

2019 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 Plan of Work. Use this space to provide updates to your state or institutions as needed.

1. Executive Summary (Optional)

- I. **During FFY 2019, 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. This means we must often consider the research focus and content of programming as well as the delivery method. 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 reaching an increased number of people through Statewide Program e-courses, which expand our audience, reaching more industry partners, volunteers, and community members. The number of courses delivered electronically increased by 50%, from 12 courses in 2017 to 18 courses in 2018. The number of participants that completed the courses increased from 9,700 to 12,000 respectively.
- The UC ANR News & Information Outreach in Spanish (NOS) unit facilitated greater engagement with the Latino community. For example, the NOS team posted almost 60 videos to social media in English and Spanish, and engagement on NOS YouTube grew from 1,200 in 2017 to 4,200 in 2019.

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. The strategic plan operationalizes efforts 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.

- Over the past two years, the growth in Giving Tuesday has been 70.4%, with an 89.6% increase in the number of gifts.
- A UC Presidential Match was secured thanks to the generosity of the Citrus Research Board. Their gift of \$500,000 was matched by the UC President's office. The first holder of this endowed research position is a Cooperative Extension Specialist.

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.

- \$1.2M in state funds was secured and approved for capital renewal.

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.

- Given the long time decline in traditional funding sources, UC ANR continues the practice of funding or co-funding academic and program staff positions with outside funding from grants, commodity groups, county resources, or other government agencies. The number of such CE Advisor positions grew from five to seven; this also reflects a sunset of commodity group funding for two of the earlier positions. There are also two co-funded CE Specialist positions. In addition, 10 Community Educators Specialist program staff were hired to work on climate change, in partnership with the California Department of Food and Agriculture.
- The percent of "engaged" staff employees has increased from 68% in 2015 to 74% in 2019. Employee wellness has increased to 66% since 2015.
- 3,014 volunteers participated in a 2018 Volunteer Feedback survey. Master Gardener, Master Food Preserver, and 4-H volunteers' average overall satisfaction was 5.5 on a 7 point scale.

II. During FFY 2019, UC ANR continued work on the following five Critical Issues which are the organization's multidisciplinary, integrated Strategic Initiatives.

Sustainable Food Systems

UC ANR's Sustainable Food Systems Strategic Initiative focuses on the following program areas and respective grand challenges:

- Sustainable production – addressing labor scarcity; regulatory requirements; water quantity and quality; farm prices; climate change; and emerging pests
- Safe processing – addressing food safety and food preservation
- Enhanced access – addressing food deserts and cost; changing food preferences; food access and security for aging seniors

This Initiative helps the state economy, protects the natural resources, builds capacity of people and communities, and helps ensure safe food.

Endemic and Invasive Pests and Diseases

UC ANR's Endemic and Invasive Pests and Diseases Strategic Initiative focuses on the following bulleted program areas that address the grand challenges of emerging pests, the public's understanding of the role of science in safe and effective pest management, and pursuing new technologies for existing pests.

- Keeping invasive pests and pathogens out of California
- New problems with existing pests and diseases
- Integrated Management

This Strategic Initiative helps the state economy, protects natural resources, builds capacity of our people and communities, and helps ensure safe food and drinking water.

Sustainable Natural Ecosystems

UC ANR's Sustainable Natural Ecosystems Strategic Initiatives focuses on the following program areas to address the grand challenges of fire, land use policy, water supply, and climate change:

- Healthy rangelands, forests, and working landscapes
- Fighting fire - resilient forests and fire-safe urban areas
- Healthy landscapes and urban forests
- Enhancing and protecting water supplies (quality and quantity)
- Land use policy
- Climate change
- Biodiversity

This Strategic Initiative helps the state economy, protects natural resources, and builds capacity of our people and communities.

Water Quantity, Quality and Security

UC ANR's Water Quality, Quantity, and Security Strategic Initiative works on: 1) conservation and enhancement strategies to bolster water resources and meet increasing agricultural, urban, and ecosystem water demands; 2) sustainable farm, urban, and natural resource management practices to protect soil and water quality from salinity, sediment, pathogens, excess nutrients, trace elements, and other contaminant; 3) quantifying the impacts of climate change on California's precious water resources and consequent impacts on agriculture, urban, and ecosystems, while seeking ways to make these sectors more resilient to climate related risks. It focuses on the following bulleted key critical issue areas:

- Safe and secure drinking water
- Safe and secure surface water
- Safe and sustainable groundwater

- Holistic water management

This Strategic Initiative helps the state economy, protects natural resources, builds capacity of people and communities, and helps ensure safe food and drinking water.

Healthy Families and Communities

UC ANR’s Healthy Families and Communities Strategic Initiative focuses on the following program areas and grand challenges:

- Food literacy and healthy lifestyles to address chronic disease and food insecurity across the lifespan of all Californians
- Scientific literacy (youth and adult) to foster access to science education and professional learning opportunities
- Positive Youth Development programming to deliver of high-quality positive youth development in all communities
- Community development and public policy to address rising social, economic and health inequality

This Strategic Initiative helps build the state economy and the capacity and health of the people and communities.

III. During FFY 2019, UC ANR’s research and extension efforts continued to contribute to the seven broad public values and the respective 24 more discrete condition changes. In the Planned Program section below there are impact stories for each of these condition changes that include measured program outcomes.

UC ANR: Promoting economic prosperity in California

- Improved individual and household financial stability
- Enhanced community economic development
- Improved animal management, productivity and efficiency
- Increased agriculture and forestry efficiency and profitability
- Increased emerging food economies and markets

UC ANR: Safeguarding sufficient, safe, and healthy food for all Californians

- Improved food security
- Improved food safety

UC ANR: Promoting healthy people and communities

- Improved health for all
- Improved community health and wellness
- Improved access to positive built and natural environments

UC ANR: Protecting California's natural resources

- Improved management and use of land
- Improved air quality
- Protected and conserved soil quality
- Increased ecological sustainability of agriculture, landscapes, and forestry
- Improved water quality
- Improved water-use efficiency
- Improved water-supply security

UC ANR: Developing a qualified workforce for California

- Increased workforce retention and competency
- Increased effective public leaders
- Improved college readiness and access
- Increased civic engagement

UC ANR: Building climate-resilient communities and ecosystems

- Increased preparedness and resilience to extreme weather and climate change

UC ANR: Developing an inclusive and equitable society

- Improved living and working conditions for California's food system and farm workers
- Increased diversity, inclusiveness, and cultural competency in California's workplaces

Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your 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
1. The <u>Merit Review Process</u>	No significant updates for FFY 2019. Process described in the Plan of Work.
2. The <u>Scientific Peer Review Process</u>	No significant updates for FFY 2019. Process described in the Plan of Work.

II. Stakeholder Input

The NIFA reviewer will refer to your 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
<p>1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation</p>	<p>Below are FFY 2019 highlights of UC ANR efforts that address all four stakeholder input strategies.</p> <p>Cooperative Extension (CE) Position Call – UC ANR actively engages stakeholders in a thorough process to determine the highest priority CE academic positions to rebuild and strengthen the UC ANR network. The process includes consultation and discussions with internal stakeholders and strongly encourages engaging external stakeholders in the development of the position proposals. The proposals are considered by UC ANR Program Council in their deliberations to provide recommendations the Vice President, who makes the final decision.</p> <ul style="list-style-type: none"> • Due to the budget situation, the release of approved positions from the 2018 CE Position Call was put on hold until the fall of 2019. UC ANR embarked on a 2019 reconfirmation process in September 2019 given the opportunity to fill a limited number of CE positions. The 2018 list of CE proposals that had been developed in consultation with stakeholders was reviewed, and some newer high priority proposals were added to address current emergency gaps. Positions were approved in December 2019, FFY 2020. <p>UC ANR's Research and Extension Center (REC) system – In May 2019 a Blue Ribbon Panel kicked-off to review the REC system with its nine centers. The panel was comprised of leaders from University of Montana, University of Nebraska, University of Florida, the Gates Foundation, and UC Davis. Their charge was to identify key capital investments that could best position the REC system in addressing societal challenges of the future through mission-based research. They were asked to consider the attributes of each REC, research priorities for the future, and strategic investments to maintain a robust research portfolio at each REC. Their report with recommendations was submitted January 2020, FFY 2020.</p> <p>UC ANR’s Statewide Programs and Institutes – Each program/institute undergoes routine program planning and review that solicits and incorporates significant stakeholder input. These processes have committees with representatives of diverse stakeholder interests from across UC and external groups. In the strategic planning processes committee members also outreach to additional</p>

	<p>stakeholders to provide input on the strengths, weaknesses, opportunities, and threats, and later on the draft strategic plan. In the program review process those ad hoc committees solicit input from additional stakeholders through interviews and web-based surveys to assess past performance and the forward-thinking strategic plan.</p> <ul style="list-style-type: none"> • During FFY 2019, the UC Master Food Preserver developed a logic model and a strategic plan working with external stakeholders represented on the diverse committee as well as engaged through consultation; these included several food banks, county health agencies, and cottage industry. • The UC Sustainable Agriculture Research and Extension Program (SAREP) completed a programmatic review by a diverse committee of internal stakeholders as well as several external stakeholders from a community organization, the Regional Coordinator at Montana State University for Western SARE; the Policy Director from the Community Alliance With Family Famers; and the Director from Roots of Change. <p>UC ANR Governing Council – This new advisory group was created in 2019 to support UC Presidential oversight and promote greater understanding of and participation in UC ANR's mission across the University. The 15 member council includes high-level internal and external stakeholders, including the Secretary of the California Department of Food and Agriculture. They meet quarterly to provide recommendations to the UC ANR Vice President, UC President, and Executive Budget Committee on UC ANR’s budget and funding models, and scope, policies, and procedures.</p>
<p>2. Methods to identify individuals and groups and brief explanation.</p>	<p>Addressed above.</p>
<p>3. Methods for collecting stakeholder input and brief explanation.</p>	<p>Addressed above.</p>
<p>4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.</p>	<p>Addressed above.</p>

III. Planned Program Table of Contents

No.	Program Name in order of appearance
1.	Healthy Families and Communities (HFC)
2.	Water Quality, Quantity, and Security (Water)
3.	Endemic and Invasive Pests and Diseases (EIPD)
4.	Sustainable Natural Resources (SNE)
5.	Sustainable Food Systems (SFS)

V. Planned Program Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). See Section V of the Guidance for information on what to include in the qualitative outcomes or impact statements. Add additional rows to convey additional accomplishments. You may expand each row as needed.

Note: In parenthesis we have included the names of the AES faculty, CE Specialists, and CE Advisors for whom we are reporting their measured outcomes, in case NIFA would like additional information for any communications using these examples.

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name/No.
1.	<p>UC ANR contributed to improved individual and household financial stability.</p>	<p>Issue California’s vibrant, diverse economy is the fifth largest in the world. To maintain its competitive edge, California must overcome technical, social, and environmental challenges. Consumer spending contributes a majority of overall economic growth. While California continued to experience historic, low unemployment rates in 2019, other issues related to financial stability continue to rise such as lack of housing, inflation, and cost of living.</p> <p>Methods 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 (CFHL, UC; EFNEP). Curricula such as Making Every Dollar Count; Eating Smart Being Active; and Plan, Shop, Save, and Cook 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 (Marisa Neelon, Deepa Srivastava, Mary Blackburn, and Anna Martin).</p> <p>As a result of UC ANR research and education, participants learned and adopted financial management practices. Outcomes with specific indicators follow.</p>	HFC

	<p>Outcomes</p> <p>Participants learned about financial management practices.</p> <ul style="list-style-type: none"> ● Over 700 CFHL, UC participants statewide responded to a survey about their experience with the Making Every Dollar Count curriculum and reported improvements in the following areas: knowing ways to save money on food (86%), knowing simple healthy meals to make (82%), and understanding food ads (83%). (CFHL, UC) <ul style="list-style-type: none"> ○ CFHL, UC participants over 60 years old in Alameda County made the following improvements: 98% knowing easy ways to save money on food, 86% knowing simple healthy meals to make, and 92% understanding food ads, as reported by 66 participants in retrospective surveys. (Mary Blackburn) ○ CFHL, UC participants in San Joaquin County were evaluated using a retrospective-pre survey with Making Every Dollar Count participants reporting improvement (80% of 129) in the food resource management skills emphasized in the lessons, e.g., easy ways to save money on food, using resources to make money go further, knowing more about simple, healthy meals to make at home. (Anna Martin) <p>Participants adopted financial management practices.</p> <ul style="list-style-type: none"> ● Over 4,000 EFNEP participants statewide responded to a survey about their educational program experiences and 83% of participants showed improvement in one or more food resource management practices. (EFNEP) <ul style="list-style-type: none"> ○ In Alameda and Contra Costa Counties, 363 of 454 EFNEP participants who are parents and caretakers responded to a pre-post survey about their participation in the Eating Smart Being Active program and 80% reported improved food resource management (comparing food prices, planning meals before shopping, checking for foods on hand, making a shopping list). (Marisa Neelon) <p>Change in condition: Participants saved money.</p> <ul style="list-style-type: none"> ● Program evaluation findings from 2019 indicate that EFNEP adult graduates reported an average monthly food cost savings of \$65.90, which collectively saved California EFNEP families \$2,930,704. (EFNEP) <ul style="list-style-type: none"> ○ Of the 187 EFNEP graduates in Tulare and Kings Counties, results from 83 participants indicated \$70.70 in average monthly cost savings, suggesting that making informed food decisions can help families improve nutrition and food resource management behaviors essential to maximizing use of limited resources, supporting a healthy diet, and improving food security. (Deepa Srivastava) <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 (Dollahite, 2014; Koszewski, 2011; Swindle, 2007). In this way, UC ANR contributes to the public value of promoting economic prosperity in California.</p>	
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<p>2.</p>	<p>UC ANR contributed to enhanced community economic development.</p>	<p>Issue California needs community economic development approaches to foster economic resilience and vigor of its working landscapes. 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>Methods UC ANR’s efforts focus on California’s agriculture, ranching, and forestry sectors to identify opportunities for economic development through innovation and entrepreneurship, while also fostering environmental and social sustainability.</p> <p>California’s Sierra Foothills are home to a diversity of small farms and ranches, most less than twenty acres, with a wide variety of crops and livestock. The diversity of local agriculture, a strong agricultural community, and a flourishing direct market economy belie the uncertain future of local agriculture. UC Cooperative Extension (UCCE) on-farm workshops were conducted focusing on building producers’ skills in economic and market analysis, risk management, and business management (Cindy Fake). Another UCCE effort in the Sierra Foothills worked with new and experienced ranching businesses and targeted grazing businesses. Small group workshops were conducted for existing businesses, larger workshops for new and aspiring businesses, and one-on-one and peer-to-peer consultations for all businesses (Dan Macon).</p> <p>UCCE scientists also identified opportunities to reduce costs on ranchers. They developed and shared the results of a cost and return study. Presentations to ranchers, agency staff, and academics on California’s Central Coast reached 82 people, extending business planning and on-the-ground practices to improve ranchers’ bottom line (Devii Rao, Donald Stewart, and Dan Sumner).</p> <p>A UCCE effort in the San Francisco Bay Area region fosters competitive and sustainable food systems. A small and urban beginning farmer learning hub was developed, as well as a report on small-scale urban and peri-urban agriculture for Santa Clara County. Eight workshops reached 242 farmers, with presentations and hands-on demonstrations on various production and business management topics, including new enterprises such as microgreens, small scale poultry, and agritourism (Aparna Gazula and Lucy Diekmann).</p> <p>Lastly, UCCE scientists also identified innovative opportunities to expand markets in forestry. A UCCE Specialist located the UC Berkeley campus is using techno-economic analysis, optimization, and lifecycle assessment to understand how emerging forest product technologies could drive carbon-beneficial forest management. Work includes providing</p>	<p>SFS, SNE, HFC</p>
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	<p>research based information to entrepreneurs and to the California state government’s Joint Institute for Wood Products Innovation (Daniel Sanchez).</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>Outcomes</p> <p>Participants planned to utilize innovation and entrepreneurial strategies.</p> <ul style="list-style-type: none"> • Of those who attended the Central Coast Rangeland Coalition’s cost study meeting, 41 completed the evaluation. Through the survey, 96% reported the meeting helped them to increase their knowledge of rangeland management, and 76% reported they learned something new that they will apply in their work or future decision-making regarding rangeland sustainability: economic, environmental, and social. (Devii Rao, Donald Stewart, Dan Sumner) <p>Participants implemented innovation and entrepreneurial strategies.</p> <ul style="list-style-type: none"> • 58 producers in the Sierra Foothills assessed their resources and decided whether to start a new farm or enterprise. (Cindy Fake) • Two ranching operations utilized planning tools to analyze and ultimately adopt enterprise expansion plans. These businesses each created an additional full-time job within the community. (Dan Macon) • After the workshop on microgreens as a new enterprise for urban farmers, 63% of the ten workshop attendees increased their knowledge of the business of growing microgreens, and 60% indicated that they would grow microgreens. One attendee indicated that they would grow microgreens as a new part of their business after the workshop. (Aparna Gazula and Lucy Diekmann) • The Joint Institute for Wood Products Innovation used the review of wood products to help prioritize applied research and collaborative action around mass timber and low-carbon fuels, including a partnership with Oregon's Tallwood Design Institute. The Air Resources Board and Governor's Office of Business and Economic Development staff increased low-carbon fuels production from forest biomass to meet climate, resource, and economic development goals in the state. (Daniel Sanchez) <p>These aforementioned measured outcomes demonstrate changes that work to improve the economic, as well as environmental and social, sustainability of California’s working landscapes. In this way, UC ANR contributes to the public value of promoting economic prosperity in California. The latest data available from the California Department of Food and Agriculture (2017) indicates the number of farms operated in California is slightly more than the previous</p>	
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		<p>year, and total livestock and livestock products cash receipts were up nearly 7% from 2016. Over the past decade timber harvesting rates have increased somewhat, according to a 2018 Legislative Analyst’s Office report.</p>	
<p>3.</p>	<p>UC ANR contributed to improved animal management, productivity and efficiency.</p>	<p>Issue California ranks fourth in the nation in total livestock receipts, with over \$11 billion (2017). It remains the largest dairy-producing state, providing over 18% of the nation’s milk supply (2017), and dairy is the state’s top producing commodity. Ranchers and dairy producers face many management and production challenges, like drought, water and air quality regulations, and invasive species, as they strive to maintain their competitive edge. Forage crops linked to the livestock industry is an important economic driver in California’s food-producing system. Although livestock are a high value commodity, at the ranch level it can be difficult to be profitable. In fact, ranchers or their family members often need to work off the ranch in order to make ends meet and keep the ranch running. At the same time, there is the need to improve the ecological viability of these animal production systems.</p> <p>Methods UC ANR partners with public, non-profit, and private groups to create and extend new knowledge about animal systems management for dairies and livestock operations.</p> <p>As part of the UC Agricultural Experiment Station, one researcher located at UC Davis is working on a multistate effort focused on animal behavior and welfare. To be sustainable in the long term, food systems must continue to meet the various criteria of social acceptability, nowhere more apparent and pressing than in the world of livestock production. This applied research on pain perception in dairy calves in response to horn disbudding has changed industry perceptions of the practice. Together with research into current husbandry methods, the research team is leading the development of new approaches for measuring animal welfare that will guide animal production systems towards even higher welfare standards in future. The important findings from this research are being delivered to stakeholder audiences from peer scientists, to industry groups, and welfare auditors (Cassandra Tucker).</p> <p>A couple dairy production projects led by a UC Cooperative Extension (UCCE) academic in the Central Valley addressed milk quality and labor skills, challenges which dairy farms always face. Two milking schools on two dairies in Fresno County were held, working with a veterinarian, to provide hands-on experience with procedures and protocols to milk cows and identify diseases. In addition, the UCCE academic helped resolve an increase in mastitis cases on a dairy. The outbreak investigation identified the source of the problem and developed recommended responses (Daniela Bruno).</p> <p>One study focused on identifying dairy calf management strategies to reduce bovine respiratory disease (BRD) on organic and conventional dairies. This multi-year study involving ten scientists and graduate students identified the prevalence of BRD in Humboldt and Del Norte Counties to be nearly 11%, and that calves in group pens had a higher BRD prevalence (Jeffrey Stackhouse).</p>	<p>SFS, SNE</p>

	<p>Another UCCE collaboration conducted a dairy manure pathogen risk assessment, which is particularly crucial for organic fields that are fertilized almost exclusively by bovine waste. The findings determined that current manure compost strategies are sufficient to limit pathogens and successfully mitigate risk on some but not all dairies. These results do not preclude any dairies from utilizing manure, but suggest care be taken to mitigate risks. Individual dairy-level results were sent to dairy managers, and the data were presented for the scientific community in Letters of Applied Microbiology (Jeffrey Stackhouse and Pramod Pandey).</p> <p>Another UCCE dairy project focused on evaluating the impact of two recent regulatory changes: the amended Veterinary Feed Directive and the California Senate Bill (SB) 27, which jointly increased veterinary oversight and involvement in the distribution and use of medically important antimicrobial drugs for livestock. Ten dairies enrolled for the surveillance study. The findings were disseminated to the dairies involved in the study and through two extension meetings (Emmanuel Okello).</p> <p>A UCCE Livestock Waste Specialist worked with Watershed and Dairy Advisors and the USDA Natural Resources Conservation Service Agronomists to provide science-based information during modifications to the regulatory requirements for the North Coast (Regional Water Quality Control Board 1) and stepwise implementation of the San Francisco Bay Board (Regional Water Quality Control Board 2). In particular, intensive input was provided to Region Board 1 during their Waste Discharge Requirements adoption process. In addition, the UCCE Specialist developed an improved solid manure sampling protocol based on research, and disseminated the information through workshops for dairy professionals in California (Deanne Meyer).</p> <p>UCCE has been an integral partner during the more than 20 years of the California Dairy Quality Assurance Program. Workshops inform dairy producers about management practices to improve environmental stewardship, in particular to reduce their impact on water resources, primarily groundwater resources. Through the partnership, agencies, industry, and academia meet quarterly to address and identify ways to work through air and water concerns. The goals of the program are to achieve environmental compliance through education by providing sufficient information for producers to do their actual work, when allowable (Deanne Meyer).</p> <p>Two UCCE academics conducting livestock management research evaluated ranch-level mineral programs and determined the status of manganese in beef-cattle operations by taking blood samples from four herds in Humboldt County. Individual level ranch results were provided to the ranches, and the findings were published for the scientific community in the Translational Animal Science journal (Jeffrey Stackhouse and Josh Davy).</p> <p>A collaborative livestock and natural resources program conducted outreach and education on a livestock protection tool: five producer-focused field days with 129 ranchers and two agency-focused field days with 46 agency and NGO staff. The agencies involved included California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, USDA</p>	
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		<p>Participants adopted practices for more productive and sustainable animal management.</p> <ul style="list-style-type: none"> • Recommended practices were implemented in response to the mastitis outbreak on a farm in the Central Valley. As a result, the levels of mastitis decreased to normal levels similar to before the outbreak and milk quality remained high. Since the issue was addressed in a timely manner there was no negative economic impact. (Daniela Bruno) • As a result of the study on bovine respiratory disease prevalence in Humboldt and Del Norte counties, local dairymen have created additional single-housing units for calves, and clientele are discussing changing bedding types. (Jeffrey Stackhouse) • Manganese results from the blood samples were shared with ranches, and two ranches made immediate changes to their mineral programs as a result. (Jeffrey Stackhouse and Josh Davy) • Knowledge of existing manure composting practices and understanding the pathogen risks associated with manure application to cropland has been applied to decision-making. Two high-risk dairies in the study immediately changed their compost strategies, and at least five dairies have transitioned from liquid manure to compost piles during the winter months to reduce the risk of surface water contamination. (Jeffrey Stackhouse) • 93% of participants in the Western Alfalfa Symposium reported that that the information they gathered at this meeting positively impacted their farming or business operations and improved profitability. After a symposium workshop in 2015 and again in 2019, which presented innovative irrigation methods, farmers modified their systems to become more efficient. Several farmers using center pivots in Intermountain California started using Low Elevation Low Pressure systems and Mobile Drip Irrigation on Center Pivots. Other participants implemented sub-surface drip irrigation techniques on their farms. The adaptation of improved technology and monitoring of irrigation has the potential to save 20% of the water used for California’s second most water-using crop. This reduces use of water resources, as well as impacts on-farm yields and profitability. (Dan Putnam) • Three farms adopted aquaculture technology and improved welfare of thousands of finfish. These technologies applied to the handling and slaughter of fish continue to be adopted as more aquaculture farms understand the value. (Jackson Gross) <p>Science-based information applied to animal production systems policy and decision-making.</p> <ul style="list-style-type: none"> • Results from the dairy surveillance study were included in the 2019 report to the state legislature: the Antimicrobial Use and Stewardship Program report by the California Department of Food and Agriculture. (Emmanuel Okello) • Research-based information was incorporated into the non-profit Central Valley Dairy Representative Monitoring Program's recommendations. The implementation of the improved protocol and the greater 	
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		<p>accuracy in measuring nutrient uptake by harvested plants will improve nitrogen management and reduce nitrate impacts to groundwater. (Deanne Meyer)</p> <ul style="list-style-type: none"> The trust developed through the California Dairy Quality Assurance Program was instrumental in creating an effective collaboration with Regional Water Quality Control Boards when new regulations were adopted and producers were required to change. <p>The novel approach for nutrient budget calculations was adopted for nutrient management in Region 2 dairies and will be used in the year ahead for Region 1 dairies. (Deanne Meyer)</p> <p>Change in condition</p> <ul style="list-style-type: none"> Improved milk quality: After the trainings, two dairies improved their procedures for their milking routine. The milk quality on the dairies greatly improved, measured by decreases in total bacteria and coliform counts. There was also improvement in the identification of sick cows. (Daniela Bruno) Improved yield: Equipment manufacturers used the science-based information on the impacts of field traffic on alfalfa production to develop innovative machinery that saves one additional trip for each harvest. Research showed that field traffic in alfalfa forage results in 25-30% yield declines, depending upon the situation. Saving one trip greatly reduces the negative effects of equipment traffic on re-growth, and thus improves yield and sustainability. (Dan Putnam) <p>These measured outcomes demonstrate farm or 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 7% and the cash receipts for dairy products increased slightly over 8%, from 2016 to 2017. In addition, because of dairy producers doing a better job at managing manure, there is less impact to surface or ground waters. Thus, UC ANR contributes to the public value of promoting economic prosperity in California, as well as the ecological viability of the livestock industry.</p>	
<p>4.</p>	<p>UC ANR contributed to increased agriculture efficiency and profitability.</p>	<p>Issue</p> <p>California is a national leader in agricultural production, leading the country in cash receipts for agricultural products, with farms and ranches receiving over \$50 billion for their output. The state accounts for almost half of the country’s fruit and nut production, and over half of the 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 food production. Factors such as high input prices (e.g. labor, fertilizers, and pesticides) and regulations affect the profitability of farm and ranch businesses. These factors often more adversely affect small-scale farmers because they often lack the resources or skills that larger farmers have.</p>	<p>SFS</p>

	<p>Methods UC ANR creates and extends new knowledge about agricultural production from variety trials to post-harvest.</p> <p>A UC Agricultural Experiment Station researcher at the UC Riverside location is working on mechanisms that regulate tolerance to abiotic stresses in plants. Increasing food demand and shrinking land availability are likely to drive crop production globally to bring more marginal production areas under cultivation. In order to make production sustainable in such circumstances, information is needed on both the mechanisms of plant responses to stress and new varieties that are able to tolerate drought, salinity, water-logging, and other stresses. This project focused on understanding these stresses in the world’s most important staple crop, rice. This has the potential to improve the long-term prospects for stable food production by the world’s poorest farmers. In addition, this work provides education and training opportunities for young scientists from around the world, ensuring that the technology development happening in California today is embedded in the global science base for tomorrow (Julia Bailey-Serres).</p> <p>A UC Cooperative Extension (UCCE) post-harvest study focused on reducing the cracking of sweet cherries. This project developed close working relationships with six of the major sweet cherry packaging facilities in the state. The study found that by using commercially available techniques and surface drying prior to storage, the risk of introduced cracked cherries goes down from 35 lb. to 19 lb. per 100 lb. of packaged product (taking into account the yearly conditions of the study). In addition, it was observed that cherry cracking severity can be significantly reduced by adding Sucrose and CaCl₂ to the water, and by gradually reducing the initial temperature of the cherries to their final storage temperature (Irwin Donis-Gonzalez).</p> <p>A collaborative UCCE project focused on small farm risk. It is part of a public and private, multi-state and multi-agency collaboration that developed tools and implemented educational programs to help small farm clientele improve businesses and risk management skills. The collaboration included colleagues from University of Wyoming, Colorado State, and University of Nebraska, and was funded by the USDA Risk Management Agency and the Cdfa Specialist Crops Block grant program. UCCE contributed to the “Ag in Uncertain Times” online education program, provided in English and Spanish, with support from the Western Center for Risk Management Education. In addition, risk management tools and materials developed are available at the eRight Risk California website. This multi-state effort has given small farmers access to expertise, tools, resources, and educational opportunities on business and risk management previously not available (Ramiro Lobo).</p> <p>Another UCCE project focused on small farm sustainability continued work in the Sierra Foothills. Participatory workshops focused on agricultural efficiency through mulching to improve soils and pruning to improve yield and reduce pesticide use. Other workshops focused on building producers’ skills in business management. Peer-to-peer learning was used as a critical component of the training (Cindy Fake and Dan Macon). One effort supported by the</p>	
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	<p>CDFA Specialty Crop Block Grant focused on mandarin orchards, and close to 3,000 growers were provided science-based tools for citrus production (Cindy Fake).</p> <p>A UCCE project working with USDA Crop Protection Network (CPN) has the long-term goal to increase the use and adoption of virus-tested sweet potatoes by commercial growers, through Extension and improvements in facilities and procedures to increase the number of available plants. Plants produced within the CPN program reduce the potential for disease spread and generally improve yield and quality. This effort is in close collaboration with UC Davis Foundation Plant Services, which provides facilities, staff, and support. Meetings and other extension efforts were held in New Orleans, Sacramento, and Merced (Scott Stoddard).</p> <p>Another UCCE project focuses on sustainable agronomic crops production in the Sacramento-San Joaquin Delta, including corn, rice, dry beans, and winter cereal crops. Findings from variety trials and other research were extended through grower meetings. In particular UCCE is developing expertise and outreach in corn nitrogen management, a critical issue for California agriculture and reported through the Irrigated Lands Regulatory Program. (Michelle Leinfelder-Miles). Ongoing, collaborative yearly rice variety trials test the performance of preliminary and advanced rice varieties at eight locations across the rice growing area of California. Information on rice productivity was shared with clientele through newsletters, blog posts, the UC Rice-online website, five educational meetings, and additional clientele consultations (Luis Espino).</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>Outcomes</p> <p>Participants learned about farm business and risk management practices.</p> <ul style="list-style-type: none"> • Local growers in San Diego County increased understanding and ability to manage risks affecting their agricultural businesses, per exit evaluations at seminars and feedback from participants. (Ramiro Lobo) <p>Participants implemented farm business and risk management practices.</p> <ul style="list-style-type: none"> • From surveys over the last five years, farm business planning has significant impacts on small farm and ranch profitability in Placer and Nevada Counties. Over 86% of participating businesses reported being profitable and paying themselves a salary, as compared to the 26% in the 2017 Census of Agriculture. In 2019 the following specific outcomes were measured: <ul style="list-style-type: none"> ○ 68 producers developed and implemented action plans resulting from what they learned in the “Start a Farm” class, Beginning Farming Academy, and/or Farm Business Planning. 	
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		<p>estimated that there is the potential to reduce the incidence of cracked cherries from around 17,500 US TONS to around 9,500 US TONS statewide. (Irwin Donis-Gonzalez)</p> <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 thus, the public value of promoting economic prosperity in California. In 2017, California farms and ranches increased cash receipts for their output by almost 6% compared to the previous year, collecting over \$50 billion.</p>	
<p>5.</p>	<p>UC ANR contributed to increased agriculture efficiency and profitability.</p>	<p>Issue Pests, diseases, and invasive plants decrease California’s agriculture efficiency and profitability. In agricultural systems, pests reduce yields, render crops unmarketable, and weeds make rangeland unpalatable to livestock. Just one species can be detrimental to crop production and revenues. The invasion of spotted-wing drosophila, for example, caused conventional raspberry growers in California to lose \$36.4 million in revenue between 2009 and 2014, and was on track to reduce California raspberry yields by as much as 50%. . As the population increases, crop production must increase to meet the greater food demands. Science-based information is needed for land owners, managers, and policy makers to develop practices and policies that sustain economic vitality while protecting environmental quality.</p> <p>Methods UC ANR 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 Agriculture Experiment Station (AES) scientists study early detection of pests to help avoid expensive pest management and disruption in commerce. At the UC Davis AES location a rapid assay is being developed to detect the spinach downy mildew pathogen, which will guide management and production decisions (Krishna Subbarao). Research at the UC Riverside AES location includes developing the first antibody-based diagnosis of citrus greening disease using pathogen effectors as detection markers (Wenbo Ma); developing decision-support for sugar-beet nematodes to know when populations are large enough to trigger a pest management tactic (Ole Becker); and synthesizing and field-testing sex attractant pheromones of North American wireworm species (Jocelyn Millar).</p> <p>University of California Cooperative Extension (UCCE) research and extension includes practices to reduce the introduction or spread of invasive species. For example, to address the issue that weedy rice infestations were not being reported, the UCCE rice team continues a collection protocol they developed in 2018 requiring suspected plants to be sampled by UCCE Rice Advisors, to prevent the movement of weedy rice seed. (Whitney Brim-Deforest and Luis Espino). The California Citrus Clonal Protection Program (CCPP) performs research and extension on topics related to citrus pathology. It also provides a safe mechanism to test, and introduce citrus varieties from any citrus-growing area</p>	<p>EIPD</p>

	<p>of the world for research, variety improvement, or direct use by industry or citrus enthusiasts (Georgios Vidalakis). One project works with the Napa County Agricultural Commissioner to optimize the detection program for vine mealybug on 48,000 acres (Monica Cooper and Matthew Daugherty). Research was conducted on the effects of crop rotation for disease management on southern blight in Colusa County where the disease has increased in recent years and results were shared through reports and presentations (Amber Vinchesi).</p> <p>UCCE scientists also identify treatment practices and pest management strategies through research and extend them. One collaborative research project focused on assessing the factors leading to canker disease in table grape vines, in an effort to develop a disease management program and support the long-term productivity and profitability of vineyards grown in the Coachella Valley. The scientist demonstrated that the risk of infection is reduced when old stumps are removed and vines are sprayed with fungicides after pruning (Carmen Gisbert). Through a project in Kern County, Pest Control Advisors (PCAs) were able to participate in projects on using mating disruption to reduce navel orangeworm infestations (David Haviland). One scientist partnered with a professor of wildland soils at Humboldt State University to analyze the effectiveness of three organic herbicides, mowing and digging as organic control options for milk thistle (Jeffrey Stackhouse).</p> <p>UCCE researchers identify best practices for applying pesticides. For example, best management practices were identified for spraying pesticides to control for navel orangeworm in orchard crops. Researchers tested impacts of weather, spray volume and droplet size. Information was extended to growers and PCAs through in-person and online training, talks, and publications (Franz Niederholzer).</p> <p>UC ANR scientists work on a variety of strategies to help growers reduce yield losses. In response to injury and yield reductions after applications of Roundup to a variety of alfalfa called Roundup Ready alfalfa within the intermountain region, researchers investigated the reason for crop injury, and agronomic practices to reduce the risk of yield losses (Thomas Getts, Rob Wilson and Giuliano Galdi). Farm advisors are identifying processing tomato plants infected with Fusarium Race-3 and providing information about the availability of Fusarium Race-3 resistant varieties of tomatoes (Zheng Wang). Since 2015, the rice industry has been experiencing armyworm outbreaks. One program conducts research and an outreach campaign to educate growers about monitoring and managing armyworms, through a newsletter, popular articles, and blog posts (Luis Espino). A statewide team is investigating walnut blight management to understand the disease, breed blight resistant varieties, and test new treatments to manage the disease (Luke Milliron). In response to unacceptable levels of damage in tomatoes in 2018 from consperse stink bug, a scientist identified overwintering sites, evaluated pheromone-bated traps for early detection of this pest, and developed reliable control strategies (Thomas Turini). A plant pathology laboratory at the UC West Side Research and Extension Center rapidly diagnoses production issues such as sites infested with soil-borne pathogens and provide answers. For example, late blight in tomatoes was diagnosed in 2019, in Fresno county and an effective treatment was suggested (Thomas Turini). UCCE scientists also provide diagnostic services to rice growers to confirm herbicide resistance in rice</p>	
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		<p>mechanical treatment (\$350-\$1150/acre) on private ownerships to fire (\$5-\$22/acre) and herbicide (\$65-\$144/acre) treatments. (Jeffery Stackhouse)</p> <ul style="list-style-type: none"> Results from the southern blight project contributed to knowledge of the effects of rotational crops on southern blight in the soil. Grower cooperators with southern blight issues were observed applying science-based practices such as avoiding rotations with sunflower, vineseed, and beans, as these are susceptible southern blight hosts. (Amber Vinchesi) <p>Participants adopted strategies to maintain yields and reduce crop losses.</p> <ul style="list-style-type: none"> Results from the Roundup Ready Alfalfa trials generated information on the maximum crop height at time of Roundup application to reduce the risk of crop injury followed by frost. In conversations with extension participant growers, approximately 50% of them were able to utilize this information to prevent yield loss in the 2019 growing season. (Thomas Getts, Rob Wilson and Giuliano Galdi) More growers have selected Fusarium Race 3 resistant cultivars since 2018. The Processing Tomato Advisory Board data indicates that more Race 3 resistant tomato varieties are available on the market, constituting an increased planting acreage and harvest tonnage. (Zheng Wang) Clientele who had heavy walnut blight infestations in the past worked with the farm advisor and adopted a recommended management program to improve their strategy for the next season, which will reduce the negative economic impact of crop loss. (Luke Milliron) The late blight was treated using UCCE recommendations and did not become an issue. In the event that it would go untreated under the wet conditions of the past spring, it could have caused complete loss of that 155-acre field resulting in \$700,000 in losses and perhaps more in the event it were to spread to other fields. (Thomas Turini) <p>Change in condition: Money saved.</p> <ul style="list-style-type: none"> The mealybug detection program results in an annual cost savings of \$25,000 to the county, which can be redirected to other regional practices to benefit growers. (Monica Cooper, Matthew Daugherty) 100% of the rice growers who received UC weed science program recommendations through the herbicide screening process, adopted them. As a result they have reduced their herbicide input costs by 25%. (Kassim Al-Khatib) PCAs have witnessed growers driving slower and using larger spray volumes, a practice consistent with the outcomes derived from navel orangeworm spray research. Assuming that half the almond acres in Colusa, Sutter, and Yuba Counties were treated at 200 gallons per acre, the 0.5% reduction in crop loss would return value (gross) of just over one million dollars to growers. (Franz Niederholzer) The \$2,000/acre stink bug damage reported to late-season processing tomatoes in 2018 was not suffered in 2019. Early detection of high-risk sites and grower practice alterations played a role, along with climatic conditions in the success experienced in 2019. (Thomas Turini) 	
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<p>6.</p>	<p>UC ANR contributed to increased emerging food economies and markets.</p>	<p>Issue California is the nation’s largest agricultural producer and exporter. The state’s agricultural sector is vibrant and diverse, producing more than 400 commodities. For many of these specialty crops, California is often the nation’s major producer. Although California already has the most diverse agriculture in the nation, the search for new opportunities, as a response to on-going challenges, does not stop. The agricultural sector’s economic viability faces uncertainty at 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>Methods UC ANR develops new scientific knowledge and extended science-based information that help create new food products and market opportunities.</p> <p>A UC Agricultural Experiment Station researcher at the UC Berkeley location is developing alternative paradigms for global food and natural resource systems. The project focuses on how public policy can be designed to protect food and resource systems against fragility while striking a balance between public and private goods. These are big picture, high level concepts that have both local use in California and wider global application. The effort includes graduate student training, ensuring the next generation of resource economists will be well-grounded in the skills they will need to continue to meet the on-going challenge of achieving long-term sustainability for food systems (Gordon Rausser).</p> <p>Another AES scientist at UC Berkeley hosted three workshops on agrifood supply chains with 30 participants each. These were held at the Energy Biosciences Institute which houses cutting-edge efforts that create new technologies affecting supply chains around the globe. The workshops aim to improve decision-making by increasing understanding of how the supply chain operates and markets interact; in order to lead to more effective designs of supply chains,</p>	<p>SFS</p>

	<p>which increase the utilization of new knowledge and allow introduction of new innovative products to the state (David Zilberman).</p> <p>An AES scientist at the UC Davis location is studying ethical cacao-chocolate commodity chains, livelihoods, and agro-diversity. UC ANR has a long tradition of partnering with stakeholders in the grower community to investigate novel opportunities for establishing food systems based on new production practices. This research on the potential of a local fine chocolate market is a current example. While the research and outreach are focused on the embryonic California cacao/fine chocolate supply chain, the potential impact has application both to cacao supply chains elsewhere in the world, and also to other supply chains which seek to improve the ability of producers to capture an ethical share of the value in the consumed product (Ryan Galt).</p> <p>UC Cooperative Extension (UCCE) academics continue to work on coffee as a new crop for small scale farmers in Southern and Central California. Trends in production and consumption of coffee show an increasing demand for specialty, high value coffees. Research continues to evaluate techniques to optimize the production of coffee nursery plants and to evaluate coffee varieties under frost-free areas growing conditions in parts of California (Ramiro Lobo).</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>Outcomes</p> <p>Participants are trying out new market opportunities.</p> <ul style="list-style-type: none"> • Small-scale prospective coffee growers have learned it is possible for them to grow their own nursery plants which results in a significant reduction for startup costs. In addition, these limited resource farmers are trialing coffee on their farm using coffee plant starts provided by UCCE. (Ramiro Lobo) <p>Science-based information applied to food economy and market policy and decision-making.</p> <ul style="list-style-type: none"> • UC ANR research on supply chains informed the June 2018 World Bank conference which focused on the impact of new value chains and technology on agribusiness and farmers and their capacity to implement innovation, as well as the policy and institutional implications of transforming value chains and the agrifood system. (David Zilberman) <p>These measured outcomes helped create new market opportunities, which can expand revenue sources and thus strengthen local food systems and emerging food economies. For example, new commercial plantings of coffee have expanded up and down the California coast offering a promising new, high value crop alternative. In this way, UC ANR</p>	
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		<p>helps maintain the competitive edge of the California food system and the state’s role as a global leader in agriculture - - contributing to the public value of promoting economic prosperity in California.</p>	
<p>7.</p>	<p>UC ANR contributed to improved food safety.</p>	<p>Issue California is a national and global leader in food production and agricultural export. The state faces social, regulatory, economic, and environmental challenges that affect our agricultural and food systems, our communities, and our public health. The Center for Disease Control and Prevention estimates that 1 in 6 people get sick from foodborne diseases each year, including 128,000 hospitalizations.</p> <p>Methods UC ANR conducts research about and delivers educational programs promoting improvement in individual and household food management practices as well as farm and food system food safety.</p> <p>A UC ANR scientist located at the Kearney Agricultural Research and Extension Center conducted research that contributes to the safe commercial production of pistachios. A new strain of pistachio was evaluated and registered for use in California after finding the strain to be of high quality and safe from poisonous substances such as aflatoxins, which are produced by certain molds. Even though aflatoxin contamination occurs less frequently in pistachio and almond nuts compared to other crops, some nuts do become aflatoxin-contaminated in commercial orchards. Replacing or excluding strains of pistachios that produce aflatoxin can reduce contamination (Themis Michailides).</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 extension (UC 4-H; CFHL, UC; EFNEP; UC Master Food Preserver). One UCCE academic’s research on food safety practices and food behaviors of seniors living with multiple chronic diseases in ten counties, led to the development and piloting of the curriculum Make Food Safe for Seniors. In 2019 that curriculum was delivered to 80 seniors in three low-income housing sites (Mary Blackburn and Katherine Uhde). Local UC Master Food Preserver programs delivered evidence-based education about food preservation and food safety (Dayna Ravalin and Katherine Soule; Hawau Bojuwon; Dustin Blakey).</p> <p>UCCE scientists extended food safety research findings with agriculture clientele. Food safety outreach and technical assistance for 110 limited-resource small farmers in Santa Clara, San Benito, and Santa Cruz counties included six extension meetings and several one-on-one trainings that included presentations and hands-on demonstrations on Food Safety Modernization Act compliance and good agricultural practices (Aparna Gazula). In another project, two</p>	<p>HFC, SFS</p>

	<p>UCCE academics conducted a dairy manure pathogen risk assessment of applying untreated, solid bovine manure as a soil amendment to agricultural lands. Findings suggested that the presence of <i>E. coli</i> O157:H7 and <i>Salmonella</i> spp. in solid bovine manure may pose potential risks to public health, if untreated manure is applied as a biological soil amendment and accidentally consumed by the public. Additional findings showed that current manure compost strategies are sufficient to limit pathogens and successfully mitigate risk on some, but not all dairies (Jeffrey Stackhouse and Pramod Pandey).</p> <p>Several projects worked to inform farm food safety decision-making and policy. One UCCE academic conducted research to provide scientific evidence to support regulations that require a minimum wait time between the use of untreated manure (i.e., raw and aged manure) and crop harvest in order to reduce microbial contamination of produce. Research findings characterize and identify risk mitigation strategies to reduce the risk of microbial contamination. Several foodborne pathogens are commonly associated with human illness such as <i>E. Coli</i>, <i>Salmonella</i> and <i>Listeria</i> in fresh produce organically grown with animal-based soil amendments. The majority of the research is collaborative, involving the participation of various stakeholders, including farmers, organic industry members, educators, researchers, and governmental agencies (Alda Pires).</p> <p>Integrated crop-livestock growers diversify their production systems by including a rotation of livestock in crop fields (i.e. re-integrating animals back into cropland), which provides numerous benefits. However, potential food safety risks related to the interface of animals and crops are largely unknown. Furthermore, these systems face challenges, including potential food safety risks and compliance with the federal Food Safety Modernization Act Produce Safety Rule. Research is being conducted to apply epidemiological quantitative tools and microbiological methods to characterize these systems and identify mitigation strategies to reduce food safety risks, particularly for those farms that integrate animals and produce production (Alda Pires).</p> <p>A major update to U.S. food safety regulations occurred in 2011, impacting growers and food processors of all sizes. UCCE academics contributed significant effort to developing industry-specific targeted supplemental materials and delivering a recognized, standardized curriculum to aid in implementation (Erin DiCaprio and Linda Harris).</p> <p>The food industry must often validate processes that are used to control (reduce) pathogens. UCCE research efforts have provided the scientific basis for validation of various processes to control foodborne pathogens and verification activities to support food safety plans (Linda Harris).</p> <p>In 2019 UCCE wrapped up its collaboration with the Bishop Paiute Tribe’s Food Sovereignty Program. UCCE provided the program with university information and training around produce safety with the goal of establishing a community safety resource person (Dustin Blakey).</p>	
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	<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>Outcomes</p> <p>Participants learned about home food safety practices.</p> <ul style="list-style-type: none"> ● Over 500 4-H youth statewide responded to the Healthy Living common measures survey and 78% of youth report knowing how to keep a cooking area clean in order to stop the spreading of germs, as a result of what they may have learned at 4-H. (UC 4-H) ● EFNEP surveyed over 4,200 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) ● Make Food Safe for Seniors participants reporting large increases between pre- and post-programs in knowing sources of harmful bacteria, recommended washing practices, and refrigeration practices. Notably, 71% knew raw food should be stored below ready-to-eat foods in the refrigerator, which increased from 14% at the start. (Mary Blackburn and Katherine Uhde) ● Local outcomes from UC Master Food Preserver programs: <ul style="list-style-type: none"> ○ In Santa Barbara and San Luis Obispo Counties, 98.8% of 623 professionals, volunteers, and teen leaders reported in retrospective surveys increased knowledge of food safety as a result of participating in the program’s evidence-based educational workshops about safe food handling practices. Additionally, 68 workshop participants assessed through paired pre- and post-assessments demonstrated a statistically significant increase in gained knowledge. (Dayna Ravalin and Katherine Soule) ○ Program participants in a Kern County Garden Club increased knowledge of food preservation tips, food safety practices, benefits, and recipes to try at home while learning about preserving lemons and repurposing canned goods. Intent to adopt dehydrating practices were observed as participants asked about where to obtain dehydrating equipment. (Hawau Bojuwon) <p>Participants adopted home food safety practices.</p> <ul style="list-style-type: none"> ● EFNEP surveyed over 3,600 participants and 86% 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) <p>Science-based information applied to individual and household food safety decision-making.</p> <ul style="list-style-type: none"> ● Research conducted by one UCCE academic found that both the online and in-person food safety extension of the Make it Safe, Keep it Safe program resulted in positive and statistically significant change among clientele. 	
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		<p>practices, even though this was not strictly required by the Food Safety Modernization Act for their operations. (Dustin Blakey)</p> <p>These measured outcomes demonstrate improved knowledge and skills around individual and household and farm food safety practices that can lead to a decrease in foodborne illness. In this way, UC ANR contributes to the public value of safeguarding sufficient, safe, and healthy food for all Californians. For example, between the years that the UC Master Food Preserver food safety project started in San Luis Obispo county and the most recent data collected by the San Luis Obispo County Public Health Department, there was a 30% reduction in reported cases of foodborne illness in the county, toward which UCCE may have been a contributor.</p>	
<p>8.</p>	<p>UC ANR contributed to improved food security.</p>	<p>Issue One out of every eight Californians does not know where their next meal will come from. Of the 4.6 million Californians facing food insecurity, 1.7 million are children. Food insecurity for youth increases school absences and behavioral problems, and reduces children's concentration and academic achievement. There is a need to increase participation in the CalFresh Food program (formerly Food Stamps), and to connect those who are not eligible to programs such as Women, Infants, and Children (WIC), summer meals, and the charitable food network. This has been even more critical during 2019 as confusion over eligibility based on immigration status has precipitated distrust and declining enrollment rates across many food assistance programs.</p> <p>Methods UC ANR conducts research to create practical solutions and delivers educational programs promoting improvement in individual and household food budget practices.</p> <p>A research group at the UC Davis Agricultural Experiment Station location has compiled a database of supermarket interventions in food deserts. Once made publicly available, this database will help explore the value of fresh food subsidies at the point-of-purchase on the nutrition, health, and wellness of groups vulnerable to malnutrition (e.g., children, elderly, low-income, immigrant, ethnic minorities). In addition, the effort studies the effectiveness of food access polices. Upon evaluation of 71 interventions, the research team found that food access policies require community engagement and cooperative management to be effective. This has the potential to improve food access polices (Catherine Brinkley).</p> <p>Putting research into practice, UC ANR 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, to deliver direct education related to food security to participants across California (UC ANR Statewide Programs listed above).</p>	<p>HFC, SFS</p>

		<p>For example, CFHL, UC in Riverside County helped start a new community garden at an African American church and helped maintain the community garden at a non-profit community organization in the low-income community of Eastside Riverside. In addition, the program partnered with Coachella Valley Unified Child Nutrition Services to implement breakfast on the playground in 10 elementary schools. CFHL, UC educators worked with UC ANR News and Outreach in Spanish to create YouTube videos to promote school breakfast participation (Chutima Ganthavorn).</p> <p>In San Luis Obispo County, the UC Master Food Preserver Program, in partnership with local food banks, provides education on proper freezing and dehydrating techniques to low-income residents who receive large quantities of seasonal produce at food distribution sites. A successful expansion of this program included conducting a train-the-trainer for six Spanish speaking peer educators and bilingual nutrition educators, who led similar education at additional food bank sites in the county. Over 1,800 low-income residents, the majority of whom were Spanish-speaking learned low-cost, safe home food preservation techniques. The program provided reinforcement items to support home implementation of the practices (for example, providing ice cube trays so participants can freeze citrus juice). In addition, UCCE addressed the underutilization of food assistance programs in the county by working with community partners to promote and enhance farmers markets to accept EBT/CalFresh and Market Match benefits (Katherine Soule).</p> <p>UC Cooperative Extension (UCCE) academics were evaluation collaborators on a project funded by the Centers for Disease Control and Prevention (CDC) called the Mandela Health and Wealth Net. This project seeks to increase access to affordable fresh fruits and vegetables and improve economic resilience in low-income communities in Alameda County by establishing a food hub, which consists of a network of locally-owned food retailers, farms, and distributors. Currently there are 18 distribution sites, 17 of which have added EBT card readers (Gail Woodward-Lopez and Janice Kao).</p> <p>UCCE co-chaired a food security symposium that brought together 98 individuals representing more than 85 direct service organizations (nonprofits, education, health care) serving southeast Los Angeles. The symposium aimed to define and examine the scope of food security, provide an overview of food assistance resources, increase understanding of current policies impacting food security, and create opportunities for collaboration among organizations (Natalie Price).</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>	
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	<p>Outcomes</p> <p>Participants learned about food resource management practices.</p> <ul style="list-style-type: none"> As a result of the Master Food Preserver Program in San Luis Obispo, over 98% of 117 food bank recipient participants reported that the lessons provided would help them increase their food resources. (Dayna Ravalin & Katherine Soule) <p>Participants improved food resource management practices.</p> <ul style="list-style-type: none"> EFNEP participants statewide responded to surveys about their participation in a nutrition education program and 47% of over 3,600 EFNEP participants showed improvement in one or more food security indicators (i.e., not eating less than you wanted so there was more food for your family or having enough money to get food for your family). (Expanded Food and Nutrition Education Program) Almost 1000 CFHL, UC participants statewide responded to a survey about their experiences with the Plan, Shop, Cook and Save curriculum and reported adopting food resource management behavior changes such as planning meals more often (49%), shopping with a list more often (53%), and comparing unit prices more often (51%). Overall, 88% of adult participants reported improvement in at least one food resource management behavior, and the participants reported statistically significant improvement in food security as measured by not running out of food before the end of the month. (CalFresh Healthy Living, UC) <p>Participants adopted gardening practices that contribute to increased access to fresh produce.</p> <ul style="list-style-type: none"> 51% of 812 members of the public who participated in UC Master Gardener volunteer-led public education events reported, through the statewide follow-up survey, that they applied gardening practices that reduced food loss. Additionally, 12% donated produce to community programs that distribute food to individuals in need of food assistance. (UC Master Gardener Program) <p>Science-based information applied to food security policy and decision-making.</p> <ul style="list-style-type: none"> 86% of the 98 survey respondents reported they increased their understanding of policies affecting food insecure individuals and food assistance programs as a result of the food security symposium in Los Angeles. In addition, bringing together 85 different organizations, building a common agenda, and creating the infrastructure for continued communication, laid the groundwork for a collective impact model. Research shows that applying such a model can achieve greater results than individual action alone, particularly when addressing complex social problems such as food security. (Natalie Price) 	
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		<p>Change in condition: Increased community access to healthy food, including fresh produce.</p> <ul style="list-style-type: none"> • Community outcomes from the Mandela Health and Wealth Net, evaluated by UC Cooperative Extension academics include: (Gail Woodward-Lopez and Janice Kao) <ul style="list-style-type: none"> ○ Residents increased pounds per transaction by 122% at corner stores and 250% at produce stands. Stores and stands increased the average number of pounds of fruit and vegetable sold in a month by 140%. ○ Of those surveyed, 41% of store customers and 55% of stand customers indicated having increased the amount of fruits and vegetables purchased as a result of shopping at MHWN partner sites. ○ On average, a shopper purchasing fruits and vegetables, purchased 2.63 servings of fruit and veg in each transaction, which equates to 26 servings per month, and over a quarter of the recommended weekly servings for fruit, dark green and “other vegetable” vegetable sub-groups • CFHL, UC participants in Riverside County benefited from collaborative projects working with community partners: <ul style="list-style-type: none"> ○ Community gardens in the low-income community of Eastside Riverside produced a small harvest for the participating families and provided a setting for learning about growing your own food. ○ The School Breakfast Campaign raised student participation in the free/reduced school breakfast program from 29% to 50% at the two elementary schools that participated in the video production. (Chutima Ganthavorn) • UCCE San Luis Obispo County efforts to increase food security resulted in: <ul style="list-style-type: none"> ○ Comparing the months of January through September, participating farmers' markets saw a 30% increase in new EBT/CalFresh customers from 2018 to 2019. This is particularly impressive considering the increase in customers from 2017 to 2018 was only 4%. ○ The overall dollar amount redemption of CalFresh benefits and Market Match also increased by 17% and 14% respectively. (Shannon Klisch & Katherine Soule) <p>These measured outcomes demonstrated learning and behaviors changes related to food resource management and informed decision-making that can lead to food policy changes at the local and state levels. According to the USDA Economic Research Service, the estimated percentage of food-insecure California households in 2016-2018 was 10.6%, which decreased by 2% from 2013-2015 estimates. UC ANR’s efforts contribute to the public value of safeguarding sufficient, safe, and healthy food for all Californians.</p>	
<p>9.</p>	<p>UC ANR contributed to improved health for all.</p>	<p>Issue California’s rapid population growth increases pressure on community resources, presenting numerous challenges to health and safety. Adult and childhood obesity is a public health crisis for the state and nation, resulting in a range of negative health consequences. Nearly 30% of California’s youth in grades 9-12 and over 60% of California’s adults are</p>	<p>HFC</p>

	<p>overweight or obese, according to the Center for Disease Control and Prevention. Childhood obesity is estimated to cost the nation \$14 billion per year.</p> <p>Methods UC ANR produces new knowledge, tools, programs, and policy-relevant research that result in healthy living for individuals.</p> <p>UC Agricultural Experiment Station (AES) scientists at the UC Davis location are investigating how adolescent brains respond to low quality food, how family characteristics like socioeconomic status affect this response, and how diet and family dynamics affect brain development and the risk of depression. Understanding these three connections can provide beneficial evidence that healthy family relationships and diets extend beyond physical health (Johnna Swartz). An AES scientist at the UC Berkeley location conducts research to understand the etiology of obesity-related disorders and has made several key discoveries about mammalian fatty acid transport and metabolism pathways. This work may contribute to new treatments for important obesity-related conditions such as liver cancer (Andreas Stahl). Other AES scientists at the UC Davis location are applying modern imaging technology and mathematical modeling to understand the eating quality and digestibility of produce following its handling under different supply chain conditions. This work will specify supply chain operating parameters that will improve the eating quality of produce (Gail Bornhorst). Another UC-Davis based AES scientists' novel work on enzymatic treatments of dairy and nut milks have been able to retain oligosaccharides that act as growth substrates for friendly gut bacteria from dairy milk while removing unwanted sugars, opening the way to low-cost, environmentally friendly processing approaches for the nutritional enhancement of dairy milk (Juliana Leite Nobrega de Moura Bell).</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 24,000 4-H youth (UC 4-H). 4-H in Mendocino County partnered with Ukiah Parks and Recreation and local organizations to deliver the Ukiah Kids Triathlon, and the Lake County Cooking Academy taught youth about making healthy food choices (Car Mun Kok). 4-H academics conducted a national pilot of Mindful Me, a curriculum designed to support primary youths' socio-emotional wellness through learning and implementing mindfulness practices (Anne Iaccopucci, Kendra Lewis, and Katherine Soule).</p> <p>UCCE academics provided oversight, leadership, and guidance for the statewide implementation of the CalFresh Healthy Living, UC (CFHL, UC) program in 32 counties. CFHL, UC delivered nutrition education programs such as EatFit; Eat Smart, Live Strong; and Hunger Attacks, to over 97,000 youth and adults and implemented over 2,000 healthy food tastings with over 53,000 students. CFHL, UC policy, systems, and environmental interventions such as Coordinated Approach To Child Health Early Care Education (CATCH ECE) and Shaping Healthy Choices Program were conducted to</p>	
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	<p>prevent overweight and obesity (CFHL, UC). UCCE academics piloted a new CFHL, UC program with local community partners in Kings County that coupled nutrition education with exercise. The 10-month pilot addressed obesity by providing collaborative activities like weekly spotlight nutrition education, Bailoterapia dance exercise lessons to parents of young children, sustainability plans, free health screenings, and childcare while parents attended dance classes (Deepa Srivastava, Vikram Koundinya, Angie Keihner, Michele Nicole Byrnes, Barbara MKNelly). Local programs utilized statewide evaluation tools to measure participant outcomes (Hawau Bojuwon; Deepa Srivastava; Anna Martin; Chutima Ganthavorn).</p> <p>UCCE academics provided oversight, leadership, and guidance for the statewide implementation of the Expanded Food and Nutrition Education Program (EFNEP) statewide programs, which delivered programs such as Eating Smart Being Active; Happy Health Me; and It’s My Choice...Eat Right! Be Active! to almost 41,000 youth and adults (EFNEP). Local programs utilized statewide evaluation tools to measure participant outcomes (Marisa Neelon; Deepa Srivastava; Chutima Ganthavorn; Anna Martin).</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 participants responded to a survey about any changes made as a result of attending (UC Master Gardener). One UCCE academic in Los Angeles County led an effort with Master Gardeners to deliver and evaluate the project, Promoting Alternatives to Citrus for Backyard and Community Gardeners in the Fight Against Asian Citrus Psyllid/Huanglongbing. Over 1,200 adults were reached by the Master Gardener volunteers and 112 completed a survey about what they learned (Rachel Surls).</p> <p>Nutrition Policy Institute provides evaluation technical assistance for all agencies implementing CalFresh Healthy Living (CFHL) interventions. Findings from 2019 statewide evaluation efforts are described below (Amanda Linares).</p> <p>As a result of UC ANR research and extension efforts, participants learned about and adopted healthier lifestyles. Outcomes with specific indicators follow.</p> <p>Outcomes</p> <p>Participants changed attitudes toward and gained knowledge about healthy eating practices.</p> <ul style="list-style-type: none"> ● 4-H teen teachers in Lake County reported increased knowledge in using kitchen equipment and increased awareness of the effects of consuming vegetables, water, and sugar-sweetened beverages, as a result of participating in the 4-H Cooking Academy after school program. (Car Mun Kok) ● 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 (66%). (CFHL, UC) 	
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		<ul style="list-style-type: none"> ○ As a result of the partnership and implementation of CATCH ECE, UCCE in Kern County was able to increase physical and social activity of 195 children ages 3-5. A total of 12 teacher extenders trained to implement CATCH curriculum adopted what they learned and contributed 83.75 hours to NFCS program. (Hawau Bojuwon and Beatriz Rojas) ○ Evaluation data collected from 153 students enrolled in the CFHL, UC Hunger Attack program in a Riverside County high school found about one-third of students made improvements in vegetable consumption (34%), sweetened beverage consumption (33%); and tracking how much they spend on food each week (37%). (Chutima Ganthavorn) ○ In Riverside County, evaluation data collected from 805 middle school students enrolled in the CFHL, UC EatFit program found students made at least one improvement in their eating behavior (95%), improvements in fast food & snack consumption (34%), improvements in beverage consumption (34%) after participating in the program. (Chutima Ganthavorn) ○ Riverside County CFHL, UC participants indicated improvement using MyPlate (70%), thinking about healthy choices when choosing food (41%), and using Nutrition Facts labels (46%), as reported in pre/post surveys by 110 participants who received nutrition education through the Plan, Shop, Save, Cook Series or through spotlight education. (Chutima Ganthavorn) ● EFNEP received survey responses from over 3,600 adult participants across the state about their participation in a nutrition education program and 95% of adult participants met all recommended practices in diet quality and 70% met all recommended practices in physical activity. (EFNEP) <ul style="list-style-type: none"> ○ EFNEP in Alameda and Contra Costa Counties conducted pre/post surveys with over 1,000 students as a sample of the 6,684 students reached through educational series, with 80% reporting improvement in choosing healthy foods and 26% drinking less sugar sweetened beverages. Teachers reported that they observed students increasing their fruit and vegetable selection and consumption at lunch; brought healthier snacks to school; and that students were sharing what they learned with their families. (Marisa Neelon) ○ Of the 187 EFNEP graduates in Tulare and Kings Counties, 95% showed improvements in one or more diet quality/nutrition practices, 87% showed improvements in food safety practices, and 51.8% indicated a positive change in physical activity behaviors. (Deepa Srivastava) ○ EFNEP adult participants in Riverside and San Bernardino Counties showed improvement in one or more diet quality indicators such as eating fruits and vegetables and consuming fewer beverages with added sugar (95% of 453). (Chutima Ganthavorn) ○ EFNEP evaluation outcomes in San Joaquin County of note include: 93% adult participants showed improvement in one or more diet quality indicators and 48% in one or more food security indicators. Additionally, 76% of adult participants improved food resource management practices. (Anna Martin) ● As a result of Nutrition Policy Institute’s evaluation technical assistance, the following statewide outcomes for all statewide implementing agencies were reported. The pre/post What Does Your Child Eat? tool was able to 	
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		<p>measure the following statistically significant participant outcomes from two different CFHL evaluation projects involving 103 children: increased frequency of consumption of fruit and vegetables, more than one kind of vegetable, and low fat, fat free, and alternative milk. Furthermore, the Youth Nutrition and Physical Activity tool identified statistically significant increases in combined fruit and vegetable consumption (0.34 times/day) and decreased frequency of sweets consumption (0.25 times/day) among the 2,932 youth in the CFHL intervention group over 42 youth in the comparison groups. (Amanda Linares)</p> <p>Participants adopted healthy lifestyle and decision-making practices.</p> <ul style="list-style-type: none"> ● Over 500 4-H youth statewide reported paying attention to how active they are each day (75%) and having a growth mindset related to health and being healthy (72%) in the the healthy living and positive youth development common measures survey about what they may have learned at 4-H. (UC 4-H) <ul style="list-style-type: none"> ○ Over 60 4-H youth increased their physical activity by participating in the Mendocino County Kids Triathlon, for which UCCE co-organizes every year. (Car Mun Kok) ○ Outcomes from 95 Mindful Me participants who completed the entire lesson were measured with paired pre and post paired assessments. Statistical analysis revealed that primary youth experienced significant increase in each of 13 components measured in the instrument, including identifying emotions, talking about their feelings, observing their surroundings, and promoting well-being. (Anne Iaccopucci, Kendra Lewis, Katherine Soule) ● The Kings County Bailoterapia pilot resulted in the following outcomes for participants. The majority (83% of 141) of participants not already practicing the promoted healthy eating or active living behavior indicated their intention to do so within the next week. Eight participants surveyed on behavioral outcomes reported a significant increase from pre to post in the frequency of making small changes to be more active as well as non-significant, but promising increases in meeting the physical activity guidelines and muscle strengthening, and number of days they exercised for 30+ minutes. Qualitative focus groups found that community partners attributed program success to organizational capacity, expertise, and funding; program monitoring and evaluation; free childcare and health screenings; and being sensitive to participants' cultural-social norms and values. (Deepa Srivastava, Vikram Koundinya, Angie Keihner, Michele Nicole Byrnes, Barbara MKNelly) <p>Participants adopted edible gardening practices and spent more time outdoors.</p> <ul style="list-style-type: none"> ● Participants of public education events led by UC Master Gardener volunteers responded to a statewide survey in 2019 and 612 participants reported starting or improving growing edible plant(s) (75%) and expanded varieties of edible plant(s) grown (62%). These behaviors are correlated with increasing consumption of fruits and vegetables. Respondents indicated that they applied knowledge gained on 772,673 square feet of food gardens as reported by 818 participants, potentially increasing their access to produce. Furthermore, 67% of 1,215 respondents spent more time gardening and outdoors, which is associated with improved individual emotional and physical health. (UC Master Gardener Program) 	
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		<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>10.</p>	<p>UC ANR contributed to improved community health and wellness.</p>	<p>Issue California’s rapid population growth increases pressure on community resources, presenting numerous challenges to health and safety. Adult and childhood obesity is a public health crisis for the state and nation, resulting in a range of negative health consequences. Nearly 30% of California’s youth in grades 9-12 and over 60% of California’s adults are overweight or obese, according to the Center for Disease Control and Prevention. Public health experts agree poor nutritional choices, lack of physical activity, school, community, and home environments, income level, and education are all factors in the obesity epidemic.</p> <p>Methods UC ANR produces new knowledge, tools, programs, and policy-relevant research that contribute to healthy communities.</p> <p>A UC Agricultural Experiment Station scientist at the UC Berkeley location is addressing the increased need for sustainable environmental practices by investigating the decision-making factors that determine the consumption of sustainable products. Some of the factors being explored include product characteristics (e.g., green, healthy), company performance (e.g., environmental, social, health), and consumer information feedback. Findings will identify frameworks and strategies to influence purchase behaviors in favor of sustainable choices (Dara O'Rourke).</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 (Deepa Srivastava; Anna Martin; Chutima Ganthavorn).</p> <p>UC ANR academics in the Nutrition Policy Institute 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 (Janice Kao; Lauren Au; Lorrene Ritchie; Christina Hecht).</p>	<p>HFC</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>Outcomes</p> <p>Partners adopted community-level changes that contribute to improved community health and wellness.</p> <ul style="list-style-type: none"> ● CFHL, UC reported statewide Policy, Systems, and Environment (PSE) changes at 397 SNAP-Ed sites, contributing to improved community health and wellness for more than 170,000 people. For example, over 223 program sites in 31 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, partner sites in 2019 conducted 78 cafeteria assessments to encourage the selection of healthy options in cafeterias. More than half of the schools reported increases from their first assessment due to adopting evidence-based, low-cost/-no-cost cafeteria makeover strategies. Finally, 30 CFHL, UC sites statewide adopted or expanded farm-to-table use of fresh or local produce. (CFHL, UC) <ul style="list-style-type: none"> ○ PSE interventions in Tulare and Kings Counties resulted in 41 nutrition changes, 15 physical activity changes, and three combined nutrition and physical activity changes combined at 37 partnering sites. Furthermore, as part of the PSE interventions, implementation of mechanisms to support sustainability of the changes also occurred. (Deepa Srivastava) ○ CFHL, UC in San Joaquin County implemented PSE change activities adopted by 60 sites. PSE changes focused on improving nutrition, physical activity, food security and food safety through implementation or improvements to garden programs, wellness policies, smarter lunchrooms, and structured physical activity opportunities. (Anna Martin) ○ Riverside County’s CFHL, UC Smarter Lunchrooms Movement measured pre/post scorecards collected from six schools and findings indicated improvement at all six schools, ranging from three to seven point improvements. Examples of improvements include addition of creative names, offering fruit taste test, displaying fruits in attractive bowls, and posting monthly menu in the main office. (Chutima Ganthavorn) <p>Science-based information applied to community health and wellness policy and decision-making at local, state, and national levels.</p> <ul style="list-style-type: none"> ● Evaluation findings of the campus vending policy, developed by UC ANR and colleagues, confirmed increased access to healthy foods for university students as now seven campuses have health/wellness policy or programs that cover vending machines. Furthermore, six campuses have added language into their vending contracts to include healthy items. These policy changes may improve the access and availability of healthy vending options increases purchasing, and likely consumption, by campus communities. (Janice Kao) 	
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		<ul style="list-style-type: none"> ● Findings from studies evaluating the implementation of the federal Healthy, Hunger-Free Kids Act suggest that policy provisions to align school meals with the Dietary Guidelines for Americans were feasible across a wide variety of schools and that schools successfully implemented reimbursable school meal nutrition standards, regardless of school poverty level. (Lauren Au) ● As a result of several collaborative research projects, a UCCE academic informed new improvements in policies and procedures related to the WIC program. Specifically, one longitudinal study will be the first to present findings to policymakers about the potential benefits of extending the age of WIC benefits until children are eligible for school meals. Other studies led to the addition of yogurt to WIC food packages and improvements to programs by showing that WIC nutrition education offered virtually (online) can be as impactful as more traditional in-person classes. (Lorrene Ritchie) ● The NPI study finding that demonstrated that young children on WIC have better diets than those that leave the program and that dietary benefits are derived from foods provided by the WIC program. This research informed Congress on the benefits of continuing to fund WIC. Specifically in California, research findings about differences in food preferences by different race/ethnicity groups supported the National Academies of Sciences, Engineering and Medicine recommendation for increased flexibility in the WIC food packages. (Lorrene Ritchie and Lauren Au) ● Several policy convenings were led by the NPI Director to share childcare research findings regarding the federal Child and Adult Care Food Program nutrition standards. These convenings helped to increase awareness among USDA and state agencies on how they can best support childcare providers to implement recent policy changes and nutrition standards. (Lorrene Ritchie) ● Policy engagement activities by NPI around improving drinking water safety, access, education and policy in the US led to increased sharing of data-driven information and best practices at federal and state agency levels (including U.S. Environmental Protection Agency Office of Drinking Water, CA Department of Social Services and CA State Water Resources Control Board) as well as to individual federal and state representatives, and contributed to the growing movement for drinking water instead of sugary drinks in the U.S. (Christina Hecht) <p>These measured outcomes demonstrated learning, action, and policy changes that can lead to improved community health and wellness. Collectively these efforts contribute to the public value of promoting healthy people and communities. However, this work needs to continue as California adult obesity rates have increased over the last few years from 24.2% in 2015 to 25.8% in 2018, according to the CDC.</p>	
<p>11.</p>	<p>UC ANR contributed to improved access to positive built</p>	<p>Issue There are documented health benefits of spending time in nature, yet a 2019 landscape and urban planning study found inequities in access to urban vegetation in communities that are more ethnically, racially diverse, and have lower income levels. Furthermore, 30% of Californian youth do not have parks, sidewalks, and community centers in their neighborhood and 30% of adults do not meet physical activity guidelines. Adult and childhood obesity is a public health crisis for the state and nation, resulting in a range of negative health consequences.</p>	<p>HFC</p>

<p>and natural environments.</p>	<p>Methods</p> <p>UC ANR delivers educational programs and policy, system, and environment (PSE) interventions with the goal of improving access to positive built and natural environments.</p> <p>One UC Cooperative Extension (UCCE) academic led a program in Santa Barbara County, which sought to increase individuals’ awareness and understanding of how their behaviors impact the health and wellbeing of their environments. The program engaged over 1,200 individuals that: 1) raised awareness of how individuals’ actions affect local water quality, and 2) increased participants’ understanding of their environment (Janelle Hansen and Katherine Soule).</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 appreciation of the environment (Hawau Bojuwon; Chutima Ganthavorn).</p> <p>UCCE academics also provided leadership and science-based information to the UC Master Gardener Program volunteers who then extended research-based information and technical assistance to members of the public about home and community gardens (UC Master Gardener Program).</p> <p>Another UCCE academic in Alameda County used her previous research in senior nutrition and lifestyle related diseases to inform her work with the UC Master Gardener and UC nutrition programs to deliver 25 on-site nutrition and gardening activities, reaching 230 senior housing elders. The goal was to address inactivity, social isolation, access, participation, and healthy nutrition and lifestyles. Low-maintenance container gardening accommodated frail and disabled seniors, providing opportunities for all residents to participate in the gardening experiences despite physical, environmental, or other barriers (Mary Blackburn and Katherine Uhde).</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>Outcomes</p> <p>Participants learned and changed attitudes about the environment.</p> <ul style="list-style-type: none"> ● Almost 600 San Luis Obispo County participants of workshops with environmental focuses made behavior changes that increased ecosystem benefits for local landscapes, including choosing low water use plants (100%), installing or improving drip irrigation (80%), and reducing their overall use of pesticides (72%). Workshop participants also reported increases in edible gardening and time spent gardening and outdoors in 	
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		<p>general. As educators and practitioners gain new knowledge and skills, environmental improvements are anticipated, which will create more opportunities to spend time outdoors, reduce community exposure to pesticides, and increase access to clean drinking water. (Maria Murrietta and Katherine Soule)</p> <ul style="list-style-type: none"> ● As a result of senior participation and effort in Alameda County on-site garden activities, almost 120 seniors reported not having a plot in the on-site community gardens prior nor ever planted a container herb garden prior to this intervention. Additionally, thirty percent of participants trained by UC Master Gardeners went on to volunteer as peer-educators and gardening ambassadors. (Mary Blackburn and Katherine Uhde) <p>Change in condition: Improved access to positive built and natural environments.</p> <ul style="list-style-type: none"> ● In 2019, 17 CFHL, UC program sites across the state newly adopted or expanded playground stencils. Combined with teacher training and delivery of evidence-based physical activity lessons, the stencils provided outdoor, engaging, and structured physical activity. Additionally, as a result of CFHL, UC interventions, 143 sites statewide established new, reinvigorated, or expanded edible gardens most commonly at schools and early care and education settings. (CFHL, UC) <ul style="list-style-type: none"> ○ As a result of CFHL, UC collaborations with Kern County Public Health Services Department, Kern County Library and McKinley Elementary School, a new community garden was built. After which 78% of 18 community members significantly increased their knowledge of gardening methods and resources available to start and sustain a garden in Kern County. Furthermore, upon sharing the results of the site visit with the Kern County Nutrition Action Plan (CNAP) coalition meeting, Parks and Recreation inquired and indicated interest for ideas to establish additional gardens in Kern County. (Hawau Bojuwon) ○ CFHL, UC in Riverside County partnered with the Master Gardener Program to help two schools adopt new gardens through policy, systems, and environment (PSE) interventions. Additionally, they continued to maintain school gardens at six other locations, which enabled sites to adopt garden-based learning programs as well as increase opportunities for healthy food access. (Chutima Ganthavorn) ● Participants of UC Master Gardener volunteer-led educational programs reported in a statewide survey that they started or improved practices on over 1,200,000 square feet of home gardens in California, as reported by 507 participants and over 130,000 square feet of school and community gardens, as reported by 74 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) <ul style="list-style-type: none"> ○ As a result of senior participation and effort in Alameda County on-site garden activities, the number of garden plots has tripled. (Mary Blackburn and Katherine Uhde) 	
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		<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>12.</p>	<p>UC ANR contributed to improved management and use of land.</p>	<p>Issue 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 better understanding ecosystem services. Research and extension are needed to help land managers and owners balance the social, economic, and ecological benefits.</p> <p>Methods UC ANR activities focus on management strategies with regard to livestock, wildlife and land maintenance.</p> <p>UC Agriculture Experiment Station scientists at the UC Davis location are using remote sensing to better monitor ecosystems for improved forest and agricultural management, especially during drought conditions. Specific projects include: investigating the drivers for burn severity in the coastal mountain ecoregions, and developing an unmanned aerial vehicle to monitor forage production for California’s rangeland (Yufang Jin).</p> <p>UCCE scientists conduct research and monitoring, which they extend to help landowners and managers improve range management to protect their resources and stay in business. One workshop held in collaboration with the USDA Agricultural Research Service, shared information on new varieties of grasses and shrubs for reseeding purposes, with the goal of helping land owners improve their rangelands. Another workshop was held highlighting the impacts of pests, such as ground squirrels and management practices (Royce Larsen).</p> <p>Several University of California Cooperative Extension (UCCE) projects have examined practices to reduce weeds on rangelands. One 6-year project has worked to assess various techniques for <i>Baccharis pilularis</i> (Coyote brush) control to determine which techniques are most effective and economically feasible. Baccharis encroachment reduces forage production through direct competition and also physically limits cattle access to forage. Numerous control strategies have been implemented and assessed, including mechanical removal, chemical application, and prescribed fire to control this aggressive resprouting species (Jeffery Stackhouse). Several scientists are investigating different herbicide control options for short-pod mustard (Richard Smith and Devii Rao). Scientists also investigated the efficacy of five herbicides across seven treatments to control shortpod mustard on a rangeland, and developed non-chemical weed</p>	<p>SNE, EIPD, SFS</p>

		<p>control options for rangeland weeds, with a focus on targeted grazing (Devii Rao, Theresa Becchetti, Rebecca Ozeran, Josh Davy, and Jeremy James). A workshop on erosion prevention and range management was provided for lessees of Monterey County Water Resources Department grazing allotments around Lake Nacimiento (Royce Larsen and Devii Rao).</p> <p>Other UCCE research was extended to decision-makers to improve understanding of park, range and forest management challenges and identify solutions. In Orange County (OC) Parks, scientists lead a monitoring program to address the presence of invasive shot-hole borer beetles and have surveyed 45 different areas of interest, including turf parks and wilderness areas. OC Parks management uses the results to make management decisions regarding tree treatments and removals, based on the level of infestation and overall tree health. A similar monitoring program for the Orange County Fire Authority discovered an infestation of the gold-spotted oak borer in the County, and the scientists coordinated efforts with the three agencies who share jurisdiction of the area of the breakout (Beatriz Nobua-Behrmann).</p> <p>A UCCE collaborative project with UC Berkeley and the California Department of Fish and Wildlife (CDFW) quantified the impacts of elk to private landowners in Humboldt, Del Norte, and Mendocino Counties. The CDFW is currently revising their elk management plan and they have limited data to support their decisions (Jeffrey Stackhouse). A livestock protection tools workshop series reached nearly 200 land owners and managers as well as policy makers and government and non-government organizational leaders. These workshops taught hands-on techniques to non-lethal predator control, led to a better understanding of livestock compensation programs, and educated policy makers on the difficulty of livestock protection on vast rural landscapes (Dan Macon and Laura Snell). An annual rangeland production study entering its 24th year, determine the forage production at eight ranches throughout the Central Sierra region, and gives ranchers a better understanding of available feed (Scott Oneto).</p> <p>UCCE scientists are collaborating with grazing allotment permittees, and the US Forest Service, to conduct a landscape-level (138 allotments in 16 national forests) investigation of mountain meadow responses to conservation grazing management strategies, as well as examining site-specific ecosystem service responses to grazing pressure across seven national forests (Leslie Roche).</p> <p>As a result of UC ANR research, outreach, and education, participants learned and adopted practices that lead to improved land management. Outcomes with specific measured indicators follow.</p>	
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	<p>Outcomes</p> <p>Participants learned about and intend to use strategies and techniques for sustainable land management.</p> <ul style="list-style-type: none"> • Rangeland weed management projects have increased ranchers’ knowledge of weed management options, leading to improved range management, increased forage availability, and possibly even increased income if they are able to increase the number of animals they can graze. 56% of 41 participants surveyed indicated they would implement what they learned within six months. (Devii Rao) • Ninety-five percent of the 37 participants in the range workshops on reseeding gained knowledge. Ninety-eight percent of the 52 participants in the Ground Squirrel Control workshop indicated they gained useful knowledge, and 85% said they would use the information they gained. (Royce Larsen) • Surveys from the erosion prevention workshop showed that 100% of attendees gained useful knowledge. One participant explained how they would use what they learned: "Immediately in an effort to reduce cattle concentration and equally distribute the herd." (Royce Larsen and Devii Rao) <p>Participants adopted strategies and techniques for sustainable land management.</p> <ul style="list-style-type: none"> • Ranchers involved in the research trial are using the information to assess options for <i>Baccharis</i> control via herbicide, mechanical removal, and the use of prescribed fire. One landowner, said: “You have begun to make major changes in saving prairies in Humboldt from being overtaken by coyote brush". By switching away from traditional mechanical treatment with heavy equipment toward the use of herbicides and prescribed fire, ranchers have saved between \$350-\$1150/acre. (Jeffery Stackhouse) <p>Science-based information was applied to land management policy and decision making.</p> <ul style="list-style-type: none"> • Expertise shared about the shot hole borer led the City of Claremont to change their shot hole borer beetles management practices and adopt an integrated pest management strategy that emphasizes tree monitoring, rapid response, and treating only infested trees. (Beatriz Nobua-Behrmann) • With expertise and leadership from the scientists, three county agencies put together a management plan for the area infested with the gold-spotted oak borer that will be carried out by the Orange County Fire Authority. (Beatriz Nobua-Behrmann) • The elk monitoring project provided the California Department of Fish and Wildlife a baseline for elk population and the ability to estimate impacts in northern California counties. (Jeffery Stackhouse) • As a result of the livestock protection tools workshop, the Modoc County Farm Service Agency with support from UCCE was able to better define their livestock indemnity program for predator kills and start educating the public about using the program. (Laura Snell) • The data from the annual forage production project is being used by ranchers, agencies and other stakeholders to quantify forage production. The values are used to document forage loss from various causes including years of drought. (Scott Oneto) 	
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		<ul style="list-style-type: none"> Grazing management monitoring in National Forests is informing the National Forest Plan Revision process, and other key public lands policy actions. For example: Sierra, Sequoia and Inyo National Forests have incorporated the work into draft or final Environmental Impact Statements and Stanislaus National Forest, references the research based findings as part of a litigation summary judgement. (Leslie Roche) <p>Change in condition: Reduced pest incidence.</p> <ul style="list-style-type: none"> Many of the Orange County Parks where treatments and/or removals of diseased trees happened showed a reduction in number of trees infested with the shot hole borer beetles by 10-30%. (Beatriz Nobua-Behrmann) <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 help maximize the benefits that managed lands provide. For example, providing science-based information for communities to more effectively manage and protect the health of trees is valuable to a community. The USDA reported in 2015 that California’s street trees remove 567,748 tons of carbon dioxide emissions annually, and capture chemicals that can travel to streams, lakes and oceans, reducing water pollution. In this way, UC ANR contributes to the public value of protecting California’s natural resources.</p>	
<p>13.</p>	<p>UC ANR contributed to improved air quality.</p>	<p>Issue</p> <p>More than 90% of Californians breathe unhealthy sometime during the year. California’s San Joaquin Valley is home to 10% of the state’s population and has some of the most polluted air in the United States. This pollution causes 1,300 premature deaths per year, as well as asthma attacks, emergency room visits, and lost school and work days costing valley residents \$11 billion each year. California has been at the forefront of developing ways to mitigate air pollutant concentrations and the impacts of existing air pollution.</p> <p>Methods</p> <p>UC ANR partners with public, governmental, and private groups to extend new knowledge and develop agricultural management practices to improve air quality.</p> <p>The UC Agriculture Experiment Station scientists at the UC Davis location are examining nitrogen spillovers from agriculture fertilizers to the air, by tracing nitrogen oxides and nitrous oxide gases in the air. The data will aid resource managers in designing regulations to guide proper management of nitrogen that improves nitrogen efficiency at the farm-scale, and reduces the social costs of excess nitrogen in the environment (Benjamin Houlton). Another project has focused on measuring nitrogen oxide emissions from soil in the Central Coast mountains to understand natural soil emissions in unmanaged landscapes. This type of monitoring will improve understanding for national and regional regulations of greenhouse gases and air pollutants (Ian Faloon).</p>	<p>SNE, SFS, HFC, EIPD</p>

		<p>University of California Cooperative Extension (UCCE) scientists identified how to safely and more efficiently spray pesticides in almonds to reduce the loss of spray evaporating into the air. The research found that when temperatures were high and humidity low, spray deposition in the upper canopies of large trees was reduced by 50% versus spraying early in the morning at cooler temperatures and higher humidity. Results along with general best management practices for spraying were extended directly to growers inside and outside the region through newsletters and twenty grower talks (Franz Niederholzer).</p> <p>UCCE scientists research by testing a steam machine as an alternative to soil fumigants to reduce plant diseases at strawberry fruiting fields and in strawberry nurseries. UCCE scientists tested soil disinfestation of strawberry fields using a steam machine that covers a 10 foot-wide swath and treats soil with steam to a depth of twelve inches. Research findings were shared through popular articles and presentations (Steve Fennimore).</p> <p>UCCE provides research and science-based information to support policy development on a variety of issues. The California Air Resources Board funded a UC ANR research team to improve the methodology to estimate greenhouse gas emissions on dairy facilities and promote understanding within the regulatory community of the diversity of dairy management practices. Research identified the practices that have been implemented on dairies to reduce methane emissions. Previous estimates indicated that 2.2 million metric tons of greenhouse gas emissions have been reduced annually, which is approximately 25% of the 2013 levels, or more than halfway to the state’s 2030 goal of a 40% reduction. Information on management practices was used to improve the existing estimates of emissions reductions to date (Deanne Meyer, Betsy Karle, Jennifer Heguy, and Peter Robinson).</p> <p>As a result of UC ANR research, outreach, and education, participants learned and adopted practices that lead to improved air quality. Outcomes with specific measured indicators follow.</p> <p>Outcomes</p> <p>Participants intend to adopt optimal use practices and pesticide alternatives.</p> <ul style="list-style-type: none"> • The finding that strawberry plant production in steam treated soils was the same as plant production in soils treated with methyl bromide/chloropicrin has caught the interest of the strawberry nursery industry, and they expressed intent to explore steam on a commercial scale. (Steve Fennimore) <p>Participants adopted optimal use practices and pesticide alternatives.</p> <ul style="list-style-type: none"> • In response to relaying best management practices for spraying, the use of 10 PM to 10 AM spraying is becoming more common in almond orchards around California during late spring and summer. As a result, growers are increasing spray coverage and reducing pesticide loss into the air, contributing to improved pest control and improved air quality. (Franz Niederholzer) 	
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		<p>Science-based information was applied to air quality policy and decision making.</p> <ul style="list-style-type: none"> The California Air Resources Board is using the activity-based information on dairy management practices as they refine their greenhouse gas inventories. The inventories will be used to determine if the targeted emissions reductions are being achieved, are likely to be achieved, or if mandatory reductions will be required. (Deanne Meyer, Betsy Karle, Jennifer Heguy, and Peter Robinson) <p>These measured outcomes demonstrate the state’s ability to identify practices to reduce pollution from pesticides. This type of research and extension can lead to reductions in toxic air contaminants from pesticide use. For example, from 2016 to 2017 there was a 2.9 million pound reduction in the toxic air contaminants from pesticides in California. In these ways, UC ANR contributes to improved air quality and the public value of promoting healthy communities.</p>	
<p>14.</p>	<p>UC ANR contributed to protection and conservation of soil quality.</p>	<p>Issue Soil health is essential for productive agriculture 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, and improvements in crop yields, drought and flood tolerance, and air and water quality. Soil health can be improved through farm management that increases soil organic matter. Proper understanding and care of soil is essential for a healthy and abundant food supply for Californians.</p> <p>Methods UC ANR develops research projects and extends information throughout the state to better monitor and understand soil composition, impacts from agricultural uses, and improved management strategies to conserve soil.</p> <p>Current research at the UC Davis Agriculture Experiment Station location focuses on understanding the interactions of soils and soil microorganism communities and how these relate to nutrient availability and uptake in agricultural systems. Collaborative research on soil amendments such as compost, biochar and biosolids demonstrates how soil biology is directly relevant to production and supports economic and environmental sustainability (Kate Scow). University of California Cooperative Extension (UCCE) scientists conducted research and extended information about soil management practices. One UCCE scientist conducted soil health management workshops for new and beginning small farmers to improve their agricultural productivity (Aparna Gazula). Other UCCE scientists led the formation of the Orchard Cover Crop Support Network of Yolo, Solano, and Sacramento Counties. A five-part series of meetings on soil health was organized for the network, which empowers growers and managers to learn from each other as they implement cover crop use in their orchards (Katherine Jarvis-Shean and Emily Lovell). A 3-year field test is evaluating the use of winter cover crops into annual production in the Sacramento Valley. In addition, the benefits of cover cropping, composting, and reduced tillage was extended through demonstration field days (Amber Vinchesi and Sarah Light).</p>	<p>SFS, SNE, EIPD, Water</p>

		<p>Because there is not a certification program in California for laboratories that conduct soil analysis, growers, consultants and analysts are left without reliable means to select a laboratory. An assessment of the quality and reliability of eight commercial laboratories was carried out to provide users with science-based evidence of the accuracy and precision of soil chemical analysis (Andre Biscaro).</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>Outcomes</p> <p>Participants learned about or intend to adopt recommended soil management practices.</p> <ul style="list-style-type: none"> • As a result of the soil health management workshop for new and beginning small farmer education <ul style="list-style-type: none"> ○ 74% or more of the 28 participants increased their knowledge of the following: cover crops, composting, soil amendments, conservation tillage and soil health assessment ○ 66% of attendees indicated that they would adopt one or more practices discussed during the workshop. (Aparna Gazula) • Through the Orchard Cover Crop Support Network, 27 growers and managers, including representatives from some of the biggest management companies in Yolo and Solano County, gained knowledge about implementing cover crop use as a soil conservation tactic, and made connections to continue to learn from each other. (Katherine Jarvis-Shean) <p>Participants adopted recommended soil management practices.</p> <ul style="list-style-type: none"> • A participating grower in the cover crop field trials, saw improvements in soil health including reduced weed pressure in cover crop treatments, and increased total carbon and nitrogen in the topsoil. Additionally, early adopters of improved soil health practices in the Sacramento Valley using cover crops and compost have reduced water use, and seen reduced pest pressure from using soil health practices. (Amber Vinchesi and Sarah Light) <p>Science-based information was applied to soil decision making.</p> <ul style="list-style-type: none"> • Growers, consultants, and academics have used the results of the soil laboratory assessment to reassess which laboratory to use. Improved profitability, research accuracy, and environmental sustainability are expected from this study. (Andre Biscaro) <p>These measured outcomes demonstrate growers learned and adopted practices that improve soil quality and conservation. As growers adopt healthy soil techniques, it could lead to improved soil quality while benefiting the biodiversity of the soil. For example, from 2016 to 2017 there was a 2.4 million pound reduction in fumigant pesticides</p>	
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		<p>used in California. Through these efforts, UC ANR contributes to the public values of protecting California’s natural resources.</p>	
<p>15.</p>	<p>UC ANR contributed to improved water quality.</p>	<p>Issue 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 standard, costly measures are required to remove it. In California, multiple areas have elevated levels of nitrate contamination 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 movement of fertilizers into groundwater and surface water. In addition to managing agricultural lands, protecting water quality from rangelands is also a major concern as surface runoff and groundwater on rangelands provide important sources of municipal water for regional communities.</p> <p>Methods UC ANR uses applied research to better understand the impacts of agricultural and rangeland management practices on water quality and extends outreach to growers, ranchers and the public.</p> <p>UC Davis Agriculture Experiment Station scientists at the UC Davis location collaborate with the California State Water Board to assess modeling tools that can be used for evaluation of assimilative capacity in groundwater basins with respect to salt and nitrates (Thomas Harter).</p> <p>A collaborative group of University of California Cooperative Extension (UCCE) scientists conduct trials evaluating the use of nitrate in irrigation water for crop production, increased nitrate retention in soils, determining nitrogen uptake by vegetable crops, evaluation of nitrate immobilization in winter-fallow beds, and evaluation of improving the efficiency nitrogen fertilization in organic vegetable production systems in Monterey County. The outcome in field trials showed significant reductions in concentration and load of pesticide in agricultural runoff. If growers implement this practice they could see a greater than 95% reduction in concentration and 99% reduction in load of pesticide in agricultural runoff. Research findings are shared with growers, conservation agencies involved with water quality regulation and the State Water Control Board (Richard Smith and Michael Cahn).</p> <p>Another ongoing activity is the expansion of CropManage, the online decision support software, which now provides a practical tool for growers to customize water and nitrogen applications for individual fields and minimize leaching losses of nitrate (Michael Cahn). A training program led by a partnership between UC ANR and the California Department of Food and Agriculture develops and implements irrigation and nitrogen management training for California’s Certified Crop Advisors (Daniel Munk, Doug Parker and Faith Kearns).</p>	<p>Water</p>

		<p>As a result of UC ANR research and extension, participants learned and adopted practices that lead to improved water quality. Outcomes with specific indicators follow.</p> <p>Outcomes</p> <p>Participants learned about recommended management practices for preserving water quality.</p> <ul style="list-style-type: none"> • There were several gains in knowledge as a result of the irrigation and nitrogen management trainings: <ul style="list-style-type: none"> ○ The percentage of California Certified Crop Advisors reporting they had good or complete understanding of the nitrogen cycle increased from 70% before the training to 97% after. ○ Knowledge of irrigation practices related to nitrogen management increased from 83% before the program to 95% following the program. ○ One participant and former Kings River Water Quality Coalition leader explained that “CCA’s and growers have never been better informed on nitrogen management issues and most growers have made significant changes to how they evaluate crop nitrogen needs.” (Daniel Munk, Doug Parker and Faith Kearns) <p>Participants adopted recommended management practices for preserving water quality.</p> <ul style="list-style-type: none"> • Several growing operations where wells have high concentrations of nitrate in their well water, are reducing their fertilizer application rates in vegetables, resulting in improved Nitrogen use efficiency. (Richard Smith and Michael Cahn) <p>Science-based information was applied to water quality policy and decision-making.</p> <ul style="list-style-type: none"> • Both the crop nutrient uptake information and studies on nitrate in irrigation water have been cited by the Central Coast Regional Water Quality Control Board and are being used to shape water quality regulations through the refinement of the agricultural discharge order (Richard Smith and Michael Cahn) • Based on the research on nitrogen use efficiency, the nitrification inhibitor, nitrapyrin, will be registered in 2020 for use on leafy vegetables (Richard Smith). <p>Change in condition: Improved water quality.</p> <ul style="list-style-type: none"> • Several major vegetable growing operations in the Salinas Valley have adopted the CropManage approach to managing fertilizer and water in vegetables. CropManage is now used in 9% of the lettuce acreage in the Salinas Valley, and has resulted in an average of a 30% reduction in nitrogen fertilizer applied to these crops. This reduction is important because high nitrogen fertilizer application rates can lead to high nitrate concentrations in rural wells in excess of safe drinking water standards. (Michael Cahn) 	
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<p>16.</p>	<p>UC ANR contributed to improved water use efficiency.</p>	<p>Issue More than nine million acres of farmland in California are irrigated, representing roughly 80% of all water used for businesses and homes. The state faces challenges to meet its water demands. As the state’s population expands and agricultural 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 in the urban sector in and around homes, to meet increasing demands.</p> <p>Methods UC ANR conducts research projects throughout the state to identify more efficient water practices and extends them to growers, managers, decision-makers and the public to transform how Californians use water. Effort by the scientists at the UC Agriculture Experiment Station (AES) has led to new methods to understand water use and improve efficiency. At the UC Davis AES location infrastructure and new models were put into place to improve spatial and temporal resolution of data in the California Irrigation Management Information System (CIMIS), which will help growers understand water stresses on ecosystems (Susan Ustin). One project collected empirical data on the water requirements for wine grape production in the San Joaquin Valley, to determine the water footprint of grapevines as a function of three irrigation treatments (Larry Williams). Breeding, genetics, weed control, and irrigation management are being evaluated at the UC Riverside AES location as strategies to lessen the impacts of the water used for turfgrass in urban landscapes and the ornamental and horticultural industries (James Baird, Amir Haghverdi, and Lorence Oki).</p> <p>University of California Cooperative Extension (UCCE) research is improving the accuracy of models to estimate crop water use of coastal berry and vegetable crops by using weather data from CIMIS stations (Michael Cahn).</p> <p>A collaborative research project by UCCE scientists is being carried out at the Desert Research Extension Center and two commercial spinach fields in Imperial County to assess the viability drip system configurations, nitrogen regimes, and plant establishment through drip instead of overhead irrigation in spinach. Research showed that drip irrigation reduced spinach downy mildew incidence approximately four to five times compared with overhead sprinkler irrigation. Downy mildew is the most important disease in spinach production, in which crop losses can be significant. Another project focused on Subsurface Drip Irrigation (SDI) trials for alfalfa, sugar beets, and dehydrated onions</p>	<p>Water</p>

		<p>indicate that the technology has the potential to improve yields and the efficiency of water and fertilizer use (Aliasghar Montazar).</p> <p>Two UCCE scientists conducted research on evapotranspiration rates and shared the results of the topography effects on vineyard evapotranspiration (ET). The scientists further provided expertise to the El Dorado Water Agency's Agricultural Committee, worked with their consultant to improve estimates of crop evapotranspiration, and contributed to the agency's development plan and report (Lynn Wunderlich and Daniele Zaccaria).</p> <p>UCCE scientists used technologies to implement Regulated Deficit Irrigation as a best management practice for water use efficiency while improving the quality of red wine grape varieties. In 2018 and 2019 the Rancho California Water District supported a water savings trial in eight vineyards in Temecula Valley using wireless technology. The wireless system is able to provide daily updated recommendations of irrigation times based on vine properties and data obtained from a local CIMIS weather station. Irrigation scheduling information was provided to the 250 members of the Small Winegrowers Association and shared through two workshops (Carmen Gispart).</p> <p>A team of UCCE scientists conducted irrigation trials to identify the actual water needs of landscape plants newly available or being introduced to the market. The scientists evaluated 26 new perennial plant selections in both sun and shade, in two climate zones, and classified them as low, moderate, or high-water users. Open Houses, attended by dozens of growers and Master Gardeners provides growers/breeders/brokers with their end-users' opinion of the new plants and helps them make decisions about which plants will be profitable at market. The scientists have provided information for 174 plant species/cultivars over the life of the project. Per the California water law, Model Water Efficient Landscape Ordinance (MWELO), the Water Use Classification of Landscape Species online database (WUCOLS) or other research-based water use information from an approved institution must be used in the development of the landscape water budgets required to receive permits pertaining to the installation of new and renovated landscapes. UCCE is the only approved institution currently doing this kind of trial. (Karrie Reid).</p> <p>Another UCCE project's research to improve water use efficiency has included the development of a novel device to enable untended measurements of irrigation water over multiple years. This work is being used to develop accurate water duty factors (the relationship between the area of a crop irrigated and the quantity of irrigation water needed for the entire growth period of the crop) for crops and regions, which will help ensure sustainable management of groundwater (Mark Battany).</p> <p>As a result of UC ANR research, outreach and education, participants learned and adopted practices that lead to improved water use efficiency. Outcomes with specific measured indicators follow.</p>	
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		<p>Change in condition change: Water saved.</p> <ul style="list-style-type: none"> As a result of using subsurface drip irrigation (SDI) and following the UCCE irrigation and nitrogen management recommendations, a sugar beet grower in the Imperial Valley was able to conserve 20% water (100 acre feet of water), and about 20% nitrogen fertilizer in 70 acres. This trial and the other SDI trials in the Imperial Valley demonstrate that SDI could be an effective on-farm water conservation practice in the low desert that could positively impact 200,000-acre alfalfa hay, 25,000 acres sugar beets, 9,000 acres spinach, and 15,000-acre onions fields. (Aliasghar Montazar) <p>These aforementioned measured outcomes have enabled water users to better understand and adopt water use efficiency measures to help California reduce its water demand while maintaining crop yields. Ultimately, improved water management will increase water cost savings, and reduce water usage, benefiting the end user and reducing the over pumping of groundwater in California. For example, it was estimated in 2000, that California growers can 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>17.</p>	<p>UC ANR contributed to increased water supply security.</p>	<p>Issue</p> <p>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. The Sustainable Ground Water 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 are essential to the health and prosperity of California.</p> <p>Methods</p> <p>UC ANR extends new knowledge using both real and virtual methods to increase understanding of groundwater resources and conservation.</p> <p>UC Agriculture Experiment Station scientists at the UC Davis location are investigating methods to better understand and improve groundwater management. For example, scientists are using tools to collect data and model groundwater systems (Thomas Harter and Graham Fogg). Other projects are assessing the use of storm and flood water on agricultural lands to improve groundwater recharge. The work has expanded to include almonds, alfalfa, vineyards and irrigated pastures (Helen Dahlke, Larry Williams, and Daniel Putnam).</p>	<p>Water</p>

	<p>In 2019, University of California Cooperative Extension (UCCE) scientists shared several tools with water agencies, and engaged with policy-makers to improve practices and decision-making. Scientists developed applied tools to support water management decisions. Specifically one team developed simulation and optimization models, cost-benefit analysis, and risk analysis to identify strategies that improve water management in light of current water allocation, climate change, and aged infrastructure (Sam Sandoval). Other scientists shared a report entitled "Managing Drought in a Changing Climate" with leaders in the water community and gubernatorial and legislative staff (Ted Grantham).</p> <p>In another example, a UCCE scientist teamed up with UC Davis collaborators to produce decision-support criteria to improve the investments made by water regulators and managers in California. The goal was to provide the State Water Resources Control Board with a comprehensive, yet simple economic model that they could use to make more informed decisions regarding water loss performance standards required by state law SB 555. Additionally, analysis of the potential impacts of the state's Sustainable Groundwater Management Act (SGMA) and the merits of different management actions was extended to water managers, farmers, state and local representatives, and community organizations (Ellen Bruno, Katrina Jessoe, Frank Loge). 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>Outcomes</p> <p>Science-based research is applied to water supply policy and planning.</p> <ul style="list-style-type: none"> • Recommendations from the UC ANR "Managing Drought in a Changing Climate", report have been incorporated in the Governor's 2020 Water Resilience Portfolio. (Ted Grantham) • The UC ANR economic model and analysis directly informed the performance standards that are currently being established by the State Water Resources Control Board under SB 555. These performance standards will be imposed on the largest 400 urban water utilities across the state. (Ellen Bruno) • The Community Water Center and the Environmental Defense Fund were able to use the analysis of SGMA impacts to determine their policy stances towards groundwater trading and make informed decisions about the allocation of water resources in California. (Ellen Bruno) • Pajaro Valley Water Management Agency and the Russian River Flood Control District adopted practices based on the UCCE applied research and findings that will increase water supply reliability. (Sam Sandoval) <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 research and extension supports communities as they develop groundwater management plans to bring pumping and recharge into balance by 2042 in compliance with the state's Sustainable Groundwater Management Act. Thus, UC ANR contributes to the public value of protecting California's natural resources.</p>	
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<p>18.</p>	<p>UC ANR contributed to increased ecological sustainability of agriculture, landscapes, and forestry.</p>	<p>Issue Endemic and invasive pests and diseases cause widespread damage to agriculture, landscapes, and forests. The spread of invasive pests has increased in recent decades, linked to global travel, produce trade, and climate change. In 2017, the California Department of Pesticide Regulation identified that California used over 205 million pounds of pesticide. Pesticide often used to control weeds, insects, and other pests, when used incorrectly, can cause environmental problems. Growers, land managers, and forestry experts need pest management tools and strategies that minimize impact on natural pest enemies and pollinators, potential for water quality problems, impact on aquatic invertebrates, and endangered species.</p> <p>Methods UC ANR partners with public, governmental, and private groups to develop and extend new knowledge about integrated pest management (IPM) for growers and land managers. Research and extension is conducted at the Agriculture Experiment Station locations and in the field through UCCE. Research at the UC Davis Agriculture Experiment Station (AES) location is examining the environmental fate of commonly used agricultural pesticides and informing state water boards, wildlife agencies, and growers about pesticide choices based on persistence and toxicity. The long-term impact is cleaner water while maintaining productive agricultural systems (Ron Tjeerdema).</p> <p>Projects at the UC Davis and UC Berkeley AES locations address the impacts of pest and disease management to minimize harm to natural populations. For example, research advances on the impact of the fungal pathogen <i>Batrachochytrium dendrobatidis</i> on amphibians is being used to develop management actions for the National Park Service (Erica Rosenblum). Other research demonstrated that because aquatic weed beds and decaying weeds benefit invertebrates, they are likely vital to fish productivity. Total weed eradication could reduce fish populations (Erin Marineau and Sharon Lawler).</p> <p>A project at the AES UC Riverside location is examining more efficient methods to screen for natural insect repellents. These repellents have higher volatility than DEET and were able to repel from a slightly further distance making them excellent candidates to protect plants and people from insects (Anandasankar Ray). Another project focused on large-scale field trials of a slow-release mesoporous pheromone occurred at five sites to test the impacts on California red scale in citrus. Field trials demonstrated that the pheromone dispensers are successfully reducing California red scale populations on leaves, twigs, and fruit by more than 90% in 3 of 5 locations. Use of this product will significantly reduce pesticide use for California red scale in the San Joaquin Valley (Elizabeth Grafton-Cardwell).</p> <p>Many UC ANR academics conduct pesticide efficacy and crop safety research studies that contribute to the USDA-IR4 program in California. The USDA-IR4 program supports research to aid in registering pesticides (herbicide, fungicides, and insecticides) on minor acreage and specialty crops. Several UC ANR scientists supervise an IR4 Field Research</p>	<p>EIPD</p>
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	<p>Center, which contribute to the pesticide residue work done in the nine Western Region field centers (Jeff Dahlberg, Brad Hanson, and Peggy Mauk).</p> <p>University of California Cooperative Extension (UCCE) research and extension includes practices to increase knowledge and reduce the introduction or spread of pests and diseases. Vegetable crops advisors in Fresno, Merced, Stanislaus, and San Joaquin Counties established the resistance-breaking tomato spotted wilt virus scouting team to detect and confirm field grown tomatoes with resistant cultivars that are infected with the virus (Zheng Wang). Surveys and limited trials were conducted to address invasive, non-native Italian white snails and identify where they expanding into ornamental crops and landscapes in San Diego County. Information is extended through presentations and blog posts (Cheryl Wilen). Scientists work with wine grape growers in Salinas Valley on coordinated control practices between all growers in the county to reduce the impact of mealybug spread of leafroll virus. UC ANR is working closely with the local grower association to provide leadership and technical support to area-wide efforts (Larry Betiga). Scouts in southern California monitored 224 orchards in 5 regions and measured the impact of grower applied insecticides on Asian Citrus Psyllid populations, which threaten the citrus industry (Elizabeth Grafton-Cardwell).</p> <p>UCCE scientists conduct research and extend research-based pest management practices. Twenty-three field, classroom, and web-based workshops were held for over 1,200 tree care, urban forestry and open space professionals, and UC Master Gardener volunteers to provide education about invasive shot-hole borers (Sabrina Drill, Beatriz Nobua-Behrman and Akif Eskalen). Pest management seminars on ground squirrel, gopher, and rodent management were provided for farmers, small farmers, and UC Master Gardener volunteers in the Santa Clara and San Benito counties reaching nearly 1,000 people. Areas of focus included pest pressures in peppers and Asian vegetables (Aparna Gazula). Classes, workshops, and field meetings were held for producers where they learned to identify and assess pest damage, identify and evaluate natural enemy populations, and use a variety of methods to manage pests on their farms and orchards (Cindy Fake).</p> <p>Several UCCE efforts in 2019 focused on pest management practices. One hundred eighty professionals were educated through the West Coast Rodent Academy in 2019 (Niamh Quinn). UCCE scientists worked with park and school agencies to provide guidance to develop IPM plans (Cheryl Wilen). A novel bait delivery method was developed and tested to target Argentine ants in vineyards. The results were shared through a publications and a demonstration event with 23 attendees (Monica Cooper). Trials were conducted to manage Medusahead, an invasive grass species on rangelands (Thomas Ghetts). UCCE scientists organize the UC Riverside Urban Pest Management Conference annually, which typically attracts 200 attendees, as well as the UC Riverside fumigation school, which is attended by 30 to 50 local pest management businesses, pesticide manufacturers, and regulatory agencies. At these events, UCCE scientists provide training on ant control, bed bugs, and wood-destroying insects, and the efficacy of pesticides used in the field (Dong-Hwan Choe). Applied pest management research to control the Sugarcane Aphid in sorghum was shared</p>	
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		<p>through educational presentations and meetings with agricultural professional associations (Nicholas Clark and David Haviland).</p> <p>Tools developed by UCCE scientists are used by the public and decision-makers. For example, Coyote Cacher, a web-based application was developed in 2018, and continues to be very successful with 58,000 visitors, posting 7,991 reports from 596 different zip codes in 2019 (Niamh Quinn).</p> <p>As a result of UC ANR research, outreach, and education, participants learned and adopted practices that led to increased ecological sustainability of agriculture, landscapes, and forestry. Research and activities that resulted in outcomes with specific measured indicators follow.</p> <p>Outcomes</p> <p>Participants learned or intend to adopt pest management practices, including Integrated Pest Management strategies.</p> <ul style="list-style-type: none"> • The effort of the tomato spotted wilt virus scouting team increased awareness of the disease, and growers are avoiding susceptible varieties, scouting fields for the disease more frequently, have easier access to report symptoms, and are more cautious to avoid transmitting virus and disease vector during field work. (Zheng Wang) • As a result of outreach efforts, stakeholders have identified additional locations that the Italian White Snail has expanded into in San Diego and Los Angeles counties. This knowledge will help PCAs and landscapers take preventative measures to reduce its impact. (Cheryl Wilen) • Growers in Salinas Valley formed neighborhood groups to coordinate control practices and reduce mealybug spread of leafroll disease between adjacent vineyard properties. (Larry Bettiga) • A pest management seminar improved skills in identifying and sustainably managing crop pests while minimizing environmental impacts. <ul style="list-style-type: none"> ○ 88% of the 46 farmer and landscaper participants in a pest management seminar were able to correctly identify key fruit tree and vine pests and their damage using an audience response system. ○ 94% were able to identify appropriate actions to manage those key pests. (Cindy Fake) • After five workshops on invasive shot hole borers 310 participants reported, <ul style="list-style-type: none"> ○ increased knowledge about the pest and management of invasive shot-hole borer biology, (49%); proper sanitation, (37%); sampling methods, (42%); and management of firewood and other wood, (51%) ○ 53% expressed intent to properly disposing of wood, and ○ 58% expressed intent to share information with co-workers and the public. (Sabrina Drill) • As a result of the 2019 Ground Squirrel and Gopher Management workshop, the 46 participants gained knowledge of pesticide labels and regulatory requirements, rodenticides and their impact on wildlife, the use 	
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		<p>of natural predators as biological control, and the public’s response to ground squirrel and gopher control. Outcomes of note include:</p> <ul style="list-style-type: none"> ○ 91 % increased their knowledge of ground squirrel control options and of the new technologies available for controlling ground squirrels and gophers ○ 94% increased their knowledge of organic and low secondary impact control options. ○ 63% indicated they would adopt one or more pest management practices discussed during the workshop. (Aparna Gazula) <p>Participants adopted recommended pest management techniques.</p> <ul style="list-style-type: none"> • Over 90% of 43 West Coast Rodent Academy participants that responded to surveys indicated they have started or improved behavior changes related to identifying rodents and implementing safe work practices that reduce the risk of contracting rodent-borne disease. <ul style="list-style-type: none"> ○ Over 85% reported behavioral changes around developing an integrated pest management plan for rodents and communicating with customers about the importance of integrated pest management. ○ 75% reported improvements in following rodenticide label instructions. ○ A majority of respondents believe these changes led to more efficient management, decreased negative environmental impacts, and increased customer satisfaction. (Niamh Quinn) • In 2019, 10 companies, covering over 5,000 acres adopted the novel method to bait Argentine ants. (Monica Cooper) • In response to the trials on Medusahead, the manufacturer of Indaziflam, which demonstrated excellent and longer control of medusahead without negative impact to perennial grasses, submitted to the EPA for a grazing label. Based on data from the Indaziflam trials, a National Wildlife Refuge treated multiple acres of medusahead with it to create fire breaks. (Thomas Getts) • Pesticide manufacturers that attended the urban pest management conference and fumigation school used the information to influence their product development and maximize product efficacy by making novel modifications. (Dong-Hwan Choe) • New information on Sugarcane Aphid control in California supported the registration of several insecticide labels to be used in California for the management of Sugarcane Aphid in sorghum. (Nicholas Clark and David Haviland) <p>Science-based information on pest detection and management influenced policy and decision-making.</p> <ul style="list-style-type: none"> • Coyote Cacher has been successfully incorporated into the Coyote Management Plans of many cities in Southern California and has been adopted by the San Gabriel Valley Council of Governments which governs 30 cities. (Niamh Quinn) 	
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		<ul style="list-style-type: none"> • The pesticide residue data from the USDA-IR4 Field Research Centers are used by the EPA, CDFA, and pesticide registrants to make decisions about registering pest control products on minor acreage crops that would not otherwise have sufficient market justification for the manufacturer. (Brad Hanson) • Several schools adopted pest management plans such as Head Start in Chula Vista. These plans will ensure a safer environment for the youth, while maintaining a healthy landscape. (Cheryl Wilen) <p>Change in condition: Reduced pest incidence.</p> <ul style="list-style-type: none"> • Reports about grower orchard Asian Citrus Psyllid (ACP) monitoring program had the effect of altering the timing and types of insecticides used in area wide treatment programs in two of the regions, resulting in significantly lower ACP populations in 2018-2019 compared to 2017. (Elizabeth Grafton Cardwell) <p>These measured outcomes can create, improve, and enrich the state’s ability to prevent, control, and mitigate pests and diseases. For example, from 2016 to 2017, the amount of reported pesticide use in California decrease by 2% or 4 million pounds. In these ways, UC ANR contributes to the increased ecological sustainability of agriculture, forestry, and urban landscapes and the public value of protecting California’s natural resources, helping California realize the many benefits of the state’s rich and diverse natural resources.</p>	
<p>19.</p>	<p>UC ANR contributed to increased ecological sustainability of rangeland management and forestry.</p>	<p>Issue 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 land owners and managers to understand the impacts of a variety of different management practices including restoration and conservation to these services. Identifying methods for ecosystem restoration and ecosystem management practices are needed for California’s plants, wildlife, and other natural resources can continue to thrive.</p> <p>Methods UC ANR has led collaborative research and extension efforts and provided support to develop new policies in an effort to increase ecological sustainability of forests and rangelands.</p> <p>UC Agriculture Experiment Station scientists at the UC Davis location have developed a new habitat model called SWAMP, which assesses how changes to agricultural practices, water availability, urban growth, and climate affect waterfowl habitat. This tool informs management decisions to enhance populations of waterfowl and other wetland dependent wildlife species. State and federal wildlife agencies, numerous conservation NGO’s, and agricultural organizations are among the active participants and audiences of this on-going research (John Eadie). Another project at the UC Davis AES location used a reconciliation ecology approach to identify how landscapes designed and created by people can function to support native species and ecosystem services. For example, one study found that approximately three times the number of migrant birds were observed foraging in native, valley oak trees as opposed</p>	<p>SNE</p>

		<p>to non-native tree species, such as London plane trees, despite valley oak only representing 15% of available canopy. This study shows urban foresters the ecological importance of native tree species in the urban landscape (Steven Greco).</p> <p>At the UC Berkeley Agriculture Experiment Station location scientists developed and disseminated a software tool, called NIMBLE to analyze complex environmental and ecological data. It is being adopted and explored by research groups nationally and internationally to analyze fisheries stock assessment models and wildlife monitoring data at large scales (Perry De Valpine).</p> <p>University of California Cooperative Extension (UCCE) scientists provide research and extension that leads to adoption of management practices. One collaborative effort with UCCE, UC Davis and UC Berkeley faculty, Plumas National Forest and the Sierra Nevada Conservancy demonstrated and monitored reforestation techniques and improved plantation resilience to fire (Ryan Tompkins). In cooperation with the California Board of Forestry, research was conducted on the impacts of fire hazard reduction treatments within riparian zones. Policy makers attended field visits to see the results (Rob York). Only 75 groves of native giant sequoia exist. One researcher is conducting studies within and outside of rare native giant sequoia groves, worked with federal scientists, and collaborated with and advised non-governmental organizations on giant sequoia management (Rob York).</p> <p>UCCE scientists also provided research and extension that aided decision-makers in policy and management decisions. Research on how to manage rangeland for biological conservation provided support for the formation of two coalitions the California Rangeland Conservation Coalition and the Central Coast Rangeland Coalition. The UCCE scientist developed research and outreach projects with the coalition members (Sheila Barry). Ten field trips were hosted over three years for California Assembly Members and their staff to develop understanding of working forests and management practices (Rob York). UC ANR scientists are members of the Environmental Flows Workgroup for the California Water Quality Monitoring Council. In this capacity research and extension activities focus on the development of a statewide framework for assessing ecosystem water needs and guidelines for managing ecosystem water throughout the state (Ted Grantham).</p> <p>As a result of UC ANR research, outreach, and education, participants learned and adopted practices that led to increased ecological sustainability of agriculture, landscapes, and forestry. Outcomes with specific measured indicators follow.</p>	
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	<p>Outcomes</p> <p>Participants adopted recommended practices for sustainable forestry.</p> <ul style="list-style-type: none"> • Research and extension on giant sequoia groves led to the development of a management plan for a grove of giant sequoias that are owned by the Save the Redwoods League. The plan is designed to protect the grove from high severity fire in the future. (Rob York) <p>Science-based information was applied to policy and decision-making.</p> <ul style="list-style-type: none"> • UC ANR's research and extension work contributed significantly to the Board of Forestry's statewide guidelines about how to conduct fire hazard reduction treatments within forest riparian zones. In 2019 these statewide guidelines were given to all professional foresters. (Rob York) • UCCE research and extension contributed to the formation of the California Rangeland Conservation Coalition and the Central Coast Rangeland Coalition (CCRC), which have successfully advanced rangeland conservation and received national recognition as a result. The CCRC developed a proposal with support from UCCE to restore grazing to some State Park lands, which is being discussed by the Director of State Parks, CDFFA, conservation organizations, California Cattlemen, as a tool to improve state land management in the face of threats from catastrophic wildfire. (Sheila Barry) • A new set of Forest Practice Regulations were rolled out in late 2018, known as Working Forest Management Plans. Assembly members informed the UC ANR scientist that the field trips were a large factor in the development of the new policies. The regulations will allow smaller forest landowners to develop CEQA certified plans to conduct timber harvests that can benefit many forest management objectives. (Rob York) • The guidance document prepared by the Environmental Flows workgroup, which include UCCE scientists, is being reviewed for adoption in state policy by the State Water Resources Control Board and Department of Fish and Wildlife. (Ted Grantham) <p>Change in condition: Land reforested.</p> <ul style="list-style-type: none"> • Science-based information led to the reforestation of 800 acres of the Plumas National Forest. Additionally, Plumas National Forest managers used herbicide in a plantation for the first time in three decades, which will improve the survival and growth of planted trees in post-fire restoration projects. (Ryan Tompkins) <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>	
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<p>20.</p>	<p>UC ANR contributed to increased ecological sustainability of ornamental and edible landscapes.</p>	<p>Issue California’s growing population of over 40 million people raises environmental concerns for the state’s urban landscapes and urban-rural interfaces, such as effects on pollinator populations, green waste, and water quality and quantity issues. There is 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, and up to 60% of water applied by sprinklers is lost due to runoff, deep percolation, and soil evaporation.</p> <p>Methods UC ANR translates research into actionable landscape management strategies and extends science-based information about environmental horticulture.</p> <p>In 2019, over 5,900 UC Master Gardener volunteers offered close to 500,000 volunteer hours in over 50 counties sharing research-based information on environmental horticulture to help the public more sustainably grow home, community, and school gardens (UC Master Gardener Program). For example in San Diego County, the UC Master Gardener volunteers disseminated information about water quality and integrated pest management through the Healthy Gardens, Healthy Homes Initiative. Sixty events were held around the county at fairs, farmer’s markets, and garden events, reaching an estimated 14,465 individuals (Cheryl Wilen).</p> <p>A UC Cooperative Extension (UCCE) environmental horticulture effort delivered a turf grass Integrated Pest Management (IPM) training to over 130 school landscape clientele at the Weed Management Expos for School sites in Northern and Southern California, co-organized by the UC Statewide IPM Program and the California Department of Pesticide Regulation (Cheryl Wilen and Maggie Reiter).</p> <p>In Kern County, environmental horticulture classes provide research-based information to horticulture professionals and members of the community. Attendees learn to preserve and enhance the urban environment through planting practices, water conservation, and implementation of IPM methods (John Karlik).</p> <p>UCCE collaboration of environmental horticulture advisors and specialists conducted a comprehensive state-wide study to determine an appropriate water budget for professionally-maintained landscapes, funded by the California Department of Water Resources. Landscape managers at 30 parks, school grounds, greenbelts, and golf courses in six climate zones across California received intensive hands-on training on irrigation scheduling based on climate and plant water needs, proper irrigation system maintenance, and how to measure and improve the distribution uniformity of sprinkler systems (Janet Hartin).</p>	<p>SFS, HFC</p>
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		<p>Change in condition: Landscaped sites saved water.</p> <ul style="list-style-type: none"> Water use measurements before and after the hands-on training were compared at each site. Twenty-one of the 30 statewide professionally managed landscaped sites significantly reduced water use without a reduction of plant health, function, or appearance, based on findings comparing pre and post hands-on training. Some sites realized a 50% or greater reduction in water use. Results of the study were also instrumental in providing research-based data that led to statewide water savings through a reduction in the state water budget allocated to urban landscapes. (Janet Hartin) <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. 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>21.</p>	<p>UC ANR contributed to increased workforce retention and competency.</p>	<p>Issue California requires a highly skilled workforce to remain competitive, prosperous, and an innovative global leader. A Pew Research Center study projects that U.S. job growth will increase as it has in the past 35 years in occupations that require higher levels of education, training, and experience. A qualified workforce is needed especially in youth education and obesity prevention, two areas in which California ranks among the worst in the country. Additionally, California is the largest agricultural producer in the U.S., thus education and training must be provided to enhance agricultural productivity and capacity to innovate.</p> <p>Methods UC ANR’s extensive network links campuses and communities across California to develop information and tools needed to train workers within educational settings and urban, agricultural, and natural resource communities.</p> <p>A team of Agriculture Experiment Station scientists at the UC Davis location built a database of pest management practices in citrus production by combining data gathered by farmers, independent Pest Control Advisors, and the California Department of Pesticide Regulation. The project was designed to generate improvements in the pest management practices of California’s citrus growers and the pest management consultants they hire. The scientists were able to use the data to make recommendations to them regarding choices of effective and non-disruptive pesticides (Jay Rosenheim). Additionally, at the Agriculture Experiment Station located at Kearney Agricultural Research and Extension Center, a scientist is working with a UC Cooperative Extension (UCCE) Emeritus Integrated Pest Management (IPM) Advisor to develop an online decision-support tool that mines information from the UC IPM Statewide Program’s Pest Management Guidelines and presents management options for multiple pests in cotton,</p>	<p>HFC, SFS</p>

		<p>citrus, alfalfa, and almond. The tool guides Pest Control Advisors in thinking through pest control decision-making and lists alternatives and mitigation for those pests. A report documents the decision-making process which can serve as an IPM plan for farms (Lori Berger, Peter Goodell).</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). UCCE academics trained after school staff and teen teachers in 4-H Water Wizards, computer science, and experiential learning methods (Marianne Bird; Fe Moncloa; Car Mun Kok).</p> <p>One UCCE academic was a collaborator on a project funded by Bechtel Foundation Common Measures to develop and pilot test a Lesson Study Model as a strategy for professional development and program improvement as an effort for program sustainability and quality (Car Mun Kok). Similarly, one multi-state research project evaluated the application of Lesson Study, an iterative and educator-centered approach to professional development, in youth development settings. The total number of participants in this study was 18 educators at 21 sites, which included clubs and schools. Findings from this research revealed the potential for Lesson Study to improve data-driven decision-making, content knowledge, lesson planning, and implementation among UCCE educators, adult 4-H volunteers, and 4-H teens (Martin Smith).</p> <p>One UCCE academic collaborated with the UC Gill Tract Community Farm to guide research, management, fundraising and experiential learning programming at the farm. The farm gets over 4,000 public visitors every year and delivers more than 20 workshops to at least 200 gardeners and farmers annually about food, nutrition, and climate justice (Jennifer Sowerwine).</p> <p>One UC ANR academic with the Nutrition Policy Institute provided evaluation capacity building as well as developed the Eating and Activity Tool for Students (EATS). It is an evaluation tool that includes borrowed validated measures as well as new specific measures designed to measure outcomes of interest for CalFresh Healthy Living (CFHL) implementing agencies in the areas of fruit and vegetable consumption, sugar-sweetened beverage and water consumption, and physical activity practices (Amanda Linares).</p> <p>As a result of UC ANR research and extension efforts, participants learned skills and adopted strategies to improve workforce competency.</p>	
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	<p>Outcomes</p> <p>Participants learned about and applied new evidence-based information in youth education programs.</p> <ul style="list-style-type: none"> ● In Sacramento County, 13 after school staff trained in 4-H Water Wizards adopted the curricula and delivered it to 278 students. Results from this year's Water Wizards evaluation were especially strong as all sites in the student survey demonstrated significant increases in knowledge on post test scores. The assessment reveals that youth increase their understanding about water, and that after school staff grow in confidence delivering 4-H Water Wizards. (Marianne Bird) ● Santa Clara County teen teachers and out of school time staff who received 4-H computer science program training reported increased confidence to teach the material to younger children (100% of 92 teens trained) and increased understanding (98% of 10 out of school staff trained). (Fe Moncloa) ● In Lake, Mendocino, Sonoma, Humboldt, and Del Norte Counties, 40 educators who received 4-H trainings reported an increased understanding of the value of inquiry and experiential learning, the difference between hands-on and experiential learning, utilizing inquiry and experiential learning methods, and knowing to ask open and closed questions. Participants also reported learning about teamwork, supporting diverse learning methods, and using simple materials to facilitate learning. (Car Mun Kok) ● Qualitative findings from the Lesson Study research project revealed improvements in educators' knowledge and skills, including content knowledge, lesson planning, teaching practice, and social connections. (Martin Smith) <p>Participants applied new evidence-based information in youth education programs.</p> <ul style="list-style-type: none"> ● Santa Clara County teen teachers and out of school time staff adopted the best practices and curriculum by delivering 4-H computer science programs to 393 children from diverse backgrounds as result of receiving training. (Fe Moncloa) ● Two groups comprising of 22 4-H teen teachers in Lake and Mendocino Counties reported that Lesson Study, including discussing, reflecting, and project planning, were useful in guiding their lesson preparation and delivery. They reported being able to use those in their own projects. (Car Mun Kok) <p>Participants learned new skills in agricultural production.</p> <ul style="list-style-type: none"> ● At the UC Gill Tract Community Farm, workshop participants were observed during hands-on activities increasing knowledge and skills related to food and soil safety and learning hands-on skills related to integrated pest management, building soil health, developing crop plans, learning principles of agroecology and regenerative farming. In addition, 30 UC Berkeley undergraduate and graduate student interns and 12 high school students annually have spent at least one semester sharpening their skills in agroecology and food justice, which contributes to building the next generation of food system leaders. (Jennifer Sowerwine) 	
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		<p>Participants applied program planning and evaluation skills to federal and state nutrition program requirements.</p> <ul style="list-style-type: none"> • Adoption of the information-sharing platform was observed as local health departments engaged in more dialogue (21 new conversations in 2019) around SNAP-Ed local evaluation work, strategies, troubleshooting, and requests for technical assistance to complete nutrition program implementation requirements. (Amanda Linares) • The EATS tools were immediately embraced by other CFHL state implementing agencies, and in 2020 has been adopted by CFHL, UC and Catholic Charities as their youth evaluation tool of choice, which makes it the preferred tool to measure youth behavioral outcomes from CFHL programming statewide. (Amanda Linares) <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. In 2019, California unemployment was 4.0%, a 0.1% decrease from the previous year. In addition, developing a more qualified landscape management and agricultural production workforce contributes to poverty reduction for smallholders and other marginalized groups, which then also facilitates interaction with commercial markets. In this way, UC ANR contributes to the public value of developing a qualified workforce for California.</p>	
<p>22.</p>	<p>UC ANR contributed to increased effective public leaders.</p>	<p>Issue In the last ten years, 37-56% of U.S. adults approved of the U.S. president’s job performance and 48-74% were confident that the U.S. president would do the right thing in world affairs. Furthermore, only 64% of U.S. adults say the overall quality of candidates running for congress in their districts was good. These Pew Research Center public opinion study findings indicate a continued need for increased effective and responsive public leaders.</p> <p>Methods 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 155,000 youth and had almost 20,000 adult volunteers contribute over 1,700,000 hours (UC 4-H). Program activities like Project 4H₂O 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 (Marisa Neelon and Charles Go; Shannon Klisch and Katherine Soule).</p> <p>UCCE academics led the California 4-H Camp Outcomes Study, which assesses youth’s independence, friendship skills, emotional safety, self-efficacy, affinity for nature, and leadership skills. The study grew to 22 camps in 2019 and</p>	<p>HFC</p>

		<p>included a new study component to better understand the adult/chaperone experience at 4-H camp. Evaluation data was shared at the 4-H Camping Institute with 50 individuals from 15 camps participating in the study, who will use the data and developed action plans for their camp programs (Marianne Bird).</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>Outcomes</p> <p>Participants adopted leadership skills and extended evidence-based information to their peers and decision-makers.</p> <ul style="list-style-type: none"> ● Over 500 4-H youth responded to the universal positive youth development common measures survey and 88% of youth report having social and leadership skills, including the ability to communicate through multiple methods and have value and respect for other cultures, as a result of what they may have learned at 4-H. (UC 4-H) ● In Contra Costa County, Project 4-H₂O's third cohort of five new 4-H teen leaders adopted research, teamwork, and communication skills. The teens were able to evaluate the outcomes of the ongoing campaign, finding that 52% reported drinking more water because they were reminded by the campaign signage and messaging. Throughout the teen-led research project, the teens demonstrated skills as effective public leaders influencing the health of their school community. (Marisa Neelon and Charles Go) ● 95% of 32 student leaders in San Luis Obispo and Santa Barba Counties reported improved presentation skills as a result of participating in 4-H SNAC. Qualitative data collected from the Leadership Academy show themes of improved recognition of career pathways, enhanced confidence and presentation skills, and increased confidence in being a leader. (Shannon Klisch and Katherine Soule) ● Across the state, teens leading resident camp programs reported significant increases in several skills including leading group discussions, working as a team member, speaking before a group, seeing things objectively, planning, teaching, sharing their opinions with adults. Teens in the Capitol Corridor resident camp staff demonstrated growth across all seven leadership skills. (Marianne Bird) <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 & 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>	
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<p>23.</p>	<p>UC ANR contributed to improved college readiness and access.</p>	<p>Issue California requires a highly skilled workforce to remain competitive, prosperous, and an innovative global leader. California was ranked 42nd in the nation for 2016 performance and has a high school graduation rate of 83%, which is slightly lower than the national average of 85%. Improved college readiness and access can contribute to the development of a qualified workforce for California and a robust and thriving state economy.</p> <p>Methods 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 UC 4-H Youth Development Program (UC 4-H), which reached over 155,000 youth and had almost 20,000 adult volunteers contributing over 1,700,000 hours (UC 4-H). Project Learning Tree, Youth Experiences in Science, and other programs trained teen teachers to deliver programs to younger children (Marianne Bird; Car Mun Kok; Claudia Diaz Carrasco; Fe Moncloa).</p> <p>As a result of UC ANR research and extension efforts, participants learned skills and reported positive aspirations that can lead to increased college readiness. Outcomes with specific indicators follow.</p> <p>Outcomes</p> <p>Participants had positive attitudes and learned information about preparing for college and careers.</p> <ul style="list-style-type: none"> ● Over 100 4-H youth statewide responded to the college & career readiness common measures survey and reported learning information to prepare them for college and a career as a result of what they may have learned at 4-H. (UC 4-H) <ul style="list-style-type: none"> ○ 91% of youth reported when choosing a career, it is important to be passionate about the work they do ○ 84% of youth report that for the type of career they want, it is important to go to college ● Over 700 4-H youth in grades 8-12 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"> ○ 91% of youth reported liking science ○ 71% of youth reported liking a job that involves using science ○ 73% of youth reported interest in studying science after high school <p>Participants adopted science and teaching skills to prepare them for college and careers.</p> <ul style="list-style-type: none"> ● Over 700 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 	<p>HFC</p>
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		<p>(91%), trying new things to see how they will work (90%), looking at how things are the same or different (85%), and comparing how different things work (81%). (UC 4-H)</p> <ul style="list-style-type: none"> ● Over 100 4-H youth statewide responded to the college & career readiness common measures survey and reported learning information to prepare them for college and a career as a result of 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 (100%), be trusted by an employer (100%), do their job well (100%), show respect for others (100%) and have a professional image on social media (91%). (UC 4-H) ● 4-H teen teachers (17) in Sacramento County reported an increase in their understanding of the science process in teaching youth (87%) and adopted and delivered the Youth Experiences in Science (YES) curricula to 334 children at 11 sites. (Marianne Bird) ● In one Mendocino County after school program, ten high school students who were trained as teen mentors for nine months reported that they understood the science activities and could teach them effectively. They then adopted best practices and curriculum in delivering science activities to younger youth starting in the 2018-2019 school year. They have since expressed additional interest in computer science activities, which will lead to the creation of a new computer science club. (Car Mun Kok) ● In Riverside County, 27 youth served as teen teachers and applied their science knowledge and skills to deliver the Project Learning Tree curriculum to 6000+ youth. Each team of teen teachers provided at least 6 hours of introductory environmental science to elementary and middle school youth. (Claudia Diaz Carrasco) ● Eight teen teachers that received 4-H training in delivering computer science programs to young children in Santa Clara County reported through interviews that their own grades improved as a result of their participation. The 92 teens and 10 school staff along with 4-H staff and volunteers adopted best practices and the curricula by delivering the program to 393 children from diverse backgrounds. Additionally, the teens reported that children they taught practiced important science process skills (e.g., observing, communicating, comparing, organizing) known to increase science literacy and critical thinking. (Fe Moncloa) <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>24.</p>	<p>UC ANR contributed to increased civic engagement.</p>	<p>Issue California requires a highly skilled workforce to remain competitive, prosperous, and an innovative global leader. Volunteering and civic engagement can develop skills and confidence that make individuals employable 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>HFC</p>

	<p>Methods UC ANR delivers educational programs that increase civic engagement.</p> <p>The UC 4-H Youth Development Program reached over 155,000 youth- an increase of 9% from the previous year- participating in clubs, afterschool programs, and camps, who were involved in projects around civic engagement, healthy lifestyles, and science, engineering & technology. Civic engagement projects included four focus areas: community engagement, service, civic education, and personal development. Almost 20,000 adult volunteers contributed over 1,700,000 hours, estimated at almost \$50 million in value (UC 4-H). 4-H teens as teachers programs created opportunities for teens to learn skills and contribute to their communities by delivering education to younger children. In Sacramento County, 57 teenagers participated in such programs and delivered science education through 4-H On the Wild Side and Youth Experiences in Science Project (Marianne Bird).</p> <p>As a result of UC ANR outreach and evidence-based educational programs, participants learned and adopted civic engagement skills and attitudes. Outcomes with specific indicators follow.</p> <p>Outcomes</p> <p>Participants had positive attitudes and gained skills for civic engagement.</p> <ul style="list-style-type: none"> ● Over 400 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"> ○ 100% of the youth reported that they like to help people in their community and 96% feel a responsibility to help their community. ○ 78% of youth report having critical teamwork skills related to diversity. These are skills that become increasingly important as the population in California and the U.S. are becoming increasingly racially and ethnically diverse. <p>Youth conducted community service projects.</p> <ul style="list-style-type: none"> ● Of the over 400 4-H youth responded to the Civic Engagement common measures survey about what they may have gained through 4-H, 89% reported they have done a community service project and look for ways to help when they learn about a problem in the community. (UC 4-H) <ul style="list-style-type: none"> ○ Seventeen 4-H teen teachers in Sacramento County delivered the Youth Experiences in Science curricula to 334 children at 11 sites, and 91% of the teen teachers reported that they felt they made an important contribution to their community. (Marianne Bird) <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</p>	
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		<p>qualified workforce. California’s unemployment rate was 4.0% 2019, which is down by 0.1% the previous year. UC ANR’s youth development programs equip the next generation to be active participants in their communities, which can contribute to a robust and thriving state economy.</p>	
<p>25.</p>	<p>UC ANR contributed to increased preparedness and resilience to extreme weather and climate change.</p>	<p>Issue The associated effects of climate change are increasing the risk of extreme weather events that negatively impact California’s ecosystems and communities. Because of our changing climate, rangelands, forests 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 so they are better prepared to deal with the growing risks. Communities need to be better prepared to deal with the growing risks of hazards from fires and droughts.</p> <p>Methods UC ANR collaborates with agencies and land owners that have been impacted by catastrophic fires and droughts and provides science-based information to aid in recovery and prevention efforts and develop improved practices.</p> <p>Research at the UC Davis Agriculture Experiment Station (AES) location is testing alfalfa and forage grasses and available germplasm from around the globe to help growers select successful species and varieties for now and the future. Growers are benefitting by understanding which varieties are adaptable to drought conditions and can optimize use of limited water resources (Charles Brummer and Dan Putnam). In another project, research has shown that the reporting time of snow melt and summer rainfall appears to influence reproduction of pest squirrels and projects that climate change will impact reproduction rate of these vertebrate pests (Van Vuren). Another AES project at the UC Davis location is modeling the risks and benefits of moving species in response to climate change. To date the model has identified scenarios of when to move species to increase diversity and when the risks are too great (Marissa Baskett). An AES project at the UC Berkeley location is focused on understanding the resilience of forest trees to drought. Scientists are mapping the geographic distribution of the 98 tree species in California, and documenting their mortality during the 2012-2016 drought (Inez Fung).</p> <p>A network of University of California Cooperative Extension (UCCE) scientists helped conduct California’s Fourth Climate Assessment. Regional outreach workshops were then held to share resources and support adaptation planning. One UCCE scientist organized a public workshop in the North Coast Region of California (Ted Grantham).</p> <p>After the devastating Camp Fire in 2018 forage crops were covered in ash, growers were unsure if the crops were safe for dairy cattle. A collaborative effort to collect samples from hay, pasture, and corn silage crops were analyzed with a veterinary toxicologist. Results were interpreted and shared with clientele, and with local agencies through the Camp Fire Research Symposium (Betsy Karle).</p>	<p>SNE, HFC, Water, EIPD, SFS</p>

	<p>A long-term forage production project tracks forage quality, forage production, and future impacts of drought and climate change. Results are summarized each year in an annual report. With partners the results were presented to 62 participants at two workshops in Solvang and Tulare, titled 2019 CA Rangeland Climate & Drought Workshops Weather, Grass and Drought: Planning for Uncertainty (Royce Larsen).</p> <p>In partnership with local individuals and non-profits UCCE scientists gathered over 30 individuals from local businesses, organizations, and government agencies involved in the emergency food response efforts in the wake of fires in Santa Rosa for an Emergency Food Response Convening. Participants shared expertise, discussed how to prepare for the future, and worked to align efforts for emergency food response. One UCCE advisor coded the data, co-authored a summary report, and shared findings with the County of Sonoma Board of Supervisors (Julia Van Soelen Kim).</p> <p>UC ANR scientists conducted research, outreach, and education projects identifying the need for guidance and training for prescribed fire operations as a management tool (Rob York). Three workshops with a focus on fire ecology, safety, planning and prescribed fire were held in San Benito County. One training included a three acre live-fire burn as part of an integrated approach to controlling yellow starthistle and mustard (Devii Rao). In another part of the state, a scientist developed a collaborative working relationship with fire safe councils, small forest landowners, and community groups, through outreach, presentations, and technical assistance on hazardous fuel reduction and forest stewardship supporting the development of the Meadow Valley Firewise Community (Ryan Tompkins). Two academics organized thirteen prescribed burns and successfully demonstrated using fire to treat over 1,100 acres across the state. In 2018, the academics formed the Humboldt County Prescribed Burn Association. Additionally, workshops and live-fire trainings in other counties have spurred movement toward the creation of at least 15 other prescribed burn associations across the state (Lenya Quinn-Davidson and Jeffery Stackhouse).</p> <p>Another scientist has continued collaboration with local and international scientists on research to better understand home loss from wildfires and strengthen the materials used by California land use planning professionals. The scientist used data on structure ignition patterns, weather conditions during wildfires, and fire progression maps, and statistical analyses to improve understanding of why home losses occur. These efforts have resulted in new insights about structure losses and how that may influence fire-related land use planning decisions (Max Moritz).</p> <p>Leadership has also been provided in fire resiliency by documenting home loss in the cities of Santa Rosa, Redding, and Paradise, sharing knowledge on home loss and the intersection of landscaping and home design with local, national and international media, hosting numerous educational events and advising and working with policy makers and agencies (Yana Valachovic and Stephanie Quarles).</p>	
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		<p>As a result of UC ANR research and extension, participants learned and adopted practices that lead to improved preparedness and resiliency to climate change and extreme weather. Outcomes with specific measured indicators follow.</p> <p>Outcomes</p> <p>Participants gained understanding of strategies to respond to climate change and extreme weather.</p> <ul style="list-style-type: none"> • Of 200 workshop participants from local government, tribes, and non-governmental organizations in the North Coast Regional workshop on climate change, 90% gained a better understanding of regional vulnerabilities to climate change and 77% learned strategies for local climate action. (Ted Grantham) • The toxicology test results showed clientele and agency staff that there was no contamination to the forage crops from the fires. It was important to verify the safety and quality of the crops, as toxicological impacts could have been financially devastating to the \$6.37 billion industry. (Betsy Karle) • Participants in the Rangeland Climate and Drought Workshops reported they will use what they learned to update their drought plans. Additionally, the annual reports are used by Agricultural Commissioners and Farm Service Agency personnel in Monterey, San Luis Obispo, and Santa Barbara Counties to understand the severity of droughts when they occur. (Royce Larsen) <p>Participants intend to adopt prescribed fire practices.</p> <ul style="list-style-type: none"> • The prescribed fire workshops led to a change in attitudes and likelihood to participate in prescribed fire activities in the future. When asked, “What ways might you consider being involved in prescribed burning?” 44% said they would become a member of a Prescribed Burn Association if we had one, and 33% said they would be willing to help develop a prescribed burn association. (Devii Rao) <p>Participants adopted prescribed fire practices.</p> <ul style="list-style-type: none"> • Support from UC ANR led to the development of the Plumas Underburn Cooperative, which has helped local landowners burn safely to reduce hazardous fuels. Additionally, the cooperative was able to secure grant funding for equipment and tools and support burn planning and workshops to be delivered in 2020. (Lenya Quinn-Davidson, Jeff Stackhouse, Ryan Tompkins) <p>Science-based information was applied to policy and decision making.</p> <ul style="list-style-type: none"> • Outcomes from the Emergency Food Response Convening included the inclusion of emergency food response in the County’s Recovery and Resiliency Framework. Longer term anticipated outcomes include improved efforts during future disasters. (Julia Van Soelen Kim) • Three bills, which were influenced by UC ANR’s work on prescribed fire were signed into law in 2019: 	
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<p>26.</p>	<p>UC ANR contributed to improved living and working</p>	<p>Issue There are 21.6 million full- and part-time jobs related to the agricultural and food sectors – 11% of total U.S. employment. Migrant and seasonal farm workers are a vital component of those jobs, yet they continue to live in poverty with poor health indicators and limited access to health care services.</p>	<p>SFS, HFC</p>

	<p>conditions for California's food system and farm workers.</p>	<p>Methods UC ANR continues research and extension efforts to improve conditions for workers in California’s food system.</p> <p>A UC Agricultural Experiment Station researcher at the UC Davis location is working on rapid tools for monitoring food and forage. This project has developed and is deploying simple, accurate, and rapid tests for a range of potential toxicants in food systems, from pesticide residues to mycotoxins, naturally occurring toxins found in food produced by certain molds. This technology has the potential to benefit both the high intensity needs of the food production systems and to safeguard farm and food system workers as well as consumer safety (Bruce Hammock).</p> <p>UC Cooperative Extension (UCCE) research is studying pest management techniques to reduce pesticide drift. Specifically, researchers are examining the efficacy of soil drench and liquid pesticide injections directly below the surface of soil as an alternative to foliar spray. One documented advantage of these pest management techniques is less pesticide “drift,” i.e. move off-target by wind. Without drift, that mechanism of exposure to humans directly or indirectly as residue on non-target sites is lessened. In addition, there are other advantages from less drift: less waste and applications can be made during windy and rainy weather. Currently more data are needed and these are not common methods in California. UCCE is extending information on the effectiveness and efficiency of these methods to growers and pest control adviser clientele so they know how to use it when the tool becomes available (Nicholas Clark).</p> <p>Outcome</p> <p>Science-based information was applied to decision making that will improve farm and food system working conditions.</p> <ul style="list-style-type: none"> • New knowledge on the efficacy of soil drench and liquid pesticide injections directly below the surface of soil supports the registration of these uses. Manufacturers are using the data to inform potential change in the federal and state pesticide label to reflect this use as allowable. A shift to using these techniques will diminish pesticide exposure risks. (Nicholas Clark) <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 improved product quality.</p>	
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<p>27.</p>	<p>UC ANR contributes to increased diversity, inclusiveness, and cultural competency in California's workplaces.</p>	<p>Issue California is the most diverse state in the nation by many standards, including race/ethnicity, languages, and socio-economics. It is a minority-majority state, where no single ethnic group forms a majority of the population. However, more than half of the children in California are Latino. The median annual income for Latino, Native American, and African American households in California are well below the state median income. This income gap correlates to opportunity gaps, in critical areas like access to high-quality youth development programs and early preparation for college. California continues to be challenged by social, health, and economic inequities.</p> <p>Methods UC ANR builds cultural competency skills, implements community-centered programs, and develops proactive policies to increase diversity and inclusiveness. UC ANR engages in intentional efforts to ensure that all members of the public have equitable access to UC ANR resources. UC ANR academics live and work in communities building trust and credibility to solve local problems together through research, outreach, and education.</p> <p>A UC Agricultural Experiment Station scientist at the UC Davis location is developing an index of insurance contracts for low-wealth, rural households. This research has application in a wide range of contexts from helping California farmers manage drought risks to being bundled with improved crop technology to help lift rural households in several African countries out of risk-induced poverty traps. The communities who produce food often get overlooked in discussions of food access and consumer diversity. Many in those communities are often trapped in low-income conditions by an inability to buffer themselves against risks involved in changing behavior. This work has the potential for local and global impact (Michael Carter).</p> <p>The 3-year UC ANR 4-H Latino Initiative pilot program ended in 2019. However, the programmatic and academic efforts will continue in many of the seven pilot counties. The goal was to expand programmatic reach to Latinos by hiring bilingual and bicultural staff that represent the communities they were serving; focusing on forming new strategic partnerships; adapting models to be culturally relevant; and building trust with new families. In addition, the program worked internally to improve intercultural competence by training six UC Cooperative Extension (UCCE) 4-H youth development advisors to implement the Intercultural Development Inventory (IDI) to 4-H staff, academics and specialists. Lessons learned were shared in the form of handbooks, scholarly journal articles, and conference presentations (4-H Youth Development Statewide Program).</p> <p>Another 4-H project called From the Ground Up is a statewide, collaborative research and extension effort. It identified promising practices to recruit, engage, and sustain the participation of Latinx youth. New asset-based community mapping and engagement tools were developed. The research findings were incorporated into a technical guide aimed at 4-H professionals and volunteers to promote social justice youth development. The research was disseminated locally, statewide, and at national conferences, and was recognized by the NIFA's Children, Youth, Families and Youth</p>	<p>HFC, SFS, SNE, EIPD, Water</p>
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		<p>at Risk program. UCCE advisors and staff from Riverside, Merced, and Santa Clara counties adopted these practices in their programs. Additionally, short workshops on intercultural conflict resolution were delivered to 4-H volunteers, along with consultations (Fe Moncloa).</p> <p>UCCE efforts in San Luis Obispo County supported other institutions in adopting improved policies, systems, and environments to improve inclusion and affirmation of marginalized populations in the workplace. A popular article assisted clientele compliance with AB 1976 that supports lactating employees who work in the field, and Family Friendly Environment guidelines were developed. Training and resources were provided to support regulatory compliance with the state law requiring gender inclusive restroom signage. Also in San Luis and Santa Barbara Counties, 4-H Student Nutrition Advisory Councils (4-H SNAC Clubs) engaged 200 student leaders, who are 92% Latino youth, in health advocacy programs, to develop youth’s skills in teaching nutrition and physical activity lessons, increasing salad bar participation in their schools, and leading community wellness activities. These predominantly Latino student leaders provided direct education to 1,414 of these peers, and indirect education to an additional 3,169 students (Katherine Soule).</p> <p>A UCCE program in the San Francisco-Bay Area region focuses on culturally responsive research, outreach, and education to small, limited-resource, socially-disadvantaged Asian farmers. These farmers face significant language and cultural barriers, including obtaining and maintaining permits.</p> <ul style="list-style-type: none"> • Research was conducted on culturally relevant crops, specifically evaluating nitrogen uptake and applied irrigation water in Asian vegetables bok choy, edible chrysanthemum, garlic chives, moringa, and lemongrass. A water and nitrogen management decision support tool for Asian vegetables was developed. • Nine food safety recordkeeping templates and a food safety plan template for small-scale farms were translated into Chinese. A sign for posting on farm and three food safety standard operating procedures were developed and translated. Two extension meetings in Chinese were conducted that included presentations and hands-on demonstrations on FSMA compliance and good agricultural practices. • Outreach and technical assistance was provided on the topic of reducing pollutant source loads, through a funded partnership contract with the Loma Prieta Resource Conservation District. Factsheets on soil testing were developed and translated into Chinese. In addition, a policy paper was published: “Comments on the Eastern San Joaquin River Watershed Agricultural Order: identifying unique needs and challenges for diversified, socially disadvantaged farmers.” One-on-one training was provided on total nitrogen applied reporting required by Central Coast Regional Water Quality Control Board. • In collaboration with the Santa Clara County Agricultural Division, UCCE coordinates an annual workshop for this audience on topics related to pesticide safety, laws and regulations, and integrated pest management, and continuing education credits are offered. (Aparna Gazula) 	
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		<p>Spanish-speaking clientele. There were six attendees, and more such workshops are being planned. (UC Master Gardener Program and Maggie Reiter)</p> <ul style="list-style-type: none"> • Los Naturalistas have started changing the narrative in environmental education and interpretative services at the forests and monuments of Southern California. There are now tours in Spanish with a Latino cultural twist, filling a void in the availability of environmental literacy services for the Spanish-speaking population of San Bernardino and Riverside Counties. Thousands of Spanish-speaking community members who visit the San Bernardino National Forest will not be excluded from educational opportunities. (Claudia Diaz and the California Naturalist Program) • Ethnic, limited resource farmers have increased awareness of Integrated Pest Management (IPM) practices and pesticide regulations. Using proper IPM practices, better understanding and use of product labels, use of proper protective equipment, and improved pesticide use safety benefits their businesses and reduces pesticide loads in the environment. (Ramiro Lobo) • As a result of the collaboration with Manzanar National Historic Site the Japanese gardens are being restored and a demonstration project is available to educate the public about how guayule (<i>Parthenium argentatum</i>) was grown for rubber during Japanese Internment. (Dustin Blakey) • As a result of the Chinese food safety workshop, 100% of the 11 small farmer participants stated that the workshop met their expectations, and nine reported that the workshop increased their knowledge on food safety and that they will recommend the workshop to others. (Qi Zhou and Aparna Gazula) • 59 student leaders, predominantly Latino, completed pre-post paired assessments, which showed a statistically significant positive change in youth development outcomes from participation, including public speaking, program planning, and teaching others. This program was selected by USDA, NIFA for expansion and implementation through a multi-state 5-year grant award. (Shannon Klisch & Katherine Soule) <p>UC ANR academics, staff, and volunteers learned skills to better engage diverse audiences.</p> <ul style="list-style-type: none"> • As a result of intercultural competence workshops and webinars for the 4-H Youth Development Program, 35 Extension professionals, 27 4-H volunteers and nine 4-H youth learned new practices to engage Latino populations as evidenced by post-pre-tests. In addition, the 4-H staff, academics and specialists who worked on their own intercultural competence moved from a focus on similarities, to an organization that also recognizes the complexity of the dimensions of diversity (e.g. from <i>minimization</i> (M= 104.32) to the <i>cusp of acceptance</i> (M = 111.18) on the IDI continuum). As 4-H academics and staff better engage Latino youth, families and communities in their programs, program diversity will increase fostering a sense of belonging for diverse youth and families in 4-H and increasing Latino youth's access to various career pathways. (Fe Moncloa and Russell Hill) 	
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	<p>Science-based information applied to making policy and decision-making.</p> <ul style="list-style-type: none"> • The State Water Resources Control Board adopted language in the revisions to the Eastern San Joaquin River Watershed Agricultural Order to allow alternate reporting requirements for diversified, small-scale, and socially disadvantaged farmers. These changes are precedential for the state of California and can benefit diversified and socially disadvantaged farmers in other counties as well as small-scale organic farms. (Ruth Dahlquist-Willard and Aparna Gazula) • In partnership with the Bishop Paiute Tribe, food safety audits were completed on all current and in-development Food Sovereignty gardens in Inyo and Mono counties. (Dustin Blakey) <p>Change in condition: Workplaces are more inclusive.</p> <ul style="list-style-type: none"> • Policy, systems, and environmental changes included installing gender inclusive restroom signs that reduced barriers for employees with marginalized identities. (Katherine Soule) • After culturally responsive trainings for Asian farmers in the San Francisco-Bay Area, they were better able to have their businesses be compliant: <ul style="list-style-type: none"> ○ 45 small, socially-disadvantaged farmers complied Agricultural Order monitoring and reporting requirements and avoid fines. Failure to comply subjects the dischargers to additional enforcement actions by the Water Board, including penalties of up to \$1,000 per day for each day of violation of monitoring and reporting requirements. ○ 60 small, socially-disadvantaged farmers successfully renewed their pesticide permits for the past four years and are legally able to apply pesticides to manage pest issues in their crops. (Aparna Gazula) <p>These measured outcomes demonstrate how UC ANR has strengthened its internal capacity to do effective outreach to diverse audiences. 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>	
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