

UNIVERSITY OF CALIFORNIA
DIVISION OF AGRICULTURE AND NATURAL RESOURCES

2012 Combined Research and Extension
Federal Annual Report

Agricultural Experiment Station
and Cooperative Extension

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**2012 University of California Combined Research and Extension Annual Report of
Accomplishments and Results**

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I. Report Overview

Executive Summary

The University of California Division of Agriculture and Natural Resources (UC ANR) is the major land grant arm for the university and the state, as part of the nationwide public university system "built on behalf of the people" (Abraham Lincoln). The Agricultural Experiment Station (AES) was established to develop cutting-edge research information that can be applied to solving real-world problems in agriculture and natural resources. Cooperative Extension (CE) was created as a cadre of academics housed in local communities to translate and test research findings for practical, local solutions. UC ANR is unique in its three way partnership with federal, state and county governments to provide these local and statewide research and extension programs that address the critical issues of California. Through its partnerships and collaborations, UC ANR is able to leverage its resources to increase its ability to address these issues.

UC, ANR's mission is to:

- Maintain and enhance connections that fully engage UC with the people of California
- Achieve innovation in fundamental and applied research and education that supports sustainable, safe, nutritious food production and delivery systems
- Economic success in a global economy
- A sustainable, healthy, productive environment
- Science literacy and youth development programs

The UC ANR system currently has academic led programs in every county in California through Cooperative Extension (CE), providing direct connections to the people of California. The Agricultural Experiment Station faculty members conduct research and teach in three colleges and one professional school on the Davis, Berkeley and Riverside campuses. Nine research and extension centers (RECs), located in a variety of ecosystems across the state, provide a core research and extension base. Six statewide programs focus on specific issues that engage UC ANR academics and UC faculty from all the other campuses, allowing integrated teams to work on complex issues that need multidisciplinary approaches.

The AES has nearly 700 academic researchers, most of whom also have professorial appointments representing dozens of scientific disciplines. Cooperative Extension, the principal outreach arm of the Division, comprises academic appointees attached to campus departments as CE specialists or county offices as CE advisors; there are about 130 specialists and 200 advisors.

FY 2012

The Division continued to tackle the cuts resulting from California's enduring state budget crisis. UC ANR's budget reduction decisions aimed to reduce administrative overhead while focusing programs and people on the future through the Strategic Vision. The resulting restructured organization is responsive to the needs articulated in the Strategic Vision and represents a strong administrative and programmatic platform for the future. Given ongoing budget cuts, UC ANR continues to seek alternative ways to support our programs.

UC ANR continues to explore the recently developed Cooperative Extension multi-county partnership model, which aims to reduce costs while maintaining the strength of programs. Significant input from internal and external stakeholders developed and guides this strategy to increase administrative efficiency. It is to be used, where appropriate, instead of the historic individual county-based administrative units. UC ANR's first multi-county partnership was successful in saving the four participating counties and the University funds while supporting local programs. The established guiding principles and best practices are being used for the subsequent multi-county partnerships under development. During FY2012, a new County Directors Council was formed to identify issues and gather information on matters of importance to UC Cooperative Extension. This council participates in the ongoing evaluations and discussions with the internal task forces formed to analyze the potential for multi-county partnerships around the state.

The Division's priority continued to be hiring new academics, given UC ANR staffing is well below optimal levels. During FY 2012 a call for positions proposals resulted in 46 CE advisor and specialist positions being released for recruitment and hiring during FY 2013 and FY 2014.

UC ANR continues to make significant progress toward its Strategic Vision 2025. The Vision identifies multidisciplinary, integrated Strategic Initiatives that represent the best opportunities for UC ANR's considerable infrastructure and talent to seek new resources and new ways of partnering within and outside the University to find solutions to the issues that will be facing California in 2025. Since FY 2009, UC ANR has been working on the following four initiatives: 1) Healthy Families and Communities; 2) Sustainable Natural Ecosystems; 3) Endemic and Invasive Pests and Diseases; and 4) Sustainable Food Systems. During FY 2012, a fifth Strategic Initiative on Water Quality, Quantity, and Quality was launched.

During FY 2012, UC ANR also launched two new special programs. The California Institute for Water Resources has the mission of supporting research and extension activities that contribute to the efficient management of California's water resources. The institute coordinates water-related research, extension and education efforts across the 10 UC campuses and across the UC ANR system. In addition, a new statewide program Informatics and Geographic Information System (IGIS) was created to become the nexus for the Division's rich and diverse geospatial and ecological data, research information, and resources for academics and the public who rely on geospatial and informatics data, analysis and display. Through data capture, information sharing, and collaboration, the aim is to increase the ability to make meaningful predictions of the agricultural, ecosystem, and community response to future change, to increase our understanding of California's diverse natural, agricultural and human resources, and to support research and outreach projects that enhance agricultural productivity, natural resource conservation and healthy communities into the future.

Guided by the five initiatives' plans, which identified focused areas of inquiry and needed areas of outreach, UC ANR completed a second round of the restructured internal competitive grants program to award \$3.8 million to sixteen projects over five years.

For FY 2012, California reports on the following seven Federal Planned Programs:

1. Healthy Families and Communities
2. Sustainable Food Systems
3. Sustainable Natural Ecosystems
4. Endemic and Invasive Pests and Diseases
5. Sustainable Energy
6. Climate Change
7. Water Quality, Quantity, and Security

The following narratives describe the FY 2012 program highlights for these Federal Planned Programs.

Healthy Families and Communities

Despite California's \$37 billion agricultural industry and world-renowned private and public universities, its residents face a crisis in the health and education of our young people: high childhood obesity, rising school dropout rates and low student achievement. UC ANR's Healthy Families and Communities strategic initiative addresses major factors contributing to childhood obesity, positive youth development and science literacy through campus and county based research and outreach programs. Contributing studies spanned the age spectrum and probed micro areas within genetics, nutrient-disease relationships to macro socio-economic systems with diverse audiences and geographic locations ranging from small rural to large urban areas within the state and internationally.

Seventy six Hatch and Multistate Research projects were awarded to investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 21 research and extension projects. CE advisors worked on 263 extension projects, and led an additional 22 research projects under the Federal Planned Program Healthy Families and Communities. The following discussion illustrates some of the significant work that was conducted by UC ANR:

Childhood Obesity

Childhood obesity is a major health, public health, and policy issue: approximately 25 million children in the United States are obese or at risk of becoming obese, with probable negative consequences for their health and for the nation's future health care costs; it is an issue that has received a significant media scrutiny and debate about how to address the pervasive problem. UC Cooperative Extension researchers are conducting nearly 10 studies to understand how obesity manifests in childhood and how to prevent it. For instance, an intervention study is examining whether dietary behavior for students can be modified, and promising results show that student knowledge improved significantly from baseline to follow up after the intervention. In another intervention study, the impact of community based programs to increase fruit and vegetable consumption in low income youth is being measured and current data show that student nutrition knowledge, attitudes, and behaviors are improving. UC Berkeley's Atkins Center has focused on several projects to promote healthy environments to

prevent obesity involving a variety of sections and partners.

Human Nutrition and Health

Researchers continue to identify links between nutrition and health from cellular to behavioral levels. Researchers investigated the mechanisms underlying how fruits and vegetables protect against obesity and nutrition related diseases such as inflammation, which can lead to cancer and have revealed exactly how soy products promote health through metabolism. Another study examined how people apply nutrition knowledge to dietary decision making and found that older adults effectively use food labels particularly well when they have specific dietary goals (e.g., sodium restriction). Researchers have identified behavioral factors that influence adolescents' consumption of calcium rich foods; the data will be used to design more effective prevention programs targeted to sub-groups at high risk for osteoporosis. Nearly three dozen studies are being conducted on health and diseases, and diet and nutrition.

Nutrition Education

Two UC Cooperative Extension nutrition programs, the Expanded Food and Nutrition Education Program (EFNEP) and the UC CalFresh Nutrition Education Program (also known as SNAP-ED), work with community agencies and schools to deliver nutrition education to low-income families, including adults and youth, to improve health, food security and assist in prevention of childhood obesity. The EFNEP and CalFresh programs are delivered in 33 counties and reached over 222,000 participants. EFNEP led to a 90% improvement in nutrition practices, an 85% improvement in food resource management (food budgeting skills), a 70% improvement in food safety practices, and a 38% percent increase in physical activity. In collaboration with UC CalFresh, UC Cooperative Extension and UC Davis researchers developed the Taste Test Tool and Teacher Observation Tool to evaluate program effectiveness. Both tools showed that nutrition education was effective: teachers reported that at the end of the program year, youth were over 60% more likely to bring fruits to school as snacks; over 90% more likely to identify healthy food choices, and over 60% more likely to choose fruits and vegetables in the cafeteria and during parties. Younger children were more likely to try new foods again and ask for the foods at home than middle and high school aged children.

Positive Youth Development

In addition to health concerns, California's youth are also facing challenges such as dropout rates and low science literacy rankings. In contrast, children who are thriving are less likely to engage in risky behaviors that might be detrimental to our society and economy, and instead are more likely to be positive contributors to our workforce. Thriving and positive youth development is fostered through research and through UC Cooperative Extension's 4-H Youth Development Program. A UC Davis child care environmental planning project led to a change in the design of an outdoor play structure. A study about helping students cope with negative peer interactions (i.e., bullying) resulted in workshops and trainings for teachers, parents, and information was disseminated through the UC Davis teacher's credential program. "Just In Time Parenting" research demonstrated documented changes in use of positive parenting behaviors-- associated with lower risk for child maltreatment and improving positive outcomes for young children-- among participants. All told, nearly a dozen studies were being conducted on health and mental health outcomes for children and adolescents.

Direct programming to promote positive youth development provides youth with numerous times to participate in projects. Overall, over 71,500 youth were engaged in community clubs, camp programs, and school programs through the 4-H Youth Development Program. Youth participate in projects ranging from agriculture; livestock; science and engineering; and healthy living activities including food and nutrition, and physical activity, for example:

- **Science Literacy:** Youth participated nearly 65,000 times in 4-H science, engineering and technology projects. After participating in Sacramento Water Wizards--a 12 week science education program about the importance of water, 65% of students indicated they were using less water. 4-H's On the Wild Side program showed that 75% of students increased their knowledge about nature and the environment. Youth used 4-H Revolution of Responsibility grants to purchase and plant almost 300 trees in San Mateo County; and build a walking trail at Ormond Beach, the largest wetland in California.
- **Healthy Living:** Youth participated 32,523 times in projects aimed to address healthy living--which is a holistic approach to well-being. For instance, youth developed and submitted and received two grants from the California 4-H Revolution of Responsibility and used them to purchase and deliver fruit and vegetables to 65 students. Other youth developed a cookbook featuring 100 healthy recipes from local cooks and made them available at no cost to families who use the Nevada County food bank.
- **Citizenship and Leadership:** Young people who are engaged in their communities and organizations in meaningful ways are more likely to be civically involved and philanthropically inclined throughout their lives. Youth were engaged 13,000 times in various 4-H citizenship projects. A dozen 4-H youth were trained and co-facilitated youth focus group discussions about community activities, drugs, gang activity, and teen pregnancy. After attending a state conference to better understand civic engagement two young people designed a flag for their county. 4-H youth used their Revolution of Responsibility grants to "adopt" families and senior citizens around the holidays and provide them with Christmas gifts and meals; provide bathroom safety equipment to senior citizens living independently; and created a device called a "U-lift" to help them recover from falls. Youth also secured, assembled, and distributed 250 first aid kits to the community.

Results from the past year reinforce the need for the research, education, and extension network which integrates lab and applied research to achieve healthy families and communities. Formal and non-formal education settings are showing impacts in factors influencing childhood obesity, human health and nutrition, positive youth development and science literacy.

Sustainable Food Systems

Projected population growth, widespread poverty, and declining agricultural productivity within the context of climate change create an urgency to increase food production in ways that are more efficient and sustainable. Food security is both a national and global issue. California agriculture plays a vital role in providing an abundant source of safe, nutritious, and remarkable inexpensive food for its residents, the nation, and the world. California has been an innovative leader in food production for more than a century. California is a major producer of vegetables, fruits, nuts, and dairy products, which are healthy and under consumed sources of nutrition for Californians and people nationwide. California agriculture faces unprecedented challenges to its

sustainability, including climate change, water, regulation, labor, invasive species, urbanization, and other factors.

Two hundred and forty six Hatch and Multistate Research projects were conducted by investigators at UC Riverside, Davis, and Berkeley with an agricultural focus. CE specialists worked on 55 research and extension projects. CE advisors worked on 444 extension projects, and led an additional 87 research projects under the Federal Planned Program: Sustainable Food Systems. The following projects illustrate the types of range of projects with important results being conducted by academic and non-academic personnel located in county extension offices, the three UC ANR campuses, several Research and Extension Centers, and occasionally on USDA facilities in collaborative efforts:

Specialty Crops

- Research on post-harvest quality and safety in fresh-cut vegetables and fruit, assessing consumer practices that may increase or reduce the likelihood of pathogen growth or survival; this data will be useful for quantitative microbial risk assessment and the development of scientifically sound consumer food safety message. Other results included information about the control of light brown apple moths with a safer fumigant for humans and the environment; finalized treatments for black widow spiders which should improve the quality of table grapes; and demonstrating practices for inhibiting the development of blossom end rot on tomato.
- Research addressing the need of specialty crop producers for sustainable and affordable pest management technologies by providing in-kind support for the USDA's IR-4 project. The increased availability of new reduced-risk pesticides has helped California's fruit and vegetable growers reduce their use of older, broad-spectrum pesticides by 66% in the past 12 years. Lastly, UC researchers also continue to support work to increase the viability of Southeast Asian agriculture in California by helping Hmong and Mein farmers gain access to direct marketing.
- One project focused on the molecular genetic improvement of California specialty crops had multiple impacts. It demonstrated a new strategy for the significant improvement of tomato fruit quality using classical plant breeding approaches. The research has also continued to identify and deploy new approaches to manage patented technologies that are important for agricultural innovation, and to advance projects from proof-of-concept stage to commercial deployment. The strategies developed for marker-free transformation of crops is now being adopted for commercial and humanitarian applications in California and Africa. This work has significant applications for intellectual property.

Plant Production and Genetics

- Pollination is of vital importance to agricultural productivity. UC researchers are determining the potential of native bees as pollinators for almonds and other crops, and have developed lists of plant species that support native pollinators. Farmers, gardeners and school groups are putting into practice bee friendly habitat using guidelines provided.

- One project led to the development of six new peach rootstocks that have been or in the process of being release for commercial use. The rootstocks are of great interest to producers because of their potential to be used in modified orchard systems that limit tree height to levels that make it possible to manage trees from the ground without level. The adoption of the rootstocks by producers has been impressive.
- A biotechnology project assessed agricultural biotech products of relevance to California agriculture; assessed other emerging technologies of relevance to California, including prospective synthetic biology products; and assessed regulatory policy, with a focus on science-based safety and trade policies. This research has been requested for use by the White House for a Presidential Memorandum, and by other federal agencies.
- Seeds represent the primary food source for the majority of human populations. Seed formation is also critical to the formation of most fruits. UC's work in genetic and molecular analysis of ovule development provides new information on the critical process of ovule development and the regulation of plant development. This understanding translates into novel methods for engineered regulation of gene expression for crop improvement or biomedical applications.

Plant Protection

- The project focused on enhancing biodiversity in agroecosystems to improve pest regulation and sustainable production provides a scientific evaluation of on-farm habitat management strategies to develop cost-effective biological control options of important arthropod pests of California vineyards. Many farmers adopting the various Floral Resource Provisioning (FPR) designs have reported that they have been able to reduce the application of insecticides or organic products for pest control. Some farmers reported that the use of certain flower mixtures have brought additional benefits, including weed suppression, improved soil quality, and improved water storage. The training of farm workers on insect identification and monitoring has proven useful.
- California is the leading strawberry producer. The phase out of methyl bromide could result in great crop losses from soilborne pathogens and weeds, causing severe economic distress for growers, price increases for consumers and reduced competitiveness for growers in international markets. UC researchers are evaluating alternative chemicals and practices for crop production. Integrated weed management strategies may allow reduced pesticide inputs and ease some of the regulatory concerns surrounding many of the older vegetable herbicides, as well as hold down production costs.

Animals and Their Systems

- A series of applied animal behavior and welfare projects develop animal behavior measurement techniques to assess on-farm welfare challenges and evaluate alternative management strategies, with a focus on improving animal welfare and reducing losses in poultry production. Another project assesses the optimization of poultry welfare and production systems by evaluating natural behaviors of hens, such as dustbathing, and various methods to facilitate that behavior. Additional work focused on extending the uses of poultry genome sequencing efforts and technology development to understand genes important in growth and development. Marek's disease, a leading cause of

mortality leading to substantial economic losses to the poultry industry is also being evaluated. New knowledge is being developed on molecular mechanisms of host-virus interactions, which may lead to novel intervention and breeding strategies to impede this disease.

- Research on the integration of ruminant digestive, metabolic and energetic relationships is producing results that are being used to improve model description of the characteristics of beef cattle production in grass fed systems, an area of growing consumer demand and market opportunity for California beef producers.
- Air quality remains a vitally important concern in California. Understanding the range of emissions from dairies and poultry operations is a major prerequisite for designing emission mitigation strategies. UC is gathering scientific measurement data and developing process-based emission models that will allow the analysis of factors that affect emissions under different farm management practices and environmental conditions.

Technological Innovation

- One project exploring rapid assessment tools for monitoring food and forage utilized an array of technologies to monitor: 1) workers for exposure to pesticides; 2) foam in furniture sold in California for the use of illegal fire retardants; and 3) biosolids from sewage treatment.
- Research focused on improving efficiency of irrigation and nutrient inputs in vegetable production has helped transform the tomato industry through drip irrigation and soil fertility management guidelines. The work is also being used in production of leafy greens and strawberries.
- Research on precision irrigation, fertilization, and management of specialty crops by wireless sensor networks features wireless nodes and actuation hardware/software. Precision agriculture leads to economic and environmental benefits since it involves applying inputs such as chemicals and water on a site-specific basis to enhance crop yield, reduce inputs, and/or reduce environmental damage.
- Research demonstrated the feasibility of using an x-ray transmission sensor to automatically detect the location of transplanted row crops in the field during cultivation. Results show that the sensor was accurate and could be used to automatically control the operation of mechanical weed knives, potentially providing farmers with an alternative to manual or chemical methods of weed control within the crop row. Researchers also worked on a project to develop mechanical harvesting for California black ripe processed olives.

Economics, Markets, and Policy

- Research assessing immigration and the competitiveness of California agriculture explain how immigration, trade and other policy changes are and are likely to affect the U.S. farm labor market. The impacts of migration and likely effects of changes to immigration were examined and have been shared broadly with policy makers.

- Impact analyses and decision strategies for agricultural research link that an earlier slowdown in agricultural research and development spending is likely to have contributed to an observed slowdown in agricultural productivity growth around the world since 1990. The research on returns to U.S. agricultural research and development also demonstrated very long lags, very significant interstate spillovers of benefits, and very high benefit-cost ratios implying continuing chronic underinvestment.
- Research on the theory and applications of commodity market modeling is influencing the approach to price analysis in the FAO and the World Bank. It is also relating developments in biofuels incentives and mandates to effects on food and fiber.
- Research in expanding Community Supported Agriculture sales and access in California produced data that was requested by the California Department of Food and Agriculture for use in rewriting California's direct marketing code, which will likely include CSAs.
- UC's work in agritourism is enabling small and mid-scale producers to diversify their operations. 355 producers were trained in agritourism challenges and opportunities, business planning, risk management, hospitality and effective marketing. The work also facilitated the development of new regional networks, and engagement with local planning and community development agencies to reduce permitting and regulatory barriers. Since the training 14% of participants hosted visitors for the first time; 30% have begun planning new agritourism activities; and 92% of non-farmer participants have helped promote agritourism in their area.
- A California agroecosystem assessment project continues to engage external stakeholders and policy makers.
- Initial outreach results of the nitrogen assessment project are being used by practitioners and policy makers alike.
- Through the study of etiology, epidemiology, and control of virus diseases in grapevines, fruit and nut trees, roses and strawberries, UC researchers have produced information on management of virus diseases which has had an impact on the management of nurseries producing these crops. The work has resulted in a revision to the Registration and Certification regulations for grapevines and trees.

Sustainable Natural Ecosystems

The term "Natural Ecosystems" refers collectively to the forests, rangelands, and wetlands. In California, these lands are typically upstream or downstream of intensively managed agricultural and residential lands. They provide valuable goods and services to society but their ecological diversity and mixed ownership increase the complexity in regards to ensuring their sustainability. A central theme of the SNE program is to better understand the ecological and physical process that control overall system productivity and thereby better understand how these processes are managed in our highly variable climate. Even the ecosystems in federal parks and wilderness areas have significant interactions via fires, atmospheric-land deposition and emissions, with the private and public landscapes that are valued for the goods and services that are consumed or managed by California's residents. Population growth, climate change, land use change and fragmentation, and limited science

literacy about these ecosystems are adding to the challenges. The goal of the ANR Sustainable Natural Ecosystems Strategic Initiative and Federal Planned Program is to have a large positive impact on California's natural resource ecosystems.

One hundred and twenty four Hatch and Multistate research projects with a natural resources focus were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 28 research and extension projects. CE advisors worked on 109 extension projects, and led an additional nine research projects under the Federal Planned Program Sustainable Natural Ecosystems. Projects are being conducted in several areas that are essential to sustaining California's natural resources. A few illustrative examples of the breadth of projects along with selected examples of high impact programs follow.

Range Resources Management

California's extensive grasslands are composed of mixes of annual grasses, perennial grasses, and well as various invasive or weed species. Streams, other water bodies, shrubs and scattered trees add to the complexity. In some sites, shrubs rather than grasses are the dominant plant. At the basic ecological process level, ongoing research is exploring the competition and productivity of these systems so that both grazing management and restoration efforts will be more effective. Where cattle and sheep grazing are practiced, new research is suggesting new ways to fine tune livestock control practices such as riparian fencing and herd movements to attract livestock away from environmentally critical areas or into areas targeted for grazing. A recent ANR publication documents the practices that can be applied in California and other western states. While the per acre rates of deposition and emissions may be small, ongoing research into the nitrogen, carbonate-carbon dioxide, and fire related processes illustrate their global importance when considering the roughly 50 million acres of rangelands (including desert rangelands) in California.

Aquatic and Terrestrial Wildlife Conservation

The viability of fish populations that bisect agricultural and urban areas as freshwater flows to the ocean is a key integrating factor across all natural ecosystems in California. Research was conducted and publications produced to develop a better understanding the factors controlling the resilience and persistence of fish populations in both systems flowing through small streams into the San Francisco Bay as well as into larger rivers flowing into the California Bay-Delta. Decades of fish population and related habitat data collected and analyzed for streams, rivers, and wetlands across California are proving invaluable as the state continues to work on refining sustainable and robust systems move water from natural bodies to urban and agricultural uses.

Forest Resources Management

In the woodlands and forest areas that are typically upslope of the grasslands, research and publications defined how improving wildlife habitats can be integrated into the land management practices of private and public land managers. In addition, new tools are being developed to identify the occurrence and potential spread of two new sources of hardwood tree mortality, Sudden Oak Death (SOD) in Northern California and Golden Spot Oak Borer (GSOB) in Southern California. In addition to the technical work of tool development, a major investment is being put into spreading the understanding to urban residents and youth who, because of their large populations, will be central to effective management of these new vectors of mortality

that are more prevalent in recreationally oriented forest lands than production oriented lands. The crucial role of water use by overly dense forests due to decades of fire suppression and the remaining runoff into streams and rivers is also a focus of UCANR research. Droughts, warming weather and changing precipitation patterns will affect forests, stream flows, as well as the fish populations and the diverted water that is moved around the state to support agriculture and urban areas.

Wildfire Management and Control

Another important issue for natural ecosystems on the residential fringe is addressing the seasonally high level of wildfire risk that can often be the single largest type of resource management expenditure in these areas. Educating homeowners about fire-safe landscaping is one of the most effective ways to connect landowners with their quasi-natural surroundings, increase fire safety, reduce costs associated with property destruction, and reduce the risk of erosion and debris flows after a fire. The UCCE Sustainable and Fire-Safe (SAFE) Landscapes program focuses on helping wildland/urban interface homeowners create and maintain fire-safe landscaping around their homes and neighborhoods. Combined with the statewide efforts to educate homeowners through online tools to ensure that all homes are more resilient to any fire risks, these efforts can significantly reduce the costs and losses that result from the interaction of residences and seasonal wildfires.

Understanding and Valuing Ecosystem Services

Across all of these natural ecosystem-based activities, UC ANR professionals worked with the institutions that combine private and public interests, and have the goal of developing clearer linkages between the provision of ecosystem services and the necessary financial remuneration to continue effective resource management. A significant component of this work has been related to the increasing interest in the need to separate out financing that would create truly global climate benefits in terms of mitigation (e.g. reduce net CO₂ flux into the atmosphere) and adaptation (e.g. direct social investment to increasing the social portfolio of desired attributes such as biodiversity in location x,y,z given the high probability of large alterations in future climate averages and extremes. As California learned in the Enron saga associated with energy deregulation, the potential for accounting trickery is great when innovation is led by financiers with little oversight from publicly financed researchers.

Endemic and Invasive Pests and Diseases

Pests and disease affect the viability and productivity of agriculture, natural resources, public health and the environment of Californians. The speed and frequency of international travel today, combined with the volume of imported food, commodities and materials have greatly increased the rate of establishment of invasive pests and diseases in California. As global climate patterns shift, the distribution of pests and diseases will change, and many habitats will become more susceptible to new threats. The Endemic and Invasive Pests and Diseases Initiative goals are to foster research and extension programs that 1) exclude pests and diseases through improved detection and diagnostics, 2) develop information that responds to emerging problems with pests and disease, and 3) provide long-term integrated pest management (IPM) solutions for established pests.

One hundred and sixty four Hatch and Multistate Research projects were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 62 research and extension projects. CE advisors worked on 298 extension projects, and led an additional 86 research projects under the Federal Planned Program Endemic and Invasive Pests and Diseases. The following discussion illustrates some of the 2012 research highlights within each of these EIPD initiative goals:

Exclusion of pests and diseases through early detection and diagnostics

The first step in controlling the damage of any pest or disease, be it arthropods, vertebrates, weeds, or pathogens, is to exclude it from entering a new region. Exclusion includes diagnostics, detection and interception. Eradication of pests and diseases may be feasible if an early detection system is in place. Lack of early detection may result in expensive pest and disease management costs in the long-term, disruption in commerce and industry prosperity, and human and animal health impacts if diseases are involved. The following are examples of UC ANR projects addressing problems in the areas of detection of invasive pests and diseases:

- Verticillium wilt on vegetable crops is caused by *V. dahliae* and on crucifer crops the disease is caused by *V. longisporum*, a hybrid pathogen of unknown origin. Using genomic, phylogenetic, morphological and taxonomic approaches, a research team provided evidence for the potential origin of *V. longisporum*, and determined that hybridization between unrelated pathogens is perhaps the norm in the evolution of new pathogens. This team undertook a major reassessment of the genus *Verticillium*, and described five new species. The molecular diagnostic tools for all species can be used in quarantine laboratories to intercede the pathogens before they are moved to areas where they don't yet occur.
- Research has shown that the predatory lady beetle, *Psyllabora vigintimaculata*, is a potentially important predator of powdery mildew in both greenhouse and orchard grape ecosystems. After studying this beetle in the greenhouse, researchers discovered that it could detect and respond to very low powdery mildew infestations. In some situations the beetle is better at detecting early infestations of powdery mildew in the field than visual assessment or spore trapping, and could be used to better time the first fungicide sprays.
- Soil-dwelling nematodes affect the growth and health of plants and can be parasites of vertebrates. Several research teams have conducted soil sample collection from California, isolation of nematodes from soil, establishment of in vitro cultures, light microscopy, photographic image acquisition and analysis, nematode morphometrics, nucleic acid extraction, PCR primer design, polymerase chain reaction amplification, DNA sequencing, contig assembly, multiple sequence alignment, and phylogenetic analyses. These gene sequences are of value to ecologists, nematologists, soil scientists and regulators because they are a type of "DNA barcode" for nematode identification.
- A research team developed methods for the detection of *Fusarium oxysporum* f. sp. *vasinfectum* race 4 in seed and soil. These methods can be used by the California cotton seed industry to ensure that the fungus is not moved within California or from California to other states and countries. Because race 4 is highly virulent on many Pima

cultivars, the ability to detect this fungus in a field will influence crop or cotton cultivar choices. Study of the races that occur outside California resulted in the discovery of at least of three yet to-be-named races which are highly virulent on cotton cultivars commonly grown in California.

- Because of their economic importance, there is intense interest from forestry and regulatory personnel in developing pheromone-baited traps for detection of cerambycid beetles, particularly for invasive species. Research determined that a number of the pheromone compounds can be blended to make generic lures to attract multiple species simultaneously. The University of California is working with USDA-APHIS to move these pheromones towards commercialization, and to make them available to forest managers and regulatory personnel charged with the detection, interception, and eradication of exotic species.

Emerging problems with pests and diseases

When new pests and/or diseases emerge, they need to be addressed in order to protect animal health, plant health, public health, food security, food safety, and the environment. Often newly arrived pests and diseases are problems because they lack natural control agents, creating devastating problems as they spread. Endemic pests and diseases can also develop into more serious problems because of external factors such as changes in climate and plant/animal management practices. The following are examples of UC ANR projects addressing problems in the areas of emerging problems with pests and diseases:

- Obscure mealybug (*Pseudococcus viburni*), Gill's mealybug (*Ferrisia gilli*) and vine mealybug (*Planococcus ficus*) have spread throughout California's grape-growing regions. Research has demonstrated these mealybugs serve as vectors of grape leafroll associated viruses. Research determined that a particular species of grapevine leafroll virus is driving a disease epidemic in Napa Valley. This is important because different species are transmitted by different insect vectors and management is dependent on identification of the correct etiological agent.
- The invasive glassy-winged sharpshooter is the vector of the grape pathogen *Xylella fastidiosa*, the etiological agent of Pierce's disease. Research projects examined the impact of grape variety on disease epidemics, the success of area wide treatment programs for reducing the number of vectors, the success of nursery treatments to prevent spread of the vector, determined that the origin of the pest was Central America, identified novel genes from grapes that would prevent infection or symptom development, began the development of transgenic plants that could resist the disease, and identified autotransporters as targets for the design of novel vaccines.
- Assays indicated that light brown apple moth is less heat tolerant than many other invasive tortricids. Species distribution models were developed for light brown apple moth which generated predictions for the potential global distribution of this leafroller pest.
- Downy brome and medusahead are the most problematic invasive annual grasses in rangelands of the western United States. However, there are no effective control strategies for these species in sagebrush habitat and control is difficult in grasslands and other rangelands. In addition, ranchers are limited in what they can afford to do for the

control of medusahead, particularly in the northeastern region of California and in the Great Basin sagebrush community. This project showed that low rates of glyphosate applied at the medusahead tillering stage in late April to early May provided 95% control of medusahead and a reduction in seed production.

- Research on Sahara mustard invasions in desert environments showed that this species has an earlier life history and more rapid growth to reproductive stage than other closely related mustard species, allowing it to spread into desert environments yet escape drought conditions. Thus, in addition to drought tolerance, rapid plant phenology may serve as a predictive trait for other potential invaders of arid and highly variable ecosystems.
- The endosymbiotic bacteria *Wolbachia* has been shown to infect the *Aphytis* wasp parasitoid of the California red scale, *Aonidiella aurantii*. This bacteria causes reproductive incompatibility between infected and uninfected strains. *Aphytis* in all five commercial California insectary populations were shown to be infected, and it appears wasps present in very hot areas of California can be naturally heat cured. These studies will help guide how augmentative releases of *Aphytis* should best be used on citrus in the San Joaquin Valley of California where more than 75% of the states citrus is now produced.

Integrated Management

When pests and/or pathogens become established in California, integrated management tactics are needed to reduce their impact on agriculture, natural resources, communities, and human health. The following are examples of UC ANR projects addressing integrated management of pests and diseases:

- Large scale field demonstrations of pheromone mating disruption programs in commercial orchards were conducted and provided a cost-effective feasible program for controlling key pests such as codling moth and navel orangeworm in pears and walnuts.
- Research was conducted to address the serious food safety problem of aflatoxin contamination in almond and pistachio nuts in California. Aflatoxin, a toxin produced as a secondary metabolite of the two filamentous fungi, *Aspergillus flavus* and *A. parasiticus*, is demonstrated to have potent carcinogenic effects in laboratory animals and acute toxicological effects (even deaths) in people. Research was conducted to determine factors affecting shifts in the soil populations of *A. flavus*/*A. parasiticus* towards an increase of the highly toxigenic populations, displace these toxigenic populations by adding a mixture of atoxigenic strains of *A. flavus* in commercial orchards, and reduce aflatoxin contamination in nuts.
- Modeling pest manager collected data, researchers found that by clustering cotton fields, pest damage generated by *Lygus hesperus* can be reduced. Research also identified neighboring crops that were associated with higher *Lygus* densities (e.g., safflower, oats, grapes, onion, uncultivated agricultural fields) and crops that were identified with substantially reduced *Lygus* bug densities (alfalfa, cotton). This can help farmers to 'design' the layout of fields within their ranches to reduce the severity of *Lygus* infestation and the need for costly and disruptive pesticide applications.

- Demonstration projects showed that spray applicators can reduce the amount of pyrethroids used to control ants in homes by about 75% and still provide excellent control. This has the potential of reducing the amount of pesticides applied in urban settings by hundreds of thousands of pounds per year in California. In addition, it will dramatically reduce the potential runoff of pesticides into urban waterways.
- Various mosquitoes, particularly *Culex tarsalis* are major vectors of bird malaria in Fresno County. There is now proof that continued pressure by environmental lobbyists to reduce pesticide use in US Waters will impact local riparian songbirds. This is significant because it justifies continued mosquito control not only from public health perspective but also to reduce impact of mosquito borne wildlife diseases.

Sustainable Energy

Public policies that add the production of biomass feedstocks for power and fuel to the existing objectives of agricultural production systems have affected the work of many ANR scientists and extension advisors. Both purpose grown crops and crops residues are used or will be used for these purposes. Adding new demands on agricultural systems alters demands for agricultural products, and results in new public scrutiny about the efficiency and sustainability of biomass production systems. The greenhouse gas intensity of farming in general is a new concern that originates in part with the need for biomass feedstocks for energy and carbon accounting associated with crop production. California also has large amounts of woody biomass from forests, and some high moisture biomass from its extensive food processing industry. Forestry residues currently are used for biopower production and this use could increase with favorable policies. Interest in biogas production from these residues and from dairy manure is increasing.

At UC Berkeley there is the Energy Biosciences Institute (EBI), which is part of a unique partnership with three other research partners, the Lawrence Berkeley National Laboratory, the University of Illinois at Urbana-Champaign, and British Petroleum (BP). It was created in 2007 by a 10-year \$500 million grant from BP. EBI applies knowledge of biological processes, materials and mechanisms to the energy sector. More than 300 researchers, including AES faculty, study the complete bioenergy life cycle, beginning with the feedstocks, continuing through biomass depolymerization, and ending with finding a more effective fermentation process. At UC Davis there is the Bioenergy Research Center, which is a coalition of over one hundred campus research scientists from a wide range of disciplines, seeking to advance the development of bioenergy: heat, power, and biofuels from biomass as part of their work, and the California Biomass Collaborative which is part of the statewide California Renewable Energy Collaborative, and includes more than 500 members from government, industry, academia, and environmental organizations.

Fourteen Hatch and Multistate Research projects with a sustainable energy focus were conducted by investigators at UC Davis, and Berkeley, and Riverside. There were also two projects conducted by CE advisors and specialists under the Federal Planned Program Sustainable Energy. Projects are being conducted in several areas that are essential to sustaining California's energy resources; a few illustrative examples follow:

Biofuel Crops

Biofuel crops must be produced as efficiently as possible in order to not compete with food crops on prime agricultural lands. They will only be grown if they improve cropping system performance in the state's diverse farming regions. UC research was conducted to evaluate potential biofuel feedstock crops for California, including sorghum, switchgrass, Miscanthus, oilseed crops, sugarbeets, and sugar cane. Cellulosic biofuels must meet the criteria of high yield, high efficiency of carbon fixation, and quality of conversion. Biofuels are needed in California to meet the state's requirements for low carbon intensity fuels under the Low Carbon Fuel Standard. Executive order S-0606 calls for in-state production of biofuels to add to the state's economy, as well as meet its new greenhouse gas reduction goals.

The California Energy Commission awarded a \$2 million grant to the California based Biodiesel Industries for research and development of biodiesel fuel. The company partnered with a CE specialist who will develop viable biofuel feedstocks at test plots. In addition, through the 2012 UC ANR internal competitive grants cycle, over \$1 million was awarded to two projects researching biofuel crops, starting work in FY2013. One project will investigate sorghum as a low-input crop for bioenergy, food and feed in California. Sorghum has considerable potential as both a short-term and long-term solution for California's need for a sustainable bioenergy feedstock. Sorghum can be used in all the various processes for bioenergy production - starch-to-ethanol, sugar-to-ethanol, and lignocellulose-to-bioenergy. Sorghum also discussed at the 2011 Alfalfa, Forages, and Biofuels Field Day at the UC Davis and UC West Side Research and Extension Center (REC). Cellulosic biofuels must meet the criteria of high yield, high efficiency of carbon fixation, and quality of conversion.

One research project focuses on perennial biofuel grasses and forage crops that might be produced in California. The objectives are to discover and report principles of forage and biofuel (phytomass) crop management, directed towards optimizing the yield, forage quality and economic viability of these crops, and to minimize potential deleterious environmental effects under western irrigated conditions. Another research project specifically evaluated the response of potential cellulosic biofuel crops to water. These studies provide the basis for understanding agronomic production techniques as well for economic costs and life-cycle greenhouse gas emissions. This new knowledge improves stakeholders' ability to make science-based decisions on production scenarios for biofuels.

Several CE specialists and advisors are working on new crops, which include new winter annual oilseed crops, sweet sorghum and sugarcane. Other research was conducted on the use of hybrid poplars and other species as biofuel feedstocks across California and the Pacific Northwest. One research project examines the potential for poplar as a key feedstock species for cellulosic biobutanol production in California, and across the Pacific Northwest. In contrast to herbaceous biofuels species, poplar has advantages in harvest and storage.

Woody Biomass

Woody biomass is a broad, generic category that encompasses all woody materials that accumulate to problematic levels. This includes material from forest, agriculture, and urban environments. Biomass from trees, shrubs, and other woody plants is found in timberland, woodland, rangeland, orchard, and urban tree environments. It includes the woody material generated from forest thinning, fuel reduction in wildfire hazard areas, storm damage, catastrophic forest mortality (drought and insect related), as well as the debris from orchard and

urban tree maintenance. Woody biomass also includes the woody residue and waste stream of manufacturing, construction, demolition, transportation (pallets and shipping containers), and many other wood use activities. This woody material is recognized to be a potential feedstock to produce bioenergy either directly through thermochemical processes such as combustion or indirectly by producing intermediary fuels such as syngas, alcohol, or wood pellets that can be used to produce electricity in steam driven generators or as transportation fuels. A variety of research and extension projects explored woody biomass as a bioenergy opportunity.

A CE specialist project analyzed the potential linkage between bioenergy, fire risk reduction, and global trade in wood products. This included multistate work with the US Forest Service, as well as private forest land owners and businesses that purchase supplies. The objective is to develop integrated decision support system. The potential impact is to increase the opportunity for private forest land owners to participate in future markets for bioenergy. Lastly, a CE advisor project is designed to evaluate the evolving woody biomass technologies for producing bioenergy and to develop knowledge and disseminate information to community leaders, entrepreneurs, business developers, investors, and community decision makers. To this end, workshops were held and factsheet were written and extended. There was significant economic success achieved through providing technical assistance that helped small busyness acquire over \$4.5 million during the past four years.

Economic Potential and Policy Related Issues

Research was conducted on economic and policy issues associated with bioenergy. For example, UC ANR's BioEnergy Workgroup together with the California Biomass Collaborative has an ongoing cooperative project to model the economic potential for biofuel crop adoption on California farms. UCCE advisors from counties throughout California continue to help gather economic and farm performance data useful for this effort. The model is being used by several potential biofuel businesses to estimate feedstock availability, location and cost. Work also continues on the development of California and national biorefinery siting models. The feasibility for both stand-alone and integrated biorefinery operations as influenced by resource supply distribution and facility scale is part of these analyses. A project using the EPIC and SWAP models is being carried out for the California Air Resources Board to estimate greenhouse gas emissions from agriculture, and the economic effects of potential regulations.

Climate Change

California is characterized by a complex physical geography, tremendous natural biodiversity, and a growing and diverse population. As the climate changes, and as our population and our urban footprint continues to grow in the next century, the interplay between climate change and urbanization will increase the challenges faced by California citizens, local and state government officials, and planners. For example, the state's water resources are predicted to be vulnerable through changes in snow pack, timing and amount of precipitation, and increasing urban demand. More weather extremes, such as an increased frequency of heat waves are expected. Climate change is also anticipated to increase the risk of catastrophic wildfire. Invasive species are likely to increase in range and impact on natural resources, as climate change creates new habitats and niches and eliminates existing ones. In addition, the state's coastal and bay areas are at risk of flooding due to a rising sea level. These projected increases in human population density and changes in climate highlight the need to coordinate

regional planning efforts to promote conservation while also meeting the needs of all Californians for reliable and clean water, healthy communities, and food.

Fourteen Hatch and two Multistate Research projects were awarded to investigators at UC Riverside, Davis, and Berkeley under the Federal Planned Program: Climate Change. CE specialists worked on one research and extension project, and CE advisors worked on four projects. Projects are being conducted in several areas that are essential to understanding the impact of a changing climate on California's natural resources, economy and population. Projects are being conducted statewide across several research domains, and involve modeling, empirical experimentation, and more narrative approaches to understand climate impacts and adaptations across numerous sectors of California's natural resources, economy and population. A few illustrative examples follow.

Empirical and modeling studies of a changing climate

Projects are being conducted that elucidate the nature of the complex processes that control global and regional climate and climate change, across many domains. These include modeling atmospheric dynamics in aerosol concentrations and types; detailed measurements of climactically important trace gases, such as carbon dioxide and carbonyl sulfide and carbon monoxide; and establishing a baseline of the biogeochemical, mineralogical, physical and morphological properties of soils that in turn influence carbon storage, nutrient cycling, biodiversity and regulation of quality and quantity of water supply. In one project examining atmospheric dynamics and weather, critical understanding of the development of the 2006 record-setting heat wave in California was gained through model simulations: these kinds of extreme weather events have dramatic consequences for public health, are predicted to increase. UC ANR academics are working closely with such agencies as California Air Resources Board, NASA, California Sea Grant, and NOAA.

Climate change and biodiversity: Response of native and important species

Projects are being conducted to predict the effects of climate change on vegetation types and species in California. These projects focus on plant trait adaptability (e.g. heritable adaptation), possible range shifts that might occur with a changing climate, interactions between native host plants and important species, and novel theoretical, statistical and practical models that test the role of climactic factors in determining distributions of California plant species currently, and in the future. These studies are critical to understanding possible changes in habitats, and also changes to fire regimes. Of note are new theoretical and applied modeling projects. For example, one project has led to a new theory of ecology, called METE, based on the maximum information entropy concept, which is now being used to develop better biological conservation practices and to improve predictions of biodiversity loss under climate and land use changes. Another project focuses on new updates to 'species distribution modeling', i.e., predicting the distribution of species from known occurrences and environmental data, which is used to predict responses to future climate change. Model improvements have been published in R, and on the Internet as free and open-source software. UC ANR academics are working closely with agencies such as US Forest Service Region 5, and other non-governmental organizations, such as The Nature Conservancy.

Economic futures

The potential impact of climate change on agriculture, the sector of the economy most likely to be affected, remains controversial. Projects are being conducted to predict the effects of climate change on agriculture from an agricultural economics perspective, by estimating the economic value of management actions such as reduction in greenhouse gas emissions. These projects also explicitly examine the uncertainties associated with such modeling frameworks, and explicitly incorporate adaptation in their models. Important work is being done to help us understand how climate change and air pollution affect the agricultural and energy sectors of the economy, particularly the effect of aerosols and greenhouse gases on the irrigated rice cultivation, and the impacts of global climate change on electricity demand. UC ANR academics are working closely with agencies such as California Energy Commission, International Energy Agency, Energy Information Administration, Environmental Protection Agency, and California Air Resource Board.

Fire regimes under a changing climate

Fire will be an important component of California landscapes in the future, and statewide estimates project an increase in fire occurrence. One project examines climate change impacts on fire regimes. California wildfires shows that seasonal high temperature anomalies are the factor most strongly associated with shrubland fire, while large-scale climate circulation patterns (El Nino) is also strongly associated with fire probabilities. They point to preliminary evidence that properly implemented fuels treatments - those which thin smaller-diameter trees and remove activity fuels and preferably reduce surface fuels using prescribed fire -- reliably reduce fire severity in all but the mildest conditions and the most extreme fire conditions. UC ANR academics are working closely with such agencies as the California Air Resources Board, NASA, California Sea Grant, and NOAA.

Social dynamics

Projects are being conducted to look at the possible different impacts of a changing climate across social and ethnic groups throughout California and nationwide. For example, one project examines the relationships between underrepresented peoples and the landscape, and discovers the natural resource management practices they engage in through regional, national and global case studies. These relationships are then verified through semi-structured interviews, oral histories, and mapping. UC ANR academics are working closely with groups such as the Bay Area Open Space Council, the National Park Service and the Department of Interior.

Water Quality, Quantity, and Security

Water, essential to all life, can only be understood in the context of larger societal concerns such as food safety, climate change, land use, agricultural and ecosystem sustainability, global population growth, and urbanization. Reflecting its significance, water is an integral component of major governmental acts such as the federal Endangered Species Act, National Environmental Policy Act, Clean Water Act, and the state's Porter-Cologne Water Quality Control Act. In California, water is the life blood of the state's economy; its availability and quality is critical for the state's agricultural, urban, and environmental systems now and in perpetuity.

Several issues regarding California's water are paramount:

- The supply of water will be limited for all users.
- Competition for water will intensify among agricultural, urban, and environmental users, with water being transferred from agriculture to the latter two groups.
- Short- and long-term climate trends will exacerbate the problems associated with water availability.
- Degradation of water quality will become more important as a major public issue.
- Legal and regulatory decisions will have significant impacts on water use and quality among all sectors.

Twenty five Hatch and Multistate Research projects were conducted by investigators at UC Riverside, Davis, and Berkeley. CE specialists worked on 15 research and extension projects. CE advisors worked on 97 extension projects, and led an additional eight research projects under the Federal Planned Program: Water Quality, Quantity, and Security. Projects are being performed in a number of areas that will directly impact California watersheds and California's water security. A few examples of these projects are provided below.

Aquaculture

Aquaculture continues to be important in the state. Aquaculture facilities may produce products for human consumption or for ecosystem restoration or maintenance (breeding and stocking). Research was performed to reduce water use and environmental impacts by converting from flow-through systems to recirculating systems. The system built at UC Davis for this project has performed well and serves as a demonstration system for other aquaculture producers.

Groundwater Supply and Use

Accurate models of groundwater systems are critical to their management. It is vital to know the potential storage capacity and the impacts of groundwater overdraft on storage capacity. Research on groundwater models was performed to better understand the relationship between groundwater overdraft, land subsidence and storage capacity. The results of this work will inform water modelers and water managers about the potential impacts of groundwater overdraft.

Groundwater Quality

Groundwater quality is receiving increased attention in California. Research and extension are underway to understand the fate and transport of contaminants in the soils of California. Recent studies have found widespread nitrate contamination in some of California's groundwater systems. UC ANR is working with multiple California agencies to create a curriculum and training to assist certified crop consultants and growers with their management of nitrogen fertilizers and irrigation water. Professionals who take this training will be certified by the State of California to write Nitrogen Management Plans that will meet state regulatory approval. This joint university/agency/industry effort seeks to reduce agricultural pollution and maintain a vibrant statewide agricultural industry. In addition, the long-term potential for groundwater contamination from increased flooding due to climate change is being assessed.

Water Use Efficiency

Environmental concerns, land use changes, climate change and populations growth continue to put pressure on water supplies in California. Water use efficiency is one method to adapt to this pressure. UC ANR continues to perform research and outreach on water use efficiency in the agricultural sector. Projects underway seek to increase efficiency through new technologies and management strategies. These projects are often crop specific and technology driven. For example, a UC Cooperative Extension farm advisor has developed a web based irrigation and fertilizer management program, called CropManage. This program will allow growers to upload field specific information to help them schedule irrigations and fertilizations. Adoption of the program will save growers money, reduce agricultural water use and reduce unintended pollutant loads from fields. This software is available for a limited number of crops but expansion to other crops is ongoing. Projects to promote and better manage microirrigation systems are saving water and chemical inputs (and also improving environmental quality) on crops from tree nuts to vineyards to alfalfa. Such research and education has enabled irrigators to better manage and maintain their microirrigation systems.

Research to assess irrigation needs utilizes plant stress measurements, soil moisture measurement technology, regulated deficit irrigation and satellite imaging. Spatial analysis of irrigation efficiencies is critical to implementing water conservation strategies as climate changes over time. For example, the California Institute for Water Resources is conducting a study utilizing geographic information systems (GIS) to spatially present and manage data on transpiration ratios, surface soil retention and evaporation rates, and local weather conditions. With this easily manipulated data, trends can be identified in order to adjust irrigation methods to fit specific crop needs.

Ecosystem Conservation and Restoration

Well functioning watersheds are important to maintaining ecosystems function. Resilient ecosystems are able to adapt to outside pressures such as climate change or changes in land use. All of which is essential to future use of the watershed and its resources. Research has recently focused on the Sacramento-San Joaquin Delta ecosystem to better understand the aquatic food webs. This will assist California in its efforts to restore ecosystem function. Upstream, research is also being performed on the effectiveness of different in-stream restoration efforts.

A Creek Carbon project studies riparian restoration areas that provide carbon sequestration pools and nitrogen uptake in ecosystems to reverse deteriorating in-stream water quality. Soil and vegetation analyses of restored sites provide comprehensive documentation of the role of riparian revegetation on soil and vegetative carbon and nitrogen cycling.

Food safety is a rapidly evolving field that requires scientific-based understanding of how to manage food risks in diverse environments. A multi-tiered, multi-level education program, targeting growers, auditors, food safety professionals and buyers, will allow on-farm management decisions to be made with full understanding of the impacts on ecosystem services (including water quality and riparian/wildlife systems). The program involves industry, government, academia, extension and environmentalists with the commitment to deliver outreach and education programs to protect ecosystem services and human health while sustaining the economic viability of farming operations.

Lastly, in a study of forest management and water yields, UC researchers, in collaboration with several non-profit agencies, are undertaking a three-part, multi-year, multi-disciplinary project to research and assess issues related to climate change, vegetation manipulation and the forest water cycle in the Sierra Nevada Mountains. The Sierras harbor globally distinctive forest resources that deliver hydropower and water supply to many Californians.

Water Policy

The importance of water to California and its economy is evidenced by the intensity of its policy debates. UC continues to inform these debates with sound science and with scientific policy analysis. UC ANR developed the state's only comprehensive water management model that incorporates both economic and engineering parameters. This model is used to estimate the impacts of changes in water supply on the water sector. Research and outreach evaluated policy options to manage nitrate pollution in our groundwater systems. Additional work was done on the impacts of a change in water supply on the agricultural economy of the Central Valley.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2012	Extension	Research
	1862	1862
Plan	270.7	407.4
Actual	252.6	361.5

II. Merit Review Process

The Merit Review Process that was Employed for this year included:

- Internal University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review

Brief Explanation

Scientific Peer Review

Each project funded under the Hatch Act is peer reviewed at the department level in the colleges/school at Berkeley, Davis, and Riverside. A peer review committee is appointed by the department chair. The committee evaluates the relevance, quality and scientific value of the proposed research. Upon completion of the peer review, the project is also reviewed at the dean's office for USDA compliance and forwarded to the Vice President's office for final review and submission to NIFA.

Merit Review

UC ANR's organizational structure emphasizes that resource allocation decisions will be driven by programmatic considerations and developed through a broad participatory process.

This process includes review of the quality and relevance to program goals for all of the Division's programs.

At the statewide level, the UC ANR Program Council met almost monthly. It was chaired by the Associate Director of Cooperative Extension and the Agricultural Experiment Station, and included the four Associate Deans, five strategic initiative leaders, and two county-based CE representatives, as well as other ex-officio administrative members. This group coordinates Divisionwide planning and delivery of programs and develops recommendations for allocation of Division resources. The Program Council reviewed all CE specialist and CE advisor position proposals from a statewide programmatic perspective to make specific recommendations on budget expenditures and resource allocation principles. These recommendations were then considered by the Vice President for final allocation decisions.

UC ANR's strategic initiative leaders and advisory panels are key players in helping the Division meet its goals, by organizing division-wide conferences, developing five-year, statewide strategic plans, and coordinating the internal competitive grants program. During FY 2012, three Strategic Initiative conferences were held.

As part of the strategic initiative conferences, many Program Teams were able to meet. UC ANR's Program Teams provide an umbrella structure for the Division's many workgroups to meet. These Program Teams carry out their essential leadership functions and enhance inter-workgroup communication and collaboration. In this way, CE and AES personnel along with non-ANR partners are brought together to work on emerging and continuing issues. They look at the Division's program priorities and determine the programs that will best address these needs.

During FY 2012, UC ANR's competitive grant program proposals were review by ad hoc, technical committees recruited by the Strategic Initiative leaders. The membership of these committees depended on the proposals received and included external experts. After the technical committees, Program Council reviewed the proposals and made recommendations for funding. The Vice President made the final decisions on allocations, awarded November 2012.

II. Stakeholder Input

Actions taken to seek stakeholder input that encouraged their participation included:

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals
- Survey of selected individuals from general public

Brief Explanation

UC ANR used a variety of mechanisms to seek stakeholder input on the development of Division program priorities and use of its research, extension and education funds. In addition, CE advisors delivering programs in 58 California counties received input on local needs from their local clientele on a daily basis. All of the input received from stakeholders was used by UC ANR members in program planning and implementation at the local, regional, and statewide level.

Strategic Initiatives Process

To implement the Strategic Vision, the strategic initiative leaders and the advisory panels developed 5-year action plans. Through this process, external stakeholders were consulted to identify the areas where ANR has the opportunity to make a significant, visible difference to the people of California.

Strategic Initiative Conferences and Program Teams Meetings

Strategic Initiative Conferences and Program Team Meetings were the primary mechanism for accomplishing UC ANR's high priority research and extension goals through grassroots leadership. These meetings brought together AES and CE personnel and non-ANR partners to work on emerging and continuing priority issues in Division program areas. ANR workgroups involve external stakeholders in their program planning process and workgroup activities and projects. The involvement of external stakeholders in the workgroups ensures that real world needs are brought to the attention of the Division as programs are planned and implemented. External stakeholders on the workgroups include individual producers, representatives from local community groups, state and federal agencies, industry groups, consumer groups, and colleagues from other higher education institutions.

Formal advisory groups

The President's Advisory Commission on Agriculture and Natural Resources meets twice annually to advise and assist UC in identifying the educational needs of the state's agricultural, natural and human resources communities and ways to meet them through science-based research, educational outreach and classroom instruction. The members represent 28 business, consumer, youth and government leaders from throughout California and meet twice a year to provide input. The UC ANR Vice President participates as a member of this Commission and brings the Commission's advice to the UC ANR Executive Council, which includes the four Deans from the UC ANR affiliated colleges/school. This leadership council then provides strategic guidance in the articulation of long-term programmatic directions Divisionwide, the allocation of resources across units, and the development of UC ANR policies.

Each of the three colleges at Berkeley, Davis and Riverside and the School of Veterinary Medicine at Davis, have external stakeholder advisory councils that met at least annually to provide feedback on their research, extension, and teaching programs. In addition, departments may have advisory boards.

Several of the Statewide Programs have external Advisory Councils that met during FY 2012 to review progress and offer recommendations for future program direction.

Commodity Organizations/Marketing Order Boards

Members of these organizations provided their annual input on research and extension needs for their commodities to UC ANR members through regular meetings and discussion of funding for research projects. These individual groups also come together to form the California Commodity Commission that meets with the Vice President annually to offer specific recommendations on program planning and funding issues.

A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them included:

Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys

Brief Explanation

Please see previous "Actions taken to seek" discussion.

A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

Methods for collecting Stakeholder Input

- Meeting with traditional stakeholder groups
- Survey of traditional stakeholder groups
- Meeting with traditional stakeholder individuals
- Survey of traditional stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief Explanation

Please see previous "Actions to seek" discussion.

A statement of how the input was considered

- In the budget process
- To identify emerging issues
- Redirect extension programs
- Redirect research programs
- In the action plans
- To set priorities

Brief Explanation

Please see previous "Actions to seek" discussion.

Brief explanation of what you learned from your stakeholders

UC ANR's stakeholders helped identify emerging and priority issues for the Division's diverse program areas. External stakeholder involvement ensures real world needs are brought to the attention of the Division as programs are planned and implemented.

IV. Expenditure Summary

1. Total Actual Formula dollars allocated (prepopulated from C-REEMS)	
Extension	Research
Smith-Lever 3b & 3c	Hatch
7,651,445	6,720,548

2. Total Actual Dollars Planned Programs Inputs		
	Extension	Research
	Smith-Lever 3b & 3c	Hatch
Actual Formula	2,158,044	5,616,706
Actual Matching	2,158,044	5,616,706
Actual All Other	97,576,021	239,580,915
Total Actual Expended	101,892,109	250,814,327

3. Amount of above actual formula dollars expended which comes from carryover funds from previous years		
	Extension	Research
	Smith-Lever 3b & 3c	Hatch
Carryover	504,106	1,388,465

V. Planned Programs:

- A. Healthy Families and Communities
- B. Sustainable Food Systems
- C. Sustainable Natural Ecosystems
- D. Endemic and Invasive Pests and Diseases
- E. Sustainable Energy
- F. Climate Change
- G. Water Quality, Quantity, and Security

A) Healthy Families and Communities

1) Healthy Families and Communities Planned Program Knowledge Areas

Program knowledge areas and percentages

KA Code	Knowledge Area	%1862 Extension	%1862 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	2%
305	Animal Physiological Processes	0%	15%
311	Animal Diseases	0%	3%
606	International Trade and Development	0%	2%
608	Community Resource Planning and Development	2%	1%
610	Domestic Policy Analysis	0%	2%
611	Foreign Policy and Programs	0%	2%
701	Nutrient Composition of Food	1%	3%
702	Requirements and Function of Nutrients and Other Food Components	1%	38%
703	Nutrition Education and Behavior	25%	10%
704	Nutrition and Hunger in the Population	1%	1%
723	Hazards to Human Health and Safety	0%	2%
724	Healthy Lifestyle	10%	1%
801	Individual and Family Resource Management	3%	0%
802	Human Development and Family Well-Being	8%	7%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	1%	5%
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures	0%	1%
805	Community Institutions, Health, and Social Services	2%	2%
806	Youth Development	40%	3%
903	Communication, Education, and Information Delivery	6%	0%
	Total	100%	100%

2) Healthy Families and Communities Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2012	Extension	Research
Plan	32.4	54.5
Actual Paid Professional	37.0	49.0
Actual Volunteer	654.0	0.0

Actual dollars expended in this program (includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c 168,042	Hatch 400,106
matching 168,042	matching 400,106
all other 14,222,409	all other 32,474,315

3) Healthy Families and Communities Planned Program Activity

Brief description of the Activity

UC ANR's integrated research and extension activities conducted research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Adults, children, youth and families in general
Children in general
- Low and moderate income adults, children, youth and families
- Adults and children at-risk for nutrition-related health problems, including individuals living in poverty, recent immigrants, and African-American, Native American, and Hispanic populations
- Nutrition and healthcare professionals
- Preschool, primary and secondary school teachers and administrators
- Professional childcare providers
- Public agencies and private organizations concerned with food, nutrition and health

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to many Communities of Practices, to answer "Ask an Expert" questions, and for other networking purposes.

4) Healthy Families and Communities NIFA Defined Standard Output Measures

FY 2012	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	358,380	343,815	3	31	130	161

Patents Listed:

1. ISOTOPIC LABELING OF COLLAGEN BREAKDOWN PRODUCTS IN URINE OR BLOOD AS A METABOLIC BIOPSY TO ASSESS BONE TURNOVER AND TISSUE FIBROGENESIS
2. A METHOD FOR AUTOMATED, LARGE-SCALE MEASUREMENT OF THE SYNTHESIS AND BREAKDOWN RATES OF THE PROTEOME OR THE ORGANEOME.
3. HUMAN MILK OLIGOSACCHARIDES ENABLE GROWTH OF SELECT BENEFICIAL GUT BACTERIA

5) Healthy Families and Communities State Defined Outputs

FY 2012	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	News-letters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	448	201	36	7	16	98	2	3

6) Healthy Families and Communities State Defined Outcomes

a) Knowledge Outcomes

- 1,106 parents, participating in parent education programs, gained knowledge of parenting techniques to promote child development and learning.

Associated Knowledge Areas: 802 Human Development and Family Well-Being.

- 117 community garden managers, non-profit agency personnel, small business owners, and low-income members of the public, participating in Master Gardener Programs, gained knowledge about home horticulture and pest management.

Associated Knowledge Areas: 805 Community Institutions, Health, and Social Services

- 7,656 children, youth, and caregivers in the general population, participating in nutrition education programs, gained knowledge of nutrition and other childhood obesity prevention strategies.

Associated Knowledge Areas: 703 Nutrition Education and Behavior

- 6,803 adults, participating in nutrition education programs, gained knowledge of safe food handling and preparation techniques.

Associated Knowledge Areas: 703 Nutrition Education and Behavior

- Youth gain knowledge in science, engineering, and technology from the 4-H Junk Drawer Robotics curriculum.

Issue (Who cares and Why)

The prosperity of the United States relies upon our investment in educating and preparing future scientists and innovators to provide solutions to vexing environmental, economic, and social problems. Science, engineering, and technology rely upon one another and all have a vital role in ensuring the prosperity of our nation. However, engineering programs are still rare within K-12 school walls and in out-of-school time programs.

What has been done

In 2001, the University of California 4-H began development of robotics activities as part of the workgroup on science, technology, and environmental literacy. These activities engaged youth, ages 10 through 13, in understanding scientific concepts and processes, the engineering design process cycle, and technology creation and building. In 2010, National 4-H Council funded the University of California 4-H to develop one of three curricular components of this national robotics curriculum effort. Called Junk Drawer Robotics, the California curriculum includes activities provided experiences by working with household items to complete simple design challenges. This curriculum was published by the National 4-H Council and began distribution in June 2011. UC ANR has implemented the curriculum in 25 California counties. In addition to dissemination in California, the curriculum is in use by 4-H programs and others across the nation.

Results

Evaluation data has confirmed gains in content knowledge around engineering and robots. This was particularly evident around improved conceptual understanding of the engineering design process and engagement in a science-based educational program. In addition, for almost all modules, youth and adults agreed that youth learned science, engineering, and technology concepts.

Associated Knowledge Areas: 806 Youth Development

- Youth increase knowledge and skills related to healthy living through participation in field day partnership between 4-H and the Expanded Food Nutrition and Education.

Issue (Who cares and Why)

Obesity among 6- to 11-year-old youth has tripled over the past 30 years. Among California 4-H members, two-thirds self-reported to be at a healthy weight, while 7 obese. Empowering 4-H youth and their families to adopt healthy habits will help California's health climate.

What has been done

A 2011 UC 4-H Field Day drew more than 100 participants and presenters. The event featured workshops and life skill stations related to family and consumer science, and new opportunities to expand knowledge related to healthy eating, health and technology integration, food safety, and physical activity. Youth learned to use technology to enhance healthy living, including mobile applications, online financial literacy, and how to track physical activity online to earn the President's Active Lifestyle Award.

Results

Pre- and post-tests revealed an increased understanding of and interest in 4-H Healthy Living projects. Attainment of knowledge and skill-based outcomes was documented. Most (88%) participants learned to safely chill large containers of food and how to safely thaw food at the "Make it Safe, Keep it Safe" workshop. Many (73%) who attended the "Money Talks for Teens" workshop learned what a budget is, and 87 percent learned to save money. Most (88%) participants attending a workshop on implementing nutrition education into 4-H project meetings were able to identify at least two benefits of the integration, and most (88%) said they could lead others in a nutrition activity. The partnership between 4-H and the Expanded Food Nutrition and Education Program yielded maximum results. Nutrition educators shared their expertise while 4-H youth development professionals and volunteers created an engaging learning environment for youth. This successful event will continue to be offered for 4-H members and their families annually, and is considered a promising model for 4-H field days across the state.

Associated Knowledge Areas: 724 Healthy Lifestyle

- UC CalFresh and food banks collaboration increased awareness for fruit and vegetable consumption.

Issue (Who cares and Why)

Obesity, diabetes and other weight-related health problems are linked to lower income families and families who are food insecure. In 2010, San Luis Obispo and Santa Barbara counties measured 11 percent and 12 percent, respectively, in poverty. In San Luis Obispo County, 28.6 percent, and in Santa Barbara County, 39.5 percent of adults lived in food insecure households. Fruits and vegetables are part of a more healthful diet, according to the USDA and Dietary Guidelines for Americans.

What has been done

In collaboration with local food banks, the UC CalFresh program provided nutrition education to families at qualifying school sites where youth nutrition education had been delivered by K-6 teachers. With agencies, UC CalFresh also worked with local elementary schools to develop nutrition education for food bank distribution events. Using produce from the food banks, UC CalFresh held nutrition workshops focusing on increasing fruit and vegetable consumption.

Afterwards, participants indicated their intent to increase fruit and vegetable consumption by completing a survey. In Santa Barbara County, the food bank

distribution takes place monthly at a Healthy School Pantry event, which includes two local elementary schools. Approximately 350 family members were invited to participate in physical activity, health and nutrition education information booths, and nutritious food demonstration workshops. In San Luis Obispo County, 40 to 50 people participated in fruit and vegetable workshops while they waited to pick up their food bank bags. Both sets of participants received a fruit and vegetable preparation demonstration and a recipe to accompany the produce given to them at the food bank distribution.

Results

Although fruit and vegetable consumption was already high among the 70 participating families in Santa Barbara County, 22 percent said they would increase consumption within the next week. In San Luis Obispo County, 80 percent of the participants indicated they would increase fruit and vegetable consumption within the next week.

Associated Knowledge Areas: 703 Nutrition Education and Behavior

b) Attitude Changes

- 12,212 individuals and families with children, participating in the nutrition education programs, increased readiness to adopt healthier dietary and lifestyle practices.

Associated Knowledge Areas: 703 Nutrition Education and Behavior, 724 Healthy Lifestyle, 802 Human Development and Family Well-Being

- Youth develop positive attitudes towards science through the 4-H Children, Youth, and Families at Risk (CYFAR) project.

Issue (Who cares and Why)

A significant proportion of California youth are at substantial risk for poor health, substance abuse and academic underachievement due to family, community, social, political and economic conditions. One approach to reducing their risk is by enhancing youth scientific literacy.

What has been done

The 4-H Children, Youth, and Families at Risk (CYFAR) project engages youth in science education to build the knowledge, skills, attitudes and positive behavior necessary for fulfilling lives. In Borrego Springs, high school teens engage 5th grade youth in afterschool gardening. In Winters, UC Davis undergraduate students act as mentors and facilitators of science education for K-8th grade youth. In Sacramento, 4-H teens work with elementary youth to hone their science skills through gardening and Youth Experiences in Science curricula. In 2011-2012, 180 youth in grades K-6 participated once or twice per week. They were informally mentored by 22 teens who delivered curriculum activities. We recruited and trained the teens in inquiry-based science education, experiential education and specifically on gardening and the environment.

Results

Program evaluation showed that participating youth had positive attitudes towards science, an understanding and appreciation for the environment, and positive relationships in the program. The evaluations showed 79% enjoy nature and 61% believe they can make a difference in the world. The youth also gained skills by using scientific tools for gardening. Evaluation is ongoing to assess youth and teen outcomes resulting from program participation. Communities also benefit from partnerships with local organizations and individuals developed to continue the activities. In Sacramento, parents of youth participants plan to charter a 4-H community club to meet after school to continue 4-H activities after CYFAR funding ends. In San Diego, two family resource centers were established in partnership with local service organizations. In Yolo County, parents and other adults were recruited to lead youth activities such as soccer. In addition, movement has begun to re-form the County Youth Coalition, which could provide ongoing programs in underserved areas of the county.

Associated Knowledge Areas: 806 Youth Development

c) Skills Acquired

- Youth improve science literacy and skills through participation in a new water conservation curriculum developed by the California 4-H Youth Development Program.

Issue (Who cares and Why)

Clean water is critical for life and needs to be managed wisely to ensure adequate supplies for natural ecosystems and human use. Thus, water quality and conservation are important public policy issues. In order to make informed decisions to address these challenges, citizens in today's society require a fundamental understanding of science. Unfortunately, standardized assessments have revealed low levels of science literacy among K-12 youth in California, which also raises concerns about the future of the state's workforce and economic prosperity.

What has been done

The California 4-H Youth Development Program developed and tested a curriculum focused on water conservation and quality. The *There's No New Water!* curriculum may be used to educate high school-aged youth about water resources while improving their science and environmental literacy. The curriculum, which was peer-reviewed and published by the National 4-H Council, is based on the idea that water is a finite natural resource whose quantity and quality must be responsibly preserved, protected, used and reused. The curriculum begins with an exploration of the natural water cycle; explores human impacts on water quality and quantity; examines the effects of the urban/rural interface; and includes service-learning projects that address local water issues. The curriculum is grounded in effective educational methods, experiential learning and inquiry, and emphasizes the application of knowledge and skills through service learning projects.

Results

There's No New Water! curriculum was evaluated in spring 2010 at an urban high school in north central California. Outcomes revealed statistically significant improvements in content knowledge in all areas, including global water distribution, water conservation, watersheds, and the urban/rural interface. Most of the 59 youth participants reported improvement in relevant life skills, including communication, teamwork, decision making, and the wise use of resources. Also 74 percent reported learning "some" or "a lot" about the importance of protecting the environment.

Associated Knowledge Areas: 806 - Youth Development

d) Behavior Changes

- 5,617 adults, participating in nutrition education programs, adopted healthier dietary practices.

Associated Knowledge Areas: 703 Nutrition Education and Behavior

- 5,900 low-income adults, participating in nutrition and consumer education programs, adopted food resource management techniques.

Associated Knowledge Areas: 801 Individual and Family Resource Management

- 5,888 low-income adults, participating in nutrition education programs, adopted safe food handling and preparation techniques.

Associated Knowledge Areas: 703 Nutrition Education and Behavior

- 597 parents, participating in parent education programs, adopted recommended parenting practices.

Associated Knowledge Areas: 802 Human Development and Family Well-Being

- Adolescents improved eating and physical activity behaviors through participating in an innovative intervention developed by UC researchers.

Issue (Who cares and Why)

Adolescents are less physically active and eat more calories than past generations. They spend about 7.6 hours each day using electronic media, and only 1.75 hours being physically active. Intakes of calcium, iron, and fruit and vegetable intakes are low while added fats and sugars, especially in soda, are high. These eating and activity behaviors have resulted in increased obesity rates for adolescents. Today 34 percent are overweight and 18 percent are obese.

Adolescent obesity increases the risk for type 2 diabetes, cardiovascular disease and cancer, and impacts school performance.

What has been done

A behavioral strategy known as goal setting has been successful in promoting positive nutrition and physical activity behavior changes in adults. Setting goals is important in many behavior change theories. Historically, goal setting has been a one-size-fits-all approach; the participant sets a goal, or the practitioner assigns one. The cognitive needs of adolescents demand an alternative approach. UC Davis and Cooperative Extension researchers developed an innovative intervention that includes a new strategy, Guided Goal Setting. Students choose personal motivators, then decide which of their weakest dietary areas they want to improve, based on a needs assessment. Using www.Eatfit.net, a choice of three goals appears, then minor goals; the student works on the one selected for the remainder of the program. 'Guided goal setting' ensures goals are appropriately designed while encouraging the budding independence of adolescents. Guided goal setting is the major behavior change strategy in two curricula used by EFNEP, FSNEP and 4-H: Eatfit and Walkfit.

Results

In a group of ethnically diverse middle school students, those completing the program with guided goal setting improved their eating and physical activity behaviors compared to students without the guided goal setting component in the curriculum. Among participants trying to reach their goals, those in the treatment group scored significantly higher than the controls on dietary behavior, physical activity behavior, and physical activity self-efficacy. No gains were found for dietary self-efficacy. Results were reported in the International Journal of Adolescent Medicine and Health. Assessment methods such as keeping a 24-hour diet and physical activity diary were effective in helping teens change their behaviors. Guided goal setting is a proven strategy to help adolescents develop lifelong healthy behaviors.

Associated Knowledge Areas: 703 Nutrition Education and Behavior

- Low-income Hispanic families adopt behaviors to help stretch food dollars to buy healthier foods through their participation in the UC CalFresh program.

Issue (Who cares and Why)

Low-income Hispanic families are at high risk for poor health outcomes related to diet. Because the home food environment can have a major impact on food choices made by children and extended family members, the UC CalFresh Nutrition Education Program offers lessons in nutrition and resource management to food stamp-eligible Hispanic families.

What has been done

The UC CalFresh Eat Smart Be Active is the adult curriculum aims to improve the quality and availability of healthy foods at home. In 2010-2011 in Santa Clara County more than 526 adults with families were reached. Members of the nutrition education staff conduct annual evaluations with the goal of improving culturally

relevant outcomes of the UC CalFresh adult program. In a new evaluation project, UC researchers interviewed participants in their homes and did before and after food inventories to measure the efficacy of a three-class series focused on shopping, resource management, food safety and a healthy diet. The small pilot study conducted by UC Cooperative Extension documented changes in the home food environment in five Hispanic families participating in the Eat Smart Be Active educational classes. Four families not participating in the classes were also recruited for the project as a control group. All children were participating in UC Cooperative Extension nutrition education lessons in school.

Results

UC CalFresh helped all families in the intervention group improve the quality and quantity of foods found at home. The changes in behavior reported to be most effective in helping to stretch food dollars included: making a shopping list, planning menu, shopping less often and using leftovers. Participants used savings to purchase additional healthy foods such as whole wheat bread. Results from the food inventory indicate that the majority of families made the following changes in the home food environment after completing the classes: increased fruit and vegetable variety by 30 percent, increased the amount of fresh fruit by 30 percent and increased the use of whole wheat bread by 100 percent. In comparison to the control group, women in the intervention group had younger children, were less likely to be single and had less soda and fewer high fat, high sugar processed foods in the home – an interesting finding worth future investigation.

Associated Knowledge Areas: 703 Nutrition Education and Behavior, 801 Individual and Family Resource Management

- Youth eat more fruit during 4-H service-learning project.

Issue (Who cares and Why)

Combating childhood obesity and malnutrition are a priority for UC Cooperative Extension. Children who are healthy do better academically, socially and economically, and this benefits all of society. A cornerstone of good health is diet, and a cornerstone of a healthful diet is adequate intakes of fruits and vegetables. Research shows that children do not meet the recommendations for fruit intake daily (averaging just 1.3 of the 2 fruit servings recommended per day). Studies have shown an inverse relationship with fruit consumption and weight status. Fruit is well liked by children, but access and perceptions of peer acceptance can be a hurdle.

What has been done

A UC Cooperative Extension advisor helped a team of four boys develop and submit two grant proposals. Using the youth service-learning model to address local community issues, these youth grantees learned to work as a team, set goals, resolve problems and try new skills. The grants were ultimately awarded, and monies were allocated for the purchase and delivery of fresh, local produce, and supplies needed to prepare the fruit. Weekly deliveries of local fruit were made to the school. The boys delivered the fruit to the classrooms for students to snack on throughout the week. Presentations were given to teach their classmates how to wash fruit and prepare it using a variety of utensils. A culminating Youth Service

Day activity included reading storybooks about fruit to preschoolers and elementary students, leading a fun fruit activity for preschoolers, and helping classmates prepare fruit smoothies on a smoothie bike.

Results

The youth grantees developed and conducted evaluations. The 65 students served in first through sixth grade reported that they liked having the fruit in the classroom during the project, and that they thought it increased how much fruit they ate. The evaluations (completed by 53 of the students) show that the number of students snacking on fruit during the school day increased from eight students before the intervention to 26 two months into the intervention and 23 during the last week, a 186 percent increase.

Associated Knowledge Areas: 703 Nutrition Education and Behavior

- Community members adopted healthful habits through participation in a collaborative UC healthy lifestyle program.

Issue (Who cares and Why)

Obesity continues to be a major concern in Stanislaus County. In 2010, 63 percent of adults in Stanislaus County were overweight, compared to 57 percent statewide. Obesity is directly linked to many chronic health concerns such as asthma, diabetes and heart disease. To address these concerns, a group of concerned Riverbank residents and community stakeholders came together and organized Get Fit Riverbank, a family-focused summer of free, healthful activities and healthful eating education. The eight-week event included nutrition classes and weekly activities such as swimming, yoga, pilates, Zumba and karate.

What has been done

UC Cooperative Extension's Nutrition, Family and Consumer Sciences program helped develop Get Fit Riverbank, along with other community stakeholders from local governments and schools. UC Cooperative Extension faculty and staff provided guidance and expertise in the nutrition-related aspects of the program. A UC CalFresh nutrition educator, taught a new family-centered curriculum called, "Let's Eat Smart and Play Hard Together" with great success. The program brought parents and children together to learn about nutrition and creating healthy meals.

Results

More than 330 residents of Riverbank spent the summer biking, walking and learning to eat better as a community. This was shown to be a highly successful community project. Pre- and post-program waist measurements were taken of adults by nursing students from California State University, Stanislaus, with an average of 2 inches lost and a maximum of 6 inches lost. Oak Valley Hospital donated pre- and post-program cholesterol and blood sugar screenings. Results showed adult participants dropped more than 9 points in their cholesterol levels and more than 10 points in blood glucose levels on average. In a survey of the participants at the end of the program, 60 percent of respondents participated in the nutrition classes and 95 percent participated in the physical activities offered. When asked if they will

continue with the healthful activities they had learned, 60 percent said they would. A majority of respondents (60%) also said they would participate again next year.

Associated Knowledge Areas: 724 Healthy Lifestyle

e) Social/Health Condition Changes

- 124 teachers made the school environment healthier for the students, having adopted one or more of the following behaviors: offer more healthy food choices in the classroom for parties and snacks, and encourage breakfast and/or more physical activity.

Associated Knowledge Areas: 703 Nutrition Education and Behavior

- A community gains a healthy, new resource through a local 4-H cooperative, conservation program.

Issues (Who cares and Why)

Central coast wetlands in Ventura County, bordering a federal superfund cleanup site and long used as an industrial dumping ground, were in desperate need of restoration and renewal. Youth, families and communities near the wetlands experience general low rates of environmental connection and education. As with most other areas of our state, childhood obesity rates in surrounding communities are on a troubling upward trend.

What has been done

Several years ago, the Ormond Beach wetlands area became an approved Master Gardener project site. Decades of industrial waste were removed by the ton with the help of community groups and the City of Oxnard. Much research and work went into creating seed banks of native plants to restore coastal wetland vegetation. In 2009 and 2010, UC Cooperative Extension led a wetlands/ecological restoration program linking teachers and youth with science education and community service opportunities at Ormond Beach. More than 1,000 middle-school-aged youth participated. In 2011, 4-H All Stars designated the Ormond Beach wetlands as the location for their service project. The youth work with community groups, government agencies, and local business to make their dream a reality.

Results

In April 2012 a walking trail complete with 10 exercise points was opened. Exercises feature yoga poses and other meditative exercises in tune with the natural setting. The All Stars will also be identifying native plants and birds and include this information along the walking path. This trail will provide many positive benefits for families and the community. Increased physical activity can help to reduce obesity, and time spent together can strengthen families. Continual renewal and restoration to a local environmental treasure brings awareness, appreciation and pride to neighboring communities. The youth leading this ambitious project gain leadership and life skills to last a lifetime.

Associated Knowledge Areas: 724 Healthy Lifestyle

- 4-H members improve their local communities by raising funds for community youth projects.

Issues (Who cares and Why)

2013 marks the centennial for 4-H in California, an important milestone for an organization that is deeply connected to communities throughout the state. Service learning has been a cornerstone of the 4-H educational approach for the past century, connecting education and community service to strengthen learning and positive youth development. To celebrate the centennial, funds are being raised for youth to design and lead community-based projects. Through these projects, youth mature and develop skills while making a difference in their communities.

What has been done

The National 4-H Revolution of Responsibility campaign is a movement for positive change in every community in America. Adapting the campaign, the California 4-H Foundation and State 4-H Office unveiled the "\$1,000 for 1,000" service learning projects campaign in late 2011. The Revolution of Responsibility Centennial Campaign celebrates the power of California 4-H youth taking action through an ambitious statewide program that is funding 1,000 service learning projects at \$1,000 each through 2014. In addition, the California 4-H Foundation and State 4-H Office created a toolkit to assist 4-H groups in planning, marketing, fundraising and evaluating their projects. Each section of the toolkit offers tips, templates, links to helpful resources, and suggested guidelines that support the efforts of youth 4-H members. The toolkit is available at <http://www.ca4h.org/Support/RofR/>

Results

From October 2011 through May 2012, this campaign funded over 50 projects around the state led by youth and coached by adult 4-H volunteers. These projects range from community gardens to creating memorials for veterans; from community beautification to cat and rabbit adoptions. Some projects have expanded their activities; for example, the 4-H Million Trees project (<http://www.4hmilliontrees.org/>), which originated in San Mateo County and has involved 42,000 youth in planting 362,000 trees across the world, is expanding locally to help those in San Bruno affected by fires. In Ventura County, the 4-H team continues and expands their restoration of the Roma-Jean 4-H Educational Wetland Path at Ormond Pointe. Many other projects continue to have a positive impact on California's communities. Projects may be viewed at <http://www.ca4h.org/Support/RofR/FundedProjects/>

Associated Knowledge Areas: 805 Community Institutions, Health, and Social Services

7) **Healthy Families and Communities Planned Program External Factors**

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government regulations
- Competing public priorities
- Populations changes (immigration, new cultural groupings, etc.)

8) **Healthy Families and Communities Planned Program Evaluation Studies**

Evaluation Results

UC ANR's most notable qualitative impacts that were realized, as well as the quantitative outcomes recorded from the evaluation studies, are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights UC ANR's most significant work during FY 2012, especially the research developments. The State Defined Outcomes section captures UC ANR's clientele behavior change outcomes, which demonstrate important program successes resulting from the research and extension continuum.

T

B) Sustainable Food Systems

1) Sustainable Food Systems Planned Program Knowledge Areas

Program knowledge areas and percentages

KA Code	Knowledge Area	%1862 Extension	%1862 Research
102	Soil, Plant, Water, Nutrient Relationships	15%	3%
111	Conservation and Efficient Use of Water	2%	1%
201	Plant Genome, Genetics, and Genetic Mechanisms	2%	20%
202	Plant Genetic Resources	4%	5%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	4%	8%
204	Plant Product Quality and Utility (Preharvest)	7%	4%
205	Plant Management Systems	30%	6%
206	Basic Plant Biology	0%	16%
211	Insects, Mites, and Other Arthropods Affecting Plants	2%	3%
212	Pathogens and Nematodes Affecting Plants	1%	4%
302	Nutrient Utilization in Animals	4%	3%
304	Animal Genome	0%	5%
307	Animal Management Systems	7%	0%
311	Animal Diseases	2%	2%
501	New and Improved Food Processing Technologies	1%	4%
502	New and Improved Food Products	2%	5%
601	Economics of Agricultural Production and Farm Management	8%	2%
604	Marketing and Distribution Practices	3%	1%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	4%	3%
723	Hazards to Human Health and Safety	2%	5%
	Total	100%	100%

2) Sustainable Food Systems Planned Program Inputs

Actual amount of professional FTE/Sys expended this program

Year: 2012	Extension	Research
Plan	98.5	136.8
Actual Paid Professional	101.1	126.4
Actual Volunteer	0.0	0.0

Actual dollars expended in this program
(includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c 643,287	Hatch 1,999,478
matching 643,287	matching 1,999,478
all other 38,850,239	all other 83,770,477

3) Sustainable Food Systems Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities will conduct research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Food producers (e.g. farmers/ranchers and rangeland owners/operators/managers, including conventional organic, small and large producers)
- Agricultural advising professionals (e.g. Pest Control Advisors, crop advisors, landscape professionals)
- Allied industry companies including seed and supply companies
- Food processors, handlers, retailers, and suppliers
- Public regulatory agencies and private non-profit advocacy groups
- Food consumers, members of the general public

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to many Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes.

4) Sustainable Food Systems NIFA Defined Standard Output Measures

FY 2012	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	551,827	3,627	8	122	465	587

Patents listed:

1. THE REDUCTION OF HYDROGEN SULFIDE (H₂S) FORMATION IN WINE YEAST STRAINS VIA ALLELE REPLACEMENT, EXCHANGING NATIVE ALLELES IN THE TARGET STRAIN...
2. STAYGREEN MAIZE
3. STAYGREEN MAIZE
4. Applications of the Required to Maintain Repression¹ Gene Sequence in Plant Breeding
5. NEW STRAWBERRY CULTIVAR 'C227'
6. A NOVEL FORMULATION OF PHOSPHORUS FERTILIZERS FOR PLANTS
7. FAIRCHILD SL MANDARIN
8. NEW STRAWBERRY CULTIVAR 'C225'

5) Sustainable Food Systems State Defined Outputs

FY 2012	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	News-letters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	676	95	100	40	27	333	5	23

6) Sustainable Food Systems State Defined Outcomes

a) Knowledge Changes

- 1,338 farm and ranch owner/operators and managers, and allied industry professionals, participating in agriculture education programs, gained knowledge of cultural practices or aspects of comprehensive management systems for plant and animal production.

Associated Knowledge Areas: 203 Plant Biological Efficiency and Abiotic Stresses Affecting Plants, 204 Plant Product Quality and Utility (Preharvest), 205 Plant Management Systems

- 692 farm owner/operators and managers and allied industry professionals, participating in agriculture education programs, gained knowledge of pest and disease management for plant production.

Associated Knowledge Areas: 212 Pathogens and Nematodes Affecting Plants

- 314 farm and ranch owner/operators and managers and allied industry professionals, participating in agriculture education programs, gained knowledge of business management practices, economics, and marketing techniques.

Associated Knowledge Areas: 604 Marketing and Distribution Practices

- 340 farm owner/operators and allied industry professionals, participating in agriculture education programs, gained knowledge of crop and varietal selection factors for plant production.

Associated Knowledge Areas: 202 Plant Genetic Resources, 204 Plant Product Quality and Utility (Preharvest)

b) Attitude Changes

None to report

c) Skill Changes

None to report

d) Behavior Changes

- 180 farm owner/operators and managers, and allied industry professionals, participating in agriculture education programs, adopted recommended cultural practices or other aspects of comprehensive management systems for plant and animal production.

Associated Knowledge Areas: 203 Plant Biological Efficiency and Abiotic Stresses Affecting Plants, 204 Plant Product Quality and Utility (Preharvest), 205 Plant Management Systems

- 210 farm owner/operators and managers, and allied industry professionals, participating in agriculture education programs, adopted superior varieties of crops for plant production.

Associated Knowledge Areas: 202 Plant Genetic Resources, 204 Plant Product Quality and Utility (Preharvest)

- Agricultural businesses become more economically sustainable through agritourism training program.

Issue (Who cares and Why)

Many factors - such as supply chain consolidation, falling wholesale prices, rising costs and economies of scale - push small- and mid-scale farmers increasingly to direct marketing and alternative enterprises to keep their agricultural businesses viable. At the same time, public demand is increasing for local agricultural products and education about local farms and ranches. Agritourism welcomes visitors to a working farm for education and enjoyment while providing additional income for the agritourism operator. In a 2009 survey by UC researchers, operators reported

agritourism as a profitable diversification strategy. However, agritourism requires farmers and ranchers to learn new hospitality skills and marketing partnerships. It is a business that is regulated by zoning ordinances and permitting in each of the state's 58 counties.

What has been done

UC ANR provided a year-long training program to 355 participants in five California regions: the North Coast, Northern Valley and Mountains, Sacramento-San Joaquin Delta, San Joaquin Valley and Foothills, and the Central Coast. Sixty county planning staff members representing 16 counties also attended the training. Workshops and follow-up meetings focused on skill development in: agritourism challenges and opportunities, business planning, risk management, hospitality and effective marketing. Participants shared best practices and organized new regional networks. Participants also worked with local planning and community development agencies to reduce permitting and regulatory barriers.

Results

Since the training, 14 percent of participating farmers or ranchers hosted visitors for the first time; 30 percent have begun planning new agritourism activities; and 92 percent of non-farmer participants have helped promote agritourism in their communities.

Associated Knowledge Areas: 604 Marketing and Distribution Practices

e) Social/Health Condition Changes

None to report

f) Environmental Changes

- New reduced-risk pesticides have helped California's \$20 billion fresh produce industry reduce use of older, broad-spectrum pesticides by 66% in the past 12 years.

Issue (Who cares and Why)

Most fruits, vegetables, nuts, herbs and spices that help make a healthy and diverse diet are specialty crops. To provide consumers with this wide array of fresh produce, growers of specialty crops need sustainable and affordable pest management technologies. The cost to register pesticides for each specialty crop far exceeds the purchases made by growers, who are a relatively minor segment of a pesticide company's customers. USDA's Interregional Research Project No. 4 (IR-4) enables the registration of low risk, effective pest management solutions for domestic, low-acreage specialty crops. California's \$20 billion fresh produce industry depends on this publicly funded IR-4 project given no other public organization does this work.

What has been done

UC ANR provides in-kind resources to IR-4. UC Cooperative Extension specialists and farm advisors conduct research to help identify and manage pest problems; they request and help prioritize IR-4 research. Four ANR units conduct IR-4 field trials at several UC sites, including Kearney Agricultural, Desert, Lindcove and West Side research and extension centers. The Western Region IR-4 Center at UC

Davis helps manage IR-4 by coordinating IR-4 activities in 13 states, working with key stakeholders, and determining the magnitude of pesticide residues on IR-4 field trial samples.

Results

Because specialty crop pest-management needs are met, California's growers can continue to supply consumers with affordable, safe and diverse fresh produce. Between 1963 and 2012, IR-4 has responded to more than 700 requests from California food crop growers. IR-4 data is used to set allowable pesticide residue levels on fresh produce. Over 13,300 new food-use pesticide registrations were supported by IR-4, which accounts for 50% of EPA's annual food-use clearances. About 80% of IR-4's work is on new reduced-risk pesticides suitable for integrated pest management, a process used to solve pest problems while minimizing risks to people and the environment. The increased availability of new reduced-risk pesticides has helped California's fruit and vegetable growers reduce their use of the older, broad-spectrum pesticides by 66% in the past 12 years.

Associated Knowledge Areas: 205 Plant Management Systems

g) Economic Changes

- 190 farm and ranch owner/operators, participating in agriculture education programs, realized lower production costs and/or higher return on investment.

Associated Knowledge Areas: 601 Economics of Agricultural Production and Farm Management, 604 Marketing and Distribution Practices

7) Sustainable Food System

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public policy changes
- Government regulations
- Competing public priorities
- Populations Changes (immigration, new cultural groupings, etc.)

8) Sustainable Food Systems Planned Program Evaluation Studies

Evaluation Results

ANR's most notable qualitative impacts that were realized, as well as the quantitative outcomes recorded from the evaluation studies, are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights ANR's most significant work during FY 2012, especially the research developments. The State Defined Outcomes section captures clientele economic change outcomes, as well as clientele adoption of recommended practices; these are the types of ultimate impacts that UC ANR research and education programs strive to realize.

C) Sustainable Natural Ecosystems

1) Sustainable Natural Ecosystems Planned Program Knowledge Areas

Program knowledge areas and percentages

KA Code	Knowledge Area	%1862 Extension	%1862 Research
101	Appraisal of Soil Resources	2%	6%
102	Soil, Plant, Water, Nutrient Relationships	9%	15%
111	Conservation and Efficient Use of Water	9%	3%
112	Watershed Protection and Management	2%	2%
121	Management of Range Resources	13%	5%
122	Management and Control of Forest and Range Fires	7%	1%
123	Management and Sustainability of Forest Resources	16%	1%
131	Alternative Uses of Land	5%	3%
132	Weather and Climate	1%	4%
133	Pollution Prevention and Mitigation	2%	6%
135	Aquatic and Terrestrial Wildlife	15%	7%
136	Conservation of Biological Diversity	8%	14%
141	Air Resource Protection and Management	7%	3%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	3%
202	Plant Genetic Resources	0%	7%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	1%	2%
212	Pathogens and Nematodes Affecting Plants	0%	4%
605	Natural Resource and Environmental Economics	3%	5%
610	Domestic Policy Analysis	0%	6%
702	Requirements and Function of Nutrients and Other Food Components	0%	3%
	Total	100%	100%

2) Sustainable Natural Ecosystems Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2012	Extension	Research
Plan	31.6	75.5
Actual Paid Professional	27.4	70.8
Actual Volunteer	0.0	0.0

Actual dollars expended in this program
(includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c 405,803	Hatch 1,230,173
matching 405,803	matching 1,230,173
all other 10,547,646	all other 469,220,071

3) Sustainable Natural Ecosystems Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities conducted research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Farmers
- Ranchers
- Inland fishery owners/operators
- Governmental agencies
- Agricultural and fishing organizations
- Owners/managers of private and public rangeland, forest and wildlands
- Community organizations
- Resource managers

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to many Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes.

4) Sustainable Natural Ecosystems NIFA Defined Standard Output Measures

FY 2012	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	21,415	0	3	39	258	297

Patents Listed:

1. On-line Gas Chromatographic Analysis of Airborne Particles
2. ENVIRONMENTALLY FRIENDLY MANUFACTURING OF MICRO/SUBMICRO FIBERS USING CELLULOSE ACETATE BUTYRATE BI-COMPONENT SYSTEMS
3. A NOVEL APPROACH TO FUNCTIONAL GENOMIC STUDIES OF THE SUPERFAMILY OF RECEPTOR-LIKE PROTEIN KINASE- (RLK's) IN PLANTS

5) Sustainable Natural Ecosystems State Defined Outputs

FY 2012	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	News-letters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	60	18	3	2	4	137	0	2

6) Sustainable Natural Ecosystems State Defined Outcomes

a) Knowledge Changes

- 239 owners/managers of private and public rangeland, forest and wildlands, participating in sustainable use of natural resources education programs, gained knowledge of strategies and techniques for sustainable use of range, forest and wildland resources.

Associated Knowledge Areas: 121 Management of Range Resources, 123 Management and Sustainability of Forest Resources, 135 Aquatic and Terrestrial Wildlife, 136 Conservation of Biological Diversity

- Youth gain knowledge about Sudden Oak Death and intend to adopt sanitation practices to help prevent this forest disease.

Issue (Who cares and Why)

Sudden Oak Death is a serious forest disease that has killed more than a million trees and infected many more. It is established in 14 California counties and part of southwestern Oregon, but has the potential to spread further in the coastal forests where it thrives. The disease is caused by a pathogen, *Phytophthora ramorum*, which spreads naturally once established in forests, but can also be spread longer distances via plants and soil that are moved by people. It is therefore vitally important to keep people from inadvertently spreading the pathogen. An education campaign to engage the

public on this issue has been in place since 2000, but most outreach has taken place at the professional and adult level; resources for youth were lacking.

What has been done

To address this lack of youth education on Sudden Oak Death, a collaborative UC Cooperative Extension effort created an outreach effort aimed at middle school youth. The resulting program, called "Can My Tree Catch the Flu?" relates the oak pathogen to the more familiar human flu virus to create a better understanding of its effects on trees and its modes of transmission. A series of activities were developed and presented in a classroom setting to middle school students, at a 4-H day camp to mixed-age youth, and as an interactive exhibit to hundreds of youth and their adult chaperones at Marin County Farm Day. These activities were then adapted into Adobe Flash animations posted on the website of the California Oak Mortality Task Force (www.suddenoakdeath.org). For each of the original four in-person activities, an interactive, animated "scene" was created that allows users to click through different views and answer questions to increase their understanding of Sudden Oak Death.

Results

Participants greatly increased their knowledge of Sudden Oak Death, from a majority (63%) knowing nothing at the start of the session to 100 percent knowing "some" or "a lot" more about the issue. More importantly, 49 percent said they would clean their shoes to prevent the spread of forest pathogens. This increased knowledge and participation in sanitation actions will help reduce the long-distance, artificial spread of the Sudden Oak Death pathogen. By bringing these activities to wider audiences through exhibits and online games, we are able to encourage even more people to help keep the pathogen from spreading, in ongoing efforts to keep forests free from this damaging disease.

Associated Knowledge Areas: 123 Management and Sustainability of Forest Resources, 212 Pathogens and nematodes Affecting Plants

b) Attitude Changes

None to report

c) Skill Changes

None to report

d) Behavior Changes

None to report

e) Social/Health Condition Changes

None to report

f) Environmental Condition Changes

None to report

g) Economic Changes

None to report

7) Sustainable Natural Ecosystems Planned Program External Factors

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public policy changes
- Government regulations
- Populations changes (immigration, new cultural groupings, etc.)

8) Sustainable Natural Ecosystems Planned Program Evaluation Studies

Evaluation Results

ANR's most notable qualitative impacts that were realized, as well as the quantitative outcomes recorded from the evaluation studies, are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights ANR's most significant work during FY 2012, especially the research developments. The State Defined Outcomes section captures economic change outcomes affecting several agricultural commodities (spinach, parsley, and walnuts), as well as an environmental condition improvements; these are the types of ultimate impacts that ANR research and education programs strive to realize.

D) Endemic and Invasive Pests and Diseases

1) Endemic and Invasive Pests and Diseases Planned Program Knowledge Areas

Program knowledge areas and percentages

KA Code	Knowledge Area	%1862 Extension	%1862 Research
102	Soil, Plant, Water, Nutrient Relationships	1%	0%
123	Management and Sustainability of Forest Resources	1%	1%
133	Pollution Prevention and Mitigation	0%	2%
135	Aquatic and Terrestrial Wildlife	2%	4%
136	Conservation of Biological Diversity	1%	2%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	3%
206	Basic Plant Biology	1%	2%
211	Insects, Mites, and Other Arthropods Affecting Plants	13%	13%
212	Pathogens and Nematodes Affecting Plants	23%	32%
213	Weeds Affecting Plants	14%	3%
215	Biological Control of Pests Affecting Plants	3%	14%
216	Integrated Pest Management Systems	35%	7%
304	Animal Genome	0%	1%
305	Animal Physiological Processes	0%	6%
311	Animal Diseases	1%	3%
312	External Parasites and Pests of Animals	1%	1%
601	Economics of Agricultural Production and Farm Management	2%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%	1%
721	Insects and Other Pests Affecting Humans	2%	3%
722	Zoonotic Diseases and Parasites Affecting Humans	0%	2%
	Total	100%	100%

2) Endemic and Invasive Pests and Diseases Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2012	Extension	Research
Plan	67.3	96.0
Actual Paid Professional	63.4	87.3
Actual Volunteer	0.0	0.0

Actual dollars expended in this program
(includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c 753,080	Hatch 1,447,627
matching 753,080	matching 1,447,627
all other 24,895,668	all other 57,857,300

3) Endemic and Invasive Pests and Diseases Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities will conduct research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Farmers
- Ranchers
- Rangeland owners/managers
- Landscaping professionals
- Owners/operators of allied agricultural industries
- General public
- Crop and pest consultants

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to many Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes.

4) Endemic and Invasive Pests and Diseases NIFA Defined Standard Output Measures

FY 2012	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	174,973	521	7	122	396	518

Patents Listed:

1. SYSTEM AND METHOD FOR DIRECT, AT-NOZZLE INJECTION OF AGROCHEMICALS USING EMBEDDED VENTURI NOZZLES
2. INHIBITION OF SOLUBLE EPOXIDE HYDROLASE BY CONFORMATIONALLY RESTRICTED AND NON-UREA COMPOUNDS
3. THE MOLECULAR RECEPTORS FOR ENDOGENOUS ANALGESIC AND ANTI-INFLAMMATORY EPOXYEICOSATRIENOIC ACIDS (EETs)
4. GENETICALLY ENGINEERED RESISTANCE TO PIERCE'S DISEASE OF GRAPEVINES USING A XYLELLA FASTIDIOSA HEMAGGLUTININ ADHESION GENE
5. A Method of Biological Control of Pathogenicity in Bacteria that Use aB Unsaturated Fatty Acid Signal Molecules (DSF)
6. RECOMBINANT VACCINE FOR AFRICAN HORSE SICKNESS
7. A HYBRID VINE BABY LIMA BEAN VARIETY RESISTANT TO THE TARNISHED PLANT BUG, LYGUS HESPERUS

5) Endemic and Invasive Pests and Diseases State Defined Outputs

FY 2012	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	News-letters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	54	38	21	18	23	250	1	11

6) Endemic and Invasive Pests and Diseases State Defined Outcomes

a) Knowledge Changes Missing outcome #10

- 1,892 farm, ranch, range and landscaping owner/operators and managers, and Pest Control Advisors and other allied industry professionals, participating in pest management education programs, gained knowledge of Integrated Pest Management strategies and techniques.

Associated Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Pathogens and Nematodes Affecting Plants, 213 Weeds Affecting Plants, 216 Integrated Pest Management Systems

- 1,418 farm, forest, range, and boat owner/operators, and Pest Control Advisers and allied industry professionals, participating in invasive species programs, gained knowledge of prevention, detection and treatment practices for invasive species.

Associated Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Pathogens and Nematodes Affecting Plants, 213 Weeds Affecting Plants

b) Attitude Changes

- 1,151 farm, ranch, and boat owner/operators and managers, and Pest Control Advisors and other allied industry professionals, participating in pest management education programs, were more likely to try out or adopt recommended strategies and techniques for invasive species and pest management.

Associated Knowledge Areas: 135 Aquatic and Terrestrial Wildlife, 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Pathogens and Nematodes Affecting Plants, 213 Weeds Affecting Plants

c) Skills Changes

- 891 farm owners/operators and managers, and Pest Control Advisers and other allied industry professionals, participating in pest management education programs, gained skills to detect, monitor, and treat pests.

Associated Knowledge Areas: 211 Insects, Mites, and Other Arthropods Affecting Plants, 212 Pathogens and Nematodes Affecting Plants, 213 Weeds Affecting Plants, 215 Biological Control of Pests Affecting Plants

d) Behavior Changes

- 303 farm and range owner/operators and allied industry professionals, participating in pest management education programs, adopted recommended Integrated Pest management practices.

Associated Knowledge Areas: 216 Integrated Pest Management Systems

e) Social/Health Condition Changes

None to report

f) Environmental Changes

- UC efforts contribute to the dramatic decline in detection of *Phytophthora ramorum* threatening the commercial nursery industry, as well as native species in California forests.

Issue (Who cares and Why)

There are issues and problems relating to diseases caused by *Phytophthora ramorum* which affect rhododendron and camellia produced in commercial nurseries and secondarily relating to native tree and shrub species in forests. Before 2004,

there were only 9 official detections of *Phytophthora ramorum* in ornamental nurseries located in California, Oregon, Washington, and British Columbia, Canada. However, in February 2004, a large Southern California nursery shipped contaminated stock throughout the entire nation. The understanding of the diseases caused by *Phytophthora ramorum* and their dynamics in nursery crops was almost entirely derived from casual field observations; thus, a more science-based approach needed to be developed.

What has been done

Research was conducted on the epidemiology of *Phytophthora ramorum* in nurseries. The objectives of the study were to help understand basic biological factors such as inoculum viability, dispersal, and infectivity that influence disease occurrence and severity in a rhododendron nursery. Experiments were conducted under conditions that simulate a commercial containerized rhododendron nursery regime in the central coast of California. The research was extended through classes and newsletters.

Results

The research on the biology and management of the disease in nurseries, as well as the local and statewide educational outreach have contributed to a dramatic decline in disease detection and limited spread by nurseries. The heavy financial burden of regulatory actions on the industry and the movement of contaminated nursery stock to other parts of the nation have been significantly reduced.

Associated Knowledge Areas: 212 Pathogens and Nematodes Affecting Plants

- UC efforts pioneer nationwide detection of the new thousand cankers disease outbreak threatening commercial walnut growers, as well as natural ecosystems containing native walnut species.

Issue (Who cares and Why)

A new disease affecting walnut trees, "thousand cankers disease," poses an environmental threat to natural ecosystems containing native black walnut species and an economic threat to commercial English walnut growers in California. If introduced to the Midwest, it may also affect commercial production of black walnut. Thousand cankers disease was first associated with widespread mortality of black walnut in Colorado, but is now known to occur in nine western and three eastern states. The disease is caused by a fungal pathogen transmitted by the walnut twig beetle, which carries spores on its back as it bores into the tree. Because numerous beetles attack a single tree, the pathogen is introduced at the many points of beetle entry. Consequently, many cankers form as the fungus colonizes and kills plant tissue.

What has been done

UCCE farm advisors, a UC Davis faculty member and a U.S. Forest Service scientist have teamed up to document the geographic distribution of the disease, identify susceptible walnut types and monitor the flight patterns of the beetle in commercial orchards. Farm advisors work directly with growers and pest control advisers to maintain a network of beetle traps containing a male-produced

pheromone. The known geographic distribution of the disease in California is better understood, in part due to extension efforts to provide images of the dramatic symptoms to the news media. Serving as liaisons between grower and PCA communities and university and government researchers, UCCE farm advisors continue to contribute samples of the insect and the pathogen to specimen collections that will help scientists understand the history of disease spread in North America.

Results

The year-round monitoring of walnut twig beetle in California orchards provides valuable insight into the epidemiology of the disease. The monitoring program has provided the framework for guidelines now used nationwide for early detection of new forest infestations. The research and extension activities have raised awareness of growers and PCAs, prompting them to quickly remove infected trees from their orchards. Before 2011, diagnoses of thousand cankers disease were made on standing trees, now, the majority of recent positive diagnoses are made on felled trees, with growers seeking disease confirmation rather than identification.

Associated Knowledge Areas: 212 Pathogens and Nematodes Affecting Plants

g) Economic Changes

- A UC led multistate research coalition discovered new strains of downy mildew fungus to help protect California's \$156 million spinach industry, the nation's number one producer.

Issue (Who cares and Why)

Spinach is a key leafy green vegetable commodity in California. California produces more than 60 percent of the country's spinach. As with many other commodities, California growers are known nationwide for producing large volumes of spinach that have extremely high quality standards. However, downy mildew is a very serious disease of spinach and causes the leaves to turn bright yellow and then brown. Growers have struggled against this disease for years and continue to battle this fungus. In the past three years, a number of serious downy mildew outbreaks have occurred California's spinach-producing areas.

What has been done

UC Cooperative Extension is part of an extensive coalition that seeks answers through research to solve this challenge. This group is made up of farm advisors, researchers from other universities, USDA researchers, growers, pest control advisers, the California Leafy Greens Research Board, commercial spinach breeders and members of the seed industry. Farm advisors collect samples of diseased spinach from throughout the state and submit these to the testing lab to determine the race of the mildew causing the outbreaks. This assay by UCCE is the state's only public testing program that can identify different races of spinach downy mildew.

Results

Together with the University of Arkansas, UCCE has discovered four new, resistance-breaking strains of the downy mildew fungus that have occurred on

spinach since 2009. Each new race damages previously resistant spinach cultivars and forces the industry to develop new resistant cultivars. Without a knowledge of which races are occurring in the state, progress cannot be made in developing new spinach lines; therefore, this race identification program is critical to the health of the spinach industry. If left unchecked, downy mildew will severely damage California's spinach industry valued at approximately \$156 million.

Associated Knowledge Areas: 212 Pathogens and Nematodes Affecting Plants

- UC research proactively addresses new diseases affecting California's \$18 million parsley crop, enabling growers to manage these problems, eliminate the use of unnecessary chemicals, and save money.

Issue (Who cares and Why)

California is well known for producing a wide range of specialty vegetable crops that contribute to agricultural diversity, including parsley. Many consumers think of parsley as an incidental garnish that merely adds color to a plate of prepared food. While indeed a garnish, parsley is widely used in dried spice mixes, soups and other prepared foods. Significant acreage in parsley is also dedicated to fresh-market uses in salads and other recipes. California produces almost 2,600 acres of this crop. California parsley is produced typically in high volumes and with high quality. However in the past few years, growers began to observe unfamiliar disease issues in their parsley fields. Leaf spots, blighted foliage and yellowed plants contributed to loss of quality and reduced yields. Because parsley growers do not have an industry research board to address such concerns, a formal and organized grant program was not available to address these issues.

What has been done

UC Cooperative Extension advisors stepped in to initiate investigations into these new parsley problems. They collaborated with farmers and pest control advisers to understand the extent of the problems and to obtain samples of the diseased crops. The UC Cooperative Extension plant pathology diagnostic lab was successful in isolating and identifying several pathogens that were responsible for causing the disease symptoms. The UC Cooperative Extension advisors collaborated with USDA researchers to characterize the discovered pathogens. They found that three new diseases were present in California parsley crops: bacterial leaf spot, *Stemphylium* leaf spot, and *Apium* virus Y disease. The team subsequently studied these three pathogens to determine the range of susceptible crops and the possible source of the pathogens. They also conducted field surveys and found that the three pathogens were present in several central and south coast counties.

Results

Key research findings will enable growers to manage the problems. Two of the problems, bacterial leaf spot and *Stemphylium* leaf spot, are seedborne issues; this means that future management steps will include the use of pathogen-free seed. The *Apium* virus Y pathogen is found to be resident in weeds, so growers will need to remove poison hemlock and other weeds in the Apiaceae plant family. Previous to this research, some growers were spraying symptomatic fields because they believed that a disease called late blight was responsible. Based on UC Cooperative

Extension findings, growers now know that late blight was not involved and that these applications are not useful for the new problems. Growers have ceased making these sprays, eliminating the use of unnecessary chemicals and saving costs. Projects such as this parsley disease investigation demonstrate the commitment that UC Cooperative Extension has for specialty and minor crops research.

Associated Knowledge Areas: 212 Pathogens and Nematodes Affecting Plants

7) Endemic and Invasive Pests and Diseases Planned Program External Factors

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public policy changes
- Government regulations
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Availability of grad. students/others)

8) Endemic and Invasive Pests and Diseases Planned program Evaluation Studies

Evaluation Results

ANR's most notable qualitative impacts that were realized, as well as the quantitative outcomes recorded from the evaluation studies, are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights ANR's most significant work during FY 2012, especially the research developments. The State Defined Outcomes section captures economic change outcomes affecting several agricultural commodities (spinach, parsley, and walnuts), as well as an environmental condition improvements; these are the types of ultimate impacts that ANR research and education programs strive to realize.

E) Sustainable Energy

1) Sustainable Energy Planned Program Knowledge Areas

Program knowledge areas and percentages

KA Code	Knowledge Area	%1862 Extension	%1862 Research
111	Conservation and Efficient Use of Water	0%	1%
123	Management and Sustainability of Forest Resources	22%	0%
133	Pollution Prevention and Mitigation	0%	2%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	30%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	3%
204	Plant Product Quality and Utility (Preharvest)	0%	11%
205	Plant Management Systems	0%	2%
206	Basic Plant Biology	0%	5%
211	Insects, Mites, and Other Arthropods Affecting Plants	0%	1%
212	Pathogens and Nematodes Affecting Plants	0%	1%
302	Nutrient Utilization in Animals	0%	1%
305	Animal Physiological Processes	0%	3%
402	Engineering Systems and Equipment	22%	4%
403	Waste Disposal, Recycling, and Reuse	0%	1%
503	Quality Maintenance in Storing and Marketing Food Products	0%	3%
511	New and Improved Non-Food Products and Processes	0%	23%
605	Natural Resource and Environmental Economics	22%	8%
608	Community Resource Planning and Development	34%	0%
609	Economic Theory and Methods	0%	1%
	Total	100%	100%

2) Sustainable Energy Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2012	Extension	Research
Plan	0.5	7.5
Actual Paid Professional	0.5	7.0
Actual Volunteer	0.0	0.0

**Actual dollars expended in this program
(includes carryover funds from previous years)**

Extension	Research
Smith-Lever 3b & 3c 21,613	Hatch 226,902
1862 matching 21,613	1862 matching 226,902
1862 all other 172,975	1862 all other 4,639,188

3) Sustainable Energy Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities will conduct research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use PSAs, newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Relevant agency and private-sector partners
- Lawmakers working on issues related to energy
- Members of the public in general
- Agricultural producers of crops for use as biofuels

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to many Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes.

4) Sustainable Energy Defined Standard Output Measures

FY 2012	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	0	0	1	0	24	24

Sustainable Energy State Defined Outputs

FY 2012	Classes/ Short Courses	Workshops	Demonstrations/ Field Days	Newsletters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	0	0	0	0	0	14	0	0

5) Sustainable Energy State Defined Outcomes

a) Knowledge Changes

None to report

b) Attitude Changes

None to report

c) Skill Changes

None to report

d) Behavior Changes

None to report

e) Social/Health Condition Changes

None to report

f) Environmental Condition Changes

None to report

g) Economic Condition Changes

None to report

6) Sustainable Energy Planned Program External Factors

External factors which affected outcomes

- Public Policy changes
- Government Regulations
- Competing Public Priorities
- Competing Programmatic Challenges

8) Sustainable Energy Planned Program Evaluation Studies

Evaluation Results

The Report Overview's federal Planned Program summary of accomplishments describes the significant research developments. No extension clientele outcomes measured through evaluation studies were captured during FY 2012.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights ANR's most significant work during FY 2012, especially the research developments.

F) Climate Change

1) Climate Change Planned Program Knowledge Areas

Program knowledge areas and percentages

KA Code	Knowledge Area	%1862 Extension	%1862 Research
101	Appraisal of Soil Resources	6%	4%
102	Soil, Plant, Water, Nutrient Relationships	6%	7%
104	Protect Soil from Harmful Effects of Natural Elements	0%	4%
122	Management and Control of Forest and Range Fires	0%	2%
123	Management and Sustainability of Forest Resources	11%	0%
131	Alternative Uses of Land	0%	1%
132	Weather and Climate	0%	22%
136	Conservation of Biological Diversity	0%	8%
141	Air Resource Protection and Management	23%	1%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	1%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	9%	4%
206	Basic Plant Biology	0%	4%
213	Weeds Affecting Plants	0%	1%
306	Environmental Stress in Animals	0%	4%
307	Animal Management Systems	23%	0%
605	Natural Resource and Environmental Economics	0%	18%
608	Community Resource Planning and Development	22%	0%
609	Economic Theory and Methods	0%	5%
610	Domestic Policy Analysis	0%	4%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	0%	10%
	Total	100%	100%

2) Climate Change Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2012	Extension	Research
Plan	0.6	9.0
Actual	0.9	7.9

**Actual dollars expended in this program
(includes carryover funds from previous years)**

Extension	Research
Smith-Lever 3b & 3c 1,104	Hatch 146,054
matching 1,104	matching 146,054
all other 338,263	all other 5,235,655

3) Climate Change Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities will conduct research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Members of the public in general
- Lawmakers working on issues relating to climate change
- Agricultural producers
- Natural resource managers
- Relevant agency and private-sector partners (including city-county and regional planners, nonprofits, government, and business people)
- Interdisciplinary teams of scientists and technologists

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to many Communities of Practice, to answer "Ask an Expert" questions, and for other networking purposes.

4) Climate Change NIFA Defined Standard Output Measures

FY 2012	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	6,434	0	0	0	19	19

5) Climate Change State Defined Outputs

FY 2012	Classes/ Short Courses	Work-shops	Demonstrations/ Field Days	News-letters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	0	0	0	0	0	16	0	0

6) Climate Change State Defined Outcomes

a) Knowledge Changes

None to report

b) Attitude Changes

None to report

c) Skill Changes

None to report

d) Behavior Changes

None to report

e) Social/Health Condition Changes

None to report

f) Environmental Condition Changes

None to report

g) Economic Condition Changes

None to report

B) Climate Change Planned Program External Factors

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public policy changes
- Government regulations
- Competing public priorities

**8) Climate Change Planned Program Evaluation Studies
Evaluation Results**

ANR's most notable qualitative impacts that were realized, as well as the quantitative outcomes recorded from the evaluation studies, are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments and the State Defined Outcomes section highlight ANR's most significant research developments during FY 2012.

G) Water Quality, Quantity and Security

1) Water Quality, Quantity and Security Planned Program Knowledge Areas

Program knowledge areas and percentages

KA Code	Knowledge Area	%1862 Extension	%1862 Research
102	Soil, Plant, Water, Nutrient Relationships	4%	14%
103	Management of Saline and Sodic Soils and Salinity	3%	1%
111	Conservation and Efficient Use of Water	34%	15%
112	Watershed Protection and Management	28%	17%
122	Management and Control of Forest and Range Fires	0%	1%
123	Management and Sustainability of Forest Resources	0%	2%
131	Alternative Uses of Land	0%	2%
132	Weather and Climate	2%	1%
133	Pollution Prevention and Mitigation	21%	10%
135	Aquatic and Terrestrial Wildlife	0%	6%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	11%
205	Plant Management Systems	1%	4%
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	3%	0%
403	Waste Disposal, Recycling, and Reuse	2%	2%
405	Drainage and Irrigation Systems and Facilities	1%	1%
501	New and Improved Food Processing Technologies	0%	5%
601	Economics of Agricultural Production and Farm Management	0%	3%
605	Natural Resource and Environmental Economics	0%	2%
610	Domestic Policy Analysis	1%	0%
723	Hazards to Human Health and Safety	0%	3%
	Total	100%	100%

2) Water Quality, Quantity and Security Planned Program Inputs

Actual amount of professional FTE/SYs expended this program

Year: 2012	Extension	Research
Plan	22.6	15.9
Actual	22.2	13.1

Actual dollars expended in this program
(includes carryover funds from previous years)

Extension	Research
Smith-Lever 3b & 3c 165,115	Hatch 166,366
matching 165,115	matching 166,366
all other 8,548,821	all other 8,681,909

3) Water Quality, Quantity and Security Planned Program Activity

Brief description of the activity

UC ANR's integrated research and extension activities will conduct research projects, workshops, education classes and demonstrations, as well as one-on-one interventions. In addition, the programs will use newsletters, mass media, web sites and collaborations with other agencies and organizations to create and deliver programs.

Brief description of the target audience

- Governmental agencies
- Water managers
- UC campus-based water centers
- The general public
- Farmers
- Ranchers
- Agricultural organizations
- Owners/managers of private and public rangeland, forest and wildlands

How was eXtension used?

UC ANR academics used eXtension to participate in and contribute to many Communities of Practice, to answer "Ask an Expert" questions, and for other purposes.

4) Water Quality, Quantity and Security NIFA Defined Standard Output Measures

FY 2012	Direct Contacts Adults	Direct Contacts Youth	Patents	Extension Peer Reviewed Publications	Research Peer Reviewed Publications	Total Publications
Actual	0	0	0	4	57	61

5) Water Quality, Quantity and Security State Defined Outputs

FY 2012	Classes/ Short Courses	Workshops	Demonstrations/ Field Days	Newsletters	Web Sites	Research projects	Videos, slide sets, other A/V or Digital Media	Manuals, other print materials
Actual	17	9	9	1	4	33	2	8

6) Water Quality, Quantity and Security State Defined Outcomes

a) Knowledge Changes

- 150 farm owner/operators and managers, and allied industry professionals, participating in agriculture education programs, gained knowledge of irrigation and water management practices.

Associated Knowledge Areas: 111 Conservation and Efficient Use of Water

- 150 farm, ranch, and rangeland owner/operators and managers, allied industry professionals, public agency representatives, and members of the public, participating in water quality education programs, gained knowledge of best management practices for preserving water quality.

Associated Knowledge Areas: 112 Watershed Protection and Management, 133 Pollution Prevention and Mitigation

- 217 farm owner/operators, allied industry and natural resource professionals, and members of the public, participating in water conservation education programs, gained knowledge of water use and conservation practices.

Associated Knowledge Areas: 111 Conservation and Efficient Use of Water, 112 Watershed Protection and Management

b) Attitude Changes

None to report

c) Skill Changes

None to report

d) Behavior Changes

- 112 farm, ranch, rangeland, landscape, and nursery owner/operators and managers and allied industry professionals, participating in sustainable use of water education programs, adopted best management practices for water conservation and preserving water quality.

Associated Knowledge Areas: 111 Conservation and Efficient Use of Water, 112 Watershed Protection and Management, 133 Pollution Prevention and Mitigation

- 161 farm, ranch and nursery owner/operator and managers, and allied industry professionals, participating in agriculture education programs, adopted recommended irrigation or other water and soil management practices.

Associated Knowledge Areas: 102 Soil, Plant, Water, Nutrient Relationships, 111 Conservation and Efficient Use of Water

e) Social/Health Condition Changes

None to report

f) Environmental Condition Changes

None to report

g) Economic Condition Changes

None to report

7) Water Quality, Quantity and Security Planned Program External Factors

External factors which affected outcomes

- Natural disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public policy changes
- Government regulations
- Competing public priorities
- Competing programmatic challenges
- Populations changes (immigration, new cultural groupings, etc.)

8) Water Quality, Quantity and Security Planned Program Evaluation Studies

Evaluation Results

ANR's most notable qualitative impacts that were realized, as well as the quantitative outcomes recorded from the evaluation studies, are reported under the State Defined Outcomes section.

Key Items of Evaluation

The Report Overview's federal Planned Program summary of accomplishments highlights ANR's most significant work during FY 2012, especially the research developments. The State Defined Outcomes section captures clientele adoption of recommended practices; these are the types of ultimate impacts that UC ANR research and education programs strive to realize.