

## FY 2020 Annual Report of Accomplishments and Results

California

University of California Agriculture and Natural Resources

### I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your FY 2020 Plan of Work located in the Institutional Profile. Use this space to provide updates if needed.

#### 1. Executive Summary (Optional)

**During FFY 2020, UC ANR continued to make significant progress implementing our Strategic Plan 2016-2020, which operationalizes our Strategic Vision 2025. Below are some strategic plan accomplishments highlighted for NIFA and organized by four themes.**

##### **Conduct Relevant Programming**

Improving the lives of 40 million Californians requires UC ANR to constantly consider what we offer and how, so that our efforts positively impact clientele. Adapting our message and offerings is a key part of the land-grant history and continues to ensure our relevancy to clientele across the state.

- UC ANR is working to expand virtual reach and has quickly adapted in order to continue to serve the people of California during the COVID-19 pandemic. Web sessions with the California Institute of Water Resources (CIWR) increased by 60% and sessions for UC Integrated Pest Management (IPM), the Master Food Preserver Program, and the Nutrition Policy Institute increased by 30% each.
- Engagement with UC ANR on social media also increased. The number of Facebook followers increased by 10% for both IPM and 4-H. On YouTube, IPM saw a surge, with 149,518 views between January and June, around four times more views in the same period compared to 2019. CIWR's blog, The Confluence, saw a 50% increase in users and page views.

##### **Increase Resources for Programming**

State and federal support for the missions of the Agriculture Experiment Station and Cooperative Extension continues to grow at a pace slower than increases in costs of conducting research and Extension, driving a need to identify and secure different sources of funding. UC ANR continues to work to increase funding for research, programs, and people through partnerships, donations, and grantsmanship by elevating the skills of people across UC ANR to seek out and attract new funding.

- UC ANR's new Innovation & Entrepreneurship initiative, the VINE partnered with community exchange platform CropMobster to quickly help local food systems and economies connect and engage during the COVID pandemic crisis.

- The Citrus Research Board (CRB) is co-funding anew 10-year Cooperative Extension Citrus IPM Advisor position. This is a new type of partnership between UC ANR and CRB.
- The California Walnut Board, The Almond Board of California, and the California Pistachio Research Board are funding four Staff Research Associate positions to support academics.

### **Enhance Facilities for Research and Programming**

Cutting edge research and Extension require facilities that are well maintained and reflective of current technology. UC ANR is addressing years of deferred maintenance. Updating facilities requires redeployment of already scarce resources and additional fundraising.

- 22 new Capital Projects were approved for FY 2020. The total value of
- The Citrus Under Protective Screening project, located at LREC and funded by the Citrus Research Board and UC ANR, began construction in November 2019.

### **Employing Top Talent**

This encompasses recruitment of top talent through good recruitment practices and offering attractive, competitive positions, as well as the retention of existing personnel by providing a safe environment that encourages continuing career, leadership, and personal growth opportunities with competitive salaries and benefits. This also involves best practices in volunteer engagement.

- UC ANR academics and staff responded to the inaugural ANR@Work Survey during spring 2020, with 74% responding that they were a “satisfied” or “extremely satisfied” UC ANR employee.
- 100% of UC Master Gardener Program staff have completed an e-training to build volunteer engagement skills.

## II. Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your 2020 Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Process	Updates ONLY
1. The <u>Merit Review Process</u>	No significant updates for FFY 2020 that aren't already described in the Plan of Work.
2. The <u>Scientific Peer Review Process</u>	No significant updates for FFY 2020 that aren't already described in the Plan of Work.

### III. Stakeholder Input

The NIFA reviewer will refer to your 2020 Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA’s attention.

Stakeholder Input Aspects	Updates ONLY
<p><b>1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation</b></p>	<p><b>UC ANR Strategic Plan Refresh 2020-25</b> – UC ANR leadership engaged internal stakeholders to refresh the strategic plan for the next five years. Four input sessions were held to hear ideas from across the UC ANR network on ways to improve UC ANR. The strategic plan goals owners shared challenges and accomplishments and presented draft strategies for the future. Over 600 people registered in total, some for more than one session. For those who missed the input sessions, recordings were posted and surveys were provided to collect additional input. The plan was revised based on input and posted with a survey for final stakeholder feedback. Those final comments were aggregated and shared with goal owners before the plan was completed.</p> <p><b>UC ANR's Research and Extension Center (REC) System Strategic Framework</b> – Building on the 2019 Blue Ribbon Panel recommendations, in January 2020 a strategic planning process was launched. The inaugural REC System strategic framework was developed with stakeholder input. At the outset of the planning process a SWOT survey was sent to all the REC Directors and County Directors to share with their programmatic and administrative staff, and the campus-based Executive Associate Deans shared it with the Agricultural Experiment Station faculty and Cooperative Extension Specialists. A Market Panel of diverse thought leaders with experience and insight in the areas of applied research and extension provided input on how to expand the REC system’s user base, and participated in the initial REC System visioning. In addition, UC ANR internal stakeholders from outside the REC system participated in many of the strategic framework workshops. Finally, all UC ANR employees, the Market Panel, the UC ANR Governing Council, and the UC President’s Advisory Commission on Agriculture and Natural Resources were invited to provide feedback on the draft framework before it was finalized.</p>
<p><b>2. Methods to identify individuals and groups and brief explanation.</b></p>	<p>Addressed above</p>

<b>3. Methods for collecting stakeholder input and brief explanation.</b>	Addressed above
<b>4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.</b>	Addressed above

#### IV. Critical Issues Table of Contents

No.	Critical Issues in order of appearance in Table V. Activities and Accomplishments
1.	Healthy Families and Communities (HFC)
2.	Sustainable Food Systems (SFS)
3.	Sustainable Natural Ecosystems (SNE)
4.	Endemic and Invasive Pests (EIPD)
5.	Water Quality, Quantity, and Security (Water)

#### V. Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). In your outcome or impact statement, please include the following elements (in any order): 1) the issue and its significance (e.g. who cares and why); 2) a brief description of key activities undertaken to achieve the goals and objectives; 3) changes in knowledge, behavior, or condition resulting from the project or program’s activities; 4) who benefited and how. Please weave supporting data into the narrative.

No.	Project or Program Title (UC ANR condition changes)	Outcome/Impact Statement	Critical Issue Name or No.
1.	<b>UC ANR contributed to improved individual and household financial stability.</b>	<b>Issue</b> California’s vibrant, diverse economy is the fifth-largest in the world. To maintain its competitive edge, California must continually overcome technical, social, and environmental challenges. In 2020, the COVID-19 pandemic significantly disrupted Americans’ economic livelihoods through cascading shutdowns and layoffs. Economists from Harvard University project that, by February 2021, 4.5 million individuals will have been unemployed for more than 26 weeks, and almost 2 million individuals will have been unemployed for more than 46 weeks. Resource management, particularly for families living below the poverty line, has become critical to make ends meet.	HFC

		<p><b>Methods</b></p> <p>In partnership with communities and allied organizations, UC ANR conducts research and delivers education leading to improvements in individual and household financial management practices.</p> <p>UC Cooperative Extension (UCCE) academics provided oversight, leadership, and guidance for the statewide implementation of the CalFresh Healthy Living, University of California (CFHL, UC) and Expanded Food and Nutrition Education Program (EFNEP) statewide programs, which shifted to a virtual format to meet clients’ needs during the pandemic. Curricula such as Making Every Dollar Count (MEDC), Eating Smart Being Active (ESBA), and Plan, Shop, Save, and Cook (PSSC). They 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 and resources management techniques.</p> <p>As a result of UC ANR’s research and education, participants learned and adopted financial management practices. Outcomes with specific indicators follow.</p> <p><b>Outcomes</b></p> <p><b>Participants learned about financial management practices.</b></p> <ul style="list-style-type: none"> <li>● Over 350 CFHL, UC participants statewide responded to a survey about their experience with the MEDC curriculum, with 87% reporting improvements in knowing ways to save money on food. (CFHL, UC)</li> </ul> <p><b>Participants improved food resource management practices.</b></p> <ul style="list-style-type: none"> <li>● Over 400 CFHL, UC participants statewide responded to a survey about their experiences with the PSSC curriculum. They reported adopting food resource management behavior changes such as planning meals more often (59%), shopping with a list more often (56%), and comparing unit prices more often (56%). (CFHL, UC; EFNEP)</li> <li>● Nearly 2,200 EFNEP participants statewide responded to a survey about their educational program experiences and 84% of participants showed improvement in one or more food resource management practices. (EFNEP)             <ul style="list-style-type: none"> <li>○ After attending UCCE San Bernardino's <i>UCCE Connects to You!</i> Zoom series, 43% of graduates showed improvement in one or more food security indicators. Sixty-four percent showed improvement in food management</li> </ul> </li> </ul>	
--	--	--	--

		<p>practices, including comparing food prices, planning meals, looking in the refrigerator or cupboard, and making a list before shopping, which saves money and stretches the food dollar. (Christine Davidson, Chutima Ganthavorn)</p> <ul style="list-style-type: none"> <li>○ Surveys from ESBA participants in Los Angeles County showed that 82% of 210 participants improved in one or more food resource management practices. In Orange County, 91% of 190 participants improved in food resource management. (Natalie Price)</li> <li>○ In San Bernardino and Riverside counties, ESBA helped 78% of 444 EFNEP participants improve one or more food resource management practices. The PSSC Series resulted in improved behaviors for 144 participants, with 44% comparing food prices after taking the course. (Chutima Ganthavorn)</li> <li>○ The EFNEP program in Alameda and Contra Costa counties delivered the ESBA curriculum in English, Spanish, and Chinese to 375 parents, where 86% of participants improved food management skills such as planning meals before shopping, making a shopping list, and comparing food prices. (Marisa Neelon, Nelly Camacho, Santos Lopez)</li> <li>○ In Tulare County, 60 participants who completed the PSSC curriculum showed significant improvements in the following areas: plan meals (85%), compare unit prices (86%), shop with a list (81%), and all five behaviors: plan, price, shop, think, fact (61%). As a result of attending PSSC classes, participants shared their successes: “I had several changes- eat healthier; use right portions, less salt, more water; use less sugar and add more fruit and vegetables”; “I have stopped buying sodas; I make more infused waters with fresh fruits and vegetables.” Of the 44 participants improved resource management behaviors in the following areas: 84% wrote a personal goal, 93% used choice-making steps with decision, 86% identified community resources they can use, 67% checked to see if they are eligible for Earned Income Tax Credit, 100% used one of the easy ways to save on food, and 93% determined using a coupon is better than buying the store brand. (Deepa Srivastava)</li> </ul> <p><b>Change in condition: Participants saved money.</b></p> <ul style="list-style-type: none"> <li>● Program evaluation findings from 2020 indicate that EFNEP adult graduates reported an average monthly food cost savings of \$58.10, which collectively saved California EFNEP families \$1,532,445. (EFNEP)</li> </ul>	
--	--	---	--



		<ul style="list-style-type: none"> <li>○ Families in Los Angeles and Orange County saved an average of \$80 and \$95.40 a month on groceries, respectively, after participating in EFNEP’s ESBA workshop series. (Natalie Price)</li> <li>○ Families in Tulare County saved an average of \$44.50 on groceries per month after participating in Eating Smart Being Active. (Deepa Srivastava)</li> </ul> <p>These measured outcomes demonstrated improved knowledge and skills related to individual and household resource management. Furthermore, longitudinal studies of EFNEP graduates indicate that they maintain positive behavior change 2-6 months after completing the program. In this way, UC ANR contributes to the public value of promoting economic prosperity in California.</p>	
<p>2.</p>	<p><b>UC ANR contributed to enhanced community economic development.</b></p>	<p><b>Issue</b> California needs community economic development approaches to foster economic resilience and vigor across its working landscapes, especially now given the severe 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. Small producers in particular face challenges managing costs, marketing, and understanding and complying with regulations.</p> <p><b>Methods</b> 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.</p> <p>A UC Agriculture Experiment Station researcher at UC Berkeley is developing approaches for public policy analysis that allow the ripple effects of high-level changes in agriculture, environment, and energy policy to be evaluated for their impacts on public welfare at the state level. A case in point is the withdrawal from the Paris Climate Agreement by the Trump administration and the decision to rejoin under the Biden Administration. Such policy changes have impacts that are felt across a range of scales and by many communities. Understanding how state legislatures and other significant actors respond to these policy changes at a national level is an important component in the economic resilience of stakeholder</p>	<p>SFS, SNE, HFC</p>

	<p>communities. This research at UC Berkeley lays the groundwork for UC to help build that resilience. (Gordon Rausser)</p> <p>A UC Cooperative Extension (UCCE) Specialist at UC Davis works to advance Greenhouse Controlled Environment Agriculture (CEA), including a collaborative California/Dutch CEA innovation project. Crops being grown with various new technologies are being studied and extended through demonstration. (J. Lieth)</p> <p>One UC Riverside UCCE Specialist is also director of the California Citrus Clonal Protection Program (CCPP), the first program of its kind in the world with its roots in the 1933 discovery of the first citrus virus by Dr. H. S. Fawcett of the 1907 Citrus Experiment Station at 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 for the propagation of healthy citrus trees for the growing California citrus industry and all Californians. (Georgios Vidalakis)</p> <p>Multiple COVID-19 grants are available to growers to provide vital financial assistance, helping to absorb sales declines and increased marketing costs associated with the COVID-19 pandemic; however, farmers from socially disadvantaged communities have limited access to these resources due to language barriers. UC Cooperative Extension (UCCE) in Santa Clara County helped farmers from socially disadvantaged communities apply for COVID-19 grant applications through the American Farmland Trust-Farmer Relief Fund, CA Family Farmer Emergency Fund, and USDA-FSA-Coronavirus Food Assistance Program. (Qi Zhou)</p> <p>UCCE works to provide science-based information to support urban agriculture's triple bottom line: social, environmental, and economic. One UCCE Advisor collaborated with the Santa Clara County Agriculture Department to feature urban agriculture in their 2019 crop report. Data from urban farms and gardens were collected, and the goals and challenges of urban agriculture locally were described. In response to COVID-19, a section on “Resilience During Times of Crisis” was included and collated ways in which urban agriculture organizations have responded to the pandemic. (Lucy Diekmann)</p> <p>UCCE provides information on agricultural tourism, i.e., agritourism, to foster opportunities for farmers and ranchers to diversify their operations and expand their revenue sources to help them stay in business. Over the past couple of years, the statewide UC Sustainable Agriculture Research and Extension Program (SAREP) provided agritourism training and tours for farmers, agricultural professionals, and community members throughout California. (Gail Feenstra)</p>	
--	---	--

		<p>UCCE works with the Eastern Sierra Tri-County Fair to expand the entry categories for participation and opportunities for community engagement; the fairgrounds are a community economic engine in this rural and remote area of the Eastern Sierra. A partnership between the Fair Board and the UC Master Food Preserver Program was established to provide education on food preservation and promote fair participation that would utilize the fairground’s commercial kitchen. (Dustin Blakey)</p> <p>UCCE is the research partner on the French Meadows Project in the Middle Fork of the American River Basin, measuring and modeling water, carbon, and forest health benefits of watershed restoration. The field sites are used as a living laboratory for extension. Working with the Nature Conservancy, Sierra Nevada Conservancy, American River Conservancy, Placer County Water Agency, Placer County, and US Forest Service, this award-winning project has developed and demonstrated a collaborative model for watershed restoration. (Safeeq Khan)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants learned or planned to utilize innovation and entrepreneurial strategies.</b></p> <ul style="list-style-type: none"> <li>● Eight clients used UCCE technical information to determine whether a small farm operation was viable in the Eastern Sierra. (Dustin Blakey)</li> <li>● As a result of the SAREP agritourism workshops in Yolo and San Diego counties, 49 participating agriculture professionals gained or increased knowledge, skills and/or attitudes about sustainable agriculture topics, practices, and strategies. (Gail Feenstra)</li> <li>● As a result of the SAREP agritourism trainings, 70 participants, primarily farmers and ranchers, reported increased understanding of agritourism enterprises, the potential costs and benefits of agritourism activities, best practices for customer service, legal risks and liabilities, and the importance of business and marketing plans for agritourism enterprises. (Gail Feenstra)</li> </ul> <p><b>Participants implemented innovation and entrepreneurial strategies.</b></p> <ul style="list-style-type: none"> <li>● UCCE’s close collaboration with local innovators helped establish a site to showcase innovations for California greenhouse growers. UCCE assistance with greenhouse technology helped new start-up firms be successful. (J. Lieth)</li> </ul>	
--	--	---	--

		<ul style="list-style-type: none"> <li>● From the 14 new citrus varieties that completed therapy and testing by the CCPP in 2020, four varieties were introduced by large California citrus producers that invested \$40,000 towards the cost of the introduction. This demonstrates that the California citrus industry believes that these four varieties have commercial potential, which will help maintain or create thousands of agricultural jobs so that these varieties can be propagated, grown, and produced. Citrus farmers have estimated that every CCPP variety introduction that is commercially viable creates one to two jobs per acre. In recent years when CCPP introduced a commercially viable variety, it was planted in 1,000-1,500 acres. The jobs created can include citrus nursery jobs, harvesting crews, field transportation, packing house staff, logistics personnel, sales and marketing staff, and cold storage and shipping staff. (Georgios Vidalakis)</li> <li>● The technical assistance provided by UCCE in Santa Clara County to 185 farmers from socially disadvantaged communities resulted in 155 getting funded for a total amount of over \$3 million in emergency relief during the COVID-19 pandemic. (Qi Zhou)</li> <li>● The UC Master Gardener and UC Master Food Preserver programs increased usage of the Tri-County Fairground, promoting this community economic engine. In particular, the strong local participation helps ensure the facility’s commercial kitchen remains available for UCCE and the community’s use. The kitchen is currently being used by nonprofits and small enterprises needing access to a commercial kitchen to produce goods for sale or catering events. (Dustin Blakely)</li> <li>● As a result of SAREP’s agritourism training, 24 participants completed a 6-month action plan, and 10 participants completed a business plan. (Gail Feenstra)</li> <li>● A follow-up survey six months after the SAREP agritourism workshops found that eight respondents had extended the information by organizing agritourism workshops or training for other farmers and ranchers, with as many as 300 producers participating. (Gail Feenstra)</li> <li>● The Santa Clara County Crop Report section on urban agriculture raised public awareness and knowledge of the multiple benefits of urban agriculture. The Agricultural Commissioner states the annual crop report is the most widely read document on the Department’s website, and is distributed to county, state, and federal elected officials. As one urban garden manager wrote, “This document is incredibly useful as a resource for my courses and other courses I work with. I have been looking for content around the impact of COVID-19 on our food system and how urban farms can be a resource during times of crisis. It is especially helpful to have all the local work that everyone is doing in one place.” (Lucy Diekmann)</li> </ul>	
--	--	---	--

		<p><b>Change in condition: Jobs created.</b></p> <ul style="list-style-type: none"> <li>The French Meadows watershed restoration project partners have appeared on various forums highlighting the role of UCCE research in changing the pace and scale of forest restoration in California. UCCE’s continued engagement with research, education, advocacy, and fundraising resulted in 3,100 acres of forest restoration within the 28,000 acres of federal and private land. In the year 2020 alone, the project generated jobs for over 100 contractors. It also removed 1.4 million board feet of timber to a local mill and more than 1,200 tons of biomass to local renewable energy facilities to help offset restoration costs and contribute to the local economy. (Safeeq Khan)</li> </ul> <p>These aforementioned measured outcomes demonstrate changes that improve the economic, environmental, and social sustainability of California’s working landscapes. For example, increased agritourism demonstrates enhanced community economic development and contributes to promoting economic prosperity among farmers and ranchers participating in agritourism (Rilla et al., 2011). (Gail Feenstra) In this way, UC ANR contributes to the public value of promoting economic prosperity in California.</p>	
<p><b>3.</b></p>	<p><b>UC ANR contributed to improved animal management, productivity and efficiency.</b></p>	<p><b>Issue</b></p> <p>California ranks fourth in the nation in total livestock receipts, with over \$11.7 billion (2018). It remains the largest dairy-producing state, accounting for about 18% of the nation’s dairy product receipts (2018), 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. 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, including the conservation of aquatic species and managing stress in sustainable aquaculture.</p> <p>Livestock operations are struggling to navigate the current COVID-19 health and economic crisis. While suffering from income losses and cash-flow constraints, a total of 34,187 dairy farms nation-wide must ensure the safety and health of their 150,000 employees, mostly of Hispanic ethnicity, who are considered essential workers. Recent U.S. statistics indicate that</p>	<p>SFS, SNE</p>

		<p>30% of the reported COVID-19 cases were among Hispanics, even though they represent 17% of the U.S. population. (Noelia Silva-del-Rio)</p> <p><b>Methods</b>          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.</p> <p>An Agriculture Experiment Station researcher at UC Davis is involved in a multi-state project to examine the effects of climate change on the resilience of freshwater fisheries and their role in resilient food systems. The project, a collaborative effort involving the Kootenai tribe, is building a socio-ecological framework to understand how freshwater fisheries can be made more resilient in the face of environmental challenges from a changing climate and biological challenges from the impact of invasive species. Since freshwater fisheries play a vital role in indigenous peoples' food systems, the research is an important venue through which UC can work with, and in service of, indigenous communities. The research reveals the physiological capacity of wild and farmed fish species to respond to multiple sources of stress. The findings have important consequences for the conservation of natural fisheries and the design of fish farming enterprises for the future. (Anne Todgham)</p> <p>An AES scientist at the UC Riverside location identified a safe control option for horn flies: blood feeders that are among the most economically important pests of cattle. Individual horn flies feed 20-30 times per day, and the economic injury level is 200 horn flies per animal. The research found that a mixture of geraniol and C8910 fatty acids killed horn flies on contact and prevented horn flies from landing on cattle for 1-2 days. Geraniol is a chemical found in citronella, and C8910 fatty acids are classified as "generally regarded as safe" (GRAS) by the Food and Drug Administration. (Alec Gerry)</p> <p>A UC Cooperative Extension (UCCE) Veterinary Medicine Specialist at UC Davis conducted a COVID-19 needs assessment to understand how dairy producers, dairy workers, and allied dairy industry perceive the health and economic implications of the COVID-19 pandemic. This project conducted three nation-wide surveys to reach three different stakeholder groups: dairy producers, dairy workers, and the allied industry. Summarizing and sharing the surveys' findings with dairy producers are still underway. (Noelia Silva-del-Rio)</p> <p>A UCCE Veterinary Medicine Specialist at UC Davis leads a dairy cattle welfare effort that studies heat stress. They developed practical guidelines on how producers should manage heat</p>	
--	--	---	--

		<p>stress, such as when producers should turn fans on, and conducted an economic analysis of cooling dry cows to help improve dry cow management. The information was extended to 20 farmers and technical personnel. (Fernanda Ferreira)</p> <p>Another UCCE Specialist at UC Davis organized workshops for dairymen to introduce dairy digester technology's uses and benefits. He also extends information about non-digester manure treatment methods for improving dairy waste management, such as liquid solid separator (mechanical), weeping wall (manure holding facility and liquid solid separator), compost bedded pack barn, and manure dryer. A series of alternative manure management projects have been installed in California. This effort includes a technical review on projects installed, feedback to the California Department of Food and Agriculture, and help in decision making for funding the dairy digester projects, which can cost in the millions. (Pramod Pandey)</p> <p>A UCCE Dairy Technology and Engineering Specialist at UC Davis works to improve milk processing. Milk-processing technological directions to improve milk safety and quality were developed and delivered to milk processors in the U.S. and non-industrialized countries. (Moshe Rosenberg)</p> <p>A dairy in Monterey County called a UCCE Dairy Advisor to provide technical support on severe milk quality issues. To address the problem, the UCCE dairy advisor set up a milking school to train the milkers on proper milking procedures and worked with the herdsman to review practices and inspect the parlor and milking equipment for areas to be improved. UCCE made several recommendations to the dairyman and the herdsman; this included selecting several cows to leave the herd which had no evident clinical issues, such as udder inflammation or abnormal milk, but rather had chronic subclinical infections that contributed to a high bulk tank somatic cell count. (Daniela Bruno)</p> <p>This UCCE Dairy Advisor also conducted a genomic study to explore the relationship between calf genomic wellness traits and average daily weight gain during the first 70 days of life in Holstein dairy calves and the impact on animal performance during the first lactation. The research found that genomic testing can predict animal performance better than average daily weight gain. This information was extended to producers to help them make breeding decisions. (Daniela Bruno)</p> <p>The Ranch to Rail Program was developed collaboratively by UCCE with the UC Davis Department of Animal Science and the California Beef Cattle Improvement Association. The</p>	
--	--	---	--

		<p>program offers producers statewide the opportunity to sell feeder steers to the Animal Science Department and get back carcass and feedlot performance data. (Larry Forero)</p> <p>A UCCE Livestock and Natural Resources Advisor worked on a collaborative research project, funded by California Cattle Council, to analyze how much forage/fine fuels cattle consume and how that affects fire behavior and fire safety. The findings were extended through an article published in four news outlets, a virtual workshop, and a recorded workshop on YouTube. The popular media also picked up the story; the Capital Press, the Sacramento Bee, and two Oregon papers. This work was also highlighted in the Fire Webinar series produced by the Public Lands Council and National Cattlemen’s Beef Association, which is still under production. Additional research questions related to how grazing and fire influence particulate matter and greenhouse gases will be explored in the future. (Devii Rao, Felix Ratcliff, Sheila Barry, Luke Macaulay, Royce Larsen, Matthew Shapero, Shane Dewees, Max Moritz, Rowan Peterson, Larry Forero)</p> <p>The cow-calf production cost study findings for California's Central Coast were extended through three presentations and downloaded 244 times in 2019. This cost study can be a valuable tool for beginning ranchers to develop a budget and business plan. A seasoned rancher can also use it; they can enter their costs and compare it to the costs in the study to help them think about where they can make changes in their operation to reduce costs. Lastly, it can also be of value to land management agencies that lease their lands for cattle grazing, as many agency staff are not familiar with the different aspects of cow/calf operations. (Devii Rao, Donald Stewart, Daniel Sumner)</p> <p>A UCCE Poultry Specialist at UC Davis led a 4-part webinar series on managing backyard flocks. Topics included Chickens 101, Biosecurity, Behavior, and Egg Handling and Food Safety. The series had approximately 50 registered participants from Northern and Southern California and included two out-of-state participants. (Richard Blatchford)</p> <p>Additional extension efforts included UCCE workshops on backyard and pastured poultry for 29 participants in the Southern San Francisco Bay Area. (Lucy Diekmann) A UCCE livestock production workshop aimed at small ruminant owners in Imperial, Riverside, and San Bernardino Counties provided information to owners and conducted a needs assessment. (Brooke Latack) Lastly, the COVID-19 pandemic forced the annual UC ANR Kearney Research and Extension Center (KARE) Alfalfa and Forage Field Day to be virtual this year. There were 55 participants. (Michelle Leinfelder-Miles, Nick Clark, Joy Hollingsworth, Anthony Fulford)</p>	
--	--	--	--



		<p>A UCCE Specialist at UC Davis evaluated the Pasture, Rangeland, and Forage Insurance (PRF) as a risk management tool for livestock and forage producers. The project used data from USDA Risk Management Agency to analyze participation in the program and found producers were using PRF in a way that increased their risk (Goodrich et al., 2020). This information was extended to the policy and decision-makers at the USDA. (Brittney Goodrich)</p> <p>As a result of UC ANR research and extension, participants made changes that improve animal production systems. Outcomes with specific indicators follow.</p> <p><b>Outcomes</b></p> <p><b>Participants learned and intended to adopt practices for more productive and sustainable animal management.</b></p> <ul style="list-style-type: none"> <li>● As a result of the backyard poultry webinar series, 71% of survey respondents reported that they were likely to change their management based on the information provided in the series. (Richard Blatchford)</li> <li>● At the backyard and pastured poultry workshop, 100% of participants increased their knowledge of pastured poultry, 91% increased their knowledge of egg handling and food safety, and 82% increased their knowledge of bird health and diseases, bird behavior and welfare, and managing poultry during disasters. (Lucy Diekmann)</li> <li>● A post-training evaluation indicated over 70% gained knowledge of the importance of cooling dry cows, which is expected to improve animal management. (Fernanda Ferreira)</li> <li>● Through an end-of-session evaluation at a meeting where the cow/calf cost study was presented, 32 survey respondents (78%) said they learned something new that they would apply in decision-making. (Devii Rao)</li> <li>● Of the 24 livestock production workshop attendees, 100% responded that they learned something new and would be using that information on their operation within the next 24 months. (Brooke Latack)</li> <li>● Post-presentation polling of the virtual KARE Alfalfa and Forage Field Day found 77% of respondents gained knowledge on water, nitrogen, pest, and cultural management practices. On the post-meeting evaluation, 92% stated that they both learned something new and intended to use what they learned in the next 12 months. (Michelle Leinfelder-Miles, Nick Clark, Joy Hollingsworth, Anthony Fulford)</li> </ul>	
--	--	--	--

		<p><b>Participants adopted practices for more productive and sustainable animal management.</b></p> <ul style="list-style-type: none"> <li>• Multiple dairy farmers in Tulare, Merced, Kings, and Tipton Areas are using dairy digesters to produce biogas, which provides additional income. In addition, these digesters reduce greenhouse gas emissions. (Pramod Pandey)</li> <li>• Multiple dairy farmers in Tulare, Merced, Kings, and Tipton Areas are using dairy digesters to produce biogas, which provides additional income. In addition, these digesters reduce greenhouse gas emissions. (Moshe Rosenberg)</li> <li>• The real-time economic and production data associated with beef cattle genetics and production systems provided through the Ranch to Rail Program validated and improved ranch breeding programs. (Larry Forero)</li> </ul> <p><b>Science-based information was applied to animal production systems policy and decision-making.</b></p> <ul style="list-style-type: none"> <li>• As a result of the UCCE project that studied and promoted grazing for fuel reduction, the National Cattlemen’s Beef Association said this research could become part of their “greater national sustainability science communication effort, in addition to the national life cycle analyses that were completed this year.” If the public understands the fire safety and natural resources benefits of grazing, they will be more likely to continue buying California beef and potentially pay a premium. (Devii Rao, Felix Ratcliff, Sheila Barry, Luke Macaulay, Royce Larsen, Matthew Shapero, Shane Dewees, Max Moritz, Rowan Peterson, Larry Forero)</li> <li>• The USDA Risk Management Agency is considering alternative recommendations for the 2022 crop year (USDA 2020) in response to the new knowledge about insurance as a risk management tool for livestock and forage producers. This will ultimately benefit the California livestock and forage producers who participate in the program by improving risk management, which increases the likelihood their operations will remain economically viable. (Brittney Goodrich)</li> </ul> <p><b>Change in condition:</b></p> <ul style="list-style-type: none"> <li>• <b>Improved milk quality:</b> The dairy implemented the UCCE recommendations immediately. UCCE followed up by evaluating milk quality reports, and the improvement in milk quality was noticeable, with bacteria counts below regulatory limits. By removing certain cows from the herd, the milk quality improved as measured by improved creamery parameters that evaluate and classify milk quality. Quality premium payments are paid for high-quality milk, and some processors implement deductions if the milk fails to meet minimum quality standards. Before UCCE</li> </ul>	
--	--	---	--

		<p>assistance, the dairy was receiving warnings and less money for the milk. After the improvements, the dairy received a few bonuses. (Daniela Bruno)</p> <ul style="list-style-type: none"> <li>● <b>Saved money:</b> As a result of extending the UCCE genomic study findings, one dairy that had been planning on making a significant investment to weigh their calves decided not to purchase expensive equipment and instead continued to do genomic testing, which they have found more valuable. (Daniela Bruno)</li> </ul> <p>These measured outcomes demonstrate ranch-level advances, which help the state’s overall improvement in animal management and production. California’s total livestock and livestock products cash receipts went up nearly 5% from 2017 to 2018 (CDFA’s latest available statistic). Thus, UC ANR contributes to the public value of promoting economic prosperity in California and the ecological viability of the livestock industry.</p>	
<p>4.</p>	<p><b>UC ANR contributed to increased agriculture efficiency and profitability.</b></p>	<p><b>Issue</b> California is a national leader in agricultural production, leading the country in cash income received for agricultural products, with farms and ranches receiving \$50 billion for their output. The state accounts for almost half the country’s fruit and nut production and over half of vegetable production. The state’s farmers and ranchers must innovate and adapt to technical, social, and environmental challenges to maintain the economic vigor of California’s agricultural 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.</p> <p><b>Methods</b> UC ANR creates and extends new knowledge about agricultural production from variety trials to post-harvest.</p> <p>A UC Agriculture Experiment Station researcher at UC Berkeley is unraveling the tricky problem of what drives technology adoption decisions by individual farmers. Fertilizer use in agriculture is a good example. Synthetic fertilizer, particularly Nitrogen, use has increased crop yields helping to reduce global food shortages. Still, it also causes increases in greenhouse gas emissions and can be a significant pollutant of freshwater supplies. Encouraging farmers to use targeted, rather than blanket, fertilizer applications can help preserve the benefits of fertilizer inputs to crops while reducing the unwanted “external” effects. Work at UC Berkeley has shown that farmers who received grants to improve the efficiency of fertilizer use that were</p>	<p>SFS</p>

		<p>not tied to the use of particular activities or products were more persistent in their uptake of the grants and changes to their behavior. These results have important implications for the design of policy instruments in agriculture. (Aprajit Mahajan)</p> <p>Another AES researcher at UC Berkeley is investigating the ties between soil biodiversity, cropping practices, and the resilience of production. The research pays particular attention to mycorrhizal fungi's role in helping crop plants cycle nutrients more efficiently in crop rotations and the value of cover crops in increasing the supply of environmental goods and services from California cropping systems. Research that spans from microscopic interactions between fungi and plant root systems to environmental benefits captured at the scale of the whole state shows that cropping system design based on sound ecological principles can produce multiple short- and long-term benefits. However, based on survey data gathered from growers, the work also highlights several potential obstacles to broader use of cover crops in California, including water use in orchard systems and perceived conflicts with food safety regulations in leafy greens. (Timothy Bowles)</p> <p>An AES researcher at UC Davis is investigating the potential for reintegration of crop and animal production systems into combined production systems in search of sustainable food production for a changing planet. When viewed through the single lens of maximizing the production of a single commodity, specialized agriculture is the economically efficient endpoint. However, there is growing recognition of the need for multifunctional agriculture that delivers sustainable food production and a range of other environmental goods and services. In this research, a combination of experimental observations from long-term experiments, computer simulation, and data meta-analysis is used to study a range of outcomes that characterize production across a range of dimensions. The results point to promising designs for integrated production in both rain-fed and irrigated agriculture. (Amelie Gaudin)</p> <p>AES researchers at UC Riverside are investigating the benefits of sustainable crop production and water use efficiency from recycling food waste as biofertilizers in horticultural crop production. Microbiologists have found that including fermented food waste in the water supply for pot-grown citrus trees promoted the growth of beneficial bacteria around the plant roots, with potential benefits for plant growth, plant health, and the production efficiency of the plants. Since the experimental system recycles food waste, it can help close a major gap in the sustainable recycling of resources in modern societies; with more than half the world's</p>	
--	--	---	--

		<p>population living in urban settings, recycling resources from cities back to agriculture is a major issue. (Deborah Pagliaccia, Samantha Ying)</p> <p>UC Cooperative Extension (UCCE) work on small farm sustainability in the Sierra Foothills delivered participatory workshops focused on building producers’ business management skills, risk management and planning, and economic and market analysis. With the onset of the COVID-19 pandemic, virtual workshops and peer support events became the primary delivery methods. Peer-to-peer learning is critical to the training; it results in the rapid adoption of new practices and improvements in farm and ranch profitability. Seventy-three percent (20,110 people) of visitors to the UCCE Foothill Farming Website focus on the Farm Business pages. The <a href="#">Farm and Ranch Standard and Emergency Operations Procedures template</a> was downloaded 2,584 times. (Cindy Fake, Dan Macon) Other workshops focused on horticultural productivity taught practical knowledge and skills on using organic matter, building healthier soil, and conserving water. These practices can mitigate plant stress due to wide temperature fluctuations, increased windy days, and stronger winds caused by climate change. Close to 1,300 growers participated in an in-person or virtual workshop, class, or grower meeting. (Cindy Fake)</p> <p>UCCE efforts in Sutter, Yuba, and Colusa Counties focus on almond and prune production, which contributes almost three-quarters of a billion dollars to the local economy. Work is underway to evaluate new rootstocks for prune and almond and almond varieties to maintain sustainable tree crop production in the face of limited resources (water, nutrients, etc.). Long-term almond rootstock and variety trials have continued to document the most economically productive combinations for the region, with support from the Almond Board of California. There is also an ongoing prune rootstock trial in a grower’s orchard. Almond research results were extended through the Almond Board of California annual conferences, and prune rootstock project annual reports were written for the California Dried Plum Board. (Franz Niederholzer, Luke Milliron)</p> <p>In 2019, another field trial was implemented in Stanislaus County to evaluate the impact of plant in-row spacing on grafted watermelon yield and fruit quality. The goal is to understand the feasibility of growing a reduced number of grafted plants without compromising yield and quality. In 2020, conversations with growers and socially-distanced, in-person field meetings continued in Merced, Stanislaus, and San Joaquin Counties. (Zheng Wang)</p>	
--	--	--	--

		<p>UCCE's work to address wheat grower usage of nitrogen fertilizer as part of a larger statewide project continued in collaboration with colleagues at UC Davis and funded by the Fertilizer Research and Education Program. Given the issue of nitrate leaching into groundwater, the regulatory environment in California has challenged growers to become more efficient with nitrogen budgeting and reporting. In many cases, regulations mean that growers have less nitrogen available to use for a particular crop. This project assists growers to maximize their yield return per unit fertilizer, maintaining productivity in the face of input restraints. The project has refined methods so growers can react to crop conditions in-season by using several in-field tools, such as reference areas, soil sampling kits, and hand-held chlorophyll meters. Thus, growers can, with improved confidence in their field nitrogen status, shift a percentage of their fertilizer application from pre-season to in-season. In-season application allows for rates to be adjusted to address changes in yield potential from pest damage, drought conditions, or frost damage. Depending on the year, this can mean higher yields or less wasted fertilizer. (Konrad Mathesius, Mark Lundy)</p> <p>Grapes are the second largest agricultural commodity in California, valued at \$6.25 billion in 2018 with approximately 900,000 acres. Currently, increasing <a href="#">labor costs</a> and severe labor shortages are starting to damage long-term grape farming profitability and competitiveness. Full mechanization on wine grape vineyards can reduce the production cost per acre from \$3,000 to \$2,500 per acre, representing close to a 20% reduction in production cost. However, wineries and juice processing plants have concerns about grape and juice quality from mechanization. UCCE Fresno and UC Davis have been working on research projects to identify the best strategy for <a href="#">mechanical pruning</a>, leafing, and shoot thinning at San Joaquin Valley, North Coastal, and Napa Valley regions. <a href="#">Research</a> findings have identified the best guidelines for adopting vineyard mechanization, and confirmed that mechanization has no negative effects on grape and wine quality; rather, it improves them. Research results were shared with growers and industry personnel through meetings, field demonstrations, newsletters, and professional society conferences. (George Zhuang)</p> <p>Other UCCE studies to improve economic sustainability for grape growers extended new information through the annual Central Coast Wine Grape Seminar, statewide industry meetings, and local grower association meetings. The most frequent extension of this information occurs during consultations on the phone or during on-site visits to discuss clonal selection, planting stock options and rootstock choices most appropriate for new vineyard developments. (Larry Bettiga)</p>	
--	--	--	--

		<p>A UCCE project focused on improving the efficiency, profitability, and sustainability of fruit and nut production in the northern San Joaquin Valley extends science-based information through annual commodity meetings, field days, and semi-monthly Integrated Pest Management breakfast meetings. These meetings often spur telephone calls requesting follow-up information and requests for farm visits. Research findings have also been picked up by the popular press agricultural magazines, further extending the reach. (Roger Duncan)</p> <p>Lastly, at the UC ANR Intermountain Research and Extension Center, results from an organic potato study documented how cover crops and amendments influence soil and plant nitrogen, helping growers increase yields, reduce input costs, and prevent nitrate losses in the environment. (Rob Wilson)</p> <p>As a result of UC ANR research and extension, participants learned and adopted agricultural management practices. Outcomes with specific indicators follow.</p> <p><b>Outcomes</b></p> <p><b>Participants adopted recommended practices for plant production.</b></p> <ul style="list-style-type: none"> <li>● Through the horticultural productivity workshops in the Sierra Foothills, 121 specialty crop producers implemented one or more new best practices on their farms, including soil moisture monitoring, irrigation scheduling, mulching, cover crops, and pruning. (Cindy Fake)</li> <li>● Presentations of UC research results are helping change grower perceptions and interest in new rootstocks. Growers are shifting their thinking about rootstock selections from traditional almond (Lovell or Nemagard) or prune (M29C or M2624) rootstock to newer, commercially available rootstocks evaluated in our studies such as Krymsk 86 and Viking in almonds and Krymsk 86 or Viking in prunes. New rootstocks can potentially improve and sustain orchard health and productivity compared to traditional rootstocks, providing more returns on the investment of community resources. Through conversations with Sacramento Valley growers and nursery sales representatives, the traditional Lovell and Nemagard rootstock plantings have decreased, and the use of the recommended Krymsk 86, in particular, has dramatically increased. (Franz Niederholzer)</li> <li>● Using the UCCE decision-making tools, one wheat grower collaborator in Yolo County reduced nitrogen applications by 30% by using in-season top-dress strategies combined with the data that was derived from the reference zones. As a result, there</li> </ul>	
--	--	--	--

		<p>was a reduction in nitrate waste in the grower's field by 30 pounds per acre. This is an example of how these methods can maintain productivity in light of nitrogen restrictions. Improved grower-collaborator confidence in using decision-support tools for nitrogen management will improve nitrogen use efficiency and ultimately reduce the application of excess nitrogen fertilizer. (Konrad Mathesius)</p> <ul style="list-style-type: none"> <li>● The extension of vineyard development practices has improved grower management decisions who adopted earlier vine training to achieve full production potential earlier in the life of their vineyards. The use of planting stock with pre-developed trunks has increased locally, based on the trial findings that justified using the more expensive planting stock given it results in earlier plant development and higher initial yields. The trial results serve as a basis for more informed planting decisions to improve yields and quality and have also demonstrated labor savings by planting vines with preformed trunks. (Larry Bettiga)</li> <li>● Building on earlier adoption of the organic potato study findings, ten potato growers in the Klamath Basin have now planted over 50 acres of cover crops on their farms, and over 20 growers have now changed their organic fertilizer program to match study recommendations, as noted through observation. The Klamath Basin USDA office also integrated results into their local cover crop cost share program. (Rob Wilson)</li> <li>● Through informal means, evaluation data has gleaned that growers and pest control advisors are using the UCCE fruit and nut production information to shape their farming and pest control programs, such as training young trees rootstock selection and using compost. (Roger Duncan)</li> </ul> <p><b>Change in conditions</b></p> <ul style="list-style-type: none"> <li>● <b>Improved productivity:</b> <ul style="list-style-type: none"> <li>○ Through conversations and on-farm observations, those who attended the UCCE Watermelon Grafting Field days in 2019 have either increased their acreage of grafted watermelon in 2020 or plan to increase in subsequent seasons. Currently, the estimated total acreage of grafted watermelon in the northern San Joaquin Valley, the most significant watermelon region of California, has at least tripled from less than 200 in 2019 to over 600 in 2021. Growers mentioned that successfully grafted fields could produce 15-25% more watermelon fruit than the non-grafted fields per acre on average. The average plant population per acre in grafted fields is about two-thirds of that in non-grafted fields. (Zheng Wang)</li> </ul> </li> </ul>	
--	--	--	--



		<ul style="list-style-type: none"> <li>● <b>Increased revenue:</b> <ul style="list-style-type: none"> <li>○ The 19 Farm Business Planning graduates shared their successes and challenges virtually and supported each other in the early months of the COVID-19 pandemic. They talked about how important it was to know others were also struggling and to hear what worked for others and get their advice. Fifty-eight percent managed to adjust their operations and reported increased cash flow during the first six months of the pandemic. (Cindy Fake, Dan Macon)</li> <li>○ Over 30,000 acres of wine grape in San Joaquin Valley has converted into a type of mechanization based on UCCE's research and extension of findings. Mechanization can save \$500 per acre for growers on production costs based on <a href="#">2019 UC cost studies</a>, thus, potentially saving \$15 million per year. The Wine Group, the second largest winery in the U.S., and other industry partners have indicated they will adopt the mechanization into the current farming practices. (George Zhuang)</li> </ul> </li> </ul> <p>These measured outcomes strengthened diverse California farm businesses by helping to increase their economic returns given increased yield, reduced inputs, or improved business management and marketing. These outcomes contribute to increased agricultural efficiency and profitability and the public value of promoting economic prosperity in California. For example, in Colusa County, the farm gate value for almonds increased by almost 66%, adding \$120 M, from 2012 to 2019, according to the County Ag Commissioner's annual Crop Report. (Franz Niederholzer) Statewide the cash income received for many of California's top commodities increased in value between 2017 and 2018, as last measured by the California Department of Agriculture.</p>	
5.	<b>UC ANR contributed to increased agriculture efficiency and profitability.</b>	<p><b>Issue</b></p> <p>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. In agricultural systems, pests reduce yields, render crops unmarketable, and negatively impact revenues. For example, fungicide use for mitigating grapevine powdery mildew accounts for 90% of the environmental cost of grape production. As California's population increases, crop production must increase to meet the greater food demands despite lagging resources for detection. (Monica Cooper) Increased demand for sustainably produced food necessitates revising traditional integrated pest management practices in both organic and conventional systems. (Surendra Dara) Science-based</p>	EIPD

		<p>information is needed for growers, managers, and policymakers to develop practices and policies that sustain economic vitality while protecting environmental quality.</p> <p><b>Methods</b>  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.</p> <p>UC Agricultural Experiment Station (AES) scientists at the UC Davis location conducted research related to pest and disease management in tomatoes, a \$1.2 billion California industry. One scientist developed and validated a molecular identification tool to identify South American tomato leafminer larvae, <i>Tuta absoluta</i>. The larval stages bore into tomato leaves, stems, and fruit but are difficult to visually distinguish from other leafminers and pinworms that are currently in California. This is a potentially serious invasive pest not yet in California, but it rapidly spread across Europe, North Africa, and West Asia, causing significant economic losses. If it invades California, the new tool will allow rapid identification and timely response to limit economic damage to the industry. (Joanna Chiu) Another UC AES scientist studied fusarium wilt, one of the most important diseases of processing tomatoes. California produces more than 90% of U.S. processing tomatoes, which are considered the largest source of phytonutrients in the average American diet. Previous research determined that application of both the antifungal bacterium, <i>Collimonas arenaea</i>, and the commercial biopesticide, Serenade Soil, can reduce Fusarium wilt of tomatoes. The original isolate was from a California state park, and therefore not allowed to be developed into a commercial product. Because of the potential benefit of <i>Collimonas</i> as a biological control, the law was changed in 2019 to allow for commercial development. The synergistic effect was patented and is in the process of licensing to a biotechnology company for commercialization. (Johan Leveau)</p> <p>Other UC AES scientists conduct research addressing citrus pests. Two scientists at the UC Riverside location are studying biological controls for Asian citrus psyllid, which spreads the bacterium that causes Huanglongbing, a disease of citrus. The psyllid is widespread in southern California, and hundreds of diseased trees were removed to prevent further spread. The disease previously devastated the Florida citrus industry, which raises concerns for California's multi-billion dollar citrus industry. Biological controls and management of Argentine ants under citrus trees have been found to reduce the psyllid populations and reduce the likelihood of transmission of the disease. (Richard Stouthamer and Mark Hoddle)</p>	
--	--	--	--

		<p>One UC AES scientist at the UC Davis location studied katydids and earwigs, which cause cosmetic damage of orange fruit by biting the rind of young developing fruit. Cosmetically damaged oranges are down-graded, resulting in a loss of income for growers. Mandarin growers have been using data developed for orange integrated pest management. Research revealed that mandarin varieties are almost entirely resistant to katydids and earwigs. Therefore, mandarin growers do not need to apply insecticides to protect their fruit. (Jay Rosenheim)</p> <p>Another UC AES scientist at the UC Davis location researches Pierce’s disease, an incurable disease of grapevines that causes yield loss and eventual death of vines. In 2014, the estimated financial impact of Pierce’s disease in California was \$104.4 million. The research identified a bacterium, <i>Paraburkholderia phytofirmans</i> that lives inside grapevines (endophyte) and controls Pierce’s disease. Initial research was conducted by injecting the bacterium with a needle into grape leaves and petioles, and further tests showed it could be sprayed on with a wetting agent and provide the same level of Pierce’s disease control. If field trials and commercialization are successful, it could be the first therapeutic control for Pierce’s disease. In another laboratory, winegrape varieties bred with native grape species to be resistant to Pierce’s disease have been patented and submitted to Foundation Plant Services for certification. Once certified virus-tested, they will be released to nurseries for propagation and eventual distribution to vineyards. These varieties can be planted in areas with chronic Pierce’s disease to reduce vine loss and maintain economic productivity. (Andrew Walker)</p> <p>Field research projects at the UC ANR Intermountain Research and Extension Center (REC) and extension activities addressed pest management challenges for growers in the region. Projects focused on blue aphid and alfalfa weevil in alfalfa production, developed alternatives to pesticides in wheat production, and identified seed treatment solutions to onion maggots and smut damage in onion production. Notable research findings included seed treatment providing better control of onion maggots and smuts than the industry-standard pesticides, chlorpyrifos and thiram, which are being phased out due to environmental concerns. (Rob Wilson) A University of California Cooperative Extension (UCCE) Advisor in the Intermountain region conducted alfalfa research and conducted extension activities about early-season insecticide applications for blue alfalfa aphids and integrated management practices for weevils. (Thomas Getts) UCCE Advisors also extended information about identifying grasshoppers' growth stages and the physical, chemical, and cultural control options in alfalfa. (Thomas Getts, Tracy Schor)</p>	
--	--	--	--

		<p>Several UCCE academics conduct research and extension on the use of natural predators for biological control of pests. In the San Joaquin Valley, a UCCE Advisor conducted pest management research to reduce spider mites in almond orchards. A project involving the previously underappreciated predator called six-spotted thrips included developing a trap, generating information on this predator's phenology, establishing 'no need to treat' thresholds, and conducting an awareness campaign. (David Haviland) Over the last thirteen years, UCCE has also promoted the use of parasitic Aphytis wasps to control a major pest of citrus, California red scale, by facilitating releases with growers. (Cindy Fake) One UCCE Specialist at UC Riverside conducted several years of research on a natural enemy for Asian citrus psyllid, a serious pest of citrus native to the Indian subcontinent that spreads a citrus-killing bacterium. This included importing, mass rearing, and releasing <i>Tamarixia radiata</i> to establish, spread, and impact the target pest populations. (Mark Hoddle)</p> <p>UCCE research led to the development of science-based recommendations for pest trapping in edible date production. This included types of traps, types of fermenting baits, and trap placement for monitoring and controlling the pest, the South American palm weevil. Findings include more effective traps, such as using picusans that capture five times more weevils. Extension clientele included date producers, pest control advisors, professional arborists, county parks and recreation workers, and state and federal agencies. The information helped inform existing monitoring and controlling efforts in San Diego and proactive surveillance programs in the Coachella Valley. (Mark Hoddle)</p> <p>Almond pest management research and extension continue to be a major focus for many UCCE Advisors. One UCCE Advisor researched brown marmorated stink bug (BMSB), a new invasive almond pest. The research found an efficient and less-costly monitoring trap for this pest, which can help detect the problem early and prevent economic losses by making spray decisions on time. With the increase of BMSB infestations in tree crops in the northern San Joaquin Valley, UCCE responded to several requests to discuss when and how to use the monitoring tools to detect BMSB presence in tree crops. (Jhalendra Rijal) One UCCE Advisor conducted several experiments on miticide effectiveness to treat spider mites and found the almond industry should eliminate the practice of making preventative applications and rely more on monitoring for making early-season treatment decisions. In another experiment at the UC ANR West Side REC, UCCE collaborated with industry partners to evaluate six conventional and three organic miticides. These study findings were shared with pest control professionals. (Kris Tollerup)</p>	
--	--	--	--

		<p>Multiple projects focused on addresses grapevine powdery mildew. A multi-state collaboration involving UCCE academics generated a rapid-detection tool for grapevine powdery mildew fungicide resistance. Over 400 samples from California were submitted annually for testing and extension of original, timely, scientific evidence to stakeholders. (Monica Cooper) One UCCE academic conducted fungicide evaluations to measure the efficacy of both registered and experimental materials for powdery mildew and Botrytis bunch rot on grapes and extended findings on the value of low-risk biological fungicides in integrated control programs. (Larry Bettiga)</p> <p>One UCCE Advisor analyzed the risks for invasion and spread of the invasive vine mealybug and European grapevine moth. This information was used to advocate for policy decisions that optimize resource allocation and support sustainable agricultural production practices. (Monica Cooper) UCCE is also working to prepare California grape growers for a potential invasion of the spotted lanternfly. This invasive pest is devastating vineyards and has become a nuisance to urban landscapes on the East Coast. Extension of science-based information through presentations and detailed videos aims to increase awareness of both growers and the general public of its potential threat, prevention, and mitigation of its spread. (Surendra Dara)</p> <p>UCCE’s network-based approach to learning among Napa growers disseminated best practices and demonstrated the value of grower-driven data collection to regional disease management. One specific focus of the network was on grapevine leafroll disease, which is one of the most economically consequential viral diseases of grapevines worldwide. (Monica Cooper)</p> <p>UCCE academics have conducted several years of rice research and extension, with an emphasis on weedy rice types and prevention strategies. Two UCCE academics conducted a comprehensive survey of all previously-known fields, which consisted of 14,000 acres, to update infestation levels and field-level information. UCCE also continues to monitor acreage infested with weedy rice after conducting research that resulted in a new seed policy, making the use of certified rice seed mandatory for all planted acres in California. Extension of UCCE research through blogs, factsheets, and presentations provided the rice industry with information and tools to address weedy rice. (Luis Espino and Whitney Brim-DeForest)</p> <p>UCCE continues to monitor usage in the Sacramento Valley and the Delta of an effective insecticide, methoxyfenozide, after contributing to its emergency registration in 2018 for armyworm infestations. (Luis Espino, Michelle Leinfelder-Miles) Armyworm research trials for insecticide options, monitoring a network of pheromone traps in the Sacramento Valley, and</p>	
--	--	--	--

		<p>delivering an intense outreach campaign to educate growers about monitoring and managing armyworms were key methods in armyworm control. (Luis Espino)</p> <p>A UCCE Advisor evaluated herbicide efficacy in drill-seeded rice in response to an increased interest in growing rice in the Delta. Findings of the trial were extended in publications and at a Virtual Rice Field Day. (Michelle Leinfelder-Miles) Another UCCE Advisor conducted a rice disease and straw management study in 2019 and shared findings with the California Air Resources Board. A UCCE Advisor and Specialist collaborated to research kernel smut, an emerging rice disease, to refine fungicide treatment recommendations. As a result, the fungicide, propiconazole, was recommended through extension outreach. (Luis Espino)</p> <p>A UCCE Advisor has been conducting extensive research in providing multiple integrated pest management options such as chemical, botanical, and microbial pesticides for pest and disease management. He also conducts research with biologicals to understand their potential in promoting crop growth and health and their direct or indirect contribution to pest and disease management. Research findings helped redefine the integrated pest management paradigm and <u>developed a new model</u> that is economically viable, socially acceptable, and environmentally sustainable. Efforts to extend information about the new model were evaluated with an online survey of respondents from several states and countries. One specific project involved three biostimulant field studies in strawberries and tomatoes. The findings informed extension efforts, such as trade journal articles and presentations. He aimed to increase industry understanding of potential yield improvements, as well as potential negative impacts of certain biostimulants that overstimulate plants. This helps respond to the organic produce industry's growth and a growing emphasis on improving conventional practices by evaluating non-chemical and reduced risk inputs. Current and previous studies helped generate data demonstrating botanical extracts, including azadirachtin and beneficial bacteria and fungi, as alternatives to chemical pesticides. Ongoing extension activities share the findings of this research with small fruit and vegetable growers. (Surendra Dara)</p> <p>In Kern County, a UCCE Advisor maintains a small diagnostics lab in the county office that conducts isolations and runs simple diagnostic tests to verify the pathogen responsible for problems seen in the field. Through this lab, a bacterial canker in processing tomatoes was diagnosed for the first time in 2019 and later confirmed by UC Davis specialists. The results help inform timely responses and technical assistance to growers. (Jaspreet Sidhu)</p> <p>A plant pathology laboratory at the UC ANR West Side REC helps UCCE diagnose various clientele's production issues. The laboratory receives samples from growers, who can receive</p>	
--	--	---	--

		<p>quick diagnoses and mitigation strategies. Through diagnostic activities, the presence of a resistance-breaking strain of Tomato spotted wilt virus was recognized, reported, and further researched. Silverleaf whitefly and virus-like symptoms are being monitored in the melon-producing areas in Fresno County, and all suspicious signs are collected and tested. Results of local trials and desert area research findings were extended to clientele. In addition, insecticide efficacy studies were conducted at the UC ANR West Side REC. (Tom Turini)</p> <p>One UCCE academic conducts research and extension on potato varieties. Approximately 200 lines were evaluated, and promising new varieties were identified during trials over the past year. A Potato Field Day was organized to share the results of the trial with growers and breeders from California and other states. These research results on new varieties were disseminated to clientele through newsletters, regional reports, magazines, and radio reports. (Jaspreet Sidhu) Another UCCE academic conducted applied research on improving existing pest management tools, such as crop improvement for Blackeye Cowpea varieties. (Nicholas Clark)</p> <p>UCCE Santa Clara County’s Small Farm Program delivered presentations at the Bay Area Chrysanthemum Growers Association Continuing Education Meeting about insect pest management in Asian vegetables. A majority of the Asian vegetables grown by farmers in the area are considered minor crops and as such lack pesticide use registration especially for some of the newer and improved pesticide products currently available for use. The presentations included information on laws and regulatory updates, managing pesticide drift, regulations and responsibilities, and how assessments are conducted on farming properties. The workshop had 59 attendees, who were primarily growers who may face language and cultural barriers to understanding federal and state pesticide safety and legal compliance requirements. The goal of these presentations was to extend research-based information on the safe handling and use of pesticides labeled for application on these crops to farmers to address disease pressures and economic concerns. (Aparna Gazula, Qi Zhou)</p> <p>With few pest control advisors serving the Sierra Foothills, UCCE programs fill a critical gap in providing integrated pest management education to horticultural crop producers, farm managers, and prospective growers. The programs deliver science-based information about identifying and managing key pests across various crops, increasing knowledge levels for effectively and sustainably managing crop pests while minimizing environmental impacts. Furthermore, these programs help the agricultural industry to meet growing demands for locally produced food. (Cindy Fake)</p>	
--	--	--	--

		<p>In managed rangelands and agricultural areas, wild pigs are a significant pest species. However, estimates of total damaged area occurring on these lands are ill-defined and subject to a high degree of variability. Wild pigs can be major vectors of disease, cause crop and forage loss, and prey directly on livestock animals. Existing research estimates damage at approximately \$1.5 billion across the U.S., and profit losses in California were estimated at 10%, 8%, and 8% for nut crops, rangelands, and grapes, respectively. The geographical extent of wild pig damage in California is currently unknown; having such data would allow land managers to more effectively mitigate wild pig damage by allowing identification of specific areas conducive to wild pigs. In 2016 a mobile app was developed, funded by the Renewable Resources Extension Act, to assist land managers by assessing the type, nature, and extent of damage occurring on their property. <u>Mississippi State University has released a slightly modified one from the UC version.</u> (John Harper, Roger Baldwin, Leslie Roach, Elise Gornish, Ken Tate)</p> <p>Local Boards of Supervisors need scientific information to make good decisions regarding Wildlife Services. Ranchers need to have as many scientifically tested non-lethal tools that work to remain as stewards of the rangeland. When Project Coyote, a non-governmental organization, targeted Mendocino County to end a contract with Wildlife Services, several UCCE reports were shared with the County Board of Supervisors that documented predator financial loss to ranchers, as well as several other scientific papers on the effectiveness of non-lethal methods of controlling predators. UCCE also did an on-line survey of ranchers to summarize their familiarity with non-lethal control methods and their experience of success or failure with those methods. A survey report was provided to each of the Supervisors. UCCE advisors participated in the public meeting to discuss the impacts of Marin County’s decision to drop the Wildlife Services contract for predator control. Also, a group of UCCE advisors and specialists put together a peer-reviewed paper on the effectiveness of various non-lethal predator control techniques. (John Harper)</p> <p>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. Videos created by CCPP reach thousands of viewers. In 2020, three videos were collectively viewed over 56,500 times. In response to a new regulation in 2010, named the Citrus Nursery Stock Pest Cleanliness Program, the CCPP developed modern technology high throughput molecular pathogen detection assays and provided diagnostic services for over 21,000 samples from citrus mother</p>	
--	--	---	--



		<p>plants, which enabled California citrus nurseries to stay open, produce and sell healthy trees to the citrus growers and general public of the state. The CCPP provided these diagnostic services through 2021 and is working to transition the service to the California Department of Food and Agriculture laboratories to continue to support quality control checks and technological updates. (Georgios Vidalakis)</p> <p>Another UC Davis UCCE Specialist provided leadership in intelligent cultivators for weed management in vegetable crops. Based on the introduction of the "robovator" from Denmark, there has been commercial adoption of this technology in the Salinas Valley and Santa Maria for use in broccoli and lettuce. Now, there is interest in using this technology for processing tomatoes. There is a critical shortage of farm labor for hand weeding, and intelligent devices help fill this void. Extension meetings and outreach ensure that growers in these areas are aware of recent developments in cultivators. (Steven Fennimore)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants gained knowledge of detection and control practices for invasive and endemic pests and diseases.</b></p> <ul style="list-style-type: none"> <li>● Several California growers and residents shared feedback after reading UCCE journal articles that they are now aware of the potential threat of spotted lanternfly on grapes. (Surendra Dara)</li> <li>● UCCE integrated pest management classes in the Sierra Foothills helped farmer and landscaper participants correctly identify key fruit tree and vine pests using an audience response system (88% of 40 attendees), identify damage or impacts of key pests (88%), and describe behavior and habitat of key pests (78%). (Cindy Fake)</li> <li>● Rice Virtual Field Day participants reported learning information about the UCCE herbicide efficacy trial (82% of 56) to be more efficient with drill-seeded rice production in the Delta. (Michelle Leinfelder-Miles)</li> <li>● Small-scale growers of Asian vegetables who attended UCCE Santa Clara Small Farm Program’s presentations responded to a survey (n=38). All attendees reported increasing their knowledge of insect management, pesticide regulations, and strategies</li> </ul>	
--	--	--	--

		<p>to reduce pesticide drift. Additionally, all attendees reported intention to apply recommended practices that will reduce pesticide drift. (Aparna Gazula)</p> <ul style="list-style-type: none"> <li>● An anonymous online survey about the extension of the new integrated pest management model resulted in 115 local and international clientele responding that they found the information useful (95.7%) and applied or would apply the knowledge on their farms. Clientele also shared that the outreach information has been, or is expected to be, applied on nearly 955,000 acres with a potential \$33.5 million improvement in farm income or savings. (Surendra Dara)</li> <li>● Potato growers indicated that UCCE’s research had increased their confidence in the new varieties since they were trialed and in their area and locally adapted. This research has the potential to increase agriculture efficiency and profitability as growers adopt some of these new, improved russet, white, red, chipping, and specialty potatoes with improved yields and quality and improved resistance to common pests and diseases. (Jaspreet Sidhu)</li> </ul> <p><b>Participants adopted prevention and detection practices for invasive and endemic pests and diseases.</b></p> <ul style="list-style-type: none"> <li>● Onion research with maggots and smut transformed onion seed treatment in Northern California and several Oregon and Washington locations. California’s two largest onion processors treated 100% of onion seed on over 6,000 acres in Northern California with UCCE’s recommended seed treatments in 2020. It also helped producers throughout the Western U.S. avoid a crisis by proactively identifying an effective pest control alternative to replace chlorpyrifos. These seed treatments are now advertised by private industry in most onion trade publications. (Rob Wilson)</li> <li>● Pest control advisors shared with UCCE that they increased their ability to identify BMSB through a detailed and comprehensive article in a UCCE newsletter. For example, one particular pest control advisor was able to correct a pest misidentification as BMSB and prevent the application of the lengthy and expensive spray program used for controlling BMSB. (Jhalendra Rijal)</li> <li>● The Kern County grower who received the bacterial canker diagnosis followed all UC recommended guidelines, such as limited movement in the field and copper applications. The particular grower is now more vigilant about implementing these practices. (Jaspreet Sidhu)</li> </ul>	
--	--	--	--

		<p><b>Participants adopted recommended treatment and management practices for invasive and endemic pests and diseases.</b></p> <ul style="list-style-type: none"> <li>• As a result of UCCE’s research and extension on the South American palm weevil and subsequent discussions with clientele in the Coachella Valley, many end-users have changed their trapping programs to include more effective traps, baits, and yeast species to start fermentation in liquid bait pots. During 2020, the Citrus Clonal Protection Program’s budwood system registered 2,170 new users for a total of 5,495. Nearly 1,000 users placed 1,315 orders for 77,521 buds of 339 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)</li> <li>• The blue aphid and alfalfa weevil insect studies brought about significant change in alfalfa management. Crop consultants and growers throughout Northern California and Southern Oregon have shared that they switched from using broad spectrum pyrethroid insecticides to more targeted insecticides to provide better pest control and preserve natural predators. (Rob Wilson)</li> <li>• Over half of the alfalfa growers in the Intermountain region have changed their control practices for pests, resulting in improved pest control and preservation of natural enemies. These changes were observed by UCCE and are due in part to UCCE’s research and extension on grasshoppers, blue alfalfa aphids, weevils, and integrated management best practices. Long-term results of utilizing an integrated pest management approach have the potential to conserve the effectiveness of insecticides currently on the market by delaying and preventing resistance from occurring while increasing agricultural efficiency and profitability. (Thomas Getts)</li> <li>• Almond growers have adopted six-spotted thrips as a natural enemy in almond pest management, as observed by UCCE. This has contributed to annual decreases in the preventative use of abamectin in almonds in the spring and decreases in miticide use at hull split over the past five years. These results demonstrate how UCCE provides practical, safe, and affordable pest control methods to farmers in the Southern San Joaquin Valley. (David Haviland)</li> <li>• Vineyard growers have changed practices, as observed by UCCE, due to extension efforts to increase awareness of the importance of application timing, material selection, and the use of resistance management strategies to improve disease control. (Larry Bettiga)</li> <li>• Through surveys and personal communications, the grower community and agricultural input collaborators reported increased use of biostimulants and soil</li> </ul>	
--	--	--	--

		<p>amendments and improved application rates and frequencies to maintain or improve yields and reduce synthetic nutrient inputs. Adoption could lead to yield improvements between 8-27% in tomatoes and 10-26% in strawberries, according to previous UCCE research. (Surendra Dara)</p> <ul style="list-style-type: none"> <li>● Azadirachtin use has increased, especially in organic strawberries, to control various pests due in part to UCCE recommendations, demonstrating how UCCE research and extension support the growing organic produce industry. (Surendra Dara)</li> <li>● Due in part to UCCE extension efforts, 44% of citrus orchards in Placer County now use Aphytis wasps, rather than spraying, for California red scale. This practice is cost-effective for growers and carries minimal environmental impacts. (Cindy Fake)</li> <li>● In 2020, through the weedy rice survey, UCCE was able to determine the exact location of infested basins and the intensity of the infestation, allowing for evaluation of the effect of recommended management practices over time. Preliminary results indicate that growers are successfully implementing the recommended management practices. Weedy rice can have a potentially huge economic impact on California's rice industry, reducing yields for impacted growers by as much as 60%. (Whitney Brim-DeForest, Luis Espino)</li> <li>● Rice growers and pest control advisors managing kernel smut have indicated that they are moving away from application timings that are not effective and adopting recommendations for kernel smut management. For example, the use of the fungicide propiconazole increased from 6,000 acres in 2018 to 36,000 acres in 2020, protecting these acres from yield losses that can be as high as 15% (Luis Espino)</li> <li>● In 2020, yield losses experienced in 2017 and 2018 by the melon industry were not experienced, despite high disease pressure. These results indicate the adoption of research findings by clientele, such as avoiding the placement of a susceptible crop that matures late in the growing season next to one that matures much earlier. (Tom Turini)</li> <li>● Rice industry professionals have increased their usage of methoxyfenozide for armyworm control from 30,000 acres in 2018 to 55,000 acres in 2020. Yield losses as high as 25% were avoided as a result of using this insecticide. Additionally, this insecticide, which is considered a “soft chemistry,” replaces repeated use of the broad-spectrum insecticide lambda-cyhalothrin, which can potentially reduce air and water quality. (Luis Espino, Michelle Leinfelder-Miles)</li> <li>● UCCE’s extension work on the “robovator” cultivator led to the addition of this product line to Salinas area equipment dealer, Pacific Ag Rentals. Over 16 of these cultivators have been leased or purchased by vegetable growers. (Steven Fennimore)</li> </ul>	
--	--	--	--

		<p><b>Science-based information was applied to integrated pest management policy and decision-making.</b></p> <ul style="list-style-type: none"> <li>● UCCE research led to the imminent registration and public release of at least one improved Blackeye Cowpea variety with aphid resistance. This has the potential to increase agricultural efficiency and profitability as growers adopt the available variety. (Nicholas Clark)</li> <li>● Local, state, and national regulatory officials utilized analysis by UCCE to optimize pest detection programs for invasive vine mealybug and European grapevine moth to ensure the greatest opportunity for detection while stewarding the limited resources. (Monica Cooper)</li> <li>● The California Air Resources Board used UCCE's research findings to justify the rice straw burning program's continuation. The program was approved, allowing growers to burn up to 25% of their acres every year for the next five years. Based on knowledge of the industry, UCCE estimates that the straw residue will be burned in 10% of the acreage every year, resulting in less disease pressure in those acres. Additionally, growers burning straw will save \$40/acre because they will not have to invest in post-harvest straw management. (Luis Espino)</li> <li>● Findings from UCCE's herbicide efficacy trial for drill-seeded rice have supported the registration of a new chemical that has low toxicity for humans and the environment. (Michelle Leinfelder-Miles)</li> <li>● Because of the Citrus Clonal Protection Program's successful technology transfer efforts, the California Department of Food and Agriculture's diagnostic laboratories have increased their diagnostic capacity and intend to implement the testing program in 2021, with the CCPP only playing a supporting and troubleshooting role. This outcome leads to the continued safe introduction and distribution of citrus varieties into the state and the protection of citrus genetic resources from exotic and endemic pests. (Georgios Vidalakis)</li> </ul> <p><b>Science-based information applied to agricultural production systems policy and decision-making.</b></p> <ul style="list-style-type: none"> <li>● The California state legislature changed wild pig hunting status to increase control after the UCCE presentation at the California Rangeland Summit, where a rancher/senator was in attendance. The senator cited the study's economic data as the reason behind the legislation. (John Harper)</li> <li>● Informed by the UCCE science, the Board of Supervisors decided not to end the contract with Wildlife Services. Project Coyote sued the county. UCCE provided</li> </ul>	
--	--	---	--

		<p>additional research-based information to the county for the required environmental impact report (EIR). UC ANR's Hopland Research and Extension Center is testing one of the new non-lethal control devices known as a Foxlite that Project Coyote claimed would control sheep's predation by coyotes. As of 2020, the contract between the County and Wildlife Services has been reinstated, and two Federal Trappers were hired to control wildlife damage. (John Harper)</p> <p><b>Change in condition: Money saved.</b></p> <ul style="list-style-type: none"> <li>• Grapevine leafroll disease incidence and severity is no longer a challenge for the majority of Napa growers, while other regions have intensified during the same period. This change was observed by UCCE and is due in part to UCCE network-based extension activities. These outcomes lead to reduced losses as leafroll disease has negative impacts on plant health, fruit quality, and yield that can equate to losses of \$30,000 to \$226,405 per hectare in California. (Monica Cooper)</li> <li>• As a result of lab diagnostic services and consultation, UCCE supported growers with recognition of the complexity of the Fusarium issues in tomatoes. For example, a concern about suspected late blight in tomatoes concentrated near an almond orchard was clarified by UCCE as symptoms due to a non-infectious agent. This diagnosis saved the producer nearly \$20,000 and reduced the pesticide load in this environment. (Tom Turini)</li> <li>• More than 70% of tomato growers who use UCCE's plant pathology laboratory have implemented some aspects of the integrated pest management program strategies for tomato spotted wilt virus, as observed by UCCE. This includes planting clean transplants, removing crops and weeds that can harbor the virus and vector, site selection away from uncontrollable sources, and using effective insecticides. As compared to the processing tomato losses observed before this work, the damage inflicted is much lower and occurs less frequently. Based on the 2019 tomato crop value, an additional 1% loss due to unmanaged TSWV has a value of \$2.8 million. (Tom Turini)</li> <li>• In formal and informal surveys conducted between December 2017 and November 2019, pest control advisors reported that approximately 80,000 acres did not receive a preventative miticide application in May of 2018 and 2019 growing seasons. This represents a 5.5% reduction in treated acres and a savings of over 2 million dollars in miticide and application costs. This outcome also demonstrates a shift in the almond industry's practice. For every 1,000 acres on which preventative sprays are not applied</li> </ul>	
--	--	---	--

		<p>approximately \$27,500 is saved and 15.7 thousand fewer pounds CO2 emitted. (Kris Tollerup)</p> <p><b>Change in condition: Reduced pest incidence</b></p> <ul style="list-style-type: none"> <li>● Grape growers in California, Washington, and Oregon increased adoption of recommended mitigation measures, resulting in declines in disease incidence and severity as observed through the sample testing. Grapevine powdery mildew fungicide resistance research and extension led to improved efficiency and profitability while reducing environmental costs. (Monica Cooper)</li> <li>● The biocontrol insectary successfully established and reared a robust population of <i>T. julis</i> wasps at IREC and the surrounding area. As a result, cereal leaf beetle populations in Tulelake were extremely low in 2019 and 2020, eliminating the need for insecticide treatment in wheat. (Rob Wilson)</li> <li>● Rice growers have been adopting practices and complying with new UCCE-informed seed policies, as evidenced by no significant increases in the last three years of the acreage infested with weedy rice. This potentially reduces income losses, decreases the use of burndown herbicides, reduces production cost, and improves grain quality. (Luis Espino, Whitney Brim-DeForest)</li> <li>● <i>Tamarixia radiata</i> continued to be released in 2020 in collaboration with the California Department of Food and Agriculture and continued to reduce populations of the citrus pest, Asian Citrus Psyllid, by about 70%. Thus, multiple studies have confirmed that this biological control program protected the citrus industry from huanglongbing in different years and in geographic locations, including the state’s coast, inland, and desert regions. (Mark Hoddle)</li> </ul> <p>These measured outcomes can improve the state’s ability to prevent, control, and mitigate pests and diseases and create new opportunities for economic sustainability. For example, using mating disruption to reduce navel orangeworm increased the crop value in almonds by more than \$250 per acre, which is more than twice the cost of using the technique. In these ways, UC ANR contributes to increased agricultural efficiency and profitability and the public value of promoting economic prosperity in California.</p>	
--	--	---	--

<p>6.</p>	<p><b>UC ANR contributed to increased emerging food economies and markets.</b></p>	<p><b>Issue</b>                  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 on-going 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 all farmers and ranchers to continually innovate to stay abreast of market forces. Small-scale and limited resource producers are more exposed to risks and more susceptible to failure, and thus need different market opportunities.</p> <p><b>Methods</b>                  UC ANR develops new scientific knowledge and extended science-based information that help create new food products and market opportunities.</p> <p>A UC Agriculture Experiment Station researcher at UC Davis guides the world-renowned strawberry breeding program. The UC program has been at the forefront of strawberry breeding for decades providing consumers in California and worldwide with some of the most widely-grown and popular varieties of this important and ever-popular berry. Keeping a season-long supply of strawberries on the tables of consumers requires a range of varieties that respond in different ways to the length of daylight to set and ripen their fruit. Over the last year, the program has released three day-neutral cultivars and two short-day cultivars. While these have all the fruit “eating quality” characteristics that would be hoped for, they have also been bred with the changing agricultural environment in mind. The withdrawal of methyl bromide as a soil sterilant from crop production means that strawberry crops are at higher risk from soil-borne diseases. The new UC varieties have some of the best disease resistance profiles, maintaining food supply while helping growers reduce pesticide use. (Steve Knapp)</p> <p>UC Cooperative Extension (UCCE) conducts research and extension to develop new varieties. UCCE research on raspberries has identified clear differences in performance, including yield and shelf life, between varieties. These findings have been extended to small growers, with diversified, organic farms of 1-1000 acres, to help them make more informed selections. (Margaret Lloyd) Grain growers in Tulalake, northeastern Siskiyou County, list grain variety development as a top research priority; thus, UCCE conducts small grain variety testing at the Intermountain Research and Extension Center. There are four trials to evaluate small grain</p>	<p>SFS</p>
-----------	--	--	------------



	<p>variety performance. In particular, grain lodging is a common harvest problem in Tulelake, and a study is underway to investigate the efficacy and crop safety of two plant growth regulators for preventing wheat and barley lodging. The findings have been disseminated through research reports and extension events. (Rob Wilson)</p> <p>Hemp is a new crop in California that became legal under the 2018 Farm Bill. As such, there are many unknowns. UCCE is a leader within the UC on hemp production and conducted the first UC field trials. A UCCE Agronomy Advisor in Sutter and Yuba Counties participated in extensive policy engagement related to hemp, including meeting with Board of Supervisor members, presenting to the California Department of Food and Agriculture, and Agricultural Commissioners throughout the state. The first extension publications on hemp production in the state have been developed. (Sarah Light, Brad Hanson, Dan Putnam, Bob Hutmacher)</p> <p>A UC ANR statewide Sustainable Agriculture Research and Extension Program (SAREP) project built upon Yolo and Solano County farms' efforts to utilize the native western blue elderberry, through growing in hedgerows, to create value-added products. This native subspecies is well adapted to an extensive range of California microclimates and is drought and fire-resilient. The project worked with farmers to establish and collect cost, management, and yield data for three different styles of demonstration hedgerows, including blue elderberry and the commercially better known <i>eastern American elderberry</i> subspecies. The team also conducted a market assessment and collaborated with food science colleagues to research the food chemistry composition of blue elderberry, a key component of the health-promoting properties of elderberries that motivate herbalists and other product makers to utilize them. They also met with members of three different California native tribes to document their perspectives on elderberry management and use. The UC SAREP elderberry hedgerow project reached at least 270 landowners, farmers, and technical service providers at in-person events. (Sonja Brodt) The SAREP program also worked with UCCE Fresno and small producers to facilitate interactive demonstration activities and translation and discussion in Hmong about growing Moringa and explore diverse value-added markets, crop production, and drying techniques. (Gail Feenstra)</p> <p>For the last five years, SAREP has also organized, convened, and provided technical assistance to the California Food Hub Network, consisting of about 21 food hubs. Each one buys from about 40 farmers. In addition, SAREP also supported beginning farmers in seven Northern California counties using the Collaborative Regional Alliance for Farmer Training (CRAFT)</p>	
--	---	--

		<p>model, in which more experienced farmers share farming and marketing insights with beginning farmers. (Gail Feenstra)</p> <p>Lastly, UCCE worked on an AFRI funded project piloting “Farm Fresh Food Boxes: Expanding Rural Economies Through New Markets for Farmers and Retailers.” The project examined the efficacy of a new, low-risk rural retail market channel for local farmers in which fresh produce boxes were pre-sold at rural grocery stores. Research methods included consumer surveys, qualitative interviews, sales data analysis, and a national consumer marketing survey to explore respondents’ local food purchasing habits. Extension methods included a virtual webinar and short course series to share findings about the promising new market channel with a national audience in March, just prior to the COVID-19 pandemic. (Julia Van Soelen Kim)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants are trying out new market opportunities.</b></p> <ul style="list-style-type: none"> <li>● Workshop participants reported they learned about and were more likely to try the new raspberry varieties, potentially increasing revenue. (Margaret Lloyd)</li> <li>● New high-yielding wheat varieties have helped California producers remain competitive in world markets. (Rob Wilson)</li> <li>● Twenty-five end-of-project survey respondents said they had gained knowledge about sourcing elderberry flowers, 31 gained knowledge about elderberry nutritional benefits, 18 gained knowledge about how to grow elderberries, and 12 had planted elderberries as a result of the project. (Sonja Brodt)</li> <li>● Small producers growing Moringa indicated that 100% learned about different moringa drying methods, 90% learned how to identify pests of moringa and food safety requirements, and 80% learned about finding and approaching buyers after participating in the project. (Gail Feentsra)</li> <li>● After the UC SAREP 2-part training “bootcamp” focused on food hub financing, 85% of the 13 participants reported knowledge gain regarding understanding their financial infrastructure, 69% on completing an action plan for their businesses, and 69% on using financial, sales, and other projections to build a financial plan for their business. (Gail Feenstra)</li> </ul>	
--	--	---	--

		<ul style="list-style-type: none"> <li>• For the beginning farmers that participated in the CRAFT model, 99% of the 409 reported increased knowledge about the recommended specialty crop production or marketing practice(s) highlighted at the tour(s) they attended. Twelve reported growing new specialty crops or making plans to grow them in the next year. (Gail Feenstra)</li> <li>• Outcomes from the pilot developing a rural retail market channel for local farmers included: identification of a new intermediated values-based supply chain with economic impacts for farmers, positive reviews from participating retailers, and greater access to healthy and local food for rural consumers. The model gained greater relevance with a rush towards local food during the COVID-19 pandemic and strengthened local values-based supply chains. (Julia Van Soelen Kim)</li> </ul> <p><b>Science-based information applied to food economy and market policy and decision-making.</b></p> <ul style="list-style-type: none"> <li>• The Sutter County Board of Supervisors ultimately decided to allow hemp production, despite moratoriums in some neighboring counties. UCCE’s expert opinion contributed to this decision, and as a result, growers have adopted the crop, as evidenced by 820 acres of hemp planted in 2019 and 447 acres planted in 2020. (Sarah Light)</li> </ul> <p><b>Change in condition: Increased sales.</b></p> <ul style="list-style-type: none"> <li>• SAREP’s work with food hubs has strengthened relationships and communication between businesses, food hubs, and farmers and increased farmer sales by 34% over three years. (Gail Feenstra)</li> </ul> <p>These measured outcomes helped create new market opportunities, expanding revenue sources and strengthening local food systems and emerging food economies. For example, recent research (Brekken, et al., 2019) shows that food hubs have contributed to strengthening emerging food markets and improving small and midscale farmers' economic prosperity. (Gail Feenstra) 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.</p>	
7.	<p><b>UC ANR contributed to improved food safety.</b></p>	<p><b>Issue</b></p> <p>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</p>	<p>HFC, SFS</p>

		<p>Control and Prevention estimates that 1 in 6 people get sick from foodborne diseases each year, including 128,000 hospitalizations.</p> <p><b>Methods</b>          In partnership with communities and allied organizations, UC ANR conducts research to design and deliver educational programs promoting improvement in individual and household food and water management practices and farm and food system food safety.</p> <p>Agricultural Experiment Station (AES) researchers at UC Davis are developing antimicrobial technologies that can be applied to food surfaces and packaging to prolong shelf life and textiles that can also make personal protective garments in medical settings. (Gang Sun) They are also identifying pesticide-induced disruptions in hormone activity that lead to impairments in reproduction and metabolism and cancer development. (Michele La Merrill)</p> <p>UC ANR statewide programs conducted extension activities about individual and household food safety. UC Cooperative Extension (UCCE) academics provided oversight, leadership, and guidance for the statewide implementation of the UC 4-H Youth Development Program, CalFresh Healthy Living, University of California program (CFHL, UC) and Expanded Food and Nutrition Education Program (EFNEP), and the UC Master Food Preserver statewide programs, which delivered the food safety education. (UC 4-H; CFHL, UC; EFNEP) The UC Master Food Preserver Program used culturally appropriate, research-based practices to teach strategies for safely preserving food in the home, reducing food waste, increasing food security, and providing engaging ways for families to explore healthy food across the state. (UC Master Food Preserver Program)</p> <p>UC ANR academics at the Nutrition Policy Institute provided leadership through the National Drinking Water Alliance to ensure that America’s children have safe access to drinking water. Their team engaged in national and state-level work to improve drinking water access in schools, with the dual goal of promoting water safety and healthy beverage consumption. This included research and development of educational resources that were disseminated widely:</p> <ul style="list-style-type: none"> <li>● A “Roadmap to Healthy Beverages” for all communities, with targeted information for Native American and rural communities, in collaboration with the Notah Begay III Foundation;</li> <li>● An infographic, “Increasing Drinking Water Availability in Schools During COVID-19 and Beyond,” in collaboration with school wellness organization, Alliance for a Healthier Generation;</li> </ul>	
--	--	---	--

		<ul style="list-style-type: none"> <li>• And the development of a suite of checklists, “Healthy Hydration,” for schools’ drinking water safety, access, and promotion, built to complement the Centers for Disease Control’s (CDC) new micro-modules on drinking water access. (Christina Hecht)</li> </ul> <p>UCCE in Santa Clara County conducted six small group meetings to educate farmers from socially disadvantaged communities on food safety and conducted 28 on-farm assessments to help growers get ready for the CDFA food safety inspection. Four Food Safety Modernization Act (FSMA) record-keeping templates were created, translated, and shared with growers. Additional FSMA informational materials were translated and distributed. (Qi Zhou, Aparna Gazula)</p> <p>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)</p> <p>A UCCE Specialist at UC Davis provided training and technical assistance on FSMA compliance to food hub operators and food processors. Through online training and conference presentations, participants learned about better risk analysis and food safety planning for their unique food production and distribution settings. (Erin DiCaprio, Gail Feenstra)</p> <p>Wildfire food safety research and workgroups spearheaded by UCCE in Sonoma County are contributing to foundational science on the under-studied but increasingly relevant topic of wildfire food safety for the Western United States. The advisors and specialists also conducted research and extension activities to respond to statewide concerns about the safety of garden soil, local produce, and backyard chicken eggs following contamination by wildfire smoke and ash. Information was offered through in-person workshops and recorded webinars in Sonoma and Ventura counties following fire events. (Julia Van Soelen Kim, Maurice Pitesky, Rob Bennaton, Mimi Enright)</p> <p>As a result of UC ANR research and education, participants learned about and adopted farm, individual, and household food safety behaviors. Outcomes with specific indicators follow.</p>	
--	--	--	--

		<p><b>Outcomes</b></p> <p><b>Participants learned about home food safety practices.</b></p> <ul style="list-style-type: none"> <li>● 310 4-H youth 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)</li> <li>● EFNEP surveyed over 1,300 youth participants, and 55% of youth participants reported used safe food handling practices more often or gained knowledge such as washing fruit and vegetables before eating or putting foods back in the refrigerator within 2 hours, as a result of participating in the program. (EFNEP)</li> </ul> <p><b>Participants adopted home food safety practices.</b></p> <ul style="list-style-type: none"> <li>● EFNEP surveyed nearly 2,200 participants, and 85% of adult participants showed improvement in one or more food safety practices, such as washing hands before preparing food or using a meat thermometer, as a result of participating in the program. (EFNEP) Local EFNEP outcomes include:             <ul style="list-style-type: none"> <li>○ EFNEP evaluation results in Los Angeles County showed that 87% of 210 adult participants improved in one or more food safety practices (i.e., washing hands before preparing food, washing all items and surfaces after cutting raw meat or seafood, not thawing frozen food at room temperature, or using a meat thermometer) after taking Eating Smart Being Active (ESBA) classes. In Orange County, this figure increased to 90% of 190 participants. In the EFNEP youth program in Los Angeles, 41% of 127 youth evaluated use safe food handling practices more often. (Natalie Price)</li> <li>○ Over 400 San Luis Obispo County members of the public, volunteers, youth leaders, and foodservice professionals participated in food safety training, with 99.5% of participants reporting increased knowledge of food safety after attending EFNEP educational workshops. (Katherine Soule)</li> <li>○ In Riverside and San Bernardino Counties, 77% of 444 ESBA participants showed improvement in one or more food safety practices. Fifty-seven percent of 261 youth in grades K-12 in San Bernardino County improved food safety knowledge and handling practices. (Chutima Ganthaworn)</li> <li>○ In Tulare County, 88% of 136 ESBA participants showed improvement in one or more food safety practices. (Deepa Srivastava)</li> <li>○ Seventy-eight percent of 77 EFNEP participants in Alameda County and 89% of EFNEP participants in Contra Costa County who participated in the ESBA</li> </ul> </li> </ul>	
--	--	---	--

		<p>workshop series showed improvement in one or more food safety practices (washing hands and food prep surfaces; thawing foods properly; and using a meat thermometer to cook meat to a safe temperature). (Marisa Neelon, Nelly Camacho, Santos Lopez)</p> <ul style="list-style-type: none"> <li>● The Central Sierra Master Food Preserver Program held courses for adults on pressure canning, preserving vegetables, fruits, and citrus, and offered "Junior Jams and Jellies" courses for youth. The program observed that adult participants made sustained, positive changes to their behaviors by preserving more food at home in safe ways. Follow-up survey respondents indicated that:             <ul style="list-style-type: none"> <li>○ 17% increased pressure canning;</li> <li>○ 25% increased preserving vegetables</li> <li>○ 39% increased preserving assorted fruits;</li> <li>○ 50% increased preserving citrus;</li> </ul>             For youth, 88% of parents reported their child had made jam or jelly with more types of produce after taking Junior Jams and Jellies courses. (Katie Johnson)           </li> </ul> <p><b>Participants learned and intended to adopt farm food safety behaviors.</b></p> <ul style="list-style-type: none"> <li>● Workshop evaluations showed that participants gained a better understanding of food safety and FSMA produce safety rules. Intended actions resulting from this program include: start recording-keeping, conduct water testing, and write a farm food safety plan. These strategies can help farmers comply with the FSMA produce safety rules, improve food safety, and reduce potential fines and shut-offs for growers due to noncompliance. (Qi Zhou, Aparna Gazula)</li> <li>● Forty-three small-scale farmers from socially disadvantaged communities attended the PSA training and received certificates of completion, which helped farmers comply with necessary FSMA food safety regulations during audits by the California Department of Agriculture. (Ruth Dahlquist-Willard)</li> <li>● Twelve food hub operators had increases in knowledge related to food safety and regulatory compliance and a result of a UC ANR conference presentation on FSMA. Participants were asked via retrospective pre/posttest to evaluate their understanding and knowledge of 1) How to develop a flow diagram; 2) How to evaluate threats from microbial sources; 3) How to conduct a hazard analysis; 4) How to implement preventive controls; 5) What a produce distribution enterprise or food hub needs to do</li> </ul>	
--	--	---	--

		<p>to comply with FSMA. A scale of 1 to 5 was used with 1=strongly disagree to 5=strongly agree. The initial average for all questions on the pretest was 2.8 and increased to 4.0 after attending the workshop. (Erin DiCaprio)</p> <ul style="list-style-type: none"> <li>• One hundred percent of 70 participants who attended UC ANR live webinars on FSMA in February and March 2020 reported an improvement in their understanding of key FSMA concepts, techniques, and programs in quality assurance and quality control after the webinar compared to before the webinar in all aspects presented. Additionally, the PowerPoint presentations were used to deliver lectures to students enrolled in a UC Davis senior undergraduate course (FST 109 Food Quality Assurance) offered in Spring 2020. Similar learning outcomes were observed in the undergraduate student cohort. (Erin DiCaprio)</li> </ul> <p><b>Participants adopted farm food safety behaviors.</b></p> <ul style="list-style-type: none"> <li>• Sixteen Southeast Asian strawberry farmers implemented the use of the PPE and displayed the signs at their farm stands. Farmers reported that the signs showing COVID-19 safety requirements were successful, as indicated by the following representative quotes from farmers: "Posting the signs helped a lot, it kept customers from touching produce, and they wore masks" and "customers were able to read the signs ahead, and understand what needed to be done and was expected at the fruit stand. While the customers were waiting in a single-file line, they were all six feet apart." The Fresno County Fruit Trail commented on the safety practices adopted by the farm stands: "The health precautions taken provided a level of reassurance as they were able to efficiently serve a steady stream of customers (and customers queued up nicely with our masks)." (Ruth Dahlquist-Willard)</li> </ul> <p><b>Science-based information applied to food system and farm food safety decision-making and policy</b></p> <ul style="list-style-type: none"> <li>• UCCE's pioneering wildfire food safety efforts led to the inclusion of emergency food response in Napa County's Recovery and Resiliency Framework, as well as the issuance of a County Request for Proposals for Emergency Food Providers that was later leveraged during the COVID-19 pandemic. (Julia Van Soelen Kim)</li> </ul>	
--	--	--	--



		<ul style="list-style-type: none"> <li>The Centers for Disease Control (CDC) incorporated NPI’s recommended water safety practice language in a recent update of their COVID-19 water guidance for schools. (Christina Hecht)</li> </ul> <p>These measured outcomes demonstrate improved knowledge and skills around individual and household and 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.</p>	
<p>8.</p>	<p><b>UC ANR contributed to improved food security.</b></p>	<p><b>Issue</b>                  One out of seven Californians does not know where their next meal will come from. Of the 4.2 million Californians struggling with food insecurity, 1.3 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. Now more than ever, COVID-related shutdowns and layoffs have highlighted how these programs are a cornerstone for families' food security and physical health.</p> <p><b>Methods</b>                  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.</p> <p>Agricultural Experiment Station (AES) researchers at UC Davis developed a database of interventions to increase access to nutritious food in food desert areas, identifying factors to consider for successful implementation of interventions. (Catherine Brinkley) Another UC Davis-based AES researcher is exploring factors affecting participation in food assistance programs has found that less than one-fifth of those who receive WIC (Special Supplemental Nutrition Program for Women, Infants and Children) vouchers redeem them in full and that receiving benefits via electronic transfers (i.e., EBT) does not affect the rate of benefit redemption. (Richard Sexton)</p>	<p>HFC, SFS</p>

		<p>UC ANR's statewide programs provide academic oversight and implementation of the Expanded Food Nutrition and Education Program (EFNEP), CalFresh Healthy Living, UC (CFHL, UC), the UC Master Gardener Program, and the Master Food Preserver Program. Each uses evidence-based curricula to deliver direct education on food security to participants across California. (UC ANR Statewide Programs listed above)</p> <p>The UC Master Food Preserver in San Luis Obispo County provided educational lessons to residents who received food assistance at food bank distribution sites during the COVID-19 pandemic. The program engaged 363 residents, the majority of whom were Spanish-speaking and living below the poverty line. In addition to teaching low-cost, safe home food preservation techniques, this program provided reinforcement items to support the household implementation of the practices related to health and safety practices during the COVID-19 pandemic. This included providing brushes for cleaning produce and bilingual handouts on practical hand and produce washing techniques to participants who learn how to wash their hands to avoid a COVID-19 infection most effectively. (Katherine Soule)</p> <p>A UCCE Advisor in Sonoma County helped convene individuals from local businesses, organizations, and government agencies involved in emergency food response efforts in the wake of the wildfires for Emergency Food Response Convenings. These events helped reflect on what worked and did not work well, prepare for future disasters, and align regional efforts. (Julia Van Soelen Kim, Mimi Enright)</p> <p>Through the UC Gill Tract Community Farm, a UCCE Specialist at UC Berkeley provided training and technical assistance to local farmers during COVID-19 on safe production and distribution. These two online training sessions helped farms stay open as an “essential business” to distribute food to community members who are food insecure. (Jennifer Sowerwine)</p> <p>Another UCCE Specialist at UC Berkeley who works on nutrition throughout the lifespan led a literature review of scientific evidence and public health messaging on breastfeeding and providing prepared meals to individuals ages 65 and older during the COVID-19. The project's goal was to ensure that community members stay as safe and informed as possible while having access to good nutrition. Their team generated educational materials on breastfeeding and meal programs serving aging adults and widely shared them with community agencies. The breastfeeding educational materials were accessed more than 100 times by viewers located in northern and southern California, in other U.S. states, and Mexico and Ireland. The resource for nutrition programs serving aging adults was shared with the Alameda County</p>	
--	--	--	--

		<p>Great Plates Delivered program, which in June 2020 was serving 360 individuals ages 65 and older and 25 restaurants. (Susana Matias)</p> <p>Researchers with UC ANR’s Nutrition Policy Institute (NPI) worked with eight school districts in California’s Central Valley to understand how school food operations pivoted during COVID-19. The aimed to distill successes and challenges and best practices for school districts and community partners to navigate emergent USDA policies related to serving free school meals during the pandemic. Research strategies included data “scraping” from school district webpages and social media, parent focus groups, stakeholder interviews, and photovoice projects. NPI partnered with Stanford University and advocacy groups to develop a series of four factsheets to make information available in a user-friendly format for foodservice professionals and members of the public. Materials and consultation were made available to community-based advocacy groups and other organizations throughout California and the nation. (Christina Hecht)</p> <p>UCCE Advisors in the Central Sierra worked with UC ANR’s Nutrition Policy Institute to assess the impact of the 2019 federal government shut down on recipients of the Supplemental Nutrition Assistance Program (SNAP). Focus groups with rural residents in Tuolumne County helped identify confusion about benefits disruption, institutional distrust, and communications issues that affected access to benefits. The results of the study were shared across UC ANR, published in a peer-reviewed journal. (Katie Johnson)</p> <p>UCCE Advisors across the state worked to increase farmers’ market access and utilization for CalFresh participants.</p> <ul style="list-style-type: none"> <li>● Researchers with the UC Sustainable Agriculture Research and Education Program (SAREP) conducted focus groups and environmental scans to assess the inclusivity of farmers’ markets in Marin and Sonoma County, developing novel, community-engaged research tools and presenting the results of the environmental scans at two national conferences. (Gail Feenstra, Julia Van Soelen Kim)</li> <li>● San Luis Obispo County UCCE worked with local groups to promote nearby farmers’ markets that accept CalFresh (SNAP) benefits through radio ads, news media coverage, and flyer distribution to 84 community agency partners. During National Farmers Market week in August 2020, staff developed promotional materials for market managers and staffed socially-distanced nutrition education booths. (Katherine Soule)</li> <li>● UCCE Riverside staff distributed brochures, posted information on social media, and enlisted assistance from UCANR News and Outreach in Spanish to make a video</li> </ul>	
--	--	--	--

		<p>promotion in English and Spanish. The video featured a tour of the Palm Springs Certified Farmers Market led by the market manager and a UCCE Educator and was shared with schools, community partners, and CalFresh participants in the Banning and Coachella Valley areas. Both videos logged in over 400 viewers at the end of September 2020. (Chutima Ganthavorn)</p> <p>As a result of UC ANR research and extension, changes were made that lead to improved food security. Outcomes with specific indicators follow.</p> <p><b>Outcomes</b></p> <p><b>Participants learned how to increase food resources.</b></p> <ul style="list-style-type: none"> <li>• Eighty-five percent of 363 UC Master Food Preserver participants at San Luis Obispo County food banks reported that the lessons provided would help them extend fresh food resources received at food bank sites. (Katherine Soule)</li> <li>• Surveys from Eating Smart Being Active (ESBA) participants in Los Angeles County showed that 49% of 210 participants improved in one or more food security indicators. In Orange County, 40% of 190 participants improved in one or more food security indicators. (Natalie Price)</li> </ul> <p><b>Participants adopted gardening practices that contribute to increased access to fresh produce.</b></p> <ul style="list-style-type: none"> <li>• Forty-nine percent of 704 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. Additionally, 14% of 706 members of the public donated produce to community programs that distribute food to individuals in need of food assistance. (UC Master Gardener Program)</li> </ul> <p><b>Science-based information applied to food security policy and decision-making.</b></p> <ul style="list-style-type: none"> <li>• UCCE’s COVID-19 educational materials adopted by Alameda County’s Great Plates Delivered program were further extended to the California Office of Emergency Services (CalOES), which intended to share a version tailored for participating restaurants throughout the state. (Susana Matias)</li> <li>• Once COVID-19 stay-at-home orders began in March 2020, Sonoma County workgroups quickly shifted their focus from post-fire recovery to pandemic response</li> </ul>	
--	--	--	--

		<p>and from in-person to virtual, which jumpstarted coordination and collaboration on emergency food response for the pandemic. (Julia Van Soelen Kim, Mimi Enright)</p> <ul style="list-style-type: none"> <li>● Study findings from the Supplemental Nutrition Assistance Program (SNAP) research by NPI and local UCCE advisors were adopted by Feeding America for federal advocacy purposes. (Katie Johnson)</li> <li>● Working with local partners, NPI's school meal research and advocacy influenced practice changes in several districts across California's Central Valley region, for example:             <ul style="list-style-type: none"> <li>○ Parlier Unified improved school meal delivery logistics so that meals were accessible to families who lived far away from their children's schools. The district also provided culturally-relevant foods such as tamales and jicama, which enhanced the appeal and healthfulness of meals;</li> <li>○ Fresno Unified streamlined meal service by offering multiple meals on one pick-up day instead of a daily meal, which increased their capacity to serve meals on weekends and holidays;</li> <li>○ Kings Canyon Unified streamlined their meal pick-up process and made phone calls to parents to remind them of meal distribution times, which increased participation in the program.</li> </ul> </li> </ul> <p>These California-based innovative practices were amplified and disseminated through various national networks of child nutrition researchers and providers. (Christina Hecht)</p> <p><b>Change in condition: Increased community access to healthy food, including fresh produce.</b></p> <ul style="list-style-type: none"> <li>● Farmers market improvement projects in Marina and Sonoma counties reached 4,775 beneficiaries and stakeholders, with 4,196 reporting buying, selling, aggregating, storing, producing and/or locally distributing agricultural products, 595 of which gained knowledge on how to access, produce, prepare, and/or preserve locally produced agricultural products. SNAP distributed in Sonoma County in 2020 increased 64% and dollar-for-dollar Market Match Incentives distributed increased 52% from the prior year. Customer transactions also increased by 55%. (Gail Feenstra, Julia Van Soelen Kim)</li> <li>● In San Luis Obispo County, eight of the county's 13 markets accepting CalFresh and offering market match incentive programs saw a 35% increase in new EBT/CalFresh customers from 2019 to 2020, up from 4% in the previous year. (Katherine Soule)</li> <li>● A UC ANR training focused on COVID-19 food safety increased urban farmers' knowledge on growing and distributing safe, fresh produce to those in need while</li> </ul>	
--	--	--	--

		<p>ensuring the protection of themselves and their customers during the pandemic, resulting in increased food distribution. UC Gill Tract Community Farm volunteers, including partners from Black Earth Farms, Sogorea Te Land Trust, and local herbal medicine makers, organized a mutual aid food distribution program. This included their participation in a Farms to Families Food box program, which produced and distributed tens of thousands of pounds of produce to over 30 local organizations and individuals, including the UC Berkeley Student Pantry, Black Earth Farms, Women’s Daytime Drop-In Center, Daily Bread, and Berkeley Food Pantry. (Jennifer Sowerwine)</p> <p>These measured outcomes showed learning and behavioral changes related to food resource management and informed decision-making that can lead to food policy changes at the local and state levels. They also demonstrate how UC’s network of researchers and educators participate in cross-sector collaboration to address emerging food security issues. In this way, UC ANR’s efforts contribute to the public value of safeguarding sufficient, safe, and healthy food for all Californians.</p>	
<p>9.</p>	<p><b>UC ANR contributed to improved health for all.</b></p>	<p><b>Issue</b> 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 Center for Disease Control and Prevention, nearly 30% of California’s youth in grades 9-12 and over 60% of California’s adults are overweight or obese. Childhood obesity alone is estimated to cost the nation \$14 billion per year.</p> <p><b>Methods</b> 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.</p> <p>UC’s Agricultural Experiment Station (AES) researchers generate new knowledge related to food and health and are working to identify interventions and policies that improve nutrition for all. At UC Davis, AES researchers are working to improve understanding of school-aged consumers’ behavior regarding diet-related health, test how sensory preferences develop, and better understand the influence of various products and environments. These findings intend to inform industry adoption of healthier product formulations and menus that appeal to young children. (Jean-Xavier Guinard) AES researchers also explore sociodemographic factors linked</p>	<p>HFC</p>

		<p>to attitudes on sugary drinks and the awareness of health consequences of their consumption among young adults, which can inform targeted interventions like social marketing campaigns (Jenifer Falbe) and investigate the value of nutrition interventions on brain development in early childhood. (Elizabeth Prado) Throughout the state, UC’s food and nutrition researchers identify innovative and therapeutic solutions that prevent adverse outcomes such as malnutrition and cancers and bolster positive outcomes such as healthy metabolism, cognitive development, and gut microbiota. (Carolyn Slupsky; Hei Sook Sul; Joseph Napoli; Gerardo Mackenzie; Peng Ji; Bo Lönnerdal; Gregory Aponte; Marc Hellerstein; Jen-Chywan Wang; Patricia Oteiza; Maria Marco) They have developed new methodologies to optimize the analysis of dietary data and are contributing to the field of precision medicine by exploring the use of genomic information to predict health outcomes such as breast cancer and autism. (Reina Engle-Stone; Steven Brenner)</p> <p>UC’s Agricultural Experiment Station (AES) researchers investigate lifestyle and environmental factors that influence a range of physical and mental health outcomes. UC Davis’ human ecology researchers explore how poverty-induced psychosocial stress affects parenting practices and child’s emotional and mental health (Leah Hibel) and the cognitive abilities of young children of Mexican origin. (Daniel Ewon Choe) They are also studying how adverse social experiences modulate brain activity and elicit depressive symptoms in adolescents (Amanda Guyer) and how parenting practices and diet can predict anxiety and depression in adolescents. (Johnna Swartz) A UC Berkeley researcher examines how occupational exposure to chronic stress and environmental pollutants affects pregnancy outcomes, including children’s birth weight and cognitive development. (Rachel Morello-Frosch) At UC Davis, researchers are investigating the value of using skin and hair tissue to diagnose exposure to harmful components, including pesticide carcinogens. (Robert Rice)</p> <p>UC Cooperative Extension (UCCE) academics provided oversight, leadership, and guidance for the CalFresh Healthy Living, UC (CFHL, UC) statewide implementation in 32 counties. The program offers educational resources for California residents eligible for CalFresh Healthy Living, California’s Supplemental Nutrition Assistance Program-Education (SNAP-Ed). CFHL, UC delivered nutrition education programs such as Happy Healthy Me, Eat and Play Together!, and Shaping Healthy Choices to nearly 73,000 youth and adults and implemented over 2,500 healthy food tastings with over 52,000 students (not an unduplicated count since students could participate in more than one tasting). CFHL, UC policy, systems, and environmental interventions such as Coordinated Approach To Child Health Early Care Education (CATCH ECE) and Shaping Healthy Choices Program integrate to create comprehensive overweight and</p>	
--	--	--	--

		<p>obesity prevention programming. (CFHL, UC) Over 350 CFHL, UC participants statewide responded to a survey about their experience with the Making Every Dollar Count (MEDC) curriculum. They reported improvements in knowing simple healthy meals to make (85%) and understanding food ads (87%). (CFHL, UC) UCCE academics also provided oversight, leadership, and guidance for the statewide implementation of the Expanded Food and Nutrition Education Program (EFNEP) statewide programs, which 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), Happy Health Me, and It’s My Choice...Eat Right! Be Active! programs to over 11,000 youth and adults. (EFNEP)</p> <p>UCCE academics provided leadership and science-based information for the statewide implementation of the UC Master Gardener Program. Volunteers delivered public education workshops, and 1,553 participants who collectively attended 207 workshops responded to a survey about any changes made from attending. (UC Master Gardener Program). For example, a UCCE academic in Los Angeles County led an effort with Master Gardener volunteers to deliver and evaluate the project, Promoting Alternatives to Citrus for Backyard and Community Gardeners in the Fight Against Asian Citrus Psyllid/Huanglongbing. As of September 2020, 2,730 adults were reached through this campaign. Their office also transitioned the “Grow LA Victory Garden” initiative to a hybrid and virtual model, using online delivery platforms Zoom, Google Classroom, and Flipgrid. This initiative offers a 4-week class on vegetable gardening for beginners, taught by experienced Master Gardener volunteers, helps new gardeners start their own gardens quickly and easily in a container, in the backyard, or at a community garden. (Rachel Surls)</p> <p>UC Cooperative Extension (UCCE) academics provided 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 participation from over 26,000 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 other youth in the community. 4-H programs across the state also offered youth opportunities to stay physically active during the COVID-19 pandemic through programs such as Soccer for Success. (Claudia Diaz Carrasco)</p>	
--	--	---	--



		<p>The UC 4-H Healthy Living Team adapted a Center for Disease Control and Prevention 4-H Junior Disease Detective: Operation Outbreak project for remote instruction during COVID-19. The project focused on epidemiology concepts and included eight interactive, virtual sessions covering public health professions, disease investigation, virus transmission, disease outbreaks, vaccines, immunity, preventative measures, and education. (Marcel Horowitz, Anne Iaccopucci, Dorina Espinoza)</p> <p>UC ANR’s Sustainable Agriculture Research and Education Program (SAREP) provides technical assistance and evaluation of school districts’ farm-to-school programs. In FY19-20, SAREP partnered with Calaveras Unified School District to evaluate the effectiveness of offering more fresh and local food to students and staff. (Gail Feenstra)</p> <p>Each of these programs works statewide to promote healthy eating and active living. Collaboration across programs that included nutrition education, gardening, and food preservation helped to bolster programs like Harvest of the Month in California’s public schools. To adapt to COVID-19 stay-at-home orders, statewide programs quickly shifted to virtual delivery platforms and employed innovative strategies such as take-home kits for cooking and gardening. Due to pandemic-related challenges placed on families, many programs opted to place a special emphasis on food security and physical activity.</p> <p>Local programs utilized statewide evaluation tools to measure participant outcomes, and UC ANR’s Nutrition Policy Institute (NPI) provided evaluation technical assistance for all agencies implementing CalFresh Healthy Living (CFHL) interventions. As a result of UC ANR research and extension efforts, participants learned about and adopted healthier lifestyles. Outcomes with specific indicators follow.</p> <p><b>Outcomes</b></p> <p><b>Participants gained knowledge about and changed attitudes toward healthy eating practices.</b></p> <ul style="list-style-type: none"> <li>● Youth across the state who participated in CFHL, UC healthy food tastings indicated that they are willing to eat the food again at school (71%) and willing to ask for this food at home (65%). (CFHL, UC) Local highlights include:             <ul style="list-style-type: none"> <li>○ CFHL, UC in Riverside reached 266 SNAP-Ed eligible individuals through nutrition spotlight education or single workshops. After the session, the participants indicated intent-to-change unhealthy behaviors. Before the course, 76% of 63 participants reported drinking a sweet beverage every day in</li> </ul> </li> </ul>	
--	--	--	--

		<p>the past week; after the class, 79% of those with unhealthy behavior reported an intent to drink sweetened beverages less often the following week. Similar results were obtained for vegetable and fruit consumption. Thirteen percent of 96 participants reported NOT eating more than one kind of vegetable each day in the past week; after the class, 75% said that they would eat more than one type of vegetable each day more often within the next week. For fruit, this was 34% pre-intervention and 45% post-intervention, respectively. (Chutima Ganthavorn)</p> <ul style="list-style-type: none"> <li>○ In the Central Sierra region, 1,731 students in Calaveras County who tried healthy food grown in school gardens were willing to eat them if served again (80%) and were willing to ask for the item at home (79%) according to the Youth Taste Test Tool. For 2,207 students in Amador County, these numbers were 68% and 67%, and for 5,804 students in El Dorado County, they were 77% and 74%, respectively. CFHL, UC educational classes helped students reduce sugar-sweetened beverage consumption and increase water consumption by 27%. Over 13,000 Harvest of the Month taste tests in 13 public schools reached 3,621 students, with 64% of students rating their taste test with a “Loved It” rating. (Katie Johnson)</li> <li>○ Yolo County CHFL, UC reached 2,491 youth and adults with direct nutrition education that included fresh fruit and vegetable tastings at schools. After the taste tests, 95% of the youth surveyed were willing to try new foods at school after receiving nutrition education. When adults were surveyed, 91% that tried the new food were willing to serve it at home. (Marcel Horowitz)</li> <li>○ In Tulare County, nutrition educators used the Taste Testing Tool (TTT) to capture student intention and food preferences immediately following healthy food tastings to 7,614 students, where 97% tried it during the activity, 81% were willing to eat it again, and 79% were willing to ask for it at home. In Kings county, of the 1,920 students who tasted a variety of healthy food, 98% tried it during the activity, 84% were willing to eat it again, and 82% were willing to ask for it at home. (Deepa Srivastava)</li> </ul> <ul style="list-style-type: none"> <li>● EFNEP received survey responses from over 1,300 youth participants across the state about their participation in a nutrition education program, and 81% of youth gained knowledge or improved their abilities to choose foods according to federal dietary recommendations. (EFNEP) Local highlights include:</li> </ul>	
--	--	---	--

		<ul style="list-style-type: none"> <li>○ In Los Angeles, 82% of 127 youth participating in EFNEP’s youth programs improved their abilities to choose foods according to USDA recommendations. (Natalie Price)</li> <li>○ In San Bernardino County, EFNEP lessons reached 1429 children, where 85% improved their abilities to choose foods according to USDA recommendations. (Chutima Ganthavorn)</li> <li>● As of September 2020, survey respondents of the UC Master Gardener Los Angeles County “Alternatives to Citrus” project gained knowledge about the importance of eating more fruits and vegetables (79%), reported an intention to eat more fruits and vegetables (68%) and gained knowledge of how to access, produce, prepare, and preserve fruits and vegetables (81%). (Rachel Surls)</li> <li>● UC ANR’s Sustainable Agriculture Research and Education Program (SAREP) program partnered with Calaveras Unified School District on farm-to-school, generating knowledge and behavior change in youth and adults. Out of 400 youth, 300 gained knowledge about eating more specialty crops. Additionally, 119 adults reported increased knowledge about the benefits of eating in-season fruits and vegetables and were introduced to 22 new fruits or vegetables. One hundred and sixty adults reported increased knowledge on how to access specialty crops in season. (Gail Feenstra)</li> <li>● Nineteen 4-H Teen Leaders in Yolo County who participated in the Cooking Academy teens-as-teacher series taught nutrition education, food preparation, and cooking lessons to 5th and 6th grade student chefs at several intervention sites. Forty-four percent of chef participants stated they learned about healthy food choices, and 89% indicated improvement in cooking self-efficacy. (Marcel Horowitz)</li> </ul> <p><b>Participants adopted healthy eating practices.</b></p> <ul style="list-style-type: none"> <li>● Over 300 youth across the state responded to the Healthy Living common measures survey and reported paying attention to how much water (69%) and how many sugary beverages (72%) they drink each day, as a result of what they may have learned at 4-H. (UC 4-H)</li> <li>● CFHL, UC surveyed 470 adults statewide with a Food Behavior Checklist pre/post survey after participating in a nutrition education program series. Respondents reported improvements in eating more than one kind of fruit (51%) and more than one vegetable (56%) each day. (CFHL, UC)</li> <li>● EFNEP received survey responses from nearly 2,200 adult participants across the state about their participation in a nutrition education program, and 95% of adult</li> </ul>	
--	--	--	--

		<p>participants met all recommended practices in diet quality and 86% improved practices in physical activity. (EFNEP)</p> <ul style="list-style-type: none"> <li>○ After attending UCCE San Bernardino's <i>UCCE Connects to You!</i> Zoom series, 79% of graduates showed improvement in one or more dietary quality indicators, such as eating more fruits and vegetables. (Christine Davidson; Chutima Ganthavorn)</li> <li>○ In Los Angeles, 91% of 210 EFNEP participants who participated in the ESBA curriculum showed improvements in one or more dietary quality indicators. In Orange County, 98% of 191 workshop participants showed improvements in one or more dietary quality indicators (Natalie Price)</li> <li>○ In Riverside and San Bernardino Counties, lessons from ESBA were provided to 604 eligible parents, with 93% showing improvement in one or more diet quality indicators. Participants in the Plan, Shop, Save, Cook (PSSC) series resulted in improvements in behaviors for 141 participants, where 64% used MyPlate, 62% used the Nutrition Facts label, 31% thought about healthy choices when choosing food. (Chutima Ganthavorn)</li> <li>○ ESBA participants in Humboldt and Del Norte counties improved diet quality indicators (81%) and adopted and practiced one or more food selection behavior(s) consistent with Federal Dietary Guideline recommendations (78%). (Dorina Espinoza)</li> <li>○ In Tulare County, 92% of 136 Eating Smart Being Active participants showed improvement in one or more diet quality indicators. (Deepa Srivastava)</li> <li>○ In San Bernardino and Riverside counties, the Shop, Save, Cook Series resulted in improvements in behaviors for 144 participants, where 64% used MyPlate, 62% used the Nutrition Facts label, 31% thought about healthy choices when choosing food.</li> <li>● In Alameda and Contra Costa counties, over 4,100 students participate in Youth EFNEP programming. Seventy-eight percent of Contra Costa County participants and 76% of Alameda County participants surveyed after the programming reported improvements in healthy food choices. (Marisa Neelon, Youth Nutrition Education Team)</li> <li>● The 400 students that participated in UC ANR SAREP's Farm to School partnership with Calaveras Unified School District reported eating more fruits and vegetables (42%), increasing fruit servings to 3 or more a day (42%), and increasing servings to 3 or more a day (57%). (Gail Feenstra)</li> </ul>	
--	--	--	--

		<p><b>Participants adopted healthy lifestyle and decision-making practices.</b></p> <ul style="list-style-type: none"> <li>● Over 310 4-H youth statewide who responded to the Healthy Living common measures survey, 76% reported paying attention to how active they are each day, what they may have learned at 4-H. (UC 4-H)</li> <li>● After completing the statewide UC 4-H Virtual Disease Detectives Epidemiology Project, youth reported that they were more likely to wash their hands before food preparation (78.1%), after sneezing or coughing (56.2%), and after shopping in a public space (87.5%). The majority (84.4%) of youth also reported that they were more likely to wear a face mask when out in public than before the project. When youth were asked what they learned from the project, one youth stated, “I learned why masks work, I learned how hand sanitizer works, and I learned how I can help my community.” (Marcel Horowitz, Anne Iaccopucci, Dorina Espinoza)</li> <li>● Seventy-seven percent of 36 elementary students in Northern California were better able to manage negative emotions as a result of 4-H Mindful Me classes. (Marcel Horowitz)</li> <li>● EFNEP received survey responses from nearly 2,200 adult participants across the state about their participation in a nutrition education program, and 86% of adult participants improved in one or more physical activity behaviors. (EFNEP)             <ul style="list-style-type: none"> <li>○ In Riverside and San Bernardino Counties, lessons from the Eating Smart Being Active were provided to 604 eligible parents, and 82% showed improvement in one or more physical activity behaviors. Examples include exercising for at least 30 minutes, doing workouts to build and strengthen muscles, or making small changes to be more active. In San Bernardino County, 34% of eligible youth reached through EFNEP improved their physical activity knowledge and practices. (Chutima Ganthavorn)</li> <li>○ Eating Smart Being Active participants in Humboldt and Del Norte counties improved physical activity behaviors (63%) after participating in the workshop series. (Dorina Espinoza)</li> <li>○ In Tulare County, 91% of 136 Eating Smart Being Active participants showed improvement in one or more physical activity behaviors. (Deepa Srivastava)</li> <li>○ In Riverside County, three youth served as teen teachers and virtually delivered the Soccer for Success program via Facebook live. The video series accumulated 396 views, helping other youth and families participate in virtual physical activity during the COVID-19 pandemic. (Claudia Diaz Carrasco)</li> <li>○ Upon completing the Healthy Choices In Motion lessons, San Mateo County teens significantly increased their physical activity knowledge (pre = 11.65 ±</li> </ul> </li> </ul>	
--	--	--	--

		<p>2.9; post = 14.70 ± 3.1; p = .001). When asked about their physical activity engagement in the teen teacher survey, 41.7% of teens that participated in the project reported being physically active for more than 60 minutes 5 days the previous week, and 33.3% reported being active all seven days. (Rachel Colorafi)</p> <p><b>Participants adopted edible gardening practices and spent more time outdoors.</b></p> <ul style="list-style-type: none"> <li>● Over 700 participants of public education events led by UC Master Gardener volunteers responded to a 2020 statewide survey and reported starting or improving the growing of edible plants (71%) and expanded varieties of edible plants grown (57%). These behaviors are correlated with increased consumption of fruits and vegetables. Respondents indicated that they applied knowledge gained over one million square feet of food gardens as reported by over 700 participants, potentially increasing their access to produce. Furthermore, 70% of 1,129 respondents spent more time gardening and outdoors, which is associated with improved individual emotional and physical health. (UC Master Gardener Program)             <ul style="list-style-type: none"> <li>○ In Los Angeles County, 71% of participants from the virtual “Grow LA Victory Garden” series said they had started a vegetable garden since taking the class. Ninety-eight percent of participants said their gardening knowledge had improved through taking the course. (Rachel Surls)</li> </ul> </li> </ul> <p>These measured outcomes lead to and demonstrate improved health for Californians where they 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 health care costs (California EFNEP Impact Report, 2018). Collectively these efforts contribute to the public value of promoting healthy people and communities.</p>	
<p><b>10.</b></p>	<p><b>UC ANR contributed to improved community health and wellness.</b></p>	<p><b>Issue</b> California’s rapid population growth increases pressure on community resources, presenting numerous challenges to health and safety. Adult and childhood obesity is a public health crisis for the state and nation, resulting in many negative health consequences. According to the Center for Disease Control and Prevention, nearly 30% of California’s youth in grades 9-12 and over 60% of California’s adults are overweight or obese. Public health experts agree that poor</p>	<p>HFC</p>

		<p>nutritional choices, lack of physical activity, school, community, home environments, income level, and education are factors in the obesity epidemic.</p> <p>Also affecting community health are pest groups such as bed bugs, cockroaches, human lice, and fleas, which pose significant importance to public health and ongoing issues for landlords, tenants, businesses, and property managers. Many of these species have developed insecticide resistance and can cause commodity damage and spread diseases and unsanitary situations.</p> <p><b>Methods</b> In partnership with communities and allied organizations, UC ANR produces new knowledge, tools, programs, and policy-relevant research that contribute to healthy communities.</p> <p>Agricultural Experiment Station (AES) researchers at UC Davis' Center Regional Change use visualization tools to incorporate social equity principles into policy and strategic planning of organizations serving economically disadvantaged communities. These tools help identify the populations and places most vulnerable to changes in environmental, economic, and social conditions and deserve special consideration in policies and plans focused on energy, transportation, land use, and related issues. (Jonathan London) Another UC Davis-based AES researcher is assessing the feasibility and impact of minimizing the use of motor vehicles through the investment in infrastructure projects that encourage bicycles as active transportation. (Susan Handy) An AES Agricultural Economist located at UC Berkeley investigates the impact of soda taxes on consumer demand and consumption; this research was shared with the San Francisco Department of Public Health as part of the city's soda tax campaign. (Sofia Villas-Boas)</p> <p>Another AES scientist at the UC Davis location, working with collaborators, is researching the yellow fever mosquito, <i>Aedes aegypti</i>, which is native to Africa but has spread into California. It can transmit Zika and other human fever disease viruses. The research identified that California populations of yellow fever mosquitoes are resistant to both organophosphate and some pyrethroid insecticides typically used by vector control districts to control mosquitoes. Populations of yellow fever mosquitos from the greater Los Angeles area and the San Joaquin Valley differ in their insecticide resistance. Another experiment documented that male yellow fever mosquitos infected with a biological control bacterium produce sterile sperm, and when they mate with females, the result is infertile eggs. Females mating with sterile males reduces mosquito reproduction. (Anton Cornel)</p>	
--	--	--	--

	<p>UCCE academics provided oversight, leadership, and guidance in educational programs and policy, systems, and environmental (PSE) interventions delivered through the statewide CalFresh Healthy Living – University of California program (CFHL, UC). CFHL, UC programs such as Coordinated Approach to Child Health; Smarter Lunchrooms Movement; Gardens; and School Wellness Policy were conducted to increase healthy choices, food-based gardening, and quality physical activity in early childhood centers, schools, and community environments. UCCE in Kern County worked with administrators and staff at Las Mariposas Head Start to provide teachers with a 4-hour Coordinated Approach to Child Health Early Childhood Education (CATCH ECE) training on evidence-based structured physical activities for early childhood settings. (Beatriz Adrianna Rojas)</p> <p>CFHL, UC in Kings County conducted an engaging and interactive physical activity workshop at the Professional in Early Childhood Education Conference organized by West Hills College Child Development Center. Sixty-three participants learned to use the evidence-based curriculum, CATCH ECE, to increase children's enjoyment and participation in moderate to vigorous physical activity, including extracurricular activities with family and friends. (Deepa Srivastava)</p> <p>UC ANR academics in the Nutrition Policy Institute (NPI) were involved in the evaluation of University of California nutrition policy implementation, the federal Healthy, Hunger-Free Kids Act implementation, the USDA Women, Infants, and Children (WIC) program, the federal Child and Adult Care Food Program nutrition standards, and drinking water. NPI also worked on the Healthy Community Study (HCS), funded by the NIH, which is the first study to examine obesity prevention efforts nationwide to determine the relative effectiveness of various approaches. One NPI academic drafted the original proposal, led the development of the school observation component of the study, and assisted with developing other nutrition-related protocols and measures. (Gail Woodward Lopez)</p> <p>A UCCE Advisor evaluates the relative efficacy and cost of IPM strategies and tactics and develops new management tools and techniques, increasing adoption of and demand for IPM services for bed bugs, cockroaches, fleas, rodents, ants, and other urban pests. Research findings have included significant decreases in pest infestations. Research has demonstrated effective new monitoring and management strategies for use in multi-unit housing environments and schools and child care environments. Science-based recommendations are shared with pest management professionals within California's structural pest control industry to address pests that cause physical and emotional harm to humans, threaten homes and other structures, and pose nuisances. (Andrew Sutherland)</p>	
--	---	--



		<p>A UCCE Advisor delivers extension events to increase the understanding of the biology and management of structural pests and increase clientele’s awareness of the more efficient and environmentally-friendly pest control methods to address issues such as insecticide resistance, commodity damage, and the spread of diseases and unsanitary situations. Clientele includes pest management and application professionals, pest control advisors, housing professionals, public schools, and municipalities. (Siavash Taravati)</p> <p>A UCCE Natural Resources Advisor in San Diego County developed a list of commonly sold drought-tolerant plants that are also toxic or harmful. Their team developed a bookmark, brochure, and the <a href="#">Planting Safely in Drought-Tolerant Landscapes website</a> that provides summary information and shows gardeners how to enjoy these plants safely. It also hosted a web-based presentation to show people how to use the website. The project involved the support of many San Diego Master Gardeners. (Chris McDonald)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Partners adopted behaviors that contribute to improved community health and wellness.</b></p> <ul style="list-style-type: none"> <li>● As a result of the CATCH ECE training at Mariposa Head Start in Kern County, 32 students increased structured physical activity to 3-5 times per week compared to their initial 2-3 times. Teachers have observed the students increasing their physical activity, and the teachers also shared that they have increased their own physical activity. (Beatriz Adrianna Rojas)</li> <li>● Before the Kings County CATCH ECE workshop, 35% (22 of 63) reported not being physically active for at least 30 minutes most days in the past week. Of the 22 participants who had not been physically active, 64% reported that they would be physically active for at least 30 minutes a day more often within the next week. Additionally, open-ended qualitative survey responses indicated participants' positive learning experiences as a result of the workshop. They expressed intent to increase their physical activity frequency and quality and their classrooms' physical activity. (Deepa Srivastava)</li> </ul>	
--	--	---	--

		<p><b>Partners adopted community-level changes that contribute to improved community health and wellness.</b></p> <ul style="list-style-type: none"> <li>● CFHL, UC reported statewide Policy, Systems, and Environment (PSE) changes at 320 SNAP-Ed sites, contributing to improved community health and wellness for more than 172,000 people. For example, 135 program sites in 27 counties made at least one physical activity-related PSE change; more than half of these sites improved the quality of structured physical activity. As a result of CFHL, UC’s Smarter Lunchrooms Movement in 2020, partner sites conducted 89 cafeteria assessments to encourage the selection of healthy options in cafeterias. Nearly three-quarters of the 27 schools assessed more than once reported increases from their first assessment due to adopting evidence-based, low/no-cost cafeteria makeover strategies. Finally, 33 CFHL, UC sites statewide adopted or expanded farm-to-table use of fresh or local produce. (CFHL, UC)             <ul style="list-style-type: none"> <li>○ In the Central Sierra region, policy, systems, and environmental changes (PSE) made in partnership with CFHL sites reached an estimated 13,579 individuals by working with 34 different sites or organizations to implement 110 changes to their policies, systems, and physical environments. Changes included promoting farm-to-school activities and supporting school gardens, developing and implementing wellness policies at schools and community organizations, improving school lunchrooms and conducting school-wide Harvest of the Month projects, guiding youth in developing their own community health projects, improving physical education programs, and more. (Katie Johnson)</li> <li>○ In Tulare and Kings counties, Policy Systems and Environment (PSE) changes related to nutrition and physical activity occurred at 19 sites reaching 5,406 participants and adopting 53 PSE changes across all settings. Top nutrition changes adopted were interactive educational displays close to the point of decision, live food demonstrations, establishing and maintaining edible gardens, and improved use of healthy beverage options. Physical activity changes adopted were improved opportunities for structured physical activity and improved quality of physical education. (Deepa Srivastava)</li> </ul> </li> </ul> <p><b>Participants learned integrated pest management strategies to maintain public health</b></p> <ul style="list-style-type: none"> <li>● Pest management professionals who attended UCCE educational programs about bedbug or cockroach IPM have adopted behavioral changes. This includes increases in monitoring services offered, increases in preventive and nonchemical control services offered, decreases in substandard pest control contracting, increases in cockroach</li> </ul>	
--	--	--	--

		<p>baiting services provided, and decreases in routine spray programs. These changes were shared with or observed by UCCE and can potentially increase control efficacy, decrease unnecessary pesticide applications, reduce pesticide exposure, and improve the quality of community health and well-being. (Andrew Sutherland)</p> <ul style="list-style-type: none"> <li>• Participants of a UCCE bed bug control workshop stated that they learned something new or interesting from the event (100% of 49 people) and intended to use some of the information in their work (98%). One participant shared that the information will be useful in managing situations in several apartments. Furthermore, an evaluation of online materials indicated that readers would use the content in their work (66%). (Siavash Taravati)</li> </ul> <p><b>Participants adopted integrated pest management strategies to maintain public health.</b></p> <ul style="list-style-type: none"> <li>• Pest management professionals who attended UCCE bed bug or cockroach programs adopted changes, such as increases in monitoring services offered, increases in preventive and nonchemical control services offered, decreases in substandard bed bug contracting, increases in cockroach baiting services provided and decreases in spray programs for cockroaches. These changes were shared with or observed by UCCE and can potentially increase control efficacy, decrease unnecessary pesticide applications, reduce pesticide exposure, and improve the quality of community health and well-being. (Andrew Sutherland)</li> <li>• After working with UCCE, a school in Riverside County had the number of RIFA mounds in many areas decrease by 50 percent, and ultimately up to 95 percent in some of the athletic fields used to be one of the most heavily infested spots. Similar results were obtained in other areas with 90% or more reduction in the number of mounds. Implementing new methods helped protect 500 school students from stings at their school site. (Siavash Taravati)</li> </ul> <p><b>Science-based information was applied to community health and wellness policy and decision-making at local, state, and national levels.</b></p> <ul style="list-style-type: none"> <li>• Following NPI’s research and advocacy work by the National Drinking Water Alliance, 69 US House of Representatives members sent a letter to the secretaries of USDA and HHS requesting the addition of a water icon to the MyPlate nutritional graphic in the upcoming 2020-2025 Dietary Guidelines for Americans (DGA). Over 170 leaders in nutrition and public health signed one or both of NPI’s comments written regarding healthy beverage recommendations in the 2020-2025 DGA. (Christina Hecht)</li> </ul>	
--	--	--	--

		<p>These measured outcomes demonstrated 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.</p>	
<p><b>11.</b></p>	<p><b>UC ANR contributed to improved access to positive built and natural environments.</b></p>	<p><b>Issue</b>                  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.</p> <p><b>Methods</b>                  In partnership with communities and allied organizations, UC ANR delivers educational programs and policy, system, and environment (PSE) interventions to improve access to positive built and natural environments.</p> <p>An Agricultural Experiment Station researcher at UC-Davis undertook a project entitled “Designing Healthy Youth Environments” to help identify how physical environments contribute to or hinder adolescents' positive development and how youth engagement might be utilized to help understand, conceive, and create supportive physical environments. This work, which appears in a recently published book, is a crosswalk between positive youth development and community development. With well-planned physical environments, youth have opportunities to develop healthy social relationships, make important contributions toward community planning, and build a sense of community through their involvement. From the perspective of community development, this work has policy and planning implications relative to urban spaces, park planning, and park design. (Patsy Owens)</p> <p>UCCE academics provided oversight, leadership, and guidance in the statewide implementation of the CalFresh Healthy Living, University of California program. (CFHL, UC) Partnerships and community-level interventions increased access to green spaces, improved outdoor physical activity, and increased opportunities to eat, work, and learn in natural environments.</p> <p>During COVID-19, statewide programs designed innovative educational solutions to help Californians stay engaged with active living, natural environments, and environmental</p>	<p>HFC</p>

		<p>education. Highlights include 4-H Advisors that co-led a collaboration among seven academics, 31 staff, volunteers, and youth representing 20 counties, four UC ANR Research and Extension Centers, and the California 4-H Office offering a 4-H Virtual Camp, “Our Wild California.” Our Wild California was the first-ever 4-H virtual camp in the state. The team formed to respond to the need to offer engaging summer opportunities for youth, as in-person camps were canceled due to the pandemic. The program reached 108 youth campers from 18 counties the opportunity to learn about the outdoors. The weeklong camp consisted of various activities designed to grow youths’ appreciation for nature. (Fe Moncloa, Russell Hill)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants learned and changed attitudes about the environment.</b></p> <ul style="list-style-type: none"> <li>Youth who participated in the “Our Wild California,” 4-H virtual camp rated learning about wildlife and making new friends as the top two reasons for youth to participate in the camp. One of their top-rated activities was classifying objects as part of the “Coding a Clean Ocean” activity. (Fe Moncloa, Russell Hill)</li> </ul> <p><b>Change in condition: Improved access to positive built and natural environments.</b></p> <ul style="list-style-type: none"> <li>Collaboration between UCCE San Mateo County and Woodrow Wilson Elementary School in San Mateo resulted in the garden growing from 5 to 18 - 4'x4' garden boxes for garden-enhanced nutrition education throughout the year. As a result of adopting the Garden Buddy system, the school was able to engage 371 students through English, Arts, and leadership education in the garden. (William Easlea, Mary Vollinger, Andra Nicoli)</li> <li>Participants of UC Master Gardener volunteer-led educational programs reported in a statewide survey that they started or improved practices on over 3,600,000 square feet of home gardens in California, as reported by over 500 participants and over 180,000 square feet of school and community gardens, as reported by over 80 participants. Gardening interventions have the potential benefit to the broader community. A 2016 nationwide study found that living near greenery may help you live longer due to less air pollution, more physical activity, more social engagement, and most significantly better mental health as measured by a lower prevalence of depression. (UC Master Gardener)</li> </ul>	
--	--	--	--

		<p>These measured outcomes demonstrated individual learning gains related to the environment and PSE changes that created more opportunities to spend time in gardens and outdoors. In this way, UC ANR improved access to green spaces and the outdoors for people and communities where they live, learn, work, and play. According to the Center for Disease Control and Prevention, you can burn up to 300 calories during just one hour of light gardening and yard work. In addition, research with students has demonstrated that just 30 minutes spent in nature after completing a stressful task improves their mood. The students who were studied exhibited lower levels of cortisol, the stress hormone. Collectively these efforts contribute to the public value of promoting healthy people and communities.</p>	
<p><b>12.</b></p>	<p><b>UC ANR contributed to increased workforce retention and competency.</b></p>	<p><b>Issue</b>                  California requires a highly-skilled workforce to remain competitive, prosperous, and an innovative global leader. Technological advances have reduced manual labor in agriculture but increased the need for skilled labor. California is the largest agricultural producer in the U.S. Thus, education and training must enhance agricultural productivity and capacity to innovate. 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 of CDFA (2017) 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.</p> <p><b>Methods</b>                  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.</p> <p>Given the COVID-19 pandemic, the annual Alfalfa and Forage Field Day, usually held at the UC ANR Kearney Research and Extension Center (KARE), was extended via a virtual platform. The field day is part of the Department of Pesticide Regulation accreditation process. In addition, three agronomy public meetings were organized with 106 total attendees who were provided a free opportunity to earn credits to maintain Pesticide Control Advisors (PCA) and Certified Crop Advisors (CCA) licenses. (Nick Clark)</p>	<p>SFS, SNE, EIPD</p>

		<p>UC Cooperative Extension (UCCE) in San Luis Obispo and Santa Barbara Counties led two all-day educational meetings, one in English and one in Spanish, focused on pest management in the garden/landscape. These helped landscape professionals acquire the needed continuing education units to renew their California Department of Pesticide Regulation Maintenance Gardener License so that they can appropriately and safely implement effective pest management programs when needed. (Chris Greer)</p> <p>The Environmental Horticulture and Urban Forestry UCCE Advisor continues the Landscape Supervisors Forum, a local professional association established 54 years ago by UCCE as a crucial local resource for staff-level municipal employees. The forum provides the opportunity to learn about new issues from academic experts, as well as for UCCE to hear about new needs and developments from the field. Since 2014, forum webcasts extend the information to even more clientele. Given the COVID-19 pandemic, the 2020 forum transitioned altogether to using the webcast format to ensure continuity and provide opportunities for arborists to get continuing education units. (Igor Lacan)</p> <p>One UCCE Advisor is a principal investigator on a CAL FIRE grant to develop a landowner-led, prescribed burn association (PBA) in three counties. UCCE convenes members to pool their knowledge, people power, and equipment to help each other conduct prescribed burns as a wildfire prevention measure. (Devii Rao)</p> <p>UCCE also helps prepare the future agricultural workforce. The 4-H Youth Development Advisor for Marin, Sonoma, and Napa Counties partnered with a local fair to host a Youth Agriculture and Animal Science Field Day. The event provided agricultural education to youth, where UC ANR specialists, advisors, and community partners collaborated to present educational sessions. (Steven Worker)</p> <p>UCCE assembled a team of professors from California's public universities with agricultural programs, including UC Davis, Chico State, Fresno State, and CalPoly San Luis Obispo. Together, they designed a video series designed to spark interest and begin training future farmers and agricultural workers in good agronomic, economic, and environmental stewardship skills. The videos depict state-of-the-art technologies and techniques in many production regions of California today, vegetable farming systems used in other parts of the world, and increasingly popular cottage farming systems popping up in urban areas for easier access to healthful foods. A key feature of the videos is showcasing leading vegetable farmers and industry leaders</p>	
--	--	--	--

		<p>and having them speak directly to students about their work and how they manage the complex dimensions of today's vegetable crop production systems. (Jeff Mitchell)</p> <p>As a result of UC ANR research and extension efforts, participants learned skills and adopted strategies to improve workforce competency.</p> <p><b>Outcomes</b></p> <p><b>Participants learned about techniques for production in the agricultural sector.</b></p> <ul style="list-style-type: none"> <li>• As a result of agronomy extension efforts, PCAs and CCAs obtained continuing education credits for their licenses. (Nick Clark)</li> <li>• Nearly 100% of 350 youth participants at the Youth Agriculture and Animal Science Field Day agreed that the event was an effective learning experience and improved their knowledge of an agricultural-related topic. (Steven Worker)</li> <li>• Four universities use the UCCE agriculture production innovation and technology video-series in courses to provide real-world information on state-of-the-art production practices and technologies to over 200 students each year. Pre- and post-video viewing surveys indicate student knowledge of production innovation and technology provided by an example video on “urban agriculture” increased from 0% being very knowledgeable to extremely knowledgeable to 67% after viewing the video. Because many of today's students in agriculture-related courses do not have practical experience with crop production, the videos have provided a critically important means for learning and increasing the practical knowledge of this next generation of production workers. In addition, the video series has had a broad interest beyond the classrooms. (Jeff Mitchell)</li> </ul> <p><b>Participants gained landscape management competencies.</b></p> <ul style="list-style-type: none"> <li>• Of the 41 individuals who attended the pest management in the garden/landscape training, 97% of respondents indicated they gained useful information in the workshop. (Chris Greer)</li> <li>• Arborists received 92 hours of continuing education units to retain and renew their certification, granted by the International Society of Arboriculture. Not all municipal employees, especially the junior ones, have funds available to attend conferences; thus, the Bay Area Landscape Supervisors Forum has played a critical role in reaching these employees for many years. (Igor Lacan)</li> </ul>	
--	--	---	--



		<p><b>Participants gained natural resource management competencies.</b></p> <ul style="list-style-type: none"> <li>The prescribed burn project has substantially increased clientele knowledge on prescribed burning. An Amah Mutsun Land Trust staff said, “Being part of a Prescribed Burn Association (PBA) would provide opportunities for Tribal members to continue gaining experience and recognition in their current prescribed burning efforts. It could provide a network of support for organizing future cultural burns within Mutsun territory, such as additional experienced prescribed fire practitioners, gear and equipment from the PBA’s fire cache, and relationships with regional burn bosses.” (Devii Rao)</li> </ul> <p>These measured outcomes demonstrate changes in learning and improvements in how participants work. A <a href="#">2007 World Bank study</a> 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. 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.</p>	
<p><b>13.</b></p>	<p><b>UC ANR contributed to increased workforce retention and competency.</b></p>	<p><b>Issue</b> 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, especially in youth education and obesity prevention, two areas where California ranks among the worst in the country. Additionally, California is the largest agricultural producer in the U.S.; Education is needed to enhance agricultural productivity and the capacity to innovate.</p> <p><b>Methods</b> 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.</p>	<p>HFC</p>

		<p>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)</p> <p>UCCE academics trained afterschool staff and teen teachers in 4-H Water Wizards, computer science, and experiential learning methods. Once schools and recreation centers closed due to COVID-19, programs adapted meetings, lessons, and youth field trips to take place virtually.</p> <p>The 4-H On the Wild Side (OTWS) program in Sacramento County is a field trip program that aims to enthuse and educate elementary school children about nature and the outdoors and encourage community involvement and leadership skills in teenagers. Over several months, teen staff and adult volunteers orchestrate and deliver weekend camp programs to 4th, 5th, and 6th grade students attending schools in neighborhoods where many families live below the poverty line. Teens receive training in environmental curricula and teach inquiry-based science, then design and deliver two weekend programs with up to 80 children at each session. In March 2020, 44 teens and ten adult volunteers registered to deliver OTWS to students from six elementary schools at Camp Gold Hollow. (Marianne Bird)</p> <p>The 4-H Youth Development Advisor for Marin, Sonoma, and Napa counties also provided a six-session training to volunteers, teachers, and allied professionals on experiential learning, asking productive questions, and embedding science into curricula. (Steven Worker)</p> <p>The 4-H Computer Science Pathway team in Santa Clara County trained staff, 4-H volunteers (adults and youth), and staff from partner organizations to use Ozobots, Sphero, virtual reality tours (Google Expeditions), unplugged Computer Science, and Scratch activities to reach 10,255 youth in Riverside, Marin, Mendocino, Santa Barbara, and Santa Clara counties. In addition to building the capacity of professionals or volunteers to implement computer science, team members also taught youth directly. (Fe Moncloa)</p> <p>In Riverside County, 17 teens were trained as Computer Science teachers to provide virtual programming to youth during the COVID-19 pandemic. (Claudia Diaz Carrasco)</p> <p>UC ANR's 4-H Advisor in Santa Barbara County provided workshops for local youth development community partners on "Creating Interactive Youth Programs Using Zoom" so that children could have access to engaging programming during the COVID-19 pandemic. (Liliana Vega)</p>	
--	--	--	--

	<p>A UC ANR 4-H Advisor provided 13 site staff from the Merced Boys and Girls Club with a monthly training, 1.5 hours per session, on Youth Development basics and working with youth in afterschool settings. This helped fill the gap due to changes in their leadership that led to gaps in professional development. (Russell Hill)</p> <p>UCCE in Riverside County leveraged strong partnerships with Desert Sands Unified School District’s early childcare education (ECE) program to provide professional development to ECE teachers on best practices in nutrition and physical activity. In 2019-2020, a CFHL, UCCE Educator provided training and technical assistance to ECE teachers to support the delivery of the Go, Glow, Grow (GGG) curriculum, benefitting 469 preschool students. (Chutima Ganthavorn)</p> <p>In Santa Clara and San Mateo Counties, UCCE works with local partners to create more collaborative spaces for organizations to work on issues related to food justice. UCCE collaborated with Santa Clara University, La Mesa Verde, Fresh Approach, Veggielution, and Valley Verde to design and host a half-day workshop on Food Justice in the South Bay to address this need. Approximately 70 people representing 38 organizations attended the March 2020 workshop. After the workshop, interested organizations began to meet as the South Bay Food Justice Collaborative. UCCE also co-coordinates the South Bay Food Justice Collaborative biweekly meetings for approximately 10-15 attendees with Professor Chris Bacon at Santa Clara University. (Lucy Diekmann)</p> <p>Academics at UC ANR’s Nutrition Policy Institute (NPI) helped nutrition and physical activity programs meet federal program evaluation requirements through overseeing the PEARS statewide activity tracking for federally-funded nutrition education programs for local health departments in partnership with the California Department of Public Health (CDPH). This included training to 433 PEARS users between October 2019 and January 2020 and developing training materials and an FAQ sheet to respond to 700 user questions received during training. (Carolyn Rider, Janice Kao) They also surveyed 56 participating local health departments to determine opportunities to improve evaluation protocols outlined in CDPH’s contracts and integrated work plan (IWP) for SNAP-Education programs. (Gail Woodward Lopez)</p> <p>NPI conducted training on Site Level Assessment Questionnaires (SLAQs) for statewide evaluation use across settings such as K-12 schools, early childcare, and retail to examine policies and practices related to nutrition and physical activity. NPI worked with 168 elementary schools and 20 secondary schools across the state to beta-test a new SLAQ for K-12</p>	
--	--	--

		<p>schools, which will support program evaluation efforts by local health departments (LHD) and UCCE programs. (Janice Kao, Carolyn Rider, Amanda Linares, Gail Woodward-Lopez)</p> <p>In addition to federal nutrition program evaluation, NPI academics have spearheaded national evaluation projects for public health agencies and non-profit organizations. Researchers provide expertise in measuring the population reach and strength (dose) of community and school-based nutrition and physical activity policies, environment, and programmatic changes to better understand the most effective strategies. These efforts have supported partner organizations such as the Alliance for a Healthier Generation and Kaiser Permanente’s Thriving Schools initiative, helping outside agencies strategically prioritize their work. (Suzanne Rauzon)</p> <p>As a result of UC ANR research and extension efforts, participants learned skills and adopted strategies to improve workforce competency.</p> <p><b>Outcomes</b></p> <p><b>Participants learned about new evidence-based information in youth education programs.</b></p> <ul style="list-style-type: none"> <li>● In Sacramento County, 4-H trained 23 teens to deliver the Youth Experiences in Science (YES) Project at seven afterschool sites. All of them indicated increased knowledge in facilitating inquiry-based science with young children, including parts of the scientific process, how inquiry relates to science, and how to teach science. These teens collectively served 204 children, more than half which received a full semester of the project before schools closed to students due to COVID-19. (Marianne Bird)</li> <li>● Forty-nine 4-H teen teachers in Lake and Mendocino Counties reported that training on the YES program increased their understanding of the scientific process, how to teach science to children, age characteristics of children, and how inquiry relates to science. 4-H educators consistently interacted with the teens and adults to ensure program success. (Car Mun Kok)</li> <li>● In Marin and Napa counties, volunteer and professional educators reported statistically significant improvement in asking productive and broad questions, selecting a teaching approach to fit learning objectives, and their confidence in leading science activities to youth after attending a six-part professional development series from 4-H. (Steven Worker)</li> <li>● As a result of 4-H computer science training, 4-H staff in San Luis Obispo held monthly computer science events at the local library from December 2019-February 2020, engaging seven youth each month. Once COVID-19 shelter-in-place began, 4-H staff</li> </ul>	
--	--	--	--

		<p>engaged youth and volunteers to offer weekly computer science sessions from April-June to reach 29 youth. Staff also held a Halloween Coding/STEM Night using Insight from Mars (STEM Challenge) and Augmented Reality (Code.org) and engaged three teen teachers and six youth participants. (Fe Moncloa)</p> <ul style="list-style-type: none"> <li>● As a result of 4-H computer science programming, youth from Santa Clara County demonstrated their new skills by teaching computer science activities to their peers at a leadership conference and reached 30 youth. (Fe Moncloa)</li> <li>● In Riverside County, 17 youth trained in computer science taught 67 other youth during COVID-19, helping maintain students' engagement with STEM during virtual learning. One nine-year-old participant reported: "I want to be an engineer and do engineering and work on cars and motors. I also want to build buildings and be a race car driver. 4-H has helped me put the pieces together; I have learned a lot by attending the events and science fairs. I have learned to assemble and code in fun ways." (Claudia Diaz Carrasco)</li> <li>● In Santa Barbara County, the "Creating Interactive Youth Programs Using Zoom" webinar was well-received by nearly 100% of 74 participants. Participants indicated that they planned to use at least one tool or concept I learned from the webinar, that they would recommend the training to others, and that the presentation modeled the tools and concepts of engaging webinars for youth. (Liliana Vega)</li> <li>● Thirteen youth development staff trained at Merced Boys and Girls Club reported using their newly acquired knowledge and skills to improve their programming with over 750 youth. (Russell Hill)</li> <li>● Seventy-five percent of 17 afterschool program leaders that participated in Sacramento County's 4-H Water Wizards Program, reaching 369 students, reported an increased comfort level in teaching science and that they better understood how to teach science to children. (Marianne Bird)</li> </ul> <p><b>Participants applied new evidence-based information in youth education programs.</b></p> <ul style="list-style-type: none"> <li>● School teachers who participated in the Forestry Institute for Teachers and FireWorks programs shared feedback that they learned how to identify trees, perform forest inventory measurements, and understand the basics of forest and fire ecology to help youth make informed natural resource decisions. (Rebecca Ozeran, Rick Satomi, Ryan Tompkins, Yana Valachovic)</li> <li>● Despite the constraints of the COVID-19 pandemic, the Sacramento 4-H On the Wild Side (OTWS) program pivoted to an online platform. Five teenagers and three adult volunteers adopted positive youth development principles by implementing "Looking</li> </ul>	
--	--	---	--

		<p>at Leaves” environmental education lessons to three classes of 4th grade students over Zoom. Teens designed an introductory video and delivered a live interactive lesson to three 4th grade classes, receiving praise from teachers and \$750 in gifts to support the project. (Marianne Bird)</p> <ul style="list-style-type: none"> <li>• Eighty-four percent of Desert Sands Unified early childcare teachers who participated in Go, Glow, Grow training indicated strongly agreed that more students can now identify healthy food choices. Seventy-four percent strongly agree that more students now are willing to try new foods at school, and 100% strongly agree that more students now wash hands more often before handling food. All teachers said they now encourage students to eat breakfast and to be physically active. One teacher remarked, “Great nutrition/healthy curriculum. The children respond and are engaged with the games, recipes, and activities. Thank you for your support in creating a healthier generation.” (Chutima Ganthavorn)</li> </ul> <p><b>Participants applied program planning and evaluation skills to federal and state nutrition program requirements.</b></p> <ul style="list-style-type: none"> <li>• Survey respondents from NPI’s statewide program evaluation training indicated that the training materials would be helpful in their work (89%) and shared positive feedback through comments. They expressed appreciation for the training format and delivery style, that the training made SLAQ assessment tools look easy, and that they would be better able to meet expectations and to use the SLAQ with their partners. Local agencies began using SLAQs as part of a new 3-year plan in FFY 2020, and a handful of SNAP-Ed agencies in Washington adopted them in 2020, too, as part of a growing interest in the SLAQ tools both within and outside of SNAP-Ed programs. (Carolyn Rider)</li> <li>• NPI’s efforts to support the California Department of Public Health (CDPH) evaluation of SNAP-Ed programs resulted in a new integrated work plan (IWP) framework. CDPH intends to implement the IWP for 2020 through 2022. It will feature a more robust evaluation framework and collaborative strategies for SNAP-Ed staff and agencies to generate more impactful evaluation results. (Gail Woodward Lopez)</li> </ul> <p><b>Science-based information was adopted for public health research and program evaluation.</b></p> <ul style="list-style-type: none"> <li>• As part of their research on dose-effective interventions, researchers at UC ANR’s Nutrition Policy Institute (NPI) found that the most promising school-based interventions focused on increasing physical activity. These findings informed Kaiser Permanente to add a "Teachers Take 5" program for school employees. In 2019, Kaiser</li> </ul>	
--	--	--	--

		<p>Permanente expanded their Healthy Schools Program into school-sector strategies to improve the social and environmental conditions that drive health for student and staff health. (Suzanne Rauzon)</p> <ul style="list-style-type: none"> <li>● NPI's evaluation of Alliance for a Healthier Generation's (AHG) Healthy Schools Program helped measure the degree of impact of various nutrition strategies in schools. This allowed AHG to prioritize higher reach and impact strategies out of 50 different Healthy Schools Program "action plan items" in thousands of schools across the nation. (Suzanne Rauzon)</li> <li>● In Santa Clara and San Mateo counties, participants in the South Bay Food Justice Collaborative shared in an end-of-year reflection that the group had helped them identify strategic partners, share information, build relationships, and fostered additional collaborations. The forum has served as a means for exchanging information and ideas that have been particularly valuable during COVID-19, helping participating organizations pivot their operations and develop new programs to respond to community needs. (Lucy Diekmann)</li> </ul> <p>These measured outcomes demonstrate changes in learning and improvements in how participants work. Youth development professionals, nutrition educators, decision-makers, growers, and land managers learned cutting-edge skills that increase workforce retention and competency. Developing a more qualified landscape management and agricultural production workforce contributes to poverty reduction for smallholders and other marginalized groups, facilitating interaction with commercial markets. In this way, UC ANR contributes to the public value of developing a qualified workforce for California.</p>	
14.	<p><b>UC ANR contributed to increased effective public leaders.</b></p>	<p><b>Issue</b>          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 fundamental “design and structure” of the American government 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 leaders at the global, national, and local levels and highlighted the importance of community leadership and resilience.</p>	HFC

	<p><b>Methods</b></p> <p>UC ANR’s extensive network and youth development programs equip the next generation of public leaders.</p> <p>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), which reached over youth and had almost 10,000 adult volunteers contribute over 1,500,000 hours. Program activities like Project 4H20, Mindful Me, Healthy Choices in Motion, and 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)</p> <p>Once schools and recreation centers closed due to COVID-19, 4-H adapted their formats to cultivate learning and leadership skills through virtual camps, gatherings, environmental education programs. For example, the 4-H Youth Development Advisor for Marin, Sonoma, and Napa counties led a team to transition the State 4-H Field Day, a culminating educational event, to a virtual setting for 500 youth participants. This gathering helped youth maintain connections and continue learning experiences during the pandemic. (Steven Worker)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants adopted leadership skills and extended evidence-based information to their peers and decision-makers.</b></p> <ul style="list-style-type: none"> <li>● Over 350 4-H youth responded to the universal positive youth development common measures survey, and 82% of youth report having leadership skills, including the ability to communicate in a group (75%) and being comfortable working in a group (91%) as a result of what they may have learned at 4-H. (UC 4-H)             <ul style="list-style-type: none"> <li>○ 100% of teens in Sacramento who delivered 4-H “On the Wild Side” lessons to younger grade levels described the project as an avenue for meaningful work and connection with others when schools shifted to virtual learning in Spring 2020. (Marianne Bird)</li> </ul> </li> </ul>	
--	--	--



		<ul style="list-style-type: none"> <li>○ Youth from across California that attended the State 4-H Field Day reported that primary benefits were improving competence (communication skills) and confidence (self-worth), with 95% reporting that the event was valuable in improving their communication skills. (Steven Worker)</li> <li>○ Youth who attended “Our Wild California” Virtual 4-H camp worked and learned together through breakout rooms and group sharing sessions. They reported feeling connected with other youth of their age during their time in the camp, that 4-H is an important part of who they are. (Fe Moncloa, Russell Hill)</li> <li>○ In Colusa, Sutter, and Yuba counties, the afterschool staff supervising Cooking Academy teens reported noticeable improvements in their ability to speak publicly and work as a team following the program. (Nicole Marshall Wheeler)</li> <li>○ Upon completing the 4-H Mindful Me program, 55% of 36 students felt they learned to be better listeners, and 77% of children agreed that you should tell people when you are thankful. (Marcel Horowitz)</li> <li>○ Teens who participated in Healthy Choices in Motion with CFHL, UC San Mateo County shared the following feedback: I am more confident in helping others (83.3%) and in myself overall (83.3%), I gained skills through serving my community that will help me in the future (83.3%), I can apply knowledge in ways that solve "real life" problems through community service (75%). (Rachel Colorafi)</li> </ul> <p>These measured outcomes demonstrated that leadership skills were learned and applied for the benefit of local California communities. Research findings published in the 2018 Health Education &amp; Behavior journal indicate that involvement in youth participatory action research 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.</p>	
<p><b>15.</b></p>	<p><b>UC ANR contributed to improved college readiness and access.</b></p>	<p><b>Issue</b> California requires a highly skilled workforce to remain competitive, prosperous, and an innovative global leader. According to the <a href="#">National Center of Education Statistics</a>, California’s 83% graduation rate lagged behind the national rate of 85% in 2017-18. Improved college readiness and access can contribute to the development of a qualified workforce for California and a robust and thriving state economy.</p>	<p>HFC</p>

		<p><b>Methods</b>                  UC ANR’s youth and community development programs equip the next generation for college and successful careers.</p> <p>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 over 100,000 youth and had almost 10,000 adult volunteers contributing over 1,500,000 hours. To address gaps in career readiness, the 4-H experience provides youth with learning opportunities to develop skills necessary to thrive in life and prepare for a career after high school. 4-H staff and volunteers create an environment conducive for the youth to explore career paths, learn the skills, practice, and experience the career through educational activities. (UC 4-H)</p> <p>In the Central Valley, 4-H Juntos promotes college readiness by working with local high schools with a lower graduation rate than the state average. Many students are English language learners or from recently immigrated families. (Russell Hill)</p> <p><b>Participants had positive attitudes and learned information about preparing for college and careers.</b></p> <ul style="list-style-type: none"> <li>● Ninety-five 4-H youth statewide responded to the college &amp; 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)                         <ul style="list-style-type: none"> <li>○ 93% of youth reported when choosing a career, it is important to be passionate about the work they do</li> <li>○ 82% of youth report that for the type of career they want, it is important to go to college</li> </ul> </li> <li>● Over 331 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)                         <ul style="list-style-type: none"> <li>○ 89% of youth reported liking science</li> <li>○ 74% of youth reported liking a job that involves using science</li> <li>○ 71% of youth reported interest in studying science after high school</li> </ul> </li> <li>● Three students enrolled in 4-H Juntos in the Central Valley have graduated thus far, while the others in 11th and 12th grade during the Juntos program are now in their senior year and on track to graduate. Students in the civic science project have shown a growing civic awareness, and preliminary qualitative findings suggest improved</li> </ul>	
--	--	--	--

		<p>science learning. Overall, students enrolled in 4-H Juntos reported an improved sense of belonging at school, stronger academic focus, and improved engagement with school personnel, indicating positive trajectories towards high school completion. (Russell Hill)</p> <p><b>Participants adopted science and teaching skills to prepare them for college and careers.</b></p> <ul style="list-style-type: none"> <li>• Over 331 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 (82%), trying new things to see how they will work (85%), looking at how things are the same or different (85%), and comparing how different things work (73%). (UC 4-H)</li> <li>• Ninety-five youth statewide responded to the college &amp; 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 (99%), be trusted by an employer (100%), do their job well (99%), show respect for others (99%), and have a professional image on social media (91%). (UC 4-H)</li> </ul> <p>These measured outcomes demonstrated knowledge and skills learned and positive attitudes related to science, college, and careers, which are a pathway to entering the workforce. In this way, UC ANR contributes to the public value of developing a qualified workforce for California.</p>	
<p>16.</p>	<p><b>UC ANR contributed to increased civic engagement.</b></p>	<p><b>Issue</b> 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 as well as creating attachment to communities that encourages people to invest, spend, hire, and promote the quality of life in their community.</p> <p><b>Methods</b> UC ANR delivers educational programs that increase civic engagement. On an annual basis, there are over 19,000 volunteers who donate almost two million hours across six statewide programs. This includes UC managed volunteers and individuals from other organizations. (UC 4-H; CalFresh Healthy Living, UC; EFNEP; UC California Naturalist, UC Master Food Preserver, UC Master Gardener).</p>	<p>HFC, SNE</p>

		<p>The UC 4-H Youth Development Program reached over 100,000 youth participating in clubs, afterschool programs, and camps, who were involved in projects around civic engagement, healthy lifestyles, and science, engineering &amp; technology. Civic engagement projects included four focus areas: community engagement, service, civic education, and personal development. Almost 10,000 adult volunteers contributed over 1,500,000 hours. (UC 4-H)</p> <p>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 and toward environmental and climate justice. (Gregory Ira)</p> <p>One UC Davis UCCE Specialist and collaborators developed a community science project where residents worked in partnership with local resource managers on a control and reduction program for the invasive European green crab. The data from this project has resulted in two high profile scientific publications (Grosholz et al. 2021. Proc. Natl. Acad. Sci. USA and Green and Grosholz 2020. Front. Ecol &amp; Env) as well as significant contribution to the Special Issue on Community and Citizen Science in California Agriculture. (Edwin Grosholz)</p> <p><b>Outcomes</b></p> <p><b>Participants had positive attitudes and gained skills for civic engagement.</b></p> <ul style="list-style-type: none"> <li>● Over 197 4-H youth responded to the Civic Engagement common measures survey about what they may have learned at 4-H.             <ul style="list-style-type: none"> <li>○ Over 197 4-H youth responded to the Civic Engagement common measures survey about what they may have learned at 4-H.</li> <li>○ 99% of the youth reported that they like to help people in their community, and 88% feel a responsibility to help their community.</li> <li>○ Nearly 91% of 4-H youth statewide who responded to a teamwork survey indicated that they respect the differences and strengths of individuals on the team and 78% reported that they work to build a team that includes people with different points of view. Critical teamwork skills are becoming increasingly important as California and the U.S. are becoming increasingly racially and ethnically diverse.</li> </ul> </li> </ul>	
--	--	--	--

		<ul style="list-style-type: none"> <li>• Participants in the California Naturalist Program showed improvements in knowledge, conservation skills, and attitudes after taking the course, with 94% intending to volunteer and reporting a change in self-confidence and self-efficacy around these topics from 24% to 49%. (Gregory Ira)</li> </ul> <p><b>Participants conducted community service projects.</b></p> <ul style="list-style-type: none"> <li>• Of the over 197 4-H youth who responded to the Civic Engagement common measures survey about what they may have gained through 4-H, 86% reported they had done a community service project, and 75% said they look for ways to help when they learn about a problem in the community. (UC 4-H)             <ul style="list-style-type: none"> <li>○ During COVID-19, a 4-H Ambassador in Santa Clara County organized a team of more than 15 youth and 12 adults to make, gather, and distribute over 2,000 masks and shields to community health centers and doctors and to families who participate in UCCE nutrition programming. (Fe Moncloa)</li> </ul> </li> <li>• Data collected by local resident volunteers helped monitor the European green crab, supporting management and reducing the target species. The project established an ongoing community science endeavor. (Edwin Grosholz)</li> </ul> <p>These measured outcomes demonstrated learning gain and behavior change related to civic engagement. Research shows civic engagement outcomes can lead to employability, emotional connection to communities, and a more qualified workforce. UC ANR’s youth development programs equip the next generation to be active participants in their communities, contributing to a robust and thriving state economy.</p>	
17.	<p><b>UC ANR contributed to improved management and use of land.</b></p>	<p><b>Issue</b> Public and private land in California is managed for a wide variety of uses. Challenges include loss of productive working landscapes, 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.</p> <p><b>Methods</b> UC ANR activities focus on management strategies concerning livestock, wildlife, and land maintenance.</p>	SNE, EIPD, SFS

		<p>A UC Agricultural Experiment Station scientist at the UC Berkeley location published a new paper that tied the community collapse of the Mojave Desert birds to changes in the water demands for evaporative cooling posed by climate change. Research findings showed that the addition of artificial water catchments positively influenced the occurrence of birds and mammals in the Mojave Desert. The community collapse of birds found in the Mojave Desert over the past century was fueled by an increase in the amount of water that birds require for cooling. Bird occupancy, richness, and diversity within each era were driven most strongly by water availability (precipitation and percent water cover), indicating that climate and land use are important drivers of species distributions. Water availability had much stronger effects than temperature, urbanization, and agricultural cover, which are typically thought to drive biodiversity decline. This research indicates the critical importance of water availability to sustaining bird populations and has broad applicability in land habitat types. (Steven Beissinger)</p> <p>Another scientist at the UC Davis location examines the California wildlife and agriculture interface, including waterfowl that transverse the Pacific flyway migration corridor, which encompasses California’s agricultural heartland. They also continue developing and expanding a bioenergetics modeling project to evaluate the effects of water policy, agricultural policy, climate change, and anthropogenic influences on wetland habitat availability and waterfowl production and conservation in the Central Valley. This scientist continues to serve on several advisory boards with the California Rice Commission and the Central Valley Joint Venture to advise growers and landowners on wetland and wildlife conservation and management in the context of sustainable agriculture in the state. (John Eadie)</p> <p>An ongoing collaboration between a University of California Cooperative Extension (UCCE) Advisor, UC Riverside professor Mike Rust, and Orange County Parks identified a new yellow jacket wasps research site to test the efficacy of new control methods in a field situation. Monitoring traps and experimental baiting stations were set up throughout the infested Caspers Wilderness Park, where the wasps prevented the public from safely using the campgrounds and other outdoor facilities. UCCE also delivered updated information on tree pest identification and best management practices via workshops in English and Spanish to green industry professionals and land managers: the people most likely to find new infestations and be charged with managing them. A total of 134 professionals were reached through the project. (Beatriz Nobua-Behrmann)</p> <p>Two San Francisco Bay Area UCCE Advisors extended science-based information to public land managers, decision-makers, and the public regarding the costs and benefits of livestock grazing</p>	
--	--	---	--

		<p>and beef production in California. They also promoted positive interactions between park users and cattle and wildlife. (Sheila Barry, Stephanie Larson) Additionally, a UCCE Advisor provided current research to inform regional conservation strategies for oak woodlands. (Sheila Barry)</p> <p>A UCCE Advisor produced the Growing a Resilient Local Food System Report on small farm viability in Santa Clara County. It advocated for increasing the number and viability of small farms given agricultural land losses in the last three decades. The report content was extended through Alliance members' presentations to County and City officials, nonprofit organizations, and the public. (Lucy Diekmann)</p> <p>A UCCE lab on the UC Berkeley campus leads community-based projects related to Sudden Oak Death, such as one called <a href="#">SOD-BLITZ</a>. Residents helped with detecting the disease and produced detailed local maps of disease distribution, identifying areas for proactive management. The map can be used to identify areas where the infestation may be mild enough to justify proactive management. A questionnaire was sent to users of the databases and maps to understand the impact of SOD-BLITZ, including property owners, professionals, and property managers. (Matteo Garbelotto)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants learned about and intended to use strategies and techniques for sustainable land management.</b></p> <ul style="list-style-type: none"> <li>• Twenty-three tree pest infestation workshop participants responded to a post-workshop survey and universally highlighted their increased knowledge on managing emerging tree pests. They said they would identify and report potential pests in the future and apply the best management practices they'd learned in the training. (Beatriz Nobua-Behrmann)</li> <li>• Evaluations from educational group meetings and one-to-one contacts indicated an increased overall understanding of livestock grazing issues as a natural resource management tool. (Sheila Barry, Stephanie Larson).</li> </ul>	
--	--	--	--

		<p><b>Participants adopted strategies and techniques for sustainable land management.</b></p> <ul style="list-style-type: none"> <li>• UCCE expertise informed oak planting plans, enabling two landowners to work with public agencies to access assistance and mitigation funds to plant and maintain oaks on over 300 acres. (Sheila Barry)</li> <li>• Questionnaires (n=100) found that UCCE’s SOD-BLITZ project had been used to identify 18,000 oak trees that were all treated to be protected from sudden oak death, with an 80% average success rate of the treatment. These are primarily high-value trees in properties with an average value for the Bay Area of \$14,000 per tree. (Matteo Garbelotto)</li> </ul> <p><b>Science-based information was applied to land management policy and decision-making.</b></p> <ul style="list-style-type: none"> <li>• The Growing a Resilient Local Food System report has been referenced by local direct-market farmers to explain their challenges with secure land tenure. The report was also used by the Santa Clara County Planning Department to preserve agricultural land on the fringes of San Jose. (Lucy Diekmann)</li> <li>• UCCE’s outreach and support in developing grazing plans led to the City of Walnut Creek reintroducing grazing. The city’s adoption of workshops, signage, and management training has also contributed to fewer conflict incidents between livestock and people hiking on trails. (Sheila Barry, Stephanie Larson)</li> </ul> <p><b>Change in condition: Reduced pest incidence.</b></p> <ul style="list-style-type: none"> <li>• One week after the yellow jacket wasp baits were placed, Caspers Wilderness Park had a 95% reduction in the number of wasps captured. This project allowed UCCE to test the efficacy of new control methods while also providing a solution to local partners and improving the use of natural areas by the general public. (Beatriz Nobua-Behrmann)</li> </ul> <p>The aforementioned measured outcomes demonstrate improved knowledge and adoption of land management practices. UC ANR has contributed to improvements in land use policies and land management practices that can maximize the benefits that managed lands provide. In this way, UC ANR contributes to the public value of protecting California’s natural resources.</p>	
<p><b>18.</b></p>	<p><b>UC ANR contributed to improved air quality.</b></p>	<p><b>Issue</b> 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</p>	<p>HFC, SFS, SNE, EIPD</p>



		<p>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.</p> <p><b>Methods</b>  UC ANR partners with public, governmental, and private groups to extend new knowledge and develop agricultural management and composting practices to improve air quality.</p> <p>UCCE Santa Clara County’s Composting Education Program focuses on diverting waste and truck trips to landfills, potentially reducing air pollution. The program targets residential areas by providing free workshops throughout Santa Clara County to educate and promote home composting. In light of COVID-19, the program swiftly transitioned from in-person to digital outreach and led over 30 online workshops reaching a total of 742 residents in Santa Clara County. The program provided virtual tutorials and live demonstrations explaining the process of home composting as they were unable to demonstrate the process in person. This digital transition resulted in an increase of reach for The Compost Education Program, setting an attendance record for most attendees in a single workshop at 112. Based on the positive response, the program plans to incorporate a virtual component to many of their future events regardless of restrictions on in-person gatherings moving forward. (Sheila Barry, Cole Smith, Ariana Reyes)</p> <p>A UC ANR Sustainable Agriculture Research and Education Program (SAREP) and UC Davis collaborative study assessed the life cycle of greenhouse gas (GHG) emissions, energy use, water use, and other environmental impacts in California almond production, among other tree crops. The almond study results showed that alternative uses of almond by-products, especially hulls and shells for cattle feed, can play a large role in offsetting system-wide GHG emissions. (Sonja Brodt) UCCE academics conducted pivotal field research on Almond Orchard Recycling, which will provide the industry with new guidelines to manage whole orchard removal. Findings were extended to clientele via articles and presentations, including at the Central Valley Summit on Alternatives to Open Burning of Agricultural Waste at the UC ANR Kearney Agricultural Research and Extension Center (REC). (Mohammad Yaghmour, Brent Holtz, Mae Culumber)</p> <p>One UCCE Advisor worked on several studies in collaboration with insecticide and pest management companies to test new and improved insecticide products against insect pests in tree crops. Trials were conducted on walnuts to test the efficacy of available insect growth</p>	
--	--	--	--

		<p>regulators. These are specific to the targeted pests and minimize non-target impacts by replacing the broad-spectrum insecticides, potentially leading to decreased air contamination and waters. The findings indicated that two commercial insect growth regulators showed good efficacy against walnut scale control. (Jhalendra Rijal)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants learned about composting practices.</b></p> <ul style="list-style-type: none"> <li>Composting Education Program participants reported in pre-post surveys that they increased knowledge in home composting methods as a result of participating in workshops led by Master Composters (n = 92). Specifically, 77% learned the basics of the composting process, 85% learned how to compost food waste, 60% learned about household organic waste diversion, and 71% learned about composting using worms. (Sheila Barry, Cole Smith, Ariana Reyes)</li> </ul> <p><b>Participants adopted composting practices.</b></p> <ul style="list-style-type: none"> <li>Composting Education Program participants reported in a three-month follow-up survey that their participation resulted in their households starting or improving their home composting method (73% of 109 respondents). Survey respondents averaged 7.5 lbs./week of food waste and 4.2 tons of yard waste diverted from landfills. Using this rate to extrapolate among all participants, an estimated 375 tons of organic waste were diverted annually. These measured outcomes demonstrate how the UCCE Santa Clara Composting Education Program diverts organic waste from the landfill and impacts the state's waste reduction. A 2011 BioCycle study of 16 households found that residential composting diverted 5.8 tons from curbside pickup over ten months. BioCycle extrapolates that for every 10,000 households composting at home, between 1,400 and 5,000 tons/year could be diverted from curbside collection, with potential savings in disposal costs alone ranging from \$72,000 to \$250,000 in Vancouver, Canada. Tons diverted from the landfill can also reduce the number of truck trips to the landfill, contributing to improved air quality (Andersen et al., 2012). (Sheila Barry, Cole Smith, and Ariana Reyes)</li> </ul>	
--	--	--	--

		<p><b>Participants adopted optimal use practices and pesticide alternatives.</b></p> <ul style="list-style-type: none"> <li>• Growers in the northern San Joaquin Valley have adopted two insect growth regulators, Centaur and Siezei, as shared by growers and observed by UCCE. Using these options instead of broad-spectrum insecticides during the winter, growers' practices reduce air and water contamination risk. With the phasing out of Chlorpyrifos, these two insect insecticides will help control scale insects without impacting the environment. (Jhalendra Rijal)</li> <li>• At least two growers have adopted the Almond Orchard Recycling as a result of training and consultations by UCCE. This practice provides an alternative to burning trees and has the potential to reduce greenhouse gas emissions, increase carbon sequestration, improve air quality, and improve soil physical and chemical properties and water holding capacity. (Mohammad Yaghmour)</li> </ul> <p><b>Science-based information was applied to industry decision making to reduce greenhouse gas emissions.</b></p> <ul style="list-style-type: none"> <li>• Findings from UC SAREP/UCD life cycle assessment of greenhouse gas emissions informed efforts to reduce the GHG footprint of the state's agricultural sector. Specifically, the Almond Board of California utilized findings about almond by-products and increased the focus on by-products utilization in its <a href="#">Almond Orchard 2025 Goals Roadmap</a>. (Sonja Brodt)</li> </ul> <p>These measured outcomes demonstrate improved knowledge and adoption of a variety of practices and policies that reduce air contaminants. From 2017 to 2018 there was a 2.8 million pound reduction in the toxic air contaminants from pesticides in California, as last measured by the California Department of Pesticide Regulation. In these ways, UC ANR contributes to improved air quality and the public value of promoting healthy communities.</p>	
<p>19.</p>	<p><b>UC ANR contributed to protection and conservation of soil quality.</b></p>	<p><b>Issue</b> 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.</p>	<p>SNE, SFS, EIPD, Water</p>

		<p><b>Methods</b>                  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.</p> <p>A UC Agricultural Experiment Station scientist at the UC Davis location researches soil carbon's role in the overall mitigation of greenhouse gasses and climate change. The Russell Ranch project's two major goals are to understand how knowledge of soil biodiversity and biological activities can inform decisions about sustainable agricultural management practices and how to best utilize nutrients recycled from commonly occurring organic wastes increasingly used as soil inputs. Detailed research looking at varying inputs under different management (tillage/cover crop) at varying depths demonstrated that increasing overall soil C is not entirely straightforward; there are pros and cons to different management and input scenarios. These are significant findings that will help inform management decisions at the farm or field scale. Understanding how agricultural practices shift microbial abundance, diversity, and life strategies can help design farming systems that support high yields while enhancing carbon sequestration and increasing resilience to climate change. (Kate Scow)</p> <p>One University of California Cooperative Extension (UCCE) Specialist and his colleagues at the University of California, Santa Cruz conducted four on-farm research trials on organic strawberries. This included an economic analysis that examined soil health management practices, particularly the practice of anaerobic soil disinfestation using cover crop or crop residue. The trials demonstrated that cover crops could be used as a partial carbon source, thus reducing the costs of this practice and offering more options in doing anaerobic soil disinfestation for growers. (Joji Muramoto)</p> <p>UCCE delivered training and technical assistance to support farmers in understanding the requirements of and submitting Healthy Soils Program grant applications to receive financial resources for implementing conservation management practices that sequester carbon and improve soil health. (Oli Bachie) In Santa Clara County, this included two Healthy Soils Program workshops in different languages, Mandarin and English, with 57 small-scale and limited resource farmers. (Qi Zhou, Aparna Gazula)</p> <p>One UCCE Advisor researched incorporating cover crops or reduced disturbance into annual crop rotations and measuring soil health treatments' impact on field crop yield for commodities, including dry beans, sunflower, corn, and wheat. Research findings were</p>	
--	--	---	--

		<p>extended through extension meetings, presentations, hands-on demonstrations, 16 new YouTube Channel episodes, ongoing collaboration with the Colusa County Resource Conservation District, engagement with local government, and publications. (Sarah Light)</p> <p>Two UCCE Advisors organized two successful field days on soil health and cover cropping and were a few days away from a third when the COVID-19 shelter-in-place ordinance went into effect. On the first field day, a survey assessed what information growers needed to incorporate cover cropping into their management practices. One concern that emerged was the need for more information around what equipment could be used. The second field day was a grower-led equipment showcase at which local growers brought tractor implements and shared knowledge about successes and challenges. Subsequently, a newsletter article was published with a local grower cover crop champion and Southwest Committee of the Western Cover Crop Council member about equipment to manage cover crops. (Sarah Light, Amber Vinchensi-Vahl)</p> <p>One UCCE academic learned through a survey of over 100 farmers that zero farmers had sampled their cover crop to quantify nitrogen and were unable to understand its role in the nitrogen budget. A pictorial guide was created to address this issue, linking images of a typical cover crop to quantities of nitrogen and carbon returning to the soil based on grower field sampling. The Cover Crop Pictorial Guide was read by 115 recipients. (Margaret Lloyd)</p> <p>One UCCE Advisor makes research-based, high-quality information accessible to growers with low-level English proficiency, entry-level knowledge and, very small scale production with often less than one acre. Increased activity included an on-farm extension meeting about compost. UCCE research determined nitrogen release rates for six categories of organic amendments, which led to usable guidelines for organic growers and regulatory agencies particularly helpful in tackling one of the most difficult nutrient challenges of organic farms. This and other nitrogen management research findings were shared through extension efforts to growers to help with California’s nitrogen planning. (Margaret Lloyd)</p> <p>A UC Davis UCCE Specialist focused on improving or maintaining interactive online soil survey applications. This work includes a package of interactive Web-Apps called SoilWeb, including SoilWeb GMap, SoilWeb Earth, California Soil Properties App, Soil Series Extent Explorer, and the Soil Data Explorer. These apps continue to receive an average of 6,000 visits per day and provide easy and rapid access to soil survey information. This includes the range in</p>	
--	--	---	--

		<p>characteristics, similarities, and mapping concepts of soil series, and map units and spatial extent and analysis of common soil survey attributes. (Anthony O’Geen)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants learned about or intended to adopt recommended soil management practices.</b></p> <ul style="list-style-type: none"> <li>● Post-event evaluations from the Soil Health and Fertility Workshop at the Alfalfa Symposium indicated that growers improved their knowledge of soil health improved as a result of the workshop (74%). From the Healthy Soils and Field Crop Grower Meeting, growers reported that they intend to use what they learn within the next 12 months (83%). (Sarah Light)</li> <li>● At the Cover Crop Field Day and Equipment Showcase, 79% of respondents indicated an increase in knowledge of equipment needed to manage cover crops after the event as compared to before. (Sarah Light, Amber Vinchesi-Vahl)</li> <li>● Small growers in the Sacramento Valley’s Mien farming communities changed attitudes and understanding of compost. This change was observed by UCCE after receiving its first phone call requests for compost after three consecutive years of education efforts. The impact of using compost is that it protects and conserves soil quality. (Margaret Lloyd)</li> <li>● More than 80% of growers reported improved accuracy and confidence with reporting their state-mandated nitrogen after attending a nitrogen management workshop. Forty-five percent of growers reported that the workshop motivated them to utilize soil tests for their farm, and 65% of participants increased understanding of nitrogen availability in organic amendments. (Margaret Lloyd)</li> </ul> <p><b>Participants adopted recommended soil management practices.</b></p> <ul style="list-style-type: none"> <li>● Growers shared in one-on-one conversations that they have adopted cover cropping. These growers expressed interest in cover cropping after attending UCCE extension workshops on healthy soil management. The anticipated long-term impacts of increased cover crop acreage include improved microbial activity and diversity, increased carbon sequestration, increased water movement and reduced flooding, reduced greenhouse gas emissions, and more resilient farmland resulting from improvements in soil function from reduced erosion and compaction. (Sarah Light)</li> </ul>	
--	--	---	--

		<ul style="list-style-type: none"> <li>● UCCE and UC Santa Cruz soil health management research and extension on strawberry production resulted in approximately 1,800 acres of primarily organic strawberry fields in California being treated by anaerobic soil disinfestation in the 2020 growing season, according to data from Farm Fuel, Inc. This represents about 40% of total organic strawberry acreages and about 5% of total strawberry acreages in the state. (Joji Muramoto)</li> </ul> <p><b>Science-based information was applied to soil decision-making.</b></p> <ul style="list-style-type: none"> <li>● Growers who used the UCCE Cover Crop Pictorial Guide reported via emails and conversations that they use the pictures to estimate total nitrogen available and integrate it into their nitrogen plans and regulatory reporting. This demonstrates how UCCE successfully responded to a knowledge gap between recognizing the benefits and grower’s ability to successfully reap those benefits and how UCCE supports small-scale growers comply with California regulations around nitrogen reporting. (Margaret Lloyd)</li> <li>● As a result of UCCE technical assistance, growers and ranchers throughout the state were able to submit and receive Healthy Soils Program funds, demonstrating how UCCE supports state agencies' priorities for healthy soils.             <ul style="list-style-type: none"> <li>○ Ten small growers in Santa Clara County were awarded Healthy Soils Program funds totaling \$86,729.87, affecting over 70 acres of farmland. This demonstrates how UCCE supports the priorities of state agencies for healthy soils. (Aparna Gazula, Qi Zhou)</li> <li>○ Thirteen growers and ranchers of the low desert were awarded Healthy Soils Program grants due to training and assistance from UCCE. (Oli Bachie)</li> </ul> </li> <li>● The SoilWeb applications have been applied to decision-making about soil management for various land use applications, including groundwater basin plans, wetlands, rangelands, grasslands, forest, urban land, and cropland. For example, this information was used to determine land suitability for the conservation reserve program, wetland reserve program, and the Williamson Act, which helps preserve farmland. (Anthony O’Geen)</li> </ul> <p>These measured outcomes demonstrate that growers learned and adopted healthy soil practices. Adoption of these practices potentially reduces the use of fumigants, which can kill both beneficial and harmful microorganisms and lead to poor soil health. (Joji Muramoto) For example, from 2017 to 2018 there was a 2.5 million pound reduction in fumigant pesticides used in California, as last measured by the California Department of Pesticide Regulation.</p>	
--	--	--	--

		<p>Through these efforts, UC ANR contributes to the public values of protecting California’s natural resources.</p>	
<p><b>20.</b></p>	<p><b>UC ANR contributed to increased ecological sustainability of agriculture, landscapes, and forestry.</b></p>	<p><b>Issue</b>                  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 2017, the California Department of Pesticide Regulation identified that California used over 205 million pounds of pesticide. 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, potential for water and soil quality problems, impact on aquatic invertebrates, and endangered species.</p> <p><b>Methods</b>                  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 University of California Cooperative Extension (UCCE).</p> <p>A UC Agricultural Experiment Station scientist at the UC Davis location is researching plant community dynamics that are important to land managers, conservation stakeholders, and agricultural operations. Plant community structure can strongly influence the ecosystem services derived. Invasive species that displace native species can be economically and ecologically damaging. The processes and systems that determine whether plant species can coexist or result in a winner-loser outcome are extremely complex. Research findings that short-and long-term evolutionary processes have profound impacts on the way that contemporary ecosystems function. Understanding how and where species evolved can help predict plant species' ability to cope with rapid environmental change and/or invasion by a non-native species. Similarly, co-evolutionary processes such as that between clovers and soil rhizobia, nitrogen-fixing bacterium, affect plants' relative competitiveness within a community structure. Collectively, this work provides a new perspective into understanding and managing diverse and dynamic plant communities. (Sharon Strauss)</p>	<p>EIPD</p>



		<p>In 1999, UC ANR established the long-term, collaborative University of California Conservation Agriculture Systems Project at the UC ANR West Side Research and Extension Center (REC) to measure soil and crop productivity changes with the implementation of the key soil health management practices of cover cropping and no-tillage. After 20 years of consistent research, overall soil function improved dramatically, contributing important findings to the field of soil health management. As a result of these practices, nitrogen in the top 3-feet of soil increased by 10%, water holding capacity increased by 20%, and carbon in surface layers of the soil increased by 30%. Additionally, soil biodiversity also increased in functionally significant ways in the no-till with cover crop system relative to the standard till without cover crop approach. Building on this research, UC ANR organized a group of 20 California farmers and private sector supporters to work on a U.S. Department of Agriculture National Resources Conservation Service (USDA NRCS) Conservation Innovation Grant Program project. This group aims to increase the adoption of reduced disturbance cropping systems at organic vegetable production farms. (Jeff Mitchell)</p> <p>One UCCE academic successfully developed three publications related to pest management and distributed pest management information in multiple languages via educational factsheets, workshops, social media (WeChat, Facebook, Instagram), and one-on-one or small group technical assistance meetings. The Santa Clara County pest management workshop was attended by 59 small-scale farmers from socially disadvantaged communities who may experience language barriers. (Qi Zhou)</p> <p>One UCCE Advisor is investigating walnut and sweet cherry diseases caused by fungal pathogens in walnuts in San Joaquin and Stanislaus counties, California. Findings in sweet cherry research include minimized canker disease transmission during pruning through disinfecting pruning tools. This research informs technical assistance to growers to minimize the spread of these fungal pathogens within walnut orchards. (Mohamed Nouri)</p> <p>A UCCE Advisor conducted applied research to improve existing pest management tools, such as evaluating potential pesticides for use in the safflower-cotton agroecosystem. (Nicholas Clark) A UCCE Advisor and Specialist examined the organic herbicide, Weed Slayer, for its efficacy and possible additions of harmful substances. A lab analysis identified glyphosate, a broad-spectrum, synthetic herbicide, in this organic herbicide, and the results were shared with Monterey County’s Agricultural Commissioner’s office. (Richard Smith, Joji Muramoto)</p>	
--	--	--	--

		<p>UCCE extends erosion prevention information through workshops for rangelands. (Devii Rao, Royce Larsen) One UCCE Advisor conducted weed management research and extension, specifically in tumbleweed in rangelands. Findings were shared in two organized two workshops and four UC Weed Blog articles. (Devii Rao, Elise Gornish, Richard Smith, Josh Davy)</p> <p>UCCE continues to manage and update information on invasive shot hole borers (ISHB), a pest disease complex affecting urban and wildland trees. The ISHB website had over 85,000 views by over 27,000 users in the last three years. From 2017-2020 there were 27,051 users (11,840 new) and 85,969 page views. This website provides: Access to 22 one to two-page handouts, seven of which are in Spanish; Tools to identify the pest in 41 different host species and; An up-to-date distribution map developed with the UC ANR Informatics and Geographic Information Systems program and an online infestation reporting tool. (Sabrina Drill, Beatriz Nobua-Behrman)</p> <p>UCCE Advisors, in collaboration with the California Invasive Plant Council and California Department of Fish and Wildlife, delivered Invasive Species Lunchtime Talks webinar series to over 820 contacts in the last three years. Topics included recreating without spreading invasive species, using detection dogs, using eDNA to study invasion ecology, exotic fish in urban rivers, and phytophthoras. (Sabrina Drill)</p> <p>UCCE Advisors working on urban IPM evaluate the efficacy and cost of integrated pest management strategies and tactics, develop new management tools and techniques, and increase adoption of and demand for IPM services relating to wood-destroying organisms, including drywood and subterranean termites. These pests cause significant and costly structural damage in California and are usually targeted with pest control programs reliant upon whole-structure treatments, fumigants, or potentially hazardous liquid insecticides. UCCE research investigates the utility and efficacy of alternative strategies that may reduce risk to the environment and communities. Findings are then extended to pest management professionals within California's structural pest control industry. (Andrew Sutherland)</p> <p>UCCE research and extension on indoor and outdoor pests that affect schools and child care environments seek to increase awareness of, demand for, and provision of integrated pest management services, strategies, tactics, and practices. Science-based recommendations are provided online and in-person to staff within school and child care environments, professional landscape managers, public school districts in California, and pest management professionals within California's structural pest control industry. (Andrew Sutherland)</p>	
--	--	--	--

		<p>A UCCE Specialist at UC Berkeley conducts research and extension on the biological control of spotted wing drosophila, olive psyllid, brown marmorated stink bug, leaf footed bug, and mealybug pests to improve the impact of natural enemies on these pest populations. The clientele served are farmers of grape, pistachio, almond, stone fruit, and some vegetable crops. UCCE works to import natural enemies from overseas, screen them for their efficacy and safety or non-target impacts. UCCE also provides farmers with methodologies to conserve or augment their numbers of natural enemies to help with sustainable tools. (Kent Daane)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants learned or intended to adopt pest management practices, including Integrated Pest Management strategies.</b></p> <ul style="list-style-type: none"> <li>● Small-scale farmers located in Santa Clara County increased their knowledge and skills on rules and regulations of pesticide applications, proper application of pesticides, and IPM techniques after attending the UCCE workshop. Attendees showed an observable interest in planting insectary plants to attract beneficial species and control aphids in Asian vegetable crop production, reducing pesticide usage, and balancing chemical and non-chemical alternatives to control pests and diseases. (Qi Zhou)</li> <li>● A rangeland erosion prevention workshop participant reported intent to adopt practices immediately to reduce cattle concentration and equally distribute herd. This will reduce erosion and improve the ecological sustainability of his rangeland. (Devii Rao, Royce Larsen).</li> <li>● Weed management workshop participants reported in a survey that they would incorporate information they learned at the workshop within six months (60% of 48 respondents) or 12 months (14%). More effective weed management will increase the ecological sustainability of rangelands. (Devii Rao)</li> <li>● Participants of the invasive species lunchtime talks responded to a short survey indicating that they learned a lot (96%), intend to look for signs of pest infestation (64%), intend to undertake activities to prevent the spread of invasive pests, such as</li> </ul>	
--	--	---	--

		<p>not moving firewood, cleaning boots, draining and cleaning gear that went in the water (57%), and plan to work to remove invasive species (56%). (Sabrina Drill)</p> <ul style="list-style-type: none"> <li>Professional landscape managers, school district staff, and child care providers who participated in integrated pest management programs responded to online and in-person event surveys. They reported increased knowledge about pest biology and ecology, pest prevention tactics, monitoring and detection techniques, the Healthy Schools Act, the legal roles and responsibilities associated with providing IPM services to schools and child care centers, and specific pest management strategies and tactics. (Andrew Sutherland)</li> </ul> <p><b>Participants adopted recommended pest management techniques.</b></p> <ul style="list-style-type: none"> <li>AAs a result of participating in the USDA NRCS Conservation Innovation Grant Program project, the 20 farmers have made structural changes to their practices, such as reducing disturbance, increasing residue cover, cover cropping, and reducing tillage intensity. These changes can preserve natural resources and reduce pollution, as described in the research findings above. Reliance on ecosystem services that result from healthy, functioning soils rather than the synthetic, non-renewable inputs and high disturbance practice is increasingly seen as a publicly desirable and environmentally sustainable way to improve our food production systems. (Jeff Mitchell)</li> <li>Many other growers have already changed their production practices responsible for spreading fungal pathogens within cherry and walnut orchards, a direct outcome of UCCE research and extension. This practice has the potential to reduce fungicide sprays applied and lead to more sustainable orchards. (Mohamed Nouri)</li> <li>One rancher, who manages approximately 70,000 acres of rangeland, altered the grazing timing to control tumbleweed more effectively after collaborating with UCCE on the project for three years. (Devii Rao, Elise Gornish, Richard Smith, Josh Davy)</li> <li>The on-line infestation reporting tool for invasive shot hole borer was adopted by 744 users since 2018, as indicated by their responses. Responses then update the live map, which is used to facilitate collaborative management efforts. (Sabrina Drill)</li> <li>Pest management professionals participating in UCCE’s educational programs about IPM for termites have increased monitoring, detection, and delimitation services. They have increased offerings of non-chemical control services, as shared with and observed by UCCE. These behaviors may lead to decreases in unnecessary pesticide applications, contributing to potential decreases in environmental contamination. (Andrew Sutherland)</li> </ul>	
--	--	---	--

		<ul style="list-style-type: none"> <li>Professional landscape managers and school district staff members who participated in integrated pest management programs changed their behavior by increasing preventive and non-chemical control tactics and by decreasing unnecessary pesticide applications, as shared with and observed by UCCE. These behaviors can lead to potential decreases in unnecessary pesticide applications and decreases in urban surface water contamination incidents by pesticides. (Andrew Sutherland)</li> <li>Fruit, nut, and vegetable farmers have adopted sustainable control programs with natural predators developed by UCCE to help them reduce pesticide use, which can negatively impact non-target natural resources. (Kent Daane)</li> </ul> <p><b>Science-based information on pest detection and management influenced policy and decision-making.</b></p> <ul style="list-style-type: none"> <li>UCCE research contributed to the registration of several insecticides to improve control of Lygus Bug, beet leaf hopper, and green stinkbug in safflower. This has the potential to increase the ecological sustainability of agriculture as growers adopt these reduced-risk insecticides. (Nicholas Clark)</li> <li>As a result of UCCE research, the Monterey County Agricultural Commissioner reported the findings to the California Department of Food and Agriculture. They issued a Stop Use Notice on the organic herbicide Weed Slayer due to findings of synthetic herbicides. Later, a similar stop use order was issued by the state of Oregon and Washington. (Richard Smith, Joji Muramoto)</li> </ul> <p>These measured outcomes can create, improve, and enrich the state’s ability to prevent, control, and mitigate pests and diseases. The work must continue as the amount of reported pesticide use in California increased between 2017 and 2018 by 1.28% or 2.6 million pounds, as last measured by the California Department of Pesticide Regulation. 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.</p>	
21.	<p><b>UC ANR contributed to increased ecological sustainability of</b></p>	<p><b>Issue</b></p> <p>Nearly 33 percent of California’s land is covered by forest, and rangeland covers an additional 57% of the state. Forest and range provide 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 restoration</p>	SNE

	<p><b>rangeland and forestry.</b></p>	<p>and conservation to 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.</p> <p><b>Methods</b>  UC ANR has led collaborative research and extension efforts and provided support to develop new policies to increase ecological sustainability of forests and rangelands.</p> <p>UC Agricultural Experiment Station scientists at the UC Davis location conduct forest resources and forest management projects. One scientist is studying the use of forest and farm organic residuals, which can provide feedstocks for energy production. This research team has developed modeling and decision support tools to help match forest biomass sources to supply chains. Dead and dying trees are a significant challenge for forest managers, and disposal options are essential. The creation of energy from these trees helps California achieve renewable energy targets, minimize pollution from wildfires, and produce many co-benefits. (Bryan Jenkins) Another scientist is studying the interactions between ecohydrology, wildfires, climate change, and management practices. Monitoring large-scale patterns of disturbance and change is inherently difficult. This research team has been deploying remote sensing techniques to map tree mortality and burn severity and predict wildfire risk. This work helps public and private forest managers make spatially explicit decisions by better understanding landscape conditions. An additional outcome has been reforestation guidance following disturbance. (Jin Yufang) Another research team has collected landscape-scale data about forest, rangeland, and grassland response to drought and wildfire. This information has been utilized to predict plant population response and help guide management interventions or restoration is needed. An additional benefit of this large dataset is the capacity to predict where native bark beetles are likely to spread and create impact. Bark beetles are the primary drivers of mortality following drought-induced tree stress in mixed-conifer forests. (Andrew Latimer)</p> <p>University of California Cooperative Extension (UCCE) academics collaborated to focus on outreach around tree mortality and reforestation needs due to unprecedented tree loss in the Sierra Nevada region associated with California’s 2012-2016 drought. A collaborative research project established a tree mortality data network, which involved forest plot measurements of tree health, size, and mortality agents in eight public and private sites. Extension efforts shared information with land managers about addressing the challenges of disposing of dead trees and replanting. (Susie Kocher and Jodi Axelson).</p>	
--	---------------------------------------	--	--

		<p>One UCCE academic conducts post-fire reforestation and restoration research and extension, with an emphasis on the silvicultural methods that establish post-wildfire forests that are resilient to re-burning in future wildfires. This project established improved practices and demonstrated the benefits of underutilized tools in the national forest toolbox. (Ryan Tompkins)</p> <p>A North Coast UCCE Advisor is the lead coordinator and partner for a \$2.68 million collaborative project funded through the Natural Resources Conservation Service’s Regional Conservation Partnership Program. UCCE administers funds and provides technical assistance for the restoration and management of deciduous oak woodlands. (Lenya Quinn-Davidson)</p> <p>UC ANR is uniquely positioned to utilize our outreach and education expertise and collaborate with local, state and federal partners to provide the resources and support private forest landowners needs. In January 2020, UC ANR's <a href="#">Forest Stewardship Education Initiative</a> hosted <a href="#">workshops</a> to help landowners learn how to articulate their vision for their forest land and identify the steps needed to achieve it. Throughout the workshop, participants gather site-specific information to better understand their forest and focus their goals on developing a management plan. With seven completed workshops, UC ANR has engaged 151 forest landowners across California. (Kim Ingram, Susie Kocher, Mike Jones, Ricky Satomi, Ryan Tompkins)</p> <p>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. Outcomes with specific measured indicators follow.</p> <p><b>Outcomes</b></p> <p><b>Participants learned strategies for reforestation.</b></p> <ul style="list-style-type: none"> <li>• Forest land managers who attended UCCE workshops reported increased understanding of how to respond to tree mortality (60% of 120). (Susie Kocher)</li> </ul> <p><b>Participants adopted recommended practices for forest management.</b></p> <ul style="list-style-type: none"> <li>• After completing the forest stewardship workshop, 66% of participants have written out their management goals, and 60% made progress on developing a management plan. Additionally, participants who complete the workshop are eligible for a free initial</li> </ul>	
--	--	--	--

		<p>site visit by an RPF. This visit can start a working relationship between the landowner and the RPF, leading to a completed management plan submitted for cost-share funding. To date, 39% of workshop participants have made contact with an RPF, and 15% have begun a cost-share funding process. Seventy-eight percent have started implementing some management activities from their plans, demonstrating improved management that contributes to protecting California's forests. (Kim Ingram)</p> <p><b>Change in condition: Land reforested and restored.</b></p> <ul style="list-style-type: none"> <li>• UCCE's post-fire reforestation and restoration work has supported overplanning and ongoing implementation of over 3,000 acres of reforestation related to the 2007 Moonlight fire. This work has been conducted in partnership with the national forest and the local resource conservation district. (Ryan Tompkins)</li> <li>• Over 500 acres of oak woodland on the North Coast have been restored by non-governmental organizations who received funds through and technical assistance from UCCE. (Lenya Quinn-Davidson)</li> </ul> <p>As the aforementioned measured outcomes demonstrate, UC ANR supports the implementation of forest and rangeland restoration practices and policy and regulation. Increased ecological sustainability of range and forest landscapes helps California realize the many benefits of the state's rich and diverse natural resources. Thus, UC ANR contributes to the public value of protecting California's natural resources.</p>	
<p><b>22.</b></p>	<p><b>UC ANR contributed to increased ecological sustainability of ornamental and edible landscapes.</b></p>	<p><b>Issue</b> 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.</p> <p><b>Methods</b> UC ANR translates research into actionable landscape management strategies and extends science-based information about environmental horticulture.</p>	<p>HFC, SFS</p>



		<p>Research on the impact of COVID-19 on gardening was launched and involved a team of researchers in Australia and Germany. A survey in English, German, Spanish, and Vietnamese was distributed in the three countries and received responses from over 3700 gardeners. In the US, the UC Master Gardener Program was instrumental in circulating the survey to a state and national audience. Currently, the team is analyzing the survey data and preparing manuscripts for publication. Ultimately, this work contributes to knowledge about gardens' role in community resilience to crises and about how to support gardeners under these circumstances. (Lucy Diekmann)</p> <p>The UC ANR Master Gardener Program has volunteers in over 50 counties that share research-based information on environmental horticulture to help the public more sustainably grow home, community, and school gardens. 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 use of social media to share science-based gardening information. Over 6,200 Master Gardeners volunteered 395,200 hours. (UC Master Gardener Program)</p> <p>In Ventura County, before the COVID-19 pandemic, the UC Master Gardener Program conducted hands-on Drip Irrigation Workshops for close to 400 attendees. A presenter reviewed the basics of drip irrigation, including the benefits of installing a drip system, the principal components, and assembly. Then participants assembled their own drip system with the help of UC Master Gardener volunteers. (Jim Downer)</p> <p>The UC Master Gardener Program in Inyo-Mono Counties responded to the COVID-19 pandemic by focusing on demonstration gardens and making videos on garden tours and how-to information on topics such as composting, growing garlic, and general gardening. Attendance to general meetings actually improved when these moved online; more than 50% attendance compared with about 30% before. Calls to the help-line doubled during the pandemic, and engagement on Facebook increased. (Dustin Blakey)</p> <p>The UC Master Gardener Program in San Luis Obispo County conducted free, monthly "Advice to Grow By" workshops in the Master Gardener demonstration garden. (Chris Greer)</p> <p>In Kern County, UC Cooperative Extension (UCCE) environmental horticulture classes continued to provide research-based information to horticulture professionals and community members,</p>	
--	--	---	--

		<p>where attendees learn to preserve and enhance the urban environment through planting practices, water conservation, and implementation of IPM methods. (John Karlik)</p> <p>UCCE environmental horticulture efforts in Southern California extended information on the selection and care of sustainable landscapes to professional horticulturists focused on drought-resistant, pest-resistant, and heat-resistant plants. In addition, there were two new publications in the <i>Efficient Urban Water Management</i> series. (Janet Hartin)</p> <p>As a result of UC ANR research and extension, participants learned and adopted sustainable landscaping and gardening practices. Outcomes with specific indicators follow.</p> <p><b>Outcomes</b></p> <p><b>Participants learned or intended to adopt recommended practices for sustainable landscaping.</b></p> <ul style="list-style-type: none"> <li>● Evaluation of the UCCE environmental horticulture efforts in San Bernardino, Los Angeles, and Riverside Counties between 2017 and 2020 found that approximately 94% of horticultural professionals indicated they would improve their irrigation practices to reduce water waste and apply fewer pesticides. They also stated that they would use science-based tools/materials to select heat and drought-resistant landscape trees based on information presented in the classes and workshops. (Janet Hartin)</li> </ul> <p><b>Participants adopted recommended practices for sustainable landscaping.</b></p> <ul style="list-style-type: none"> <li>● Members of the public participating in the volunteer-led UC Master Gardener education events reported the following, through a statewide follow-up survey:             <ul style="list-style-type: none"> <li>○ Created and enhanced pollinator-friendly gardens; for example, 65% (of 406 respondents) started or improved their use of plants that attract and support pollinators. Nearly 53% 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 almost four million square feet of pollinator habitat. This improves yields from home food gardens and supports local agriculture productivity.</li> <li>○ Used recommended green waste reduction practices; for example, 47% (of 297 respondents) started or improved using finished compost as a soil</li> </ul> </li> </ul>	
--	--	---	--

		<p>amendment. This improves soil by recycling organic matter and contributes to less green waste in landfills.</p> <ul style="list-style-type: none"> <li>○ Adopted improved landscape water use efficiency practices; for example, in 2020, 62% (of 552 respondents) started or improved using mulch. In addition, participants reported removing almost 140,000 square feet of turf. These practices reduce landscape water use.</li> <li>○ Adopted integrated pest management practices; for example, 75% (of 550 respondents) started or improved monitoring for pests or diseases, which slows their spread and protects natural and managed ecosystems. (UC Master Gardener Program)</li> <li>● The survey of the San Luis Obispo County UC Master Gardener workshops had 75 respondents reporting starting or improving the following practices: (Chris Greer)             <ul style="list-style-type: none"> <li>○ Choosing the right plant for the right place (64%)</li> <li>○ Using finished compost as a soil amendment (40%)</li> <li>○ Removing or not introducing invasive plants (56%)</li> <li>○ Reducing pesticide applications (44%)</li> <li>○ Selecting low water use plants (100%)</li> <li>○ Using mulch (100%)</li> </ul> </li> <li>● In the Ventura County UC Master Gardener Program survey from the drip irrigation workshops, 145 (38%) reported they had installed a drip irrigation system following their participation in the workshop, and 108 (28%) said that they had installed an irrigation controller. (Jim Downer)</li> <li>● From participant evaluations in Kern County, all respondents indicated they were changing at least two horticultural practices, 27% indicated a change in four, and 36% a change in five. (John Karlik)</li> </ul> <p><b>Change in condition: Expanded community gardens.</b></p> <ul style="list-style-type: none"> <li>● In the remote Inyo-Mono Counties area, during the COVID-19 pandemic, the UC Master Gardener Program was able to expand the Bishop Community Garden to include a new free-access garden, where local residents in need can enter and harvest any produce that is ready at any time. It also added a new native plant garden in cooperation with Inyo National Forest, part of the USDA Forest Service. (Dustin Blakey)</li> </ul> <p>Together these measured outcomes 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.</p>	
--	--	---	--

		<p>UCCE research estimates that implementing best management practices for 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.</p>	
<p><b>23.</b></p>	<p><b>UC ANR contributed to improved water quality.</b></p>	<p><b>Issue</b> Poor water quality can result from a variety of point and non-point 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.</p> <p><b>Methods</b> 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.</p> <p>A UC Agricultural Experiment Station scientist at the UC Berkeley location conducted research to identify alternative best management practices to evaluate the dynamics and magnitude of groundwater quality improvements that may be explicitly achieved with public supply wells. The work focused on public supply wells in economically disadvantaged communities, which are often hardest hit by agricultural nitrate pollution, given their geographic locations. Agriculturally managed aquifer recharge and nutrient management practices were the two methods found to effectively reduce the increase in nitrate concentration at the public supply well. When both practices were combined, the strongest improvements in long-term water quality were achieved. (Thomas Harter)</p> <p>University of California Cooperative Extension (UCCE) conducts several nitrogen-related research and extension projects. New groundwater regulations, including the Irrigated Lands</p>	<p>Water, SFS, SNE, EIPD</p>

		<p>Regulatory Program (ILRP), aim to protect groundwater quality and require farmers to report Total Nitrogen Applications (TNA) 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 provided one-on-one technical assistance with nitrogen reporting requirements to help farmers comply with regulations. (Ruth Dahlquist-Willard; Aparna Gazula; Qi Zhou; Margaret Lloyd)</p> <p>California regulations in response to nitrate leaching into groundwater mean that growers have less nitrogen available to use for a particular crop. One collaborative UC Davis and UCCE project assisted growers in maximizing their yield return per unit fertilizer to maintain productivity in the face of input restraints. The research was conducted in a Yolo County field during the bulk of the growing season and used several in-field tools such as reference areas, soil sampling kits, hand-held chlorophyll meters, and refined methods that help growers react to crop conditions in-season. The in-season application allows for adjusted rates to address changes in yield potential from pest damage, drought conditions, or frost damage. The results of the study were shared via case studies, blog pieces, a YouTube how-to guide for in-field soil nitrogen testing, and a web tool that interprets results and ties it back to local soil conditions. (Konrad Mathesius)</p> <p>One UCCE Advisor was invited by the El Dorado Agricultural Water Quality Corporation to assist its members in meeting requirements for submitting nitrogen budget plans. In the region, agricultural production occurs on sloped land in a range of microclimates and soil types using limited resources. Farms are typically adjacent to sensitive natural resource lands or growing residential areas. All growers are now required to submit a nitrogen budget plan, even if they are not in a high vulnerability area. These plans require a good understanding of both nutrient use and irrigation methods. (Lynn Wunderlich)</p>	
--	--	---	--

		<p>A multi-year stakeholder-guided scientific assessment process culminated in a 300-page book, <i>The California Nitrogen Assessment</i>, published in 2016, identified the magnitude and sources of nitrogen pollution in California and assessed the potential for technical and policy solutions to reduce this pollution. This publication has been used to engage state-level policymakers. (Sonja Brodt)</p> <p>One UCCE Advisor completed a multistate, street-side bioswales project in the San Francisco Bay Area, examining green infrastructure for stormwater management. This project uniquely connects water quality issues with tree management to prevent contaminated runoff from reaching the creeks of the Bay. The findings were shared with urban water managers, city planners, and public works personnel. (Igor Lacan)</p> <p>UCCE water quality research projects in Orange County are extended through a close partnership with Orange County Environmental Resources' Watersheds division and their stormwater program. One UCCE academic develops educational tools for both professionals and the general public. (Darren Haver)</p> <p>One UC ANR academic with the California Institute for Water Resources develops content-rich, research-based outreach materials, highlights diverse academic perspectives and untold stories related to complex water issues, monitors water policy and research, and implements appropriate strategies for disseminating and engaging governmental and community stakeholders. (Faith Kearns)</p> <p>Two UCCE Advisors' 7-year project with East Bay Municipal Utility District (EBMUD), the Range Health Conditions Assessment and Monitoring Program, addresses several land management issues, especially related to concerns over livestock grazing and its potential impact on drinking water. UCCE built a web-based platform for field staff and ranchers to collect and use geographic information system (GIS) data, which improves how data is collected and used to inform management decisions. (Scott Oneto, Theresa Becchetti)</p> <p>As a result of UC ANR research and extension, participants learned and adopted practices that improve water quality. Outcomes with specific indicators follow.</p> <p><b>Outcomes</b></p>	
--	--	---	--

		<p><b>Participants learned about recommended management practices for preserving water quality.</b></p> <ul style="list-style-type: none"> <li>● As measured in pre/post self-reported questionnaires, attendees increased their knowledge and understanding of issues presented related to the bioswales project in the San Francisco Bay Area. Additionally, clients reported that they would change some of their practices, such as reducing algaecides and monitoring soil water content, to better use and manage water and stormwater. (Igor Lacan)</li> </ul> <p><b>Participants adopted recommended management practices for preserving water quality.</b></p> <ul style="list-style-type: none"> <li>● Irrigated Lands Regulatory Program (ILRP)             <ul style="list-style-type: none"> <li>○ UCCE technical assistance contributed to 39 Fresno growers completing required paperwork for the ILRP, avoiding costly fines, and meeting compliance with nitrogen-related regulations that aim to protect groundwater quality requirements. (Ruth Dahlquist-Willard)</li> <li>○ In Santa Clara County, 36 small farmers who received one-on-one technical assistance from UCCE to test soil nitrogen content and irrigation water nitrate concentration submitted their TNA Report. Most of these farmers grow Asian leafy vegetables in greenhouses, such as amaranth, bok choy, gai choy, gai lan, a choy, Chinese celery, edible chrysanthemum, yam leaves, garlic chives, and pea tips. The whole project included over 200 acres of farmland, with approximately 25,819.47 pounds of nitrogen application and 14,392,637 tons (457,033,950 gallons) of water application in total. Furthermore, these farmers were able to avoid costly fines. Farmers shared that they are more willing to adopt agricultural practices that could reduce fertilizer application, which can ultimately benefit the agricultural system and our environment. (Qi Zhou, Aparna Gazula)</li> <li>○ Yolo, Solano, and Sacramento Valley growers changed nitrogen management behaviors for what is reported to the ILRP, as observed by UCCE through one-on-one consultation. Improving nitrogen management will minimize over and under fertilization. This reduces nitrogen leaching, thereby improving water quality, reducing excess costs, or potentially increasing agricultural productivity. (Margaret Lloyd)</li> </ul> </li> </ul> <p><b>Science-based information was applied to water quality policy and decision-making.</b></p> <ul style="list-style-type: none"> <li>● El Dorado Agricultural Water Quality Corporation members were able to comply with nitrogen budget plan requirements, with UCCE’s technical assistance with</li> </ul>	
--	--	--	--

		<p>implementing the policies that aim to improve water quality through efficient and environmentally sound production. (Lynn Wunderlich)</p> <ul style="list-style-type: none"> <li>● Orange County Environmental Resources' Watersheds division and stormwater program have adopted UCCE research presentations for training delivered to structural pest control operators and stormwater managers; these individuals are required to complete training to obtain permits for their work. The potential impact is that the operators will understand how their activities could result in water quality impairments in both natural and manmade urban water conveyances and understand the tools available to mitigate these potential impacts. (Darren Haver)</li> <li>● In the summer of 2019, the California governor signed into law SB 200, the Safe and Affordable Drinking Water Fund, to help communities address drinking water contamination from agricultural nitrates and other pollutants. The president of the California Rice Commission explicitly attributed this bill in part to the work of the UCCE collaborative Nitrogen Assessment Project, which increased understanding of nitrogen impacts in the state, clarified the role of agriculture in nitrogen pollution issues, convened diverse stakeholders around the issue, and examined the tradeoffs of policy solutions. (Sonja Brodt)</li> <li>● Social network analysis has repeatedly shown the California Institute for Water Resources as a central node in expanding reach and connecting water users on the Twitter social network, including well-respected journalists, agencies, and California's governor. Furthermore, public and private feedback from California government agencies, coalitions, and foundations have confirmed the usefulness of the institute's work in providing information about complex California water issues. In addition, the Water Talk podcast is being adopted as a teaching tool by K-12 teachers and decision-makers. (Faith Kearns)</li> <li>● EBMUD adopted the UCCE-built web-based platform on mobile devices as well as the use of geographic information system (GIS) technology for data-driven decision making. Other EBMUD divisions, including the integrated pest management team and the recreation unit, are also adopting the technology. As a result of this change, EBMUD, the largest landowner along the Mokelumne watershed, is protecting water quality to the 1.3 million customers in the Bay area. (Scott Oneto and Theresa Becchetti)</li> </ul> <p><b>Change in condition: Improved water quality.</b></p> <ul style="list-style-type: none"> <li>● The Yolo County grower collaborator reduced nitrogen applications by 30% by using the recommended in-season top-dress strategies combined with the data derived from</li> </ul>	
--	--	--	--



		<p>the reference zones. Because the grower could estimate yield impacts due to the drought, they were able to react and reduce the top-dress application. Research shows these practices improve grower capacity to respond to seasonal conditions and ultimately lead to reduced leaching of unsafe-levels of nitrates into groundwater while still maintaining grower productivity. (Konrad Mathesius)</p> <p>These aforementioned measured outcomes demonstrate improved knowledge and adoption of mitigation management practices. By reducing pollutants such as nitrates from fertilizers, pesticides, and animal waste that runoff or leach from agricultural and rangelands into water supplies, UC ANR helps preserve water quality. Improved practices will enable managers to reduce pollutants, leading to more environmentally sustainable farming and ranching. Thus, UC ANR contributes to the public value of protecting California’s Natural Resources.</p>	
<p>24.</p>	<p><b>UC ANR contributed to improved water use efficiency.</b></p>	<p><b>Issue</b>                  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 uses of water 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.</p> <p><b>Methods</b>                  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.</p> <p>A UC Agricultural Experiment Station (AES) scientist at the UC Berkeley location improved a previous assessment of unsustainable irrigation water consumption in 2000, which found that about 40% of global irrigation by volume is unsustainable, based on 16 major crops that account for 70% of global crop production. The newer study considered 130 primary crops, or nearly 100% of global crop production, and found that 51% of global irrigation volumes are unsustainable. Moreover, the findings included crop-specific and country-specific analyses of unsustainable irrigation and evaluated the extent to which it is affected by international trade.</p>	<p>Water, SFS, SNE, HFC</p>

		<p>This research meets gaps in knowledge around the environmental impacts of unsustainable irrigation and their displacement through trade. (Paolo D’Odorico)</p> <p>An AES researcher at UC Riverside is investigating which tree varieties and species will best tolerate drier weather patterns that might become more common in California as the climate changes. The most recent drought lasted four years and contained the three driest years since records began. Under drier conditions, perennial, woody plant species such as avocado, citrus, and grape to produce economically viable crops is a major concern. While variation in drought tolerance exists in these species, indicating that the selection of well-adapted varieties might be possible, it is also important to search for alternative species that might replace these familiar components of our agriculture. This type of future-proofing research is a major reason why UC has contributed to the long-term success of California food systems. (Louis Santiago)</p> <p>Two University of California Cooperative Extension (UCCE) Advisors delivered the 4-H Water Wizards program and trained afterschool staff or teachers on the Water Wizards curriculum. The 11-session curriculum was modified for delivery in both virtual and small-group settings, providing students with lessons focused on water stewardship and environmental conservation. (Marianne Bird; Nicole Marshall Wheeler)</p> <p>For over six years, numerous UCCE academics have collaborated with the California Department of Water Resources (DWR) to make available to growers Evapotranspiration (ET) Reports, which calculate the water use of a generic orchard by crop and region. The reports are posted online as well as emailed to 162 recipients throughout the state. A survey went out to email recipients evaluating the use of this information. Based on survey responses, one UCCE academic co-organized a five-part webinar on using ET as an irrigation management tool; over 100 attendees attended the webinar. The webinar was posted on SacValleyOrcards.com, along with one hands-on training on a newer irrigation timing tool. (Katherine Jarvis-Shean, Blake Sanden, Kari L. Arnold, Nick Clark, George Zhuang, Roger Duncan, Mae Culumber, Allan Fulton, Dani Lightle, Elizabeth Fichtner, Mohammad Yaghmour)</p> <p>One UCCE Advisor provided and installed over 700 various soil moisture sensors and 59 Evapotranspiration (ET) Tule sensors in commercial fields in the Imperial, Coachella, and Palo Verde valleys. The data were collected and analyzed, and the results were periodically discussed with the cooperative growers to evaluate their irrigation practices, learn about the advantages of sensor-based irrigation management, and encourage using them to improve irrigation management and scheduling. Additionally, a research project with eight commercial</p>	
--	--	--	--

		<p>growers was conducted to assess subsurface drip irrigation's economic viability versus the most common practice of furrow irrigation in sugar beets in the Imperial Valley. (Aliasghar Montazar)</p> <p>One UCCE irrigation study about cut-off dates on forage production in Shasta Valley pastures was conducted between 2013 and 2019. UCCE researchers determined no statistical difference in forage quality and spring forage yield between cut-off treatments and full irrigation treatments. However, the fall cut-off treatment resulted in a non-significant decrease in yield in the fall cut-off treatment and a significant effect on pasture soil moisture level and fall forage yield. Findings were shared via reports and a workshop in 2020, attended by 17 clientele. (Giuliano Galdi, Rob Wilson)</p> <p>Another UCCE irrigation management effort conducted research and extended findings via six educational presentations about pressure chamber use and seven meetings about irrigation management. Furthermore, the Almond Board of California's Sustainability Program survey data from 2014-2018 was analyzed to establish a baseline of behavioral changes related to plant-based irrigation management. (Luke Milliron)</p> <p>UCCE provides training and technical assistance to growers about the State Water Efficiency and Enhancement Program (SWEEP). Two UCCE academics organized three SWEEP workshops with 51 attendees in Santa Clara county. (Qi Zhou, Aparna Gazula) UCCE academics also provide technical assistance to small-scale, diversified farms in Fresno county who face challenges related to reduced groundwater availability, increased energy costs for groundwater pumping, and increasing regulation of groundwater quantity and quality. (Ruth Dahlquist-Willard)</p> <p>Another UCCE project's research to improve water use efficiency has included developing a novel device to enable untended measurements of irrigation water over multiple years. This work establishes accurate water duty factors for crops and regions, which will help ensure sustainable management of groundwater. (Mark Battany)</p> <p>One UCCE Advisor conducted a water use efficiency field trial regarding foliar sprayed CaCO<sub>3</sub> to reduce sunburn and enhance grape quality. Findings were extended to commercial growers, consultants, and winery personnel. (George Zhuang)</p>	
--	--	--	--

		<p>One UC Davis UCCE Specialist and a Smith Fellowship cohort worked on a broad conservation effort related to the 754,707 public comments submitted during the 2017 executive review of 27 national monuments in the U.S. They produced a Conservation Letters publication to extend findings of this policy-relevant culturonomics project, which studied human sentiment and cultural trends using artificial intelligence and deep learning to analyze digitized text in the 754,707 public comments. A notable finding was that while most human comments opposed the review, two-thirds of the words received most likely originated from software robots. The purpose of this project was to understand the public sentiment around public land use and environmental actions. (Mallika Nocco)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants learned and changed attitudes about the environment.</b></p> <ul style="list-style-type: none"> <li>● Students who participated in Sacramento 4-H’s Water Wizards program increased their awareness and value of water stewardship, as observed by 4-H and afterschool program staff. In final program evaluations, an afterschool leader shared, “The best part of the [Water Wizards] program is further explaining and highlighting the importance of water conservation and being environmentally friendly,” and “I think the students learned a lot about water and how they had a responsibility to take care of water issues.” (Marianne Bird)</li> <li>● Sixty-seven percent of 221 students in Yuba County that participated in 4-H Water Wizards self-reported using less water. (Nicole Marshall Wheeler)</li> </ul> <p><b>Participants learned about recommended irrigation practices.</b></p> <ul style="list-style-type: none"> <li>● After learning about the forage production cut-off irrigation research findings, Shasta Valley producers adopted recommendations and improved their irrigation practices. These changes were observed through UCCE’s field visits. The long-term impact of this project will be assessed in the following seasons. (Giuliano Galdi)</li> <li>● Evaluation from UCCE workshops showed that 100% of 40 farmers 100% of 40) increased their knowledge of SWEEP grants and their knowledge and skills of using and maintaining overhead sprinkler irrigation systems, variable frequency drives, soil quick</li> </ul>	
--	--	--	--

		<p>nitrate tests, and soil moisture sensors. Attendees also shared the intent to adopt the quick nitrate tests to assist in nutrient management. (Qi Zhou, Aparna Gazula)</p> <p><b>Participants adopted recommended irrigation or other water and soil management practices.</b></p> <ul style="list-style-type: none"> <li>• Evapotranspiration Report users reported using the information to make irrigation management decisions (70% of 64 survey respondents) or plan to in the future (17%). Of those who use ET emails to make irrigation decisions, 78% use them to set their irrigation schedule. Research has shown that scheduling irrigation based on ET can improve plant health and yields (Hanson et al. 2004), making more efficient use of water resources. (Katherine Jarvis-Shean)</li> <li>• One grower adopted pressure chamber irrigation across his 2,000 acres of walnuts and shared that the trees look healthier and shared with UCCE that without using the pressure chamber, "we would have over-irrigated during heat spells." Furthermore, the Almond Board's Sustainability Program data indicated that approximately 75% of almond growers in the Sacramento Valley regularly use the pressure chamber, which was 48% higher than the rest of the state. Fewer (56%) of growers in the Sacramento Valley reported that the season's first irrigation was based on pressure chamber measurements, which was 37% higher than statewide adoption. The greater rate of pressure chamber adoption in the Sacramento Valley than the rest of the state is a testament that UCCE's extension efforts and colleagues' efforts in the Sacramento Valley indeed have an impact. More immediate results from adoption and correct interpretation of pressure chamber readings include water savings by delaying irrigation in the spring. (Luke Milliron)</li> <li>• As a result of UCCE research and extension, wineries/growers in the San Joaquin Valley and coastal regions have adopted foliar sprayed CaCO<sub>3</sub> to protect fruits from sunburn. (George Zhuang)</li> </ul> <p><b>Science-based information was applied to water use policy and decision-making.</b></p> <ul style="list-style-type: none"> <li>• The San Luis Obispo County Planning Department used the water duty factor developed for capers in the Paso Robles area to conduct their water offset program when growers change crops to capers. (Mark Battany)</li> <li>• As a result of UCCE technical assistance, 13 Santa Clara small-scale growers applied what they learned to submit SWEEP grant applications. Furthermore, 12 out of the 13 growers were awarded the grants, totaling \$337,000, affecting over 50 acres of farmland. The growers now have the resources to apply practices that preserve water and conserve natural resources. This includes strategies such as replacing inefficient</li> </ul>	
--	--	---	--

		<p>pumps, replacing leaking pipes and sprinklers, installing water monitoring tools (such as a flow meter) to assist with irrigation schedule, and replacing smaller pipes to a bigger size to maintain a better pressure in the irrigation system. (Qi Zhou, Aparna Gazula)</p> <ul style="list-style-type: none"> <li>• The 21 Fresno County growers who received UCCE technical assistance for applying to SWEEP were awarded funding to implement irrigation systems that reduce greenhouse gases and save water on California agricultural operations. (Ruth Dahlquist-Willard)</li> <li>• Accountability in civic processes was spurred as a result of sharing the UCCE culturonomics project findings. This work has policy implications for how the executive branch solicits and analyzes public comments around proposed environmental actions. (Mallika Nocco)</li> </ul> <p><b>Change in condition: Water saved.</b></p> <ul style="list-style-type: none"> <li>• As a result of the sensor-based irrigation scheduling and management program and the information developed regarding soil moisture thresholds of various crops, 18 growers adopted soil moisture sensing tools to irrigate dehydrated onions, carrots, alfalfa, lettuce, date palm, and sugar beets. Two cooperative growers with this project who adopted soil moisture technology and subsurface drip irrigation and linear mover irrigation systems were able to conserve an average of 22% water and increase an average of 18% production in dehydrated onions, alfalfa, and sugarbeet fields. (Aliasghar Montazar)</li> <li>• Sugarbeet growers who participated in the subsurface drip irrigation study conserved on average 1.5 acre-foot per acre. Furthermore, the results indicate that adopting drip irrigation may help growers increase sugar beet yields by 18%, conserved water, and enhanced water and nitrogen use efficiency. (Aliasghar Montazar)</li> </ul> <p>These aforementioned measured outcomes demonstrate how water users better understand and adopt water use efficiency measures to help California reduce its water demand while maintaining crop yields. 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 2000 that California growers could save approximately \$64.7 million per year by using California Irrigation Management Information System (CIMIS) weather data to inform more efficient water practices. Thus, UC ANR contributes to the public value of protecting California's Natural Resources.</p>	
--	--	---	--

<p>25.</p>	<p><b>UC ANR contributed to increased water supply security.</b></p>	<p><b>Issue</b>                  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, a trend that 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, which would further limit 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.</p> <p><b>Methods</b>                  UC ANR extends new knowledge using both real and virtual methods to increase understanding of groundwater resources and conservation.</p> <p>A UC Agricultural Experiment Station scientist at the UC Davis location researches a promising method to increase groundwater recharge, which is to intentionally flood farmland with excess winter stormwater, known as as-MAR. The flooded fields allow the water to permeate into the ground and recharge the groundwater basin. In collaboration with the Almond Board of California, three flooding experiments were conducted in mature almond orchards to study root health and tree productivity in response to winter recharge. Trees showed no difference in yield and hydration of the tree. However, there was a difference in root growth, with trees in the recharge treatment showing higher standing root length. (Helen Dahlke) At the UC Riverside location, an AES scientist uses watershed science to study climate change impacts on California's natural resources. Understanding drought impacts and predicting climate change are critical challenges. This research team reconstructs past climatic conditions by analyzing lake sediments to understand historic snowfall in the Sierra Nevada mountains and using this information to predict California's future water supply. An additional component of their work is the analysis of atmospheric deposition of nutrients. These combined biogeochemical studies will help land managers make informed decisions around water and nutrient availability. (James Sickman)</p>	<p>Water, SFS, SNE</p>
------------	--	--	------------------------

		<p>The implementation of the Sustainable Groundwater Management Act (SGMA) in 2014 requires groundwater basins to implement management that gradually becomes sustainable, and UCCE academics help implement this policy. A significant impediment to this process has been the lack of information about water conditions (withdrawals, resupply, crop requirements, and associated soil salinity concerns) to achieve this end. One University of California Cooperative Extension (UCCE) Advisor addressed this issue by providing San Luis Obispo and Santa Barbara counties with the weather data to assist local groundwater management. Beginning in 2013, this advisor began measuring water-related weather variables over the Paso Robles Groundwater Basin and watershed with a total of 11 weather stations with the intent to make this data available to clientele in real-time on a UCCE website. The water-related data measured by these stations include the reference evapotranspiration and rainfall, which are both key variables to understand the water consumption and recharge conditions. Current and archived data is now <a href="#">publicly available</a> due to a partnership with the Western Weather Group. In another project, UCCE addressed looming action deadlines imposed by the Sustainable Groundwater Management Act for all medium and high priority groundwater basins in the state. By engaging in local water policy efforts with water districts and advisory councils, the County Water Offset Program, the County Public Works on Groundwater Recharge, and Agricultural Commissioner and Planning, UCCE promoted satellite imagery evaluating past and current water use. UCCE also served as a reviewer and technical service provider for the California Department of Food and Agriculture's Statewide Water Efficiency Enhancement Program. (Mark Battany)</p> <p>One UCCE Advisor conducted research with four commercial growers in the Palo Verde Valley to assess alfalfa deficit irrigation. Alfalfa accounts for about 28% of the crops grown and is the dominant water user in the low desert. While surface irrigation systems currently irrigate more than 95% of California low desert alfalfa, one strategy to enhance the water-use efficiency and on-farm water conservation in alfalfa fields is partial-season irrigation or moderate summer deficit irrigation. This is one of those impactful practices/efforts that may provide a significant water conservation capacity in the low desert region and has a huge impact in the Colorado River Basin. The United States Bureau of Reclamation (USBR) and The Metropolitan Water District of Southern California (MWD) selected this study as an agricultural water conservation pilot project in the Colorado River Basin. (Ali Montazar)</p> <p>Another UCCE Advisor conducted a study called "Efficiency of Flood Irrigation System-Pasture Evaluation," which evaluated this management technique's effectiveness through measurement and dissemination of flow and run-off data throughout the season. Another</p>	
--	--	--	--



		<p>project, "Evaluation of Intermountain Alfalfa Irrigation System," measured all the water applied to a field, considered the quality of irrigation, monitored groundwater levels, and quantified production. Research findings were extended in the last few years about these two research projects during extension meetings and included content in short irrigation courses offered in northeast California. This research and extension work built the knowledge, foundation, and relationships for UCCE to support land managers and growers as new groundwater regulations were implemented with severe fines for non-compliance with groundwater measurement reporting. Assembly Bill 589 was passed and became law on January 1, 2018, allowing any groundwater diverters who complete UCCE's course on measurement devices and methods to design, install, and certify the accuracy of their measurement device. This work has met the needs of land managers and growers who lacked the tools and knowledge to meet these groundwater management regulations. (Larry Forero)</p> <p>A UCCE Advisor participates in the Groundwater Advisory Committee meetings for Butte, Scott, and Shasta Valleys in Siskiyou County. In 2019, UCCE started to collect monthly groundwater level data in Scott Valley to monitor its variation throughout the year. The data generated has been used to calibrate an integrated hydrologic model. (Giuliano Galdi)</p> <p>One UCCE Specialist at UC Berkeley worked to address California water managers and farming communities' needs to understand the economic impacts of groundwater restrictions and the potential for groundwater markets. Clientele included water management agencies, community members, farmers, and the public that can benefit from the improved allocation of scarce water resources, particularly as it relates to SGMA. (Ellen Bruno)</p> <p>Two UCCE Specialists from UC Davis and UC Berkeley led a <a href="#">multi-agency network</a> to develop applied research for protecting riparian and freshwater ecosystems throughout the State of California. This effort included estimating the <a href="#">natural flow regime</a> of all rivers in California and functional flow metrics, <a href="#">predicting these metrics</a> for every 200-meter river reach, and developing <a href="#">guidelines</a> to determine instream flows that protect the native river ecosystems in the entire state. (Samuel Sandoval Solis, Theodore Grantham)</p> <p>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.</p>	
--	--	---	--

		<p><b>Outcomes</b></p> <p><b>Science-based research is applied to water supply policy and planning.</b></p> <ul style="list-style-type: none"> <li>● The public availability of evapotranspiration and rainfall data demonstrates how UCCE provides research and extension that supports local implementation of state policies. Comprehensive and accurate water-related weather data for San Luis Obispo County helps to ensure that management, assessments, and modeling of groundwater pumping and recharge will be as accurate as possible, leading to a greater likelihood of success in achieving sustainable groundwater use as mandated by state legislation. (Mark Battany)</li> <li>● Engagement of UCCE in local water policy demonstrates how UCCE extends scientific knowledge to support the implementation of statewide groundwater management policies. By providing policy and decision-makers with the most accurate, water-related information and the best factual guidance available, there is an increased likelihood of beneficial and fair policy outcomes. (Mark Battany)</li> <li>● As a result of sharing the positive findings from the Palo Verde Valley research, the Natural Resource Conservation Service and other agencies intend to recognize the alfalfa deficit irrigation practices as a formal Agricultural Water Management Program. Accordingly, they will provide incentives to growers who adopt the alfalfa deficit irrigation practices to contribute to water supply security in the Colorado River Basin. The study findings indicate that the low desert growers may conserve one acre-foot per acre following this study's proposed practices. There are about 200,000-acre alfalfa fields in the low desert; thus, adopting this practice may provide 200,000 acre-feet water conserved for the region. (Ali Montazar)</li> <li>● Participants of irrigation systems Extension meetings experienced changes at the ranch level, with growers being better able to respond to annual questions associated with the Central Valley Regional Quality Control Board Irrigated Lands Regulatory Program. (Larry Forero)</li> <li>● UCCE research and expertise have effectively delivered training that helps growers comply with CA State Water Resources Control Board Diversion Reporting requirements. Over 1,200 land managers and growers, i.e., diverters, from across the state avoided large expenses from contracting expertise for design and installation of measuring devices and significant fines and penalties from the CA State Water Resources Control Board for not meeting groundwater management regulations. (Larry Forero)</li> </ul>	
--	--	---	--

		<ul style="list-style-type: none"> <li>● Water measurement and participation in Siskiyou County's Groundwater Advisory Committee meetings demonstrate how UCCE supports policy implementation, specifically implementing the mandatory Siskiyou County Groundwater Sustainability Plan. Furthermore, the water measurement data is being used to develop the integrated hydrologic model, creating different scenarios to increase the Siskiyou County community preparedness and resilience to extreme weather, drought, and climate change. (Giuliano Galdi)</li> <li>● Community organizations such as the Community Water Center and the Environmental Defense Fund adopted policy stances toward groundwater markets, informed by UCCE extension of science-based information. (Ellen Bruno)</li> <li>● With UCCE technical assistance, water managers have made observable changes to management actions regarding groundwater resources allocation in California. (Ellen Bruno)</li> <li>● The State Water Resources Control Board utilized UCCE's Decision Support System and applied research findings in the South Fork of the Eel River, specifically in decisions around new water rights applications and protecting the environment. (Samuel Sandoval Solis)</li> </ul> <p>These measured outcomes strengthened understanding of water supply and helped improve the actions taken to ensure a stable water supply to meet California's demand. UC ANR's research and extension 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.</p>	
<p><b>26.</b></p>	<p><b>UC ANR contributed to increased preparedness and resilience to extreme weather and climate change.</b></p>	<p><b>Issue</b> 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, and peri-urban areas are experiencing the effects of intense wildfires and persistent droughts. Land managers and land owners need effective response and adaptation strategies to best manage the land to better prepare to deal with the growing risks. Communities need to be better prepared to deal with the growing risks of hazards from fires and droughts.</p>	<p>HFC, SFS, SNE, EIPD, Water</p>

		<p><b>Methods</b>  UC ANR collaborates with agencies and landowners that have been impacted by catastrophic fires and droughts and provides science-based information to aid in recovery and prevention efforts and develop improved practices.</p> <p>A UC Agricultural Experiment Station scientist at the UC Riverside location conducted field research after fire and storm events to understand debris flows to mitigate hazards. The findings will help scientists and the Los Angeles County Department of Public Works personnel modify their approach to assessing debris flow risk after fires to mitigate danger during post-fire storms. (Andrew Gray) At the UC Davis location, an AES scientist completed an intensive study of the plants, invertebrates, mammals, birds, bats, pollinators, and flowering plants within the burn perimeter of the 2014 King Fire. The goal was to map and understand the food web networks and assess species vulnerabilities. The size and intensity of wildfires in California are increasing, and having baseline data to evaluate recovery and species declines provides critical information for forest managers. (Rahel Sollman)</p> <p>One University of California Cooperative Extension (UCCE) Advisor organized 11 workshops on prescribed fire on private lands in the Sierra Nevada region and were attended by almost 400 landowners and staff from partner organizations. Workshops consist of two parts, a one-day classroom session on options for private lands burning, use of prescribed fire to manage forest ecosystems and rangelands, air quality and smoke management, permitting and legal considerations, fire weather, fire terms and fire behavior, burn planning and technical assistance and cost-share programs. Part two includes field-based instruction on burn unit preparation, equipment and tools, firing techniques, and personal protective equipment. (Susie Kocher)</p> <p>Another UCCE academic conducts post-fire reforestation and restoration research and extension, particularly on the silvicultural methods that establish post-wildfire forests that are resilient to re-burning in future wildfires. This project established improved practices and demonstrated the benefits of underutilized tools in the national forest toolbox. He also delivers wildfire preparedness information and assists communities in completing assessments for Firewise USA, a national recognition to empower communities on defensible space, home hardening, and evacuation planning. (Ryan Tompkins)</p> <p>A UCCE Advisor serving Placer, Nevada, Sutter, and Yuba Counties provided natural resource management and climate mitigation assistance to clientele through applied research, hands-on</p>	
--	--	--	--

		<p>extension activities in the areas of climate change variability and adaptation, and wildfire. (Dan Macon)</p> <p>Weather events can cause significant damage to crop production in a given year, and the gradual shift in climate is posing challenges for existing crop production, demanding adaptation by farmers to the evolving conditions. UCCE’s North Coast temperature inversion studies provide real-time temperature data to grower clientele and National Oceanic and Atmospheric Association (NOAA) scientists. Seventeen weather stations and 35-foot towers were installed for measuring inversion conditions using a practical method developed by UCCE, and UC ANR’s Informatics and Geographic Information Systems program created a website with real-time data. The findings helped determine the benefits of adopting expensive wind machines in light of climate change and significant weather events, especially for farmers who manage sensitive crops. (Mark Battany, Rhonda Smith, Glenn McGourty)</p> <p>One UCCE academic has engaged with the walnut industry since 2011 regarding the need for research in walnut climate adaptation for walnut growers to sustain yields and profits through the life of their orchard under future warm winters. In 2020, the walnut industry awarded \$200,00 for a four-year research trial, which UCCE will design and lead in the coming years. (Katherine Jarvis-Shean)</p> <p>A UCCE lab on the UC Berkeley campus has been actively involved in redesigning vegetation surveys along power lines for power companies and developing an outreach program on fire response that is inclusive of both vegetation and building hardening. The lab proposed to work with Pacific Gas and Electric (PG&amp;E) and other crews to train workers on correctly identifying possible hazard trees along electrical lines, collecting any fruit body available, correctly sampling the wood, and collecting necessary information using a beta version of a mobile application, EvaluTree. The data would be collected and stored online, and the lab would assess the samples for wood decay. Any canker rots would be identified and communicated to PG&amp;E. A database of all trees sampled would also be generated and made available to PG&amp;E. These vegetation surveys would impact 16 million Californians and trillions of dollars in value of properties and products. Additionally, the lab is one of two in the world to diagnose important wood decay pathogens directly from wood with confidence. The lab developed and validated a procedure to deal with forensic evidence to be used in litigation. (Matteo Garbelotto)</p>	
--	--	---	--

		<p>A UCCE advisor led the adaptation of the FireWorks curriculum to California’s oak woodlands ecosystems. The curriculum was developed with Native Californian input to ensure proper discussion of California’s long history and current status with fire. It was designed with a trauma-informed lens to reduce the potential re-traumatization of youth impacted by wildfire. Through Community Education Specialists’ efforts and community partners' efforts with project sub-awards, the curriculum and related lessons on fire ecology, community preparation, and resilience to wildfire reached over 2,500 youth and adults in Northern California. Youth participants in the FireWorks curriculum lessons learned how to create their own emergency evacuation kit, or “go bag,” and teachers and students learned how to assess and improve their school’s fire safety. Twelve sets of curriculum materials, valued at over \$1,000 per complete set, are now available for teachers to borrow, expanding accessibility to this crucial information regardless of socioeconomic status. (Rebecca Ozeran, Hannah Bird, Ali Stefancich)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants gained understanding of prescribed fire strategies to respond to climate change and extreme weather.</b></p> <ul style="list-style-type: none"> <li>• Sierra Nevada prescribed fire workshop participants reported improved understanding of why and how to use prescribed fire (73%), prescribed fire logistics (87%), and how to carry out prescribed fire on the lands they manage (81%). (Susie Kocher)</li> </ul> <p><b>Participants adopted climate-resilient strategies.</b></p> <ul style="list-style-type: none"> <li>• As a result of UCCE’s North Coast temperature inversion study, an early adopter purchased ten permanent wind machines for the 100-acre vineyard and saved considerable water. Additionally, a land manager at an 800+ acre site leased additional wind machines, strategically placing them in more beneficial areas as identified by UCCE’s measurements. Furthermore, these early adopter examples coincided with a severe drought and water supply cutbacks, resulting in a tremendous number of wind machines being installed in Sonoma County. The impact of this effort has been a shift from water-intensive sprinklers towards water-conserving wind machines while still achieving frost protection for sensitive crops during significant weather events</li> </ul>	
--	--	--	--

		<p>associated with climate change. Additionally, the adoption of wind machines will likely reduce pumping pressure in the Russian River Watershed, protecting water supply in the event of future droughts. (Mark Battany)</p> <ul style="list-style-type: none"> <li>• The six grazing businesses that expanded or became established with UCCE technical assistance applied drought and wildfire mitigation strategies on more than 2,200 acres in the wildland-urban interface. (Dan Macon)</li> </ul> <p><b>Science-based information was applied to fire and climate-resilient policy and decision making.</b></p> <ul style="list-style-type: none"> <li>• UCCE extended concepts and tactics used to inform fire resilient restoration plans on recent fires across the Forest Service, Bureau of Land Management, and private lands in the northern Sierra, including the 2018 Camp Fire, the 2019 Walker Fire, and the 2020 North Complex fires. (Ryan Tompkins, Susie Kocher)</li> <li>• Two communities completed their assessment and received Firewise recognition status due to receiving UCCE technical assistance and support. The two communities serve 800 residences as part of an important attempt to include neighborhoods that traditionally haven't received services and to be inclusive of all neighborhoods in an economically diverse community. (Ryan Tompkins)</li> <li>• Acknowledging that winters will continue to warm and threaten production is a significant change in the California Walnut Board's decision-making and due in part to UCCE's ability to engage in policy through relationship-building and sharing science-based information. The industry's funded research will provide the growers of ~300,000 acres of vulnerable walnut varieties with warm winter solutions for sustained walnut production. (Katherine Jarvis-Shean)</li> <li>• As a result of UCCE's beta mobile application, EvalUTree, and proposed redesign of vegetation surveys, PG&amp;E decided to implement the approach in all of their future vegetation surveys. The returns to PG&amp;E are considerable because the company will have a shortlist of red flagged-trees for their preventive removal, thus drastically reducing the frequency of unpredictable tree failures leading to human casualties, property damage, and wildfires. The process has also been adopted in a pilot Department of Defense project and has the potential to be used on all lands administered. It can be used to mitigate wildfire ignition caused by tree failure, a huge issue in California. (Matteo Garbelotto)</li> <li>• UCCE's wood decay data was utilized in five legal cases involving tree failure. All cases settled thanks to the data provided. Although the settlement amounts are unknown,</li> </ul>	
--	--	--	--

		<p>the original amounts litigated were about \$115 million cumulatively. (Matteo Garbelotto)</p> <ul style="list-style-type: none"> <li>• The Yuba Environmental Science Charter Academy in Yuba County conducted a school fire safety evaluation and made plans to improve the building hardening as a result of hosting FireWorks lessons. Furthermore, the Mendocino County Board of Education was able to supply go bags to over 200 students and teachers who participated in FireWorks field trips and lessons, increasing their community's preparedness to respond to wildfire threats. (Rebecca Ozeran, Hannah Bird, Ali Stefancich)</li> </ul> <p>The aforementioned measured outcomes demonstrate participants learning about and developing new management paradigms to address the challenges of a changing climate. There is much work to be done; for example, in 2020, over four million acres burned, and over 10,000 structures were damaged or destroyed in California. Compared to 2018, this is an increase of over two million acres and 14,000 structures. Adopting mitigation strategies and new policies informed by UC ANR's science-based research will help increase forest and rangeland resiliency and decrease the impact of fires and droughts. In these ways, UC ANR contributes to building climate-resilient communities and ecosystems.</p>	
<p><b>27.</b></p>	<p><b>UC ANR contributed to improved living and working conditions for California's food system and farm workers.</b></p>	<p><b>Issue</b>                  In 2019 there were 22.2 million full- and part-time jobs related to the agricultural and food sectors – 11% of total U.S. employment. 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, one of the most hazardous industries for workers, with over 75,000 injuries and illnesses reported annually across the U.S. (Monica Cooper) Farmworker communities have been hard hit by the pandemic; crowded living and working conditions, low wages, and fear of deportation all contribute to high rates of COVID-19.</p> <p><b>Methods</b>                  UC ANR continues research and extension efforts to improve conditions for workers in California's food system.</p>	<p>HFC, SFS</p>



	<p>U.C. Cooperative Extension (UCCE) responded to the COVID-19 pandemic to help keep small farms safe. The UCCE Fresno County small farms team distributed masks, hand sanitizing wipes, and COVID-19 safety signage in multiple languages to roadside strawberry stands in early April 2020, the beginning of the strawberry season in Fresno. Farmers were concerned both that they might lose customers under the shelter-in-place order that had just been implemented and that customers might not follow COVID-19 safety procedures, possibly increasing the risk of COVID-19 spread to other customers or to the farmers and their family members. (Ruth Dahlquist-Willard) UCCE in Santa Clara County also distributed over 80 COVID-kits to farmers from socially disadvantaged communities to ensure worker safety. (Qi Zhou)</p> <p>UCCE also works to help reduce the risk from pesticides and herbicides for farmworkers. UCCE worked with the Mien immigrant farming communities in the Sacramento Valley to start a new on-farm extension meeting and a new partnership with the International Rescue Committee, in addition to the existing annual meeting. These strawberry farmers rely heavily on pesticides for managing weeds and insects and had limited access to the information given internet and language barriers. UCCE developed six pesticide handling and safety signs in English and Mien languages for on-farm use. The “Common Weeds of Mien Strawberry Farms in Sacramento,” a 20-page pictorial guide, was developed based on photos taken at the farms. A hands-on activity was conducted to calibrate farm equipment for pesticide applications and correctly identify weeds on the farm. (Margaret Lloyd)</p> <p>UCCE worked on a Training Pesticide Applicators Pest Management Alliance grant funded by the California Department of Pesticide Regulation. Three hands-on trainings were delivered, including two in Spanish, for pesticide applicators on air blast sprayer calibration and drift reduction. Pesticide drift is a health concern for farmworkers, as well as the surrounding farm and school communities and the environment. (Lynn Wunderlich)</p> <p>Since 2014 a collaborative project working across UCCE, UC Davis, and the country has evaluated the use of grafted tomatoes to gain traits from the wild tomato species, so the rootstocks have higher vigor and greater resistance to soil-borne diseases and nematodes. For the past several years, the field trials have demonstrated that for processing tomatoes grafting onto vigorous, disease-tolerant rootstocks increases yield by about 15% in fields without major disease problems. In fields with soil-borne pests, the benefit is expected to be much higher. The plants being more resistant to soil-borne pest problems can decrease the use of fumigants. This information has been extended via a California Grower Guide, a national project website</p>	
--	---	--

		<p>(<a href="http://www.vegetablegrafting.org">www.vegetablegrafting.org</a>), field days, a national webinar presentation, and numerous other extension presentations. (Brenna Aegerter, Scott Stoddard, Zheng Wang)</p> <p><b>Outcomes</b></p> <p><b>Participants adopted practices that lead to improved farm worker safety.</b></p> <ul style="list-style-type: none"> <li>• Sixteen small-scale strawberry farmers implemented the use of personal protective equipment and displayed the signs at their farm stands. Farmers reported that the signs displaying COVID-19 safety requirements were successful, as indicated by the following representative quotes from farmers: "Posting the signs helped a lot, it kept customers from touching produce and they wore masks" and "customers were able to read the signs ahead, and understand what needed to be done and was expected at the fruit stand. While the customers were waiting in a single-file line, they were all six feet apart." Also, the Fresno County Fruit Trail commented on the safety practices adopted by the farm stands: "The health precautions taken provided a level of reassurance as they were able to efficiently serve a steady stream of customers (and customers queued up nicely with our masks)." (Ruth Dahlquist-Willard)</li> <li>• Through observations during farm visits, farmworkers started wearing masks when working, and through interviews, learned they were washing their hands more often. These practices ensure a safer working environment for farmworkers, protect workers' health, and limit/slow the spread of COVID-19. (Qi Zhou)</li> <li>• Twenty-eight small farmers for whom English is a second language learned the English name for the weeds to communicate with pesticide dealers for the correct recommendation of an effective herbicide. These growers can also now correctly calibrate equipment to maximize herbicide efficacy. The impact is a reduction in the handling of pesticides by workers and the use of and residue of pesticides in the environment. (Margret Lloyd)</li> <li>• Respondents replied "maybe" or "probably will" when asked the likelihood of adopting recommended practices for vineyard and orchard management. For example, 62% of around 60 participants in the vineyard training indicated they would use low drift nozzles, and 65% of close to 70 participants in the orchards training indicated they would use tape/ribbon to check airflow in trees. These practices can improve farmworker working conditions and health from reduced pesticide drift. (Lynn Wunderlich)</li> <li>• Grafting has been adopted by Morning Star, the world's largest tomato processor and the owner of a California grafting nursery facility, with the capacity to produce grafted</li> </ul>	
--	--	---	--

		<p>tomatoes for thousands of acres. If the price comes down, wider adoption of grafting is expected to follow, which is expected to lead to reductions in the use of the soil fumigant metam given the grafted plants are more resistant to soil-borne pest problems (Grieneisen et al., 2018). These reductions in metam use should improve air quality and reduce occupational exposure by pesticide handlers. (Brenna Aegerter, Scott Stoddard, Zheng Wang)</p> <p>These measured outcomes 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.</p>	
<p>28.</p>	<p><b>UC ANR contributes to increased diversity, inclusiveness, and cultural competency in California's workplaces.</b></p>	<p><b>Issue</b> 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.</p> <p><b>Methods</b> 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.</p> <p>UC ANR's Diversity, Equity, and Inclusion (DEI) Alliance, an informal group of UC ANR personnel, promotes equity, diversity, and inclusion within UCCE. In 2020, the Alliance met monthly, launched an internal website, informed goals and metrics for UC ANR's 5-year strategic plan, developed baseline data of employee diversity and satisfaction, published a website of antiracism resources, developed a diversity style guide for publications and</p>	<p>HFC, SFS, SNE, EIPD, Water</p>

		<p>facilitated ANR employee participation in the 21-Day Racial Equity Challenge. Furthermore, the Alliance advocated for increased organizational capacity. As a result, the following will begin in 2021: an appointed DEI Advisory Committee, three employee resource groups for black and allied employees, LGBTQ+ employees, and employees of color, and unconscious bias training. (UC ANR DEI Alliance)</p> <p>UC Cooperative Extension (UCCE) participates in the Racial Equity in the Food System Workgroup run by Michigan State University’s Center for Regional Food Systems. This workgroup brings together Cooperative Extension professionals and other food system stakeholders to connect, learn, and collaborate to build racial equity in the food system and our own institutions. The UCCE Urban Agriculture/Food Systems Advisor in Santa Clara and San Mateo Counties led the webinar planning subcommittee in organizing five webinars for a national audience of land-grant universities, nonprofits, and local government staff. In total, the webinars had more than 2500 unique registrants, reaching land-grant universities in all 50 states and the majority of the historically black colleges and universities and more than 240 nonprofit organizations, 75 government entities, and 25 foundations and food businesses. (Lucy Diekmann)</p> <p>National data indicates that Master Gardener volunteers are overwhelmingly white, female-identified, college-educated, affluent, employed outside of the home, or retired. What we know about the UC Master Gardener volunteer population suggests it is in line with the national trend, and does not reflect the diversity of California residents and gardeners. To address this issue, the program is taking a two-pronged approach: 1) focus on outreach to communities historically underinvested by Extension, and 2) increase the cultural competency and awareness of the UC Master Gardener Program personnel and volunteers. The program also extended UC’s free implicit bias training to UC Master Gardener Program personnel and volunteers statewide through a blog, which resulted in 579 page views. Three inclusive volunteer selection trainings were offered to a total of 150 people. (Marisa Coyne) The UC Master Gardener programs in Riverside and San Bernardino Counties targeted volunteer recruitment and outreach to better represent the cultural and ethnic diversity in those communities. The two counties' combined populations are approximately 4.7 million people, and over half of the residents of both counties identify as non-white. The Riverside County program has nearly 400 volunteers and the San Bernardino County program has around 225 volunteers. (Janet Hartin)</p>	
--	--	--	--

		<p>UC ANR’s statewide California Naturalist program is also working to broaden participation from historically underrepresented groups by focusing on improving access through scholarships and building relationships primarily with workforce development organizations in the southern part of the state. In response to the national push for racial justice in early 2020, the program completely re-examined its efforts and re-worked its existing strategic objective on Diversity, Equity, and Inclusion. The new strategic objective now emphasizes building meaningful relationships with organizations serving underrepresented groups, ensuring the relevance of program content, language, and delivery, increasing recruitment by reducing barriers to access and taking responsibility for our own professional development and growth. (Gregory Ira)</p> <p>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.</p> <p><b>Outcomes</b></p> <p><b>Participants gain confidence in integrating a racial equity lens in their work.</b></p> <ul style="list-style-type: none"> <li>• The webinar series on racism in the food system led and produced by Michigan State University’s Center for Regional Food Systems conducted a survey to evaluate their program. Forty-four percent of respondents learned about educational resources they can use to inform their work, 25% of respondents gained confidence in using a racial equity lens in their work, and 21% now have more people they can contact who support this work. (Lucy Diekmann)</li> </ul> <p><b>UC ANR better engages communities historically underrepresented in its programs.</b></p> <ul style="list-style-type: none"> <li>• Over the past three years the UC Master Gardener Program in San Bernardino County tripled the collective number of Latino, Hispanic, Black, and Native American volunteers, who have been historically underrepresented in the program. The number of individuals from these communities increased by over 200%. For example, UC Master Gardener and California EFNEP staff partnered with the San Bernardino City Unified School District, in which 87% of students who qualify for free lunches, launch school gardens and teach classes on gardening and healthy diets and lifestyles. Through the outreach, several participating teachers applied for and were accepted into the current UC Master Gardener training, enabling them to continue to provide UC ANR education to such students. (Janet Hartin)</li> </ul>	
--	--	--	--

		<ul style="list-style-type: none"> <li>• The California Naturalist Program developed new partnerships with the following organizations serving underrepresented groups: Community Nature Connection, Nature for All, Outward Bound Adventures, Southern California Mountains Foundation's Urban Conservation Corps, and several more community colleges. Southern California has seen the largest growth of partner organizations serving underrepresented groups. In the Central Sierra region, non-white participation has gone up from 20% in 2019 to 35% in 2020. (Gregory Ira)</li> </ul> <p><b>UC ANR academics, staff, and volunteers learned skills to better engage diverse audiences.</b></p> <ul style="list-style-type: none"> <li>• Counties with large UC Master Gardener volunteer enrollments, including Santa Clara, Contra Costa, and Alameda, have adopted implicit bias training requirements for volunteers involved in the selection process. This will help reduce implicit bias in the application review and interview processes, leading to a more diverse volunteer population and improving the current volunteer population's cultural competency. Volunteer sense of belonging within and commitment to an organization depends on the practices of staff and the other volunteers (Studer and von Schnurbein, 2013). While implicit bias training alone is not sufficient to address inequity in hiring and, by extension, volunteer selection, implicit bias awareness can be a critical component of equitable volunteer selection. (Marisa Coyne)</li> </ul> <p>These measured outcomes demonstrate how UC ANR has strengthened its internal capacity to do effective outreach to diverse audiences to have participants better reflect the state's diversity. UC ANR increased access to opportunities and created environments where different kinds of people can thrive and succeed. In this way, UC ANR contributes to the public value of developing an inclusive and equitable society. The UC Berkeley Hass Institute of Fair and Equitable Society finds California ranking high in inclusiveness. However, the state dropped from fifth to eighth in the nation between 2018 and 2019, indicating there is still a lot of work to do.</p>	
--	--	---	--