana Reyes)

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, 76% (of 123 respondents) started or improved their use of plants that attract and support pollinators, and 61% (of 121 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 619,428 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, 57% (of 108 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, 62% (of 843 respondents) started or improved using mulch, and 63% (of 842 respondents) started or improved the practice of selecting low water-use plants. In addition, participants reported removing 41,145 square feet of turf. These practices reduce landscape water use.
* Adopted integrated pest management practices; for example, 76% (of 523 respondents) started or improved monitoring for pests or diseases, and 59% (of 522 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 Homeowners Association used UCCE science-based, sustainable landscaping information to set goals for their redesign project. (Dustin Blakey)

**Change in condition: Community landscapes are more sustainable.**

* Landscape beds mostly designed by UCCE using sustainable landscape design principles were installed at the historic Inyo County courthouse. (Dustin Blakey)
* In the second half of 2022, the compost system diverted 1158 lbs. of food waste and 19 tons of manure and woodchips from the waste stream and yielded 9.6 cubic yards of finished compost. Community composting turns urban waste products into valuable soil inputs for urban agriculture, which research shows reduces greenhouse gas emissions, sequesters carbon in the soil, and increases access to compost for urban residents who do not have access at home (e.g., people living in multi-unit apartment buildings). In addition, two organizations participating in the community composting meetings have secured additional funding to launch or expand their community composting operations. (Lucy Diekmann)

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 UCCE Advisor in the Eastern Sierra region leveraged the UC network to bring water quality expertise in regional water quality planning for the Bishop Creek watershed. UCCE gathered and provided local rancher input and science-based information for the Lahontan Regional Water Board’s water quality plans. (Reported by Dustin Blakey; collaborators mentioned: Tina Saitone and Kenneth Tate)

A UCCE Advisor continued water quality extension efforts in Los Angeles, Orange, Riverside, and San Bernardino Counties. Clientele include pest management and application professionals, pest control advisors, and municipalities. As one example, the UCCE Advisor delivered an online workshop titled “Review of Federal and California Pest Control Regulations” presentation hosted by the Pest Control Operators of California and collected outcomes via post-talk surveys. (Siavash Taravati)

UCCE’s research-based information is also equipping decision-makers with data to develop successful policies to meet state goals to protect water quality. Policy engagement activities were conducted related to “Ag Order 4.0,” a regulatory program to protect groundwater from nutrient contamination on the Central Coast. (Margaret Lloyd)

A UC Cooperative Extension (UCCE) Livestock and Natural Resources Advisor helped livestock industry clientele address increasing levels of water quality and quantity state regulations, including the Irrigated Lands Regulatory Program and Sustainable Groundwater Management Act. UCCE conducted studies on groundwater, geology, winter recharge, evapotranspiration, and applied water science to bolster data for the Big Valley Groundwater Basin. Findings were extended in monthly public meetings to keep the public educated on the status of the plan. (Laura Snell and David Lile)

*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 to report total nitrogen applications and other data to regional water quality coalitions. Growers and ranchers 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. 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. UCCE assisted small and medium size 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. (Ruth Dahlquist-Willard; Aparna Gazula; Margaret Lloyd)

*CropManage App*

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)

A UCCE Orchard Systems Advisor continued walnut nutrient budget research and extension in sustainable nitrogen management. Walnuts were added to UCCE’s CropManage app, which helps walnut growers to plan and track nitrogen needs, use, and adapt to changing water quality regulations. A Leaf Nitrogen Prediction tool was developed to help growers monitor their orchard nitrogen status early in the growing season, so they could take corrective action if changes in nitrogen application timing or amount led to undesirable outcomes. Science-based information was extended to clientele via industry publications, educational presentations, policy engagement activities, and podcasts. (Reported by Katherine Jarvis-Shean; collaborator mentioned: Michael Cahn)

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.**

* Ninety-three percent of the 56 survey-takers who participated in the “Review of Federal and California Pest Control Regulations” presentation stated that they learned something new and 93% stated that they have or will implement some of the practices they learned from the presentation in the future. These practices have the potential to reduce pesticide run-off in the region. (Siavash Taravati)
* During the IRLP on-farm workshops, 24 organic small farmers in Santa Clara indicated that they would adopt one or more practices discussed. (Aparna Gazula)

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

* CropManage was used infive commercial fields (lettuce and processed onions) and adopted the CropManage irrigation and nitrogen management tool for the first time in the desert. Adopting water and nutrient management practices is vital for addressing water quality concerns in the low desert region. (Ali Montazar)
* ILRP
	+ 28 growers completed the required paperwork and avoided costly fines related to the ILRP (Ruth Dahlquist-Willard)
	+ Forty socially disadvantaged Asian farmers utilized UCCE’s one-on-one technical assistance to complete their TNA reports. Additionally, Santa Clara 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 $1,000 per day for each day for non-compliance. (Aparna Gazula)

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

* Lahontan Region Water Board’s Vision Plan was informed by UCCE’s clientele input and science-based information and in September 2021, the water board adopted the vision plan. This included the addition of an addendum to existing ranch management plans that are specific to the local context.(Dustin Blakey)
* UCCE research (Lazicki et al. 2020) was used to establish a discount factor for organic fertilizers in “Ag Order 4.0” in the Central Coast. This will prevent organic producers from being incorrectly penalized for misuse of nitrogen. These findings stand to reduce groundwater contamination from nitrates and increase profitability from optimum crop fertility for 1.1 million acres of certified organic land in CA (2016) and, in the region, 100+ organic vegetable operations. (Margaret Lloyd)
* The state’s Fertilizer Research and Education Program course is using two of UCCE’s trainings for the nitrogen self-certification program. Self-certification saves growers hundreds of dollars needed to pay a certifier annually for IRLP compliance. The program content helps farmers with balancing their nitrogen budget to avoid environmental pollution, minimize cost and maximize yield. (Margaret Lloyd)
* Leaf analysis laboratories have adopted UCCE’s Leaf Nitrogen Prediction tool to monitor orchard nitrogen status early in the growing season. This information allows growers to take corrective action if changes in nitrogen application timing or amount lead to undesirable outcomes. Additionally, a water quality agency utilized UCCE’s walnut nutrient research findings and science-based information in an educational video and brochure. Since the majority of nitrogen overapplication finds its way to shared groundwater resources, this improved efficiency due to growers’ adaptation to regulations benefits both growers in fertilizer savings and any Central Valley resident reliant on groundwater near areas of walnut production. (Katherine Jarvis-Shean)
* UCCE was able to support the Modoc and Lassen County clientele in creating a localized plan for the basin and charge for water use, rather than utilize the Department of Water Resource’s plan. Furthermore, since UCCE completed the annual groundwater reports between 2020-2022, Modoc and Lassen Counties saved over $200,000 in regulatory fees. This builds on an outcome reported last year: Data collected by UCCE was used by the Big Valley Groundwater Sustainability Plan, which was submitted to the Department of Water Resources (DWR), along with UCCE’s chapter, “Projects and Management Actions.” (Laura Snell)

The measured outcomes 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 and rangelands 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) study to understand the effectiveness of lawn removal incentives to decrease outdoor water use in Southern California found that most of the 1,153 respondents did not remove their lawns to receive an available rebate or incentive. Primary reasons were to improve the appearance of their landscapes, reduce maintenance, and save money. Findings were shared with water districts and in publications. In addition, the UCCE Advisor shared compelling science-based information about urban water use and the effects of poor irrigation practices with Metropolitan Water District members and agencies. (Reported by Janet Hartin; collaborator mentioned: Rachel Surls)

A UCCE Advisor conducted a dryland small grain trail to evaluate potential alternative crops grown for hay given water scarcity and new water use regulations in Siskiyou County. Fourteen varieties of triticale, wheat, and barley treatments were tested and findings were disseminated to clientele through newsletters and social media. The UCCE Advisor also evaluated new, low-energy precision application sprinklers (LEPA) as an alternative to the commonly used mid-elevation sprinkler application (MESA) systems. The research findings confirmed that newer sprinkler systems are indeed more efficient. While both systems were set to deliver the same amount of water per center pivot rotation, the LEPA system delivered 10% more water to the ground than the MESA system on average. Consequently, alfalfa yields under LEPA were 23% higher than MESA on average. (Giuliano Galdi)

UCCE Farm Advisors and UC Davis AES faculty found that a walnut grower could save approximately 868,928 gallons per acre, per year, through a combination of starting irrigation in May or June, rather than starting when most growers typically do in March or April and using pressure chambers to wait for trees to indicate that they were under some minor water stress. A UCCE Orchard Systems Advisor in the Sacramento Valley extended information about the pressure chamber through peer-reviewed publications, popular press articles, podcasts, and farm calls, as well as through educational presentations that reached 1,677 attendees. (Luke Milliron)

A UCCE Advisor conducted applied research and extension activities in irrigation efficiency in San Diego County, where virtually no surface or groundwater water is available. Improving irrigation efficiency is essential to maintain nursery and floriculture industry profitability, and compliance with water quality regulations. Educational presentations and YouTube videos reached clientele, who include growers, production managers, Pest Control Advisers, local agencies, and non-profit organization staff. (Gerry Spinelli)

A UCCE Vegetable Crops Advisor added watermelon to UCCE’s CropManage smart irrigation tool and conducted research to address how irrigation water should be reallocated between premature and post-harvest stages. The study observed current practices: large-scale watermelon growers who usually harvest more than three times applied an average of 50 inches of water per acre (1 acre-inch of water = 27,154 gallons), of which 32% by average was applied during the harvest window. However, based on the recommendations made by CropManage, 43% of the total irrigation should be applied throughout the harvest time according to the fluctuation pattern of crop canopy coverage and water demand for crop regrowth between each harvest for continued fruit production. These findings were shared with growers at field trials along with the scientific principles behind this water reallocation. (Zheng Wang)

A UCCE Advisor continued water user efficiency research with collaborative growers of sweet corn in the Imperial Valley and lettuce in the Imperial and Coachella Valleys. The two-year evaluations confirmed that subsurface drip irrigation was significantly more efficient than furrow irrigation and findings were disseminated to clientele via outreach activities. (Ali Montazar)

A UCCE Advisor continued research and extension in sustainable rangeland management, especially addressing many droughts over the last 20 years. (Royce Larsen)

*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. CDFA for the first time approved and announced a new solicitation and incentives program for the desert called “SWEEP Pilot Program for the Southern Desert Region.” As a technical provider for the SWEEP Pilot program, UCCE provided technical assistance to many growers in the desert. (Ali Montazar) UCCE Santa Clara Small Farms Program developed educational materials in Chinese, English, and Spanish, delivered live and recorded presentations and technical assistance, and developed a webpage for small and medium size growers, processors, and marketers of vegetable and specialty crops, and public and private agencies. (Aparna Gazula)

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.**

* Over 86% of water district representatives who viewed presentations about the lawn removal incentives study adjusted their rebate policies, added or strengthened an educational element, or indicated they would consider doing so in light of this study. Over 94% indicated they would discontinue or consider discontinuing rebates and incentives to residential customers who replace removed lawns with synthetic turf in hot inland and desert areas due to high-temperature injury to humans and pets. (Janet Hartin)
* ​​Seventeen surveyed participants at a field meeting reported an improved understanding of what pressure chamber measures (100% marked yes from 19% at the start), how to take the measurement (100% up from 41%), and how to interpret the results for refined irrigation management (100% up from 29%). Because of this hands-on field meeting, 88% of respondents reported an increased likelihood to adopt pressure chamber readings. (Luke Milliron)
* End-of-session survey responses from San Diego nursery and floriculture clientele indicate that 54% of Spanish-speaking and 59% of English-speaking participants plan to adopt the tools that UCCE presented about evapotranspiration-based irrigation scheduling, and distribution uniformity, and that 55% of participants increased their skills “a lot” or “hugely”. (Gerry Spinelli)
* Santa Clara SWEEP presentation attendees shared their intent to adopt the quick nitrate tests to assist in nutrient management. (Aparna Gazula)

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

* Multiple hay growers adopted new UCCE’s research findings in their Local Cooperative Solutions Plans and were compliant with the Scott-Shast Drought Emergency Regulation. Specifically, growers planted the new efficient small grains crops instead of alfalfa, as well as placed them in dry corners of center pivots when end guns are turned off. These alternative crops can extend the grazing season without irrigation and provide animal feed when hay prices are high. Crops grown for hay account for about 20% of the County's agriculture production or about $59M per year (2019). (Giuliano Galdi)
* Siskiyou County growers changed MESA sprinklers to low-energy precision application sprinklers as part of their Local Cooperative Solution Plans, helping them to comply with the irrigation water curtailments. LEPA sprinklers increased water use efficiency and led to higher alfalfa yields. (Giuliano Galdi)
* Grower adoption of plant-based irrigation management is continuing. For example, after working with one grower for a couple of years, he reported he had adopted best management practices recommended by UCCE across 500 acres of walnuts and almonds. The grower also reported that his trees looked healthier and noted, "I should have listened to you and started a year earlier." Another grower adopted pressure chamber-based irrigation across his 2,000 acres of walnuts, after nearly two decades of being exposed to UCCE information on the pressure chamber. This grower shared that the trees looked healthier and shared that without using the pressure chamber, "we would have over-irrigated during heat spells." These anecdotes show that adoption requires a year-after-year repeated extension to the same clientele to get adoption. (Luke Milliron)
* As a result of UCCE’s technical assistance, seven small-scale growers applied what they learned to submit SWEEP grant applications. Furthermore, two out of the seven growers were awarded the grants, totaling $177,600. The growers now have the resources to apply practices that reduce greenhouse gasses, save water, and conserve natural resources. (Aparna Gazula)

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

* Since recommending this to Metropolitan Water District member agencies and 15 other agencies across the state, at least six are now partnering with Master Gardeners to provide this needed education to the public and several have increased their independent efforts. (Janet Hartin)
* As a result of UCCE’s outreach activities of the new SWEEP Pilot Program for the Southern Desert Region, 51 agricultural operations submitted applications for this program. CDFA awarded 17 projects for more than $2.7 million in funds, which is a significant achievement for UCCE and the low desert region. (Ali Montazar)
* Rangeland clientele shared testimonials that UCCE’s forage production studies and technical assistance have improved decision-making and increased understanding of range ecology, irrigated pasture work, oak survival, grass losses due to drought, range techniques, and reporting to California Department of Fish and Wildlife. (Royce Larsen)

**Change in condition: Water saved.**

* Eight commercial fields in the Imperial Valley (nearly 500 acres) adopted drip irrigation for sweet corn. The data demonstrated that growers who adopted drip irrigation and followed irrigation and fertilizer management recommended by the UCCE Advisor were able to conserve 2.2 ac-ft/ac (37%) water and reduce fertilizer cost by 146 $/ac (26%). The growers also increased marketable yields by 5% (21 ctn/ac). (Ali Montazar)
* Watermelon growers shared that they followed UCCE’s recommendations made by CropManage to allocate 40% of total water to the harvest window, resulting in a reduction of 15% of total applied water without a melon yield drop compared to the last season. By reallocating more water to the harvest period, this is a saving of 217,232 gallons of water per acre. Now, the impacted acreage of watermelons in the northern San Joaquin Valley that uses CropManage for the irrigation decision support increased from zero before 2021 to 200 acres in 2022. (Zheng Wang)
* Twenty-five commercial fields in the Imperial and Coachella Valleys (nearly 800 acres) adopted drip irrigation for romaine and head lettuces. Data from a two-year evaluation of the drip-irrigated fields was conducted in comparison to lettuce fields under furrow irrigation demonstrated that growers who adopted drip and followed UCCE’s irrigation and fertilizer management recommendations were able to germinate lettuce using drip, and conserve 24% of fertilizer and 11% of water. (Ali Montazar)

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 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.

**Methods**

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

A UCCE Specialist located at UC Berkeley conducted quantitative economic analyses of the incentives, institutional constraints, and behavior of water users with the goal of addressing agricultural water management challenges in the face of water scarcity. This research evaluates the potential for and effectiveness of different policies for managing water resources, with a focus on groundwater in California and the Sustainable Groundwater Management Act (SGMA).

This involved tracking the unfolding of SGMA at the irrigation district level to study the political economy and analyzing available data on water use and water prices to empirically evaluate the impact of rising groundwater prices on water use. This work has resulted in a book chapter, several outreach pieces, a podcast episode, and two policy briefs. Findings were also shared at professional organization meetings like the Groundwater Resources Association's Built for Change Conference and the Kern Water Summit in Bakersfield, both of which had about 40 and 200 water and agricultural professionals in the audience, respectively. (Ellen Bruno)

As a result of UC ANR research, outreach, and education, participants learned and adopted practices that lead to increased water supply security. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants gained understanding of water supply security regulations.**

* Farmers, state-level regulators, and other stakeholders who participated in SGMA presentations demonstrated a change in their knowledge of the impacts of SGMA as observed through follow-up conversations with UCCE. In addition, the follow-up conversations allowed the UCCE Specialist to further explain the potential economic impacts of SGMA and the merits of different management actions. (Ellen Bruno)

The measured outcome 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. 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. 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.

**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.

In partnership with the California Department of Food and Agriculture, sithe UC ANR Climate Smart Agriculture Educator team has provided hands-on assistance to farmers and ranchers through grant application assistance, workshops, field days, and events. Translation services are offered in English, Spanish, Mandarin, Hmong, Cantonese, and Punjabi. Since 2019, clientele in 33 counties were able to receive 420 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 climate-smart projects. (Hope Zabronsky)

A UCCE Specialist located at UC Merced in climate adaptation in agriculture collaborated with a diverse team of researchers from UC Merced and UC Santa Cruz on studying the energy and water co-benefits from covering canals with solar panels. He presented the results from this study in several extension talks including the Latino Leaders for Water Education panel discussion, which was attended by about 150 elected officials serving Latino communities. Information from this study was also extended extensively through media outlets, including TIME Magazine, Los Angeles Times, and VOGUE Magazine. The paper was also circulated and discussed widely on Twitter and reached more than 350,000 people over the past year. (Tapan Pathak)

The UC Sustainable Agriculture Research and Extension Program (UC SAREP) worked with a UCCE Livestock and Natural Resources Advisor and an Academic Program Manager from UC ANR’s Hopland and Sierra Research and Extension Centers to provide outreach on integrating livestock into cropping systems, with a focus on grazing in orchards and vineyards. They organized webinars, a symposium, and blog posts geared toward livestock and crop producers as well as researchers and extension, to understand how innovative producers are integrating livestock and crops, disseminate results from UC researchers on ecosystem services from this system, and identify research needs. (Reported by Sonja Brodt; collaborators mentioned: Rebecca Ozeran and Jackie Beck)

A UCCE Pomology Advisor continued extending results about the air and soil quality benefits of whole orchard recycling. It costs $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)

A UCCE Orchard Systems Advisor continued extension work to increase awareness of the impacts of climate change on tree crops and the need for adaptation to increase resilience. She has targeted multiple audiences including agricultural stakeholders because they need to implement climate resilience measures, funders and policymakers because they need to fund research and adopt policies that support resilience, and the general public needs because they need to support resilience policies and funding. (Katherine Jarvis-Shean)

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.**

* Two producers who attended the integrated crop-livestock webinars indicated in a post-webinar survey that they intended to use the new information they learned on their farms. Integrating grazing in cropping systems, such as sheep in vineyards, has potential to increase long-term carbon sequestration and enhance soil nutrient cycling (Brewer and Gaudin 2020). These benefits will increase resilience to extreme weather and climate change, especially with respect to increasing water infiltration and water-holding capacity of soil under drought conditions. (Sonja Brodt)

**Participants adopted climate-resilient strategies.**

* As a result of the HSP, SWEEP, and AMMP grant funded projects, with almost $36M awarded since 2019, farmers and ranchers implement science-based climate-smart practices that support climate change mitigation by reducing greenhouse gas emissions and sequestering carbon, and promote 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. (Climate Smart Agriculture)

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

* The published feasibility study on covering canals with solar panels directly influenced Turlock Irrigation District to implement the first-in-the-nation construction of solar panels over water canals. On February 8, 2022, Turlock Irrigation District was awarded $20 million from the California Department of Water Resources to a project, and they publicly acknowledged that their project was directly inspired by the UCCE published study. Results show potential water savings of 63 billion gallons of water annually, which is comparable to the amount needed to irrigate 50,000 acres of farmland or meet the residential water needs of more than 2 million people. And the 13 gigawatts of solar power the solar panels would generate each year would equal about one sixth of the state’s current installed capacity — roughly half the projected new capacity needed by 2030 to meet the state’s decarbonization goals. This project shows promising potential for water saving and electricity that would benefit both agricultural and urban sectors. (Tapan Pathak)
* UCCE policy engagements on the topic of whole orchard recycling, contributed to the California Governor signing AB 2101 (Flora) California Climate Resiliency Project Registry: whole orchard recycling projects in 2022. This bill expands the list of projects that may be included on the registry to include whole orchard recycling projects. (Brent Holtz)
* The UCCE co-authored and research-based sections of the California Environmental Protection Agency’s 2018 Indicators of Climate Change in California was largely retained in the 2022 update. (Katherine Jarvis-Shean)
* In the last two years the US Environmental Protection Agency’s and California Department of Pesticide Regulation approved the registration of Dormex®, a climate resiliency tool to adapt to warmer winters, for use in pistachios and walnuts. (Katherine Jarvis-Shean)

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

* 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 102,000 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 gases on their operation. (Hope Zabronsky)
* A case study on the Alternative Manure Management Program (AMMP) evaluated the benefits of this program. The Zuppan Dairy milks 600 cows in Glenn County and previously managed animal waste by scraping manure into a lagoon system. They received an AMMP grant to cost share the installation and implementation of a manure solids separator for their operation. This project helped the dairy reduce methane emissions (812 MTCO2e per year), save $13,000 annually on fertilizer costs, and improve their ability to evenly distribute manure on their fields. (Climate Smart Agriculture Program)

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 Food Systems

**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 are experiencing the effects of intense wildfires. Land managers need effective response and adaptation strategies to prepare to deal with wildland fires which have increased in frequency and size across the state.

**Methods**

UC ANR collaborates with agencies, land managers, and communities that have been impacted by catastrophic fires. Science-based information is provided to aid in wildfire response. 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.

UCCE Advisors in the Sierra Foothill region expanded the only multi-county livestock disaster pass program to address growing wildfire concerns for ranchers and rangeland managers. The pass program received an award from the California State Association of Counties in the Rural Disaster & Emergency Response category. (Dan Macon)

 A UCCE Livestock and Natural Resources Advisor, working in the North Bay and Sacramento Valley regions, is collaborating with the county Agricultural Commissioner, Office of Emergency Services, Sheriff Department and Cal Fire in four counties to assist in the development of Ag Pass programs. (Morgan Doran)

Another UCCE Advisor in the Central Sierra region helped develop and implement a Livestock Ag Pass Programs, by assisting with the development of the language and providing a 4-hour training for the livestock producers. (Scott Oneto)

A UCCE Advisor organized and hosted Siskiyou County’s first Livestock Pass training after several county agencies and organizations developed the program. The county board of supervisors approved the Livestock Pass Program, which has the goal to identify commercial livestock operators to emergency responders so that access to care for livestock sheltering in place may be granted safely and efficiently. The UCCE Advisor learned from other UCCE colleagues who implemented this program in other counties, provided briefings at agency meetings, created factsheets and stakeholder presentations, built a database of ranch/operation information, and delivered the training to 56 ranchers in its first year. (Grace Woodmansee)

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.

**Outcomes**

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

* The Nevada, Placer, and Yuba livestock industry adopted UCCE’s expanded, multi-county livestock disaster pass program for the first time during the 2022 fire season. As a result, 74 ranchers in Nevada, Placer, and Yuba Counties received training in wildfire behavior, the emergency management system, and ranch-level wildfire preparation. (Dan Macon)
* Napa County now has an established Ag Pass program while Sacramento, Yolo and Solano counties have programs in development. These programs are highly desired by commercial livestock operators in order to provide essential care for their livestock and/or evacuate livestock during disaster situations. (Morgan Doran)
* A Livestock Ag Pass program was implemented in Amador County, and others are in process in the neighboring Central Sierra counties. (Scott Oneto)
* Four Siskiyou County ranchers successfully requested and used a Livestock Pass as a result of UCCE’s Livestock Pass training and support. This program increased safety for stakeholders during wildfire emergencies and potentially reduced livestock losses-therefore, this project builds climate resilience in communities across Siskiyou County. (Grace Woodmansee)

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. According to CAL FIRE, the total acreage burned in 2022 was well below the 5-year average; less than 400,000 acres burned in 2022 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

Sustainable Natural Ecosystems

**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 California Naturalist 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 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**

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

* Based on initial results from the new Climate Stewards courses, participants reported statistically significant gains in learning climate stewardship, self-efficacy, environmental agency, and climate communication skills. (Greg Ira)

**Participants adopted climate-resilient strategies.**

* Certified Climate Stewards in the first two years of the program conducted 4,838 service hours over 602 service activities ranging from community resilience and adaptation, participatory science, conservation and restoration (stewardship), education and interpretation, and environmental and climate justice activities. Furthermore, 111 participants (90% of respondents) indicated that the course improved their capacity to do climate volunteer service either now or in the future and 69 participants (85% of respondents) indicated that the course improved their capacity to do the work they are currently doing or work they would like to do in the future. Of the 620 participants who took the Climate Stewards course, 382 became certified Climate Stewards and 112 completed a community college course without seeking certification. (Sarah Mae Nelson)

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

* 494 Climate Stewards participants who were either certified or completed a community college course in the first two years of the program potentially reduced carbon emissions by 1,412.84 tons of CO2 per 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. (Sarah Mae Nelson)
* The California Naturalist program’s partners responded to a survey of the organizational leadership (n=28) and the single most commonly cited (82% of respondents) benefit of participation in the program was that it promotes, “local environmental stewardship and/or community resilience.” (Greg Ira)

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

**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. In 2020, over four million acres burned, and over 10,000 structures were damaged or destroyed in California. 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.

A UC Cooperative Extension (UCCE) Advisor, Inland Empire Resource Conservation District, and California Climate Action Corps collaborated on a state grant to provide drought, heat, and pest-resistant “climate-ready” landscape trees identified in the study to residents of neighborhoods with low canopy cover. The UCCE Advisor also conducted research on the impact of mulch on the growth and development of four species of “climate-ready” tree species. Results were shared with civic leaders throughout California, highlighting that rock and gravel mulches that decrease soil evaporation, weed seed germination, and buffer soil temperature similarly to wood-based mulches are better choices in fire prone areas. (Janet Hartin)

UCCE organized several Prescribed Fire for Working Landscapes workshops, giving ranchers and land managers first-hand experience in preparing for and implementing prescribed burning projects on private lands. (Dan Macon)

A UCCE Specialistcontinued research and extension efforts related to the importance of land use planning in fire-related losses through delivering best practices guides, [articles](https://www.frontiersin.org/articles/10.3389/ffgc.2022.848254/full), developing a novel framework in the [Regional Wildfire Mitigation Program](https://rwmpsantabarbara.org/), and policy engagement activities with the California Department of Forestry and Fire Protection (CAL FIRE) and legislative staffers. (Max Moritz)

A UCCE Livestock and Natural Resources Advisor addressed wildland fire issues. Workshops to clientele were delivered on the use of prescribed fire to reduce fire fuels, natural resource issues, post-wildfire recovery, and dollar value estimates of losses from the fires on grazing lands in Napa, Yolo, and Solano counties. (Morgan Doran)

Several UCCE Advisors and a Specialist located at UC Santa Barbara 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 were published in the California Agriculture journal and shared in policy engagement activities. (Reported by Royce Larsen and Devii Rao; collaborators mentioned: Sheila Barry, Matthew Shapero, Max Moritz, and Larry Forero)

A UCCE Advisor in Plumas, Sierra, and Lassen Counties continued to serve on the incident management team for Prescribed Fire Training Exchanges, known as TREX. This included growing and developing the Plumas Underburn Cooperative, delivering organized prescribed fire and fuel management workshops, facilitating learning networks, and supporting forest manager and landowner efforts in hazardous fuel reduction. In another project, the UCCE Advisor 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)

UCCE bolstered their fire research and education team, hiring a new cohort of UCCE Fire Advisors and an Academic Coordinator who have been sharing science-based information with local, national, and international audiences including media and with policymakers. During 2022 the team delivered 47 home-hardening talks, had 60 media posts, and reached 25,097 people through these combined activities. Additionally, the team provided 15 training workshops and reached 8,864 people through these virtual and in-person events. Two major outcomes were new contributions of funding support from the California legislature to sustain these staff and activities and the development of policy to improve fire resiliency. (Yana Valachovic)

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.**

* Community volunteers donated 31,000 hours, up from 27,000 hours the previous year, and $1.2 million of community investment in wildfire preparedness actions to reduce fuels and improve home resistance to wildfires across seven California counties. This 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.**

* Over 94% of civic leaders completing surveys indicated the information shared would “definitely” help inform their policies and education regarding using low-combustible mulch products that reduce fire risk while offering the same benefits of wood mulches (less soil evaporation, fewer weeds). (Janet Hartin)
* The passage of AB1445 was directly influenced by a UCCE Specialist’s engagement with legislative staffers in Sacramento regarding fire and land use planning. Additionally, the Governor's Office of Planning and Research utilized information from the specialist in a [new guidance document](https://opr.ca.gov/docs/20201109-Draft_Wildfire_TA.pdf) on fire hazard planning. (Max Moritz)
* Napa, Yolo, and Solano counties to make more accurate loss assessments and resource allocations for affected landowners after wildland fires, which was enabled by UCCE’s information and workshops. Additionally, UCCE workshops on prescribed burning initiated the formation of two prescribed burn associations that will help make rural communities more wildland fire resilient.(Morgan Doran)
* Clientele credit attitude shifts and policy changes in California to UCCE’s role in providing science-based information related to prescribed grazing: “Thanks to the visibility UC has brought to this issue, the 2022-23 State Budget specified that prescribed wildland grazing and prescribed grazing infrastructure are eligible for Fire Prevention Grants and even the California Air Resources Board’s 2022 Scoping Plan recognizes the value of using livestock to consume vegetation to reduce fuel loads…in forests, grasslands, and shrublands.” – Vice President of Government Affairs, California Cattlemen’s Association. (Royce Larsen and Devii Rao)
* Policies shaped by UC ANR efforts to improve fire resiliency led to another bill that was signed into law in 2022: SB 896 (Dodd). This bill requires CAL FIRE to utilize a common reporting platform to share with the legislature and others interested defensible space data collected and to make that platform available to community groups. This will help track community engagement and action more accurately throughout California’s communities. SB 896 also requires that CAL FIRE’s local assistance grant program for fire prevention and home hardening education activities give priority to any local governmental entity qualified to perform defensible space assessments in very high and high fire hazard severity zones. (Yana Valachovic)

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

* Over 700 climate-ready landscape trees, an increase from 400 trees in 2021, were provided gratis to residents of low-shade neighborhoods and planted in 100 public spaces. Since, on average, less than 40% of trees in urban settings live 20 years or more, greatly limiting their ability to maximize their ecosystem benefits, tree recipients also received training on proper tree care in English and Spanish from Master Gardeners. (Janet Hartin)
* Sierra Foothill region landowners who attended UCCE’s Prescribed Fire for Working Landscapes workshops successfully and safely burned more than 50 acres in 2021-22. These activities have removed flammable fuels from local landscapes while enhancing the profitability of targeted grazing businesses. (Dan Macon)
* UCCE technical support for the Plumas Underburn Cooperative and local California prescribed training exchange (Cal-TREX) event in the Northern Sierra region contributed to the implementation of 20 community prescribed fires, up from 11 the previous year, in Plumas County. (Ryan Tompkins)

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. According to CAL FIRE, the total acreage burned in 2022 was well below the 5-year average; less than 400,000 acres burned in 2022 versus the 5-year average of 2,300,000+ acres.