# Delivering on the UC ANR Mission

## 2021 UC ANR Annual Report

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

# Delivering the UC ANR Mission

In 2021, University of California Agriculture and Natural Resources continued to adapt to pandemic-related conditions to optimize its operations, research and engagement across its locations and programs that aim to serve all 40 million residents of California. Despite ongoing changes, the UC ANR workforce has responded to increasingly complex issues such as wildfire resiliency, groundwater management, and working with small-scale farmers to navigate regulatory challenges and new markets. UC Cooperative Extension staff and volunteers demonstrated their ingenuity and commitment to addressing COVID-19 by participating in a national campaign with Extension Foundation and the Centers for Disease Control that leverages Cooperative Extension networks to reduce adult vaccine hesitancy. Statewide programs such as the Expanded Food and Nutrition Education Program, the UC Master Gardener program and CalFresh Healthy Living, UC contributed to community health by improving food security, nutrition and home gardening skills for families living in California's densely populated urban centers.

UC ANR continued to strengthen its commitment to diversity, equity and inclusion, or DEI, in all that we do. A new DEI Advisory Council will steer ongoing recommendations for improving how we operationalize DEI internally and in the communities we serve. We expanded DEI training and are working to implement best practices around equity in hiring. UC ANR recently recruited a Vice Provost, who will focus on DEI in our programs and work with academics to develop more inclusive scholarship, and a Director, who will focus on the DEI across our organizational culture.

The state budget, signed by Governor Newsom in July 2021, included a historic increase for UC ANR. This revived UC ANR's budget to pre-COVID levels and provided an additional $32 million in ongoing funding that will restore our academic footprint across the state, adding 120 new Advisors and Specialists and more than 60 new positions for program support and operations. Our UC ANR locations worked closely with community partners and stakeholders to identify positions that will address California's emerging and future needs, such as wildfire, drought and climate adaptation.

We are incredibly grateful to Senator John Laird, chair of the Senate Budget and Fiscal Review Subcommittee on Education, for recognizing this critical need and spearheading the boost to UC ANR's budget that will result in transformational gain for UC Cooperative Extension and residents in our state. As we pause to reflect on the year, we hope you enjoy this selection of UC ANR's impact stories from across the state. We are grateful for the talents, partnerships and synergies that together are improving the ability of Californians to meet today's challenges and ever-changing demands.

*Glenda Humiston,*
*Vice President, UC ANR*

## 2020-2021 Highlighted Outputs & Activity

**20**
**novel ideas led to patents**

**1,320**
**policy engagement activities**

**2,840**
**credible, audience-driven educational materials**

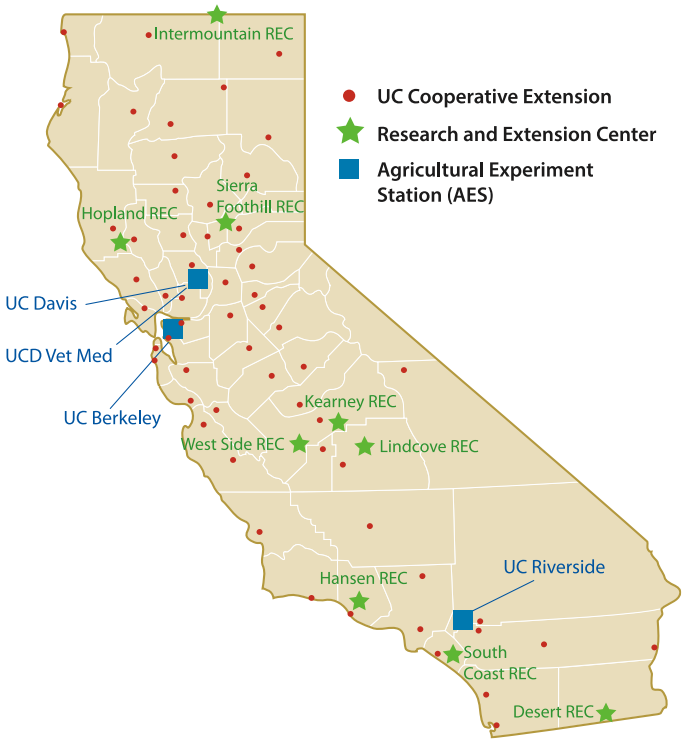
**21,460**
**meetings, workshops, field days and courses held**

**537,190**
**direct contacts/ educational exchanges with adults and youth**

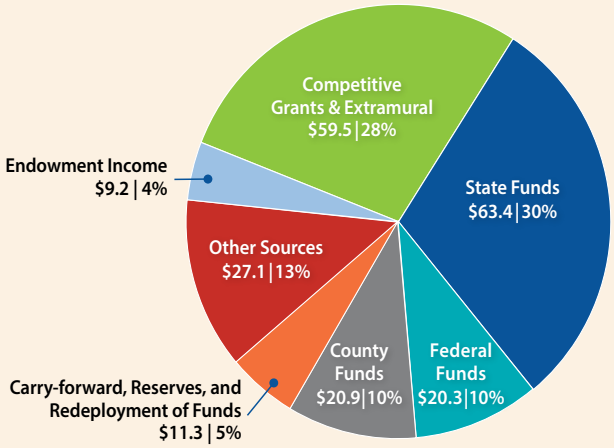
UC ANR operates a statewide network of researchers and educators dedicated to the development and application of knowledge to address local agricultural, environmental and health issues. The network of local Cooperative Extension sites and research and extension centers is often the face of the University to residents who may never set foot on a UC campus. By working and living among those we serve, UC ANR expands UC's reach to engage all people and communities in California, ensuring equal access to the UC system.

In 2021, 150 University of California Cooperative Extension (UCCE) Advisors were conducting research, outreach and education from locally based CE offices serving all 58 counties from 70+ locations throughout the state. Nine research and extension centers (RECs), located in a variety of ecosystems across the state, provide places for researchers to conduct field experiments and educational opportunities for the public. Approximately 560 affiliated Agricultural Experiment Station (AES) researchers were located at three campuses, and 120 UCCE specialists were located at six campuses, RECs and county offices.

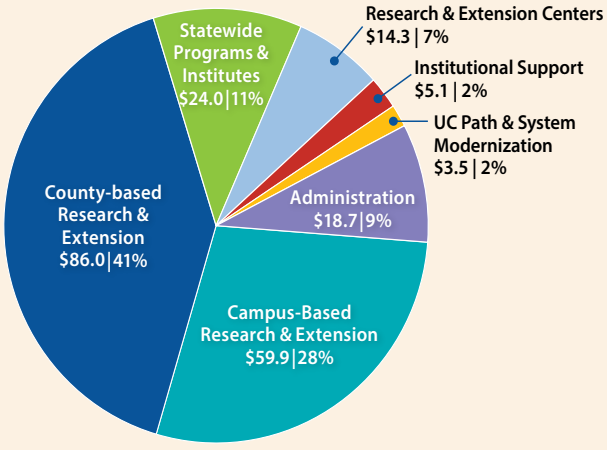
UC ANR includes statewide programs and institutes, which work through and with our county offices and community partners. The statewide programs include UC California Naturalist, UC Master Gardener, 4-H Youth Development, Expanded Food and Nutrition Education, UC Master Food Preserver, Informatics and Geographic Information Systems, UC Integrated Pest Management, UC Sustainable Agriculture Research and Education, Agricultural Issues Center and CalFresh Healthy Living, UC. The institutes are the Nutrition Policy Institute, California Institute for Water Resources, and UC Organic Agriculture Institute.




**Total Fund Sources = $211.5 M**




**Total Fund Uses = $211.5 M**



# Promoting Economic Prosperity in California

## Increased agricultural efficiency and profitability

### Organic biosolids show promise as a cost-effective soil amendment

UCCE continued innovative research on using regulated, locally available biosolids to substitute for conventional nitrogen fertilizers. Information about biosolids, how to access them, special considerations for their use, and new findings of their feasibility as a substitute for synthetic fertilizer were shared at a Virtual Field Day and various presentations throughout 2021. For example, of the 23 agricultural industry participants who learned about using biosolids at the UC Small Grains Virtual Field Day, 65% reported increased knowledge about using biosolids. Sixty percent also indicated they were likely to use biosolids as a soil amendment. This strategy can reduce growers' fertilizer costs, provide a slow-release nitrogen source, reduce nitrate leaching, close nutrient cycles and feed soil microbial communities. (Konrad Mathesius)

### UCCE research reduces costs and water use for spinach growers

For the past three years, UCCE has researched the viability of adopting drip irrigation for organic and conventional spinach production to lower costs and reduce crop loss related to downy mildew. Field experiments were conducted at the UC Desert Research and Extension Center and three commercial fields in the low desert of California. Researchers observed that downy mildew incidence was two-to-five times lower in plots using drip irrigation compared to sprinkler-irrigated plots. One cooperative grower reported a considerable cost reduction of $300 per acre when using drip irrigation for their conventional spinach due to fewer treatments. The observations from the commercial sites showed that water, nitrogen fertilizer and energy savings would be an additional $350 per acre under a drip irrigation system in spinach. These savings demonstrate that drip irrigation can support more profitable and efficient spinach farming in California. (Ali Montazar)

### Grafted watermelon production research increases growers' yields

Comparative research on grafted watermelon examined how the use of grafted plants may out-yield non-grafted watermelons and maximize revenue for growers. A UCCE Vegetable Crops Advisor who joined UC ANR in 2018 has published research and extended information about this opportunity. As a result, growers' adoption of grafted watermelon continued to increase over time, from less than 250 acres in 2018 to over 1,500 acres in 2021. On average, growers reported that their successfully grafted fields produce 15% to 25% more watermelons than non-grafted fields per acre while using 30% fewer plants and the same amount of water and fertilizers. One greenhouse manager also shared that UCCE's research and extension efforts increased the demand for grafted watermelon transplants by 10 to 15 times since 2018 for a total sale value of over $600,000. (Zheng Wang)

## Improved animal management, productivity and efficiency

### Ag Pass project influences local and state wildfire preparedness policy

Ag Passes provide ranchers and farmers with limited, emergency access to routes and areas that protect agricultural assets during disasters such as wildfires. A UCCE Livestock and Natural Resources Advisor has helped redefine the Ag Pass in Ventura County, establish a new program in Santa Barbara County, and publish a "how-to" guide for Ag Passes for distribution throughout California, the nation and globally. In July 2021, UCCE and the Santa Barbara County Agricultural Commissioner's Office hosted their first training and issued Ag Pass identification cards to producers, representing the culmination of 16 months of multi-agency planning and coordination. When the Alisal Fire in Santa Barbara County severely impacted homes, agriculture and transportation, the Ag Pass program worked to allow ranchers and orchardists to access their properties, evacuate livestock and irrigate. These successes and advocacy by UCCE and local partners informed the passage of AB 1103, providing a formalized framework for counties throughout the state to institute Ag Pass programs. (Matthew Shapero)

### Water diversion training saves ranchers money and ensures regulatory compliance

UCCE's Water Diversion Monitoring and Reporting Training team provided information on key regulations and economic incentives for more than 60 livestock producers. The goal of the training was to enable ranchers to self-certify to report water usage and remain in regulatory compliance. This replaces the need to hire a costlier professional engineer to meet state-mandated reporting requirements. UCCE conducted visits to assist producers with complex reporting requirements and advise on their water monitoring systems. It is estimated that each of the 60 attendees will save at least $750 per year in potential consultant fees, providing a value of $45,000 annually. (Tracy Schohr, Larry Forero)

### New forecasting technologies enhance growers' yields and sustainable practices

A UCCE Specialist at the Digital Ag Lab develops, tests and seeks feedback for improving new technologies for growers. For example, myvirtualorchard.com is a free, interactive online application to visualize the results of aerial imagery. Users can analyze their within-field variability, define management zones, and export their shapefile data. Two additional technologies were designed for yield forecasting. One uses aerial imagery and a deep learning algorithm to detect and count the number of almond tree flowers. Another uses 3D modeling to estimate canopy light interception. In 2021, 205 post-training survey responses were received from Digital Ag Lab stakeholders such as growers, consultants, crop advisors, educators and the research community, indicating that over 50% on average improved their knowledge after attending the Lab's trainings. Insights from yield forecasting technologies can help growers optimize their fields by recovering low yield zones, avoiding loss and improving sustainability. (Alireza Pourreza)

## Improved individual household and financial stability

### Alameda and Contra Costa households improve food resource management

UCCE academics oversaw the statewide Expanded Food and Nutrition Education Program (EFNEP), which serves adults with income less than 185% of the federal poverty level. In Alameda and Contra Costa counties, EFNEP shared the "UCCE Connects to You!" series on stretching household food budgets with 371 parents. Surveys from 248 course graduates show that 93% and 97% of participants in Alameda and Contra Costa counties, respectively, improved food resource management behaviors such as planning meals before shopping, making a shopping list, and comparing food prices after participating in the series, which are shown to save money. The counties' youth EFNEP programs were adapted to an online learning format for 3,500 participants. A follow-up survey of 295 6th-8th grade students showed that 49% percent of Contra Costa County youth and 60% of Alameda County youth improved their food resource management behaviors to prepare simple, nutritious, affordable food. (Marisa Neelon)

## Enhanced community economic development

### Agritourism diversifies economic opportunities for farmers and ranchers

UCCE fosters opportunities for farmers and ranchers to learn about agritourism, which can help diversify farmers' operations and generate additional revenue. In 2021, the statewide UC Sustainable Agriculture Research and Education Program (SAREP) conducted an agritourism intensive course through webinars and in-person workshops. Of 68 participants in the series, 87% reported increased their knowledge of direct sales options. Twenty-four farmers took steps to start or expand their agritourism business, and 12 implemented at least one element of their new marketing strategy developed during the course. The Agritourism Program also completed eight webinars and two in-person workshops to assist California farmers and ranchers in pivoting their business to agritourism and direct sales in response to COVID-19 supply chain disruptions. (Gail Feenstra)

## Increased emerging food economies and markets

### Simplifying agricultural supply chain data

Supply and demand fluctuations in agricultural commodities in response to prices, costs and shocks to production remain a challenge for understanding global food production and supply. Recently, the COVID-19 pandemic affected the entire food supply chain from field to consumer, highlighting the need for better data solutions. An AES researcher at UC Davis is working with colleagues to address the resilience of the agricultural production and distribution system by studying how storage and transportation constraints affect global price shocks and how producers can respond to these price changes. The project will generate new web-based tools that allow farmers, decisionmakers and the public to extract easily accessible agricultural production data and summary statistics. This novel effort seeks to engage a wider audience in current issues in agricultural economics. (Aaron Smith)

### Scaling production of native oysters in the Tomales Bay

A UCCE Specialist at UC Davis founded a diverse network of academics, shellfish growers, resource managers, tribal members and other stakeholders focused on Olympia oyster restoration spanning from British Columbia to Baja California. The group's goals include improving the oyster's resilience to climate change and developing a new small-scale commercial fishery for Olympia oysters. Two prominent shellfish growers in Marin County's Tomales Bay have begun testing growing these native oysters, with thousands being raised in bags in the bay. This new small fishery can support restoration by increasing the abundance of the local wild populations, benefiting both the seafood market and the environment. (Ted Grosholz)

### Three new cherry cultivars transform the market

In the San Joaquin Valley's changing climate, the popular and well-liked Bing cherry variety has struggled to perform well in the region. A UCCE Pomology Specialist at UC Davis has worked on low-chill cherry cultivars with a similar flavor profile and earlier market window than the traditional Bing. These varieties included Brooks, Coral Champagne and Tulare cherries. When these new cultivars were first introduced, their lighter skin color at peak ripeness did not meet the USDA's existing maturity color standard for shipment to high-value, early export markets. However, the USDA changed these standards after UCCE demonstrated that the new cherry cultivars had strong consumer acceptance and improved long-distance shipping performance when picked at their optimum maturity. As a result, these new cultivars are becoming dominant across California and now comprise approximately 40% of cherry acreage across the state. (Carlos Crisosto)

**$41.63**

**monthly food cost savings reported by 1,450 EFNEP families statewide**

**$20 million**

**estimated revenue from increased yields for farmers using almond rootstocks**

# Developing an Inclusive and Equitable Society

## Increased diversity, inclusiveness and cultural competency in California's workplaces

### California Naturalist framework advances JEDI goals

UC ANR's statewide California Naturalist program continues to broaden its participation and address justice, equity, diversity and inclusion, or JEDI. The program established a framework for operationalizing its JEDI efforts centering on Four "R's": relationships, relevance, recruitment and responsibility. It launched a new demographic data collection approach that leverages course evaluations and event registrations. The new framework has resulted in partnerships with the California Tribal College, the Anahuacalmecac School, and Audubon Center at Debs Park. California Naturalist and Climate Stewards course content is now made locally and culturally relevant through co-design of the course syllabus with partners. Barriers to participation have been addressed through new scholarship programs, and California Naturalist team members pursue professional development, including completing the Intercultural Development Inventory training. (Greg Ira)

### UCCE collaborates to improve DEI in the nonprofit agricultural services sector

A UCCE Specialist at UC Berkeley served on the California FarmLink Board and helped their organization establish a new Diversity, Equity and Inclusion Committee. They developed a survey that was administered to similar nonprofits to learn more about the status of DEI principles, practices, challenges and successes that various organizations had with implementing DEI. The report "California FarmLink DEI Assessment: Policies, Principles and Practices of DEI and Inclusive Governance within the California Nonprofit Agricultural Services Sector" was presented to the organization and to other agricultural partners at the EcoFarm conference. As a result of these efforts, California FarmLink increased their adoption of new DEI principles and diversified their board to improve racial and farmer representation. (Jennifer Sowerwine)

### Investigating the benefits of diversity in educational settings

An AES researcher at UC Davis investigated daily experiences with ethnic diversity among middle school youth and incorporated other target audiences such as teachers and administrators. The project generated changes

in knowledge, including an increased understanding and appreciation for ways to capitalize on the positive effects of diversity in educational settings. School administrators, staff, and teachers, also increased their awareness of how exposure to diversity might be important to adolescent development. Furthermore, undergraduate students, graduate students, and postdoctoral scholars from diverse backgrounds were provided opportunities to engage in this research, leading to professional development and publication opportunities. Positive impacts on participating graduate students' and postdoctoral scholars' workforce transition were also reported. (Adrienne Nishina)

## Improved living and working conditions for California's farm workers

### UCCE research strengthens values-based certifications for the agricultural sector

A UCCE Specialist at UC Berkeley conducts research on food justice and recently partnered with the Equitable Food Initiative (EFI) to conduct an evaluation of its values-based certification for the agricultural sector. EFI certification is a comprehensive audit that applies broadly to all fruit and vegetable crops and encompasses labor conditions, food safety and pest management practices. The UCCE Specialist engaged in EFI's continuous improvement process to strengthen both its social certification and workforce development programs. After working with UCCE, EFI has implemented many of the evaluation-based recommendations. The number of EFI certified farms had increased from 19 in 2017 to 48 in 2021, and the number of workers on certified farms rose from 10,000 to more than 57,000, respectively. (Christy Getz)

**80%**

**of UC SAREP training attendees intended to use what they learned when working with farmers of color**

**40**

**community and clinic partners from Northern California tribes certified to conduct research**

# Protecting California's Natural Resources

## Increased ecological sustainability of agriculture, landscapes and forestry

### Virtual workshops for industry professionals improve tree care

In San Bernardino, Riverside and Los Angeles counties, UCCE's Environmental Horticulture Advisor presented information to more than 1,500 landscapers, urban foresters, arborists and other green industry professionals on selection and care of drought-, heat- and pest-resistant landscape trees at various virtual events. Presentations focused on how tree canopies in densely populated urban areas with low tree canopy cover and extreme heat islands can be enhanced through use of newly identified trees from the ANR/US Forest Service "Climate-ready trees" study. In follow-up surveys, over 92% of attendees indicated that information presented would result in improvements in tree selection and care. Over 94% indicated the information would help them conserve water and other resources. (Janet Hartin)

### Weeding with robotic technology

Despite advancements in technology, weed management remains an issue in many crop production systems, often requiring herbicides to achieve control. An AES research project at UC Davis helps California's vegetable and strawberry growers with weed management options, including efficacy assessments for new products or new uses for existing ones. The agricultural labor crisis makes manual weeding costly and difficult to schedule for many growers. While herbicides can provide one opportunity to alleviate this scarcity of labor, they can come with environmental concerns. The Specialist's research assesses the extent to which mechanical weeding can replace manual weeding and herbicide use, offering environmental and economic benefits for growers and consumers. (Steve Fennimore)

### Tracking and explaining forest species composition changes

An AES faculty in the UC Riverside Department of Evolution, Ecology and Organismal Biology is conducting a long-term study to track changes in species composition in Southern California forests. The study has found evidence for an ongoing shift in composition from the ponderosa pine to an increased dominance of the California black oak. This type of change has implications for carbon sequestration and will also influence how wildfires burn in the future. The study investigators are working to identify physiological mechanisms responsible for these shifts so that forest managers can identify solutions to mitigate negative environmental impacts. (Marko Spasojevic)

### Urban home gardeners monitor for Asian Citrus Psyllid

A UCCE Advisor and staff in Los Angeles County continued to deliver their popular Alternatives to Citrus workshop alongside local UC Master Gardener volunteers. This workshop provides general information to the public about adding fruit trees to home gardens, and in particular, focuses on challenges related to citrus trees. Citrus can be difficult to maintain in home gardens due to a tiny insect called the Asian citrus psyllid, which can carry a disease called huanglongbing, also called citrus greening, that kills the tree and can endanger neighboring citrus trees and commercial orchards. When surveyed one to three months after their participation in the event, 94% of the 244 Alternatives to Citrus workshop participants said that they had monitored their citrus trees for Asian citrus psyllid based on what they learned. (Rachel Surls)

## Improved management and use of land

### Managing California rangelands for multiple ecosystem services

Rangelands are the primary resource for livestock grazing, as well as support diverse native plant and animal species and provide many key ecosystem services such as food production and habitat for pollinators. Managing land for a variety of ecosystem services often involves complex trade-offs between forage production, invasive species and native species persistence. An AES researcher in plant ecology at UC Riverside is conducting research to provide decision support methods that can identify solutions to these complex trade-offs. Findings are currently being shared with federal land managers to help inform invasive plant and native plant management, and future work will be shared with land managers and land management agencies. This research will help inform conservation planning and land management on public rangelands. (Loralee Larios)

### Innovative testing strategies protect oaks and conifers worldwide

A UCCE Specialist at UC Berkeley spearheaded several new testing approaches for pathogen detection in plants, fruits, plant products, oaks and timber. These range from generating composite samples, to training dogs using sniffing jars, to sampling spores in the air (airspora). The lab also developed the first polymerase chain reaction (PCR) test officially employed by a nation to detect *Phytophthora ramorum*, which causes sudden oak death. As a result of these efforts, PCR tests are now routinely used in California for all regulated pathogens for all crops, resulting in billions of dollars of savings nationally, by improving the power of pathogen detection. Additionally, entities in the European Union have adopted the airspora sampling and PCR tests to identify Heterobasidion spp. in conifers, equating to millions of euros in savings. (Matteo Garbelotto)

### National Park Service approves grazing experiment for Pinnacles National Park

A UCCE Advisor and a UCCE Specialist collaborated with the National Park Service regional office to update a grazing plan for Pinnacles National Park in San Benito County. They clarified key questions from the regional office, determined sampling methods, trained contractors and park staff and obtained input from local ranchers about the plan. The National Park Service used the information provided by UCCE to inform their approval of experimental grazing on 75 acres. This represents a major step forward and attitude change on the role of grazing by the National Park Service: one that views grazing as a potential conservation tool rather than a threat to the park environment. (Devii Rao, Leslie Roche)

## Increased water supply security

### UCCE technical assistance supports counties' water supply planning

Two UCCE Advisors responded to the needs of Lassen County and Modoc County for assessing agricultural irrigation needs and potential for enhanced groundwater recharge. They participated in weekly coordination of groundwater planning, outreach and applied research related to the Big Valley groundwater planning process. The Boards of Supervisors in Lassen and Modoc counties used technical information written by UCCE to develop the Big Valley Groundwater Sustainability Plan. The plan outlined potential mitigation projects and management actions that landowners may adopt to help balance county water budgets. (David Lile, Laura Snell)

## Improved water use efficiency

### Irrigation strategies to conserve Southern California water

The Western United States is generally arid and subject to drought, while also being home to some of the largest cities in the nation. In Southern California, the demand for landscape irrigation is significant, and enhancing irrigation efficiency is a critical water conservation approach given the region's high population and dependency on water from other regions. An AES researcher at UC Riverside conducted the final year of a three-year research trial that examined on-demand smart irrigation controllers that monitored soil moisture. The trial evaluated the efficiency,

reliability and ease for these controllers that can help save water in urban irrigated settings such as parks, schools and private homes. (Amir Haghverdi)

### Statewide assessment on household water use informs local and state decision-making

A UCCE Specialist at UC Riverside analyzed residential water consumption patterns in California and found that it has fallen dramatically in the past three decades: the result of water conservation policy and the work of state and local water managers. The UCCE Specialist used household-level data from multiple regional water agencies to investigate the effectiveness, costs and unintended consequences of different conservation efforts such as education, rebates, lawn replacement and pricing program. The California State Water Resources Control Board used these findings to inform state regulations. Elsinore Valley, Eastern and Western municipal water districts and Jurupa Community Services District also used UCCE's recommendations to develop and implement conservation programs. (Mehdi Nemati)

## Improved water quality

### Research on biostimulants improves yields and nitrogen fertilizer use

Biostimulants are being explored to reduce nitrogen fertilizer use and increase yields in crops such as California strawberries. The goal was to understand the costs versus benefits of using otherwise expensive biostimulant products. Study results were presented at a field day at the study site, two local workshops and national and international conferences. The UCCE Advisor also looked at nitrogen fertilizer removal and its effects on harvested produce in several fruits and vegetables in the Central and South Coast, including strawberries and celery. Four large celery growers accounting for approximately 80% of the Ventura County acreage and eight strawberry growers have reported benefits from the nitrogen uptake information developed in UCCE's study. Some reported reducing nitrogen fertilizer use, while others increased yield. Growers are also leveraging the study data to comply with state regulations. (Andre Biscaro)

## Protection and conservation of soil quality

### Water management improves soil health and addresses Delta drought

A UCCE Advisor forged new connections between UCCE, local growers and water agencies and studied the relationships between surface water quality and soil health in the Sacramento-San Joaquin Delta region. These efforts came about after the 2015 drought program between growers and the State Water Resources Control Board where growers voluntarily reduced water diversions by over 25%. After research findings were presented to the agricultural community, 96% of 125 people responding to a post-event survey said they learned useful information about soil health practices, and 97% of 112 respondents intended to use what they learned in the next 12 months. It is anticipated that these efforts will also raise awareness for agency personnel about the link between water and soil health and contribute to water supply policies that increasingly consider soil health practices. (Michelle Leinfelder-Miles)

## Improved air quality

### UCCE research improves funding and adoption for orchard recycling

Whole-orchard recycling is the on-site grinding or chipping of whole trees during orchard removal and incorporating the ground or chipped biomass into the topsoil before replanting. This process can cost growers up to $1,000 per acre and is more expensive than options like biomass cogeneration, a choice that became less available after many biomass facilities closed since 2015. Since UCCE began researching whole orchard recycling and its air and soil quality benefits, more than 400 growers farming more than 40,000 acres have chosen to recycle their orchards. This momentum helped launch new and much-needed funding of over $18 million for 539 growers, who recycled 25,934 acres and diverted 727,980 tons of woody biomass from being burned. UCCE's research informed CA Assembly Bill No. 2831, which included a section on carbon offset credits to growers who implement whole orchard recycling. These efforts improve air quality and increase soil's resilience to climate change by sequestering carbon. (Brent Holtz)

**1.5 million**

**million square feet of pollinator habitat improved as a result of UC Master Gardener events**

**$478,000**

**in state grants awarded to UCCE's small farm partners to improve irrigation and soil quality**

# Safeguarding Abundant and Healthy Food for All Californians


## Improved food safety

### Research on biocontrol to improve food safety

California produces almost all the almonds, pistachios, and figs in the United States. These crops are occasionally contaminated with aflatoxin, a specific kind of toxin produced by fungi. Due to their toxicity, aflatoxins are strictly regulated worldwide, and food crops routinely tested. The aflatoxin-producing fungi are common in soil and the spores are airborne, which makes management challenging. The only reliable method of control is using strains that do not produce toxins to displace or exclude the aflatoxin-producing strains. Research conducted by an AES Plant Pathologist at UC Davis is studying two commercialized strains to document the best timing, rate, and placement. This new knowledge on how to achieve good biocontrol of aflatoxins will improve public food safety, and the marketability of these crops. (Themis Michailides)

### Research on cultural food preparation informs regulations

In partnership with the California Department of Food and Agriculture, UC ANR supports the Produce Safety Technical Assistance Program, focusing on food safety compliance for California's small-scale, culturally diverse growers. The program includes direct assistance from six new UC ANR Community Education Specialists and a website offering food safety resources in six languages. UCCE also conducted consumer research resulting in 6,000 responses related to preparation practices for Hispanic and Asian specialty crops. The data was used for a U.S. Food and Drug Administration comment letter co-written with the National Sustainable Agriculture Coalition to consider including 14 new crops on the "Rarely Consumed Raw List." This would exempt growers of these crops from the Food Safety Modernization Act's Produce Safety Rule. Upon reviewing the comment letter, UCCE was invited to present its findings to the FDA in the summer of 2021. (Erin DiCaprio, Aparna Gazula, Ruth Dahlquist-Willard, Ramiro Lobo, Margaret Lloyd, Qi Zhou)

### Small-scale farmers achieve food safety certification

UCCE provides technical assistance on Food Safety Modernization Act (FSMA) compliance for farmers from socially disadvantaged communities. In Santa Clara County, the Small Farm Program offered workshops on food safety for small-scale farmers in English and Chinese.

They also produced a video addressing the six most common food-safety issues on farms. The team also worked with Community Alliance With Family Farmers, Cornell University's Produce Safety Alliance, and the University of Florida to host a two-day Produce Safety Growers Training to help small farmers receive FSMA food-safety certification training, followed by on-farm food safety assessments that helped prepare for inspections. After participating in trainings, 79 small-scale farmers received their required FSMA certification. (Aparna Gazula, Qi Zhou)

## Improved food security

### UCCE spearheads local efforts on farmers market incentive programs

UCCE in San Luis Obispo County partners in the EBT at Farmers Markets working group of the San Luis Obispo Food System Coalition to increase the use of CalFresh nutrition assistance benefits at farmers markets to buy fresh produce. The coalition improved the visibility of farmers market incentives through social media, text messaging, educational flyers, press releases, paid advertisements, and promotion at local food banks and farmers markets. Additionally, the workgroup applied for and received $30,000 in funding from the Danone Foundation to pilot a Farmers Market Navigator program for Hispanic and Latino customers who use CalFresh. Since UCCE San Luis Obispo started convening the workgroup in 2017, a 171% increase in CalFresh and Market Match redemption has been observed, with a 49% increase occurring between 2020 and 2021. This has also generated $386,000 in direct income for local farms. (Katherine Soule, Shannon Klisch, Emily Dimond, Rosa Vargas)

### Innovative teaching kitchens improve students' food security

A UCCE Specialist at UC Berkeley continued research on the potential for college-level nutrition courses to address nutrition and food security by including an integrated teaching kitchen. Out of 216 participants who completed the course, 171 completed pre-and post- food security survey data. Respondents have shown statistically significant improvements in food security, increasing those who indicated they were "food secure" at follow-up by 44%. The number of respondents indicating "very low food security" also decreased by 76%. This year, they improved upon the study design to include a comparison group in addition to the teaching kitchen intervention group. (Susana Matias)

**84%**

**of 1,400 EFNEP participants showed improvement in one or more food safety practices**

**79**

**small farms received food safety certification with UCCE's technical assistance**

**1,600**

**pounds of produce from school gardens donated to CFHL, UCCE San Luis Obispo partners**

# Developing a Qualified Workforce

## Increased civic engagement

### Californians engage in conservation and climate adaptation projects

The UC California Naturalist Program engages Californians in the state's unique ecology and stewardship opportunities. It aims to increase knowledge, skills, identity and self-efficacy related to California's natural history and environmental issues, increase public participation and civic engagement in environmental education, and enhance citizen science and climate adaptation. In 2021, more than 500 certified California Naturalist volunteers contributed 9,135 hours in environmental education, 9,834 hours in participatory citizen science, 9,124 hours in conservation and restoration, 730 hours in community resilience and adaptation, and 394 hours planning toward environmental and climate justice. The total value of all volunteer service is estimated to be over $1.1 million. (Gregory Ira)

### Volunteers in Orange and Los Angeles counties identify bad beetles

UCCE in Orange and Los Angeles counties developed several participatory science projects to engage the public in urban pest management. UCCE's Invasive Shothole Borers Monitor Project trained 27 volunteers to identify trees infested with invasive shothole borers, a cryptic tree-killing pest. Focused on Orange and Los Angeles counties, the program collected 45 reports of suspected infestations and demonstrated that online volunteer training could accurately identify ISHB-infested trees 85% of the time. The ISBH Monitor Project has since been adapted and piloted as a well-received 4-H youth science project. In collaboration with local leaders and conservation agencies, UCCE also participated in the Santa Monica Mountains Bad Beetles Project, which trained 35 volunteers to identify and report trees infested with invasive shothole borers and gold spotted oak borer. Bad Beetles volunteers submitted 206 reports of invasive shothole borers infestations, which helped map the incidence of this pest in the region and direct rapid response efforts. (Beatriz Nobua-Behrmann)

## Improved college readiness and access

### New UC curriculum increases college-readiness

Pathways to Your Future is an education and career exploration project designed for youth in grades 7-12 that uses a sequenced curriculum and guest speakers such as college alumni, collegiate 4-H youth and college admissions advisors. It also engages youth in a tour of college campuses. The program is geared towards helping youth identify their passions, professional interests and goals, and various higher education opportunities and requirements. Evaluation of the Pathways to Your Future curriculum showed that its 228 participants were more prepared for post-high school education. Outcomes included statistically significant improvements in the ability to research post-high school education career options, knowing which major to pursue, learning about scholarships and applications, and knowledge about the importance of post-high school education needed for a desired career. (Martin Smith)

## Increased workforce retention and competency

### UCCE engages 4-H youth in agricultural workforce opportunities

UCCE Napa County and the Sonoma-Marin Fairgrounds co-hosted an outdoor Youth Animal Science Drive-Thru event to teach 4-H youth and other educators about livestock animal production for beef cattle, dairy cattle, small ruminants and poultry. Each track had five interactive stations designed to highlight biosecurity, production, husbandry, welfare, ecosystem services, nutrition, food safety and fire preparedness. Speakers included members of UCCE, Santa Rosa Junior College, Sonoma Marin Cattlewomen, North Bay Dairy Women, Sonoma-Marin, and Napa County Young Farmers and Ranchers, Halter Project, and 4-H volunteers and members. Out of 130 youth that attended the Animal Science Drive-Thru event, 100% agreed that the various learning tracks improved their knowledge of an animal science-related topic. (Steven Worker)

### Training the next generation of sheep shearers

Sheep shearers are increasingly rare in the United States, as are opportunities to learn about sheep shearing, the process of fleece removal. A UCCE Advisor collaborated with industry partners to offer a sheep shearing course for its 27th year. Students learn about the sheep shearing process, equipment and sheep and range production topics in this course. In 2021, the online registration was filled within two minutes of going live, demonstrating the need for these types of educational resources. After participating in the course, 48% said that the instruction provided them with more knowledge and skills than they expected. Twenty-eight students completed the course, with three mastering the skill set sufficiently to receive Intermediate Certification. (John Harper)


## Increased effective public leaders

### 4-H programs cultivate youth leadership

In 2021, UC 4-H in Colusa, Sutter and Yuba counties held 4-H officer training for 51 youths, with 84% reporting feeling connected to their fellow 4-H officers and 75% reporting excitement to be a 4-H club officer in a leadership role after the training. These counties also fostered youth leadership by partnering with CalFresh Healthy Living, UC on a Cooking Academy series, where 13 4-H teen teachers educated 273 youth at 16 sites on cooking and nutrition topics. After participating, 92% of teen teachers reported good or excellent ability in leading group discussions compared to 54% before the teen teacher experience. Similarly, 100% of teens reported good or excellent ability in working as a team member after being a teen teacher, compared to 69% before the teen teacher experience. (Nicole Marshall-Wheeler)

**1.7 million**

**hours of public service delivered by 14,600 UC-trained volunteers**

**89%**

**of 4-H youth respect the differences and strengths of individuals on the team**

# Building Climate-Resilient Communities and Ecosystems

## Increased preparedness and resilience to extreme weather and climate change

### Protecting wildlife communities from wildfire impacts

While the value of wildlife is broadly appreciated by the public, wildlife populations and communities are in decline across the Western United States as their habitats are altered or converted for human uses such as roads, fences, agriculture, and housing. An AES researcher at UC Berkeley is working to improve our understanding of how human infrastructure impacts wildlife movement, especially for larger mammals, and what types of habitat conservation strategies can help. This research will help inform conservation planning and wildlife management at large scales across the western United States, and has already informed local infrastructure decision-making related to postfire wildlife movement. It is also being incorporated into state and federal strategies for mitigating wildfire impacts on wildlife. (Justin Brashares)

### UCCE provides statewide leadership on land management and wildfire prevention

UC Cooperative Extension (UCCE) academics continued cutting-edge work on climate-resilient land management strategies. For example, 13 workshops statewide provided resources and knowledge on preventative actions against wildfires for 254 private landowners across the state. In a follow-up survey of 110 participating landowners, 86% indicated an interest in prescribed fire, 95% in fuels reduction, 87% in tree-thinning, and 83% in creating a forest management plan. (Kim Ingram) In Lassen County, 12 private landowners and U.S. Forest Service land managers implemented a UCCE Advisor's recommendations on post-fire land restoration, including reseeding, controlling invasive species, restoring meadow sod, and postfire grazing management. Collectively, this represents thousands of acres of private land most heavily impacted by wildfire and hundreds of thousands of acres of U.S. Forest Service land. (David Lile)

## Exploring how temperature change affects plant-pollinator interactions

An AES researcher in community ecology at UC Riverside is researching how changing environmental conditions, such as warming temperatures over time, may disrupt plant-pollinator species interactions. Using controlled greenhouse conditions, the experiment will expose native wildflowers and solitary bees to elevated temperatures to test how interdependent species respond to different levels of warming over multiple generations. The project will yield insight into how plant and bee phenology react to the same shifts in environmental conditions. This information can help bee managers and conservation practitioners better understand how warming temperatures will affect native wildflowers that provide ecologically and economically valuable resources for orchard crop pollinators. (Nicole Rafferty)

## Community resilience models for living with wildfire

New models of resilient community design are critical for fire-prone regions engaged in rebuilding after wildfire, many of which are simultaneously experiencing an increase in new residents. An AES faculty member in Landscape Architecture and Environmental Design at UC Davis is conducting a research project that seeks to incorporate a broader understanding of fire's natural presence, using art and education to connect with communities about the inevitability of wildfires and how to adapt to living in a fire-prone area. The project also aims to develop new strategies that provide community residents with affordable mechanisms for understanding their air quality at local and time-relevant scales. (Emily Schlickman)

## UCCE climate research guides agency decision-making and policy implementation

A UCCE Specialist at UC Merced researched agricultural resilience to climate and weather risks, focusing on climate impacts on specialty and agronomic crops. The California Natural Resource Agency used UCCE's research and extension in their most recent report to guide future policy decisions. The UCCE Specialist also held a position on the agency's expert advisory panel on expanding climate action in response to Governor Newsom's Executive Order. Anticipated impacts of UCCE's research include protecting and restoring practices for carbon sequestration and accelerated climate-smart land management. The findings were also used in a report by the Delta Stewardship Council released in May 2021 called "Delta Adapts: Creating a Climate Resilient Future." (Tapan Pathak)

**5,000**

**acres in the Sierra Foothills and Sacramento Valley are now using grazing for wildfire mitigation**

**$235,000**

**new investments in wildfire preparedness resulting from UCCE's technical assistance**

## UC Climate Smart Agriculture program cuts greenhouse gas emissions

In partnership with the California Department of Food and Agriculture, UC ANR operated the UC Climate Smart Agriculture program, whose statewide educator team provided hands-on assistance to more than 200 farmers and ranchers including grant application assistance, workshops and field days. More than 120 producers received funding after getting technical assistance, and educators assisted the farmers with climate-smart practices such as cover cropping, installing solar panels and installing dairy manure solid separator systems. Collectively, growers supported by the programs have reduced their greenhouse gas emissions by 33,000 metric tons per year: the equivalent of removing 7,000 cars from the road. (Caddie Bergren, Nicki Anderson, Samikshya Budhathoki, Esther Mosase, Valerie Perez)

# Promoting Healthy People and Communities

## Improved health for all

### Text messages entice CalFresh participants to eat California-grown produce

Academics at UC's Nutrition Policy Institute developed and evaluated an innovative pilot project delivering food and nutrition information to CalFresh EBT participants via text-messaging. NPI, the UCSD Center for Community Health, ideas42, and the San Diego County Health and Human Services Agency developed a series of text messages about California-grown produce in English, Spanish and Arabic. The text messages were sent to all CalFresh participants in San Diego County, representing approximately 170,000 households, each month. Each text message included a link to a newly developed, multilingual website that highlighted how to purchase and prepare 24 different seasonal specialty crops and described the health benefits. Surveys from website visitors indicated that 65% consumed more fruits and vegetables after receiving the texts, while 66% reported buying more California-grown produce. Additionally, 79% reported gaining knowledge about eating more specialty crops, while 85% would like to continue receiving the messages. Based on the successes of the innovative text-messaging pilot developed by NPI, the San Diego County Health and Human Services Agency plans to continue sending nutrition education text messages to all CalFresh participants monthly. (Wendi Gosliner, Ron Strochlic, Celeste Felix)

### San Luis Obispo and Santa Barbara youth say "YES" to healthy choices

UCCE academics and supervisors offer local leadership and guidance on the CalFresh Healthy Living, UCCE program, which provides nutrition education aligned with policy systems and environmental change initiatives to improve community health. In 2021, CalFresh Healthy Living, UCCE in San Luis Obispo and Santa Barbara counties provided virtual nutrition education that directly reached 3,288 youth. Out of 282 4th and 5th grade youth surveyed, 70% indicated that when they have a choice, they will try to eat more fruits, 47% will eat more vegetables, 48% will drink more water and 79% will opt for more physical activity. (Katherine Soule, Shannon Klisch, Kelly Hong, Miguel Diaz, Abbi Marrs, Melissa LaFreniere, Betsy Plascencia, Rosa Vargas)

### Upcycled ingredients improve bioavailability and delivery of supplements

An AES researcher in food science and technology at UC Davis is working to develop new formulations that improve the bioavailability and delivery of nutritional supplements and probiotics. These formulations combine spent ingredients from food processing industries such as grape pomace or apple pomace with nutritional supplements or probiotic bacteria using a patented technology developed at UC Davis. In the case of nutritional supplements, it enhances the delivery of bioactive components to the gut. In probiotics, it enhances the survival of probiotic bacteria during digestion and enhances the persistence of these

probiotics in the gut. These formulations also improve products' shelf life and stability during storage, helping to meet the needs of industry and consumers for more sustainable products that improve human health. (Nitin Nitin)

### CFHL, UC leads efforts to improve health by community design

CalFresh Healthy Living, UC catalyzes policy, systems and environmental changes statewide to promote community health. For example, policy, systems and environmental changes statewide were improved or expanded for edible gardens at 93 sites by distributing seedlings and materials for gardening at 84 sites, incorporating garden produce for meals and snacks at 22 education sites, and distributing produce for families at 17 sites. (CFHL, UC) Local programs such as CalFresh Healthy Living, UCCE in San Luis Obispo County engaged 41 of their partners to collectively adopt 47 nutrition and four physical activity changes, reaching 13,327 community members. (Katherine Soule, Shannon Klisch, Kelly Hong, Miguel Diaz, Abbi Marrs, Melissa LaFreniere, Betsy Plascencia, Rosa Vargas) CalFresh Healthy Living, UCCE in Santa Clara, San Mateo, and San Francisco promoted healthy changes at 51 sites by deploying innovative virtual taste-test strategies and seedling delivery programs that continued farm-to-school and Smarter Lunchroom Movement efforts despite pandemic restrictions. (Laura Vollmer)

## Improved community health and wellness

### Tribal partners in Riverside County develop new healthy systems and strategies

CalFresh Healthy Living, UC and UCCE in Riverside County partnered with the Torres Martinez Desert Cahuilla Indian Tribe on three projects to advance community health initiatives. The tribal youth participatory action research project engaged 11 youth ages 12-17 to explore the local food environment and contributed to the tribe's decision to reinstate the Tribal Youth Council, which uses youth feedback to design community programs. Additionally, an intergenerational group of 32 tribal members participated in the vegetable planting in the A'Avutem (elders) garden, 30 participated in a UCCE-led farm tour, and 20 youth participated in CalFresh Healthy Living, UCCE education on farm-to-school. The Tribe recently formed a Community Wellness Committee to guide their Centers for Disease Control-funded Advancing California's Opportunities to Renew Native Health Systems (ACORNS) project, which will instate culturally tailored healthy policies and connections between clinical and community services that address chronic disease. (Chutima Ganthavorn, Andra Nicoli)

### UC 4-H mindfulness curriculum promotes positive mental health for youth

Mindful Mechanics, a mindfulness curriculum developed by UC ANR and the University of New Hampshire, was designed as a tool to have mental health conversations and interventions with 4-H youth members ages 12 and older. In 2021, a statewide, virtual project featuring 13 lessons for teens took place in the winter: about one year into stay-at-home orders started exacerbating mental health issues for many youths. The project taught youth proven methods for increasing positive psychology such as checking in with their bodies, managing thoughts and emotions, focusing on the present moment, practicing gratitude and positive self-talk, and visualizing joy. Mindful Mechanics was adopted by the National 4-H program to have mental health conversations and interventions with 4-H youth members nationwide. (Anne Iaccopucci, Katherine Soule)

## Improved access to positive built and natural environment

### UC Master Gardener volunteers improve community gardens

The UC Master Gardener Program teaches people how to grow food and garden sustainably through public education workshops and outreach. Gardening interventions also have the potential to benefit the broader community. A 2016 nationwide study found that living near greenery may help a person live longer due to less air pollution, more physical activity, more social engagement, and better mental health as measured by a lower prevalence of depression. In 2021, 76 public participants in the UC Master Gardener volunteer-led educational programs reported in a statewide survey that they have applied skills in sustainable gardening practices that they learned from the program to over 510,000 square feet of school and community gardens, providing an important benefit to their broader communities. (UC Master Gardener)

**510,000**

**square feet of school and community gardens improved with the support of UC Master Gardener**

**28,000**

**individuals benefited from policy, systems, and environmental changes at 210 CFHL, UC sites**

## For questions about this annual report please contact

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