Beyond the Irrigation District:

Investing in On-Farm Water Stewardship For California's Future

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By
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June 2014

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Acknowledgements

This report was made possible by the generous support of the 11th Hour Project, Gaia Fund, and Farm Aid.

We would like to acknowledge the assistance of the California Roundtable on Water and Food Supply and Ag Innovations Network for their support over the years, especially the work of Katy Mamen, Joseph McIntyre, Serena Coltrane-Briscoe, and Gisela Wendling.

The authors would like to thank Renata Brillinger, Jeanne Merrill, and Adam Kotin of CalCAN for their assistance with this report.

We would also like to thank all of the people in the various organizations who provided information for this report.

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List of Acronyms

AIN – Ag Innovations Network
AFT - American Farmland Trust
APEP - Advanced Pump Efficiency Program
AWEP - Agricultural Water Enhancement Program
BMP - Best Management Practice
CA CCA - California Certified Crop Advisers
CalCAN- California Climate & Agriculture Network
CAFF - Community Alliance with Family Farmers
CAP - Conservation Activity Plan
CARCD- California Association of Resource Conservation Districts
CASGEM- California Statewide Groundwater Elevation Monitoring
CAWSI - California Agricultural Water Stewardship Initiative
CDFA- California Department of Food and Agriculture
CDPH- California Department of Public Health
CIMIS - California Irrigation Management Information System
CIT - Center for Irrigation Technology
CRP - Conservation Reserve Program
CSP - Conservation Stewardship Program
CSU - California State University
CSWA- California Sustainable Winegrowing Alliance
DU - Distribution Uniformity
DWR - Department of Water Resources
EFA- Ecological Farming Association
EQIP - Environmental Quality Incentives Program
FREP- Fertilizer Research and Education Program
IE - Irrigation Efficiency
INM- Irrigation and Nutrient Management
IRTC - Irrigation Training and Research Center
IRWM- Integrated Regional Water Management
IRWMP - Integrated Regional Water Management Plan
IWMP - Irrigated Water Management Plan
LWG - Local Working Group
MCL- Maximum Contaminant Level
MIL - Mobile Irrigation Lab
NMTP- Nutrient Management Training Program
NRCS - Natural Resource Conservation Service
PG&E - Pacific Gas and Electric
RCD - Resource Conservation District
RMS - Resource Management Strategies
RWMG - Regional Water Management Group
RWQCB - Regional Water Quality Control Board
SISC- Stewardship Index for Specialty Crops
STAC - State Technical Advisory Committee
SWFM - Storm Water Flood Management
UCANR - University of California Agriculture and Natural Resource
UCCE - University of California Cooperative Extension
USDA - United States Department of Agriculture
USGS- United States Geological Survey
WUE - Water Use Efficiency

Chapter 1. Introduction

California produces about half of the U.S.-grown fruit, vegetables, and nuts, as well as nearly 14% of our nation's agricultural exports. To produce these crops, agriculture utilizes over three-quarters of the state's developed water from surface and groundwater sources. Many farmers have taken significant steps towards optimizing water use through the adoption of on-farm water stewardship practices; over the past four decades, farmers in California have doubled production while only increasing water use by 10% due to efficiency measures.[1] But statewide concerns regarding water availability, water quality, and agricultural water use are still prevalent.

Fortunately, opportunity exists for many farmers to further optimize water use through a combination of efficient irrigation system technologies, agro-ecological farming, and best management practices (BMPs). On-farm water stewardship can take many forms depending on crop types, farm location, budget, and production goals. But the key concept is to manage the irrigation system, soil, water supply, and crop to optimize water use. Here are some examples of practices:

- Precision irrigation technology, such as micro-sprinkler/drip irrigation technology increases irrigation efficiency
- Maintaining and upgrading irrigation systems and parts, such as drip lines, emitters, pumps, and irrigation wells ensures efficient water delivery.
- Irrigation scheduling with soil moisture monitoring, plant water status, or weather data information will reduce over-irrigating
- Improving soil health through conservation tillage, cover crops, and/or composting amendments can increase the soil organic matter, the water holding capacity of the soils, and infiltration rate of water.
- On-farm ponds can be used to capture runoff from rain events, or tail-water from irrigation to be re-used on the farm
- By practicing dry farming, with sufficient rainfall and the right management techniques, some crops in some locations in California can be grown without irrigation

Most of these practices are not new; drip irrigation, for example, has been available since the early 1970s. Although many farmers across California are already using practices such as these, in the state as a whole adoption of on-farm stewardship practices has been slow.[2] Through additional efficiency measures, the Department of Water Resources (DWR) estimates that California agriculture could reduce water use by up to one million acre-feet annually,[3] and this is likely a conservative estimate. But many growers cite unfamiliarity with technology as a barrier

[1] American Farmland Trust. Spring 2012. California Agricultural Vision: From Strategies to Results, Progress Report. Available at http://www.cdfa.ca.gov/agvision/

[2] Cooley, H., Christian-Smith, J., & Gleick, P. 2009. Sustaining California Agriculture in an Uncertain Future. Pacific Institute. Available at http://pacinst.org/publication/sustaining-california-agriculture-in-an-uncertain-future/

[3] California Department of Water Resources. 2010. California Water Plan Update, 2009. Available at http://www.waterplan.water.ca.gov/cwpu2009/index.cfm

to adopting new practices. Surveys conducted of growers by American Farmland Trust (AFT) indicated that up-front cost, risk of adoption, lack of information and technical assistance were all large barriers inhibiting the adoption of new practices and technologies.[4] An earlier survey by the Farm Water Coalition found that many farmers had received no technical assistance on water use and did not know how to implement irrigation scheduling.[5]

Education, outreach, and technical assistance projects are proven successful means to address barriers and encourage adoption of on-farm water stewardship practices. Through methods such as on-farm demonstrations, site visits, educational materials, and one-on-one technical assistance, farmers can gain the knowledge and resources they need to implement new stewardship practices. Further, new research on water stewardship topics such as optimum irrigation amounts for various crop types, best cover crop mixes, and tillage regimes are continually emerging; it is primarily through targeted education and assistance that farmers will be exposed to new practices and information.

Given that adoption of on-farm water stewardship practices in California has been slow, Community Alliance with Family Farmers (CAFF) researched the organizations and companies that provide outreach, education, and technical assistance to farmers, as well as potential Federal and State funding streams for these programs. Our goal was to understand the state of programs and funding, identify challenges, and make recommendations to increase outreach, education, and technical assistance to farmers regarding on-farm water stewardship.

Analysis of funding sources found that, overwhelmingly, California is not adequately supporting on-farm water stewardship outreach, education, and assistance programs. As a result, these programs are understaffed and underfunded, making them unable to provide the level of assistance that they want to provide and that farmers require. These programs are resource intensive. For example, just to do an on-farm assessment of the efficiency of an irrigation system can cost between $1,000-$2,000; it requires the equipment and staff time of experts who can travel, demonstrate practices, and provide the on-site evaluation. Until these programs receive sufficient funding, they will be unable to support California farmers and fully assist with the adoption of new practices.

This paper proceeds in the following manner:

- Chapter 2 discusses groundwater overdraft, water quality concerns, and climate change as major threats to clean and reliable water supplies in California. On-farm water stewardship is a tool for farmers to optimize their water use, address local water quality and quantity concerns, and enhance their resiliency to climate shocks and drought.

- Chapter 3 surveys non-governmental organizations that are providing outreach and assistance to farmers in California, with a focus on Resource Conservation Districts, to identify their innovative programs and discuss barriers to providing services to farmers.

[4] American Farmland Trust. Spring 2012. California Agricultural Vision: From Strategies to Results, Progress Report. Available at http://www.farmland.org/documents/SpecialityCropGrowersBMPs.pdf

[5] Agricultural Water Management Council and California Farm Water Coalition. 2010. Irrigation Practices and Influencers Survey Findings: San Joaquin Valley

- Chapter 4 discusses university programs in California that conduct innovative research and develop new technologies for on-farm water management, as well as their outreach and education programs.

- Chapter 5 looks at the private industry contributions to on-farm water stewardship, including private irrigation equipment suppliers and private consultants, especially the California Certified Crop Advisors.

- Chapter 6 investigates federal assistance programs with a focus on analyzing the USDA Natural Resources Conservation Services' Environmental Quality Incentives Program (EQIP) spending in California from 2002-2010. The Agricultural Water Enhancement Program and NRCS collaborative projects with the Federal Bureau of Reclamation are also discussed.

- Chapter 7 examines the state's Integrated Regional Water Management Plans in their role as master water plans for California by analyzing 12 IRWMPs in areas with significant irrigated agricultural and the relevant statutes.

- Chapter 8 considers California Water Policy, including California water bonds, cap-and-trade funds, and the now-defunct Agricultural Water Management Council, and makes recommendations for improvements to provide future support to on-farm water stewardship projects.

- Chapter 9 concludes this report.

Chapter 2. Dilemmas

On-farm water stewardship can play a key role in restoring and protecting California's water resources. All across the state are numerous examples of water quality and quantity concerns. Though many users have already adopted innovative practices to conserve water resources, it is clear that both urban and agricultural water users will have to increase efficiency to meet current and future challenges. In this chapter, groundwater overdraft, water quality issues and regulations, and climate change will be discussed as some of the greatest water-related concerns facing California. On-farm water stewardship can play a key role in helping California face these challenges.

2.1 Groundwater

2.1.1 Groundwater Overdraft

The US Geological Survey (USGS) defines groundwater overdraft as the "long-term water level decline caused by sustained groundwater pumping." Groundwater is recharged as surface waters, precipitation, and irrigation water infiltrates into the ground, and due to the variability of these sources, annual fluctuations in water levels are normal. Groundwater recharge rates vary considerably due to factors such as climate, soil permeability, and the location of recharge zones, meaning that it can take months to decades to even thousands of years for groundwater to be replenished. If water is consistently pumped from a basin in a greater volume than the recharge, water levels will decline over time. In order to manage groundwater levels, basin-specific studies are done to determine how much groundwater can be pumped yearly in what is known as safe or perennial yield.[6]

If groundwater basins are in overdraft, then there can be serious implications for water users in terms of water quality and quantity:

- **Wells run dry:** As groundwater levels decline, established shallower wells are often not deep enough to reach the lower water levels. Private well owners may have to dig new wells or deepen existing wells to access water.
- **Salt Water Intrusion:** In coastal areas, declining fresh water allows for ocean water to infiltrate into the aquifer. Well owners find themselves pumping salinized water, which is unsuitable for human consumption and eventually unsuitable to irrigate most crops.
- **Land Subsidence:** As groundwater levels decline, the subsurface porous spaces that were once full of water become empty. In many areas, the land settles down to compact these spaces causing the land surface to sink. This process cannot be reversed.

[6] Reilly, T.E., Dennehy, K.F., Alley, W.M., & Cunningham, W.L. 2008. Groundwater Availability in the United States. United States Geological Survey Circular. Available at http://pubs.usgs.gov/circ/1323/

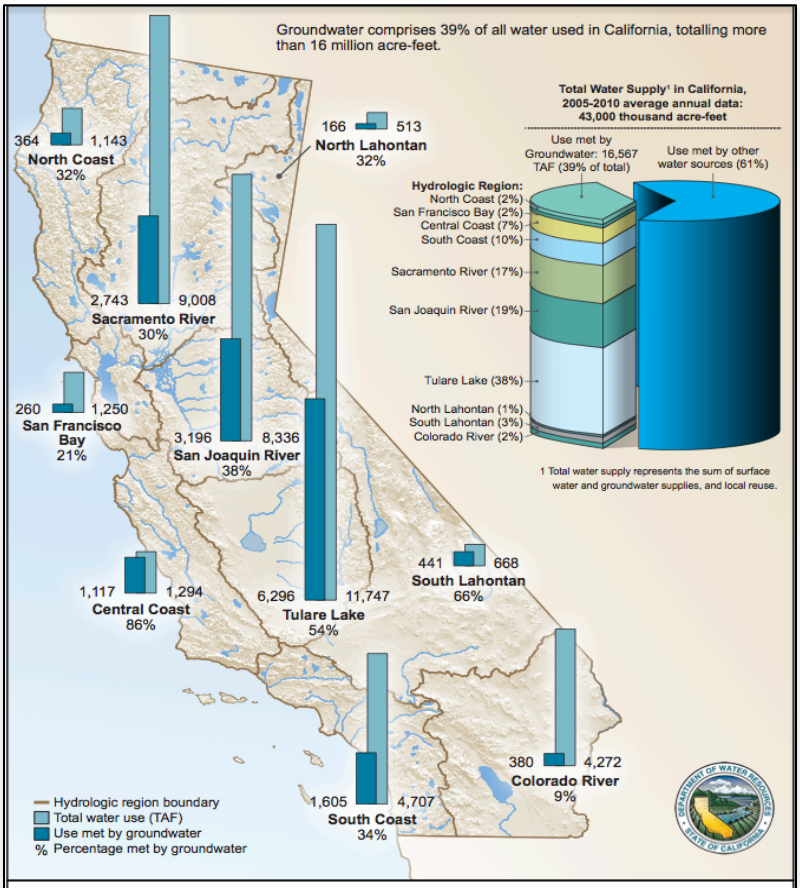
- **Water Quality:** With less groundwater to dilute them, contaminants become concentrated. Salinity and nitrate contamination in groundwater is common in California.[7]

As a source for irrigation water, groundwater has been vital to the growth of agriculture in California, especially in areas like the San Joaquin Valley that have scarce surface water resources. Groundwater also supports irrigated agriculture across the state during times of drought when surface waters are diminished. The Department of Water Resources (DWR) estimates that groundwater met about 39% of the state's water demand across urban and agricultural sectors between 2005-2010 (*fig.1).*

The effects of groundwater overdraft are currently being experienced in many places in California, from Sonoma Valley and the Santa Rosa Plain in the North Coast, to the San Joaquin Valley, or to the Pajaro Valley and the Paso Robles Basin along the Central Coast. For example:

- In the summer of 2013, private wells in Stanislaus County ran dry, most likely due to a combination of a dry winter and increased agricultural pumping for area orchards.[8]

- In the Pajaro Valley, salt water is intruding into the main aquifer at a rate of about 200 feet per year and has already crossed Highway 1 several miles inland. This has led to the creation of a community process involving landowners, agriculture, government, and other local



Source: *Draft California Water Plan Update 2013*, Department of Water Resources

Fig. 1: **Groundwater Contribution to California Water Supply by Hydrologic Region**

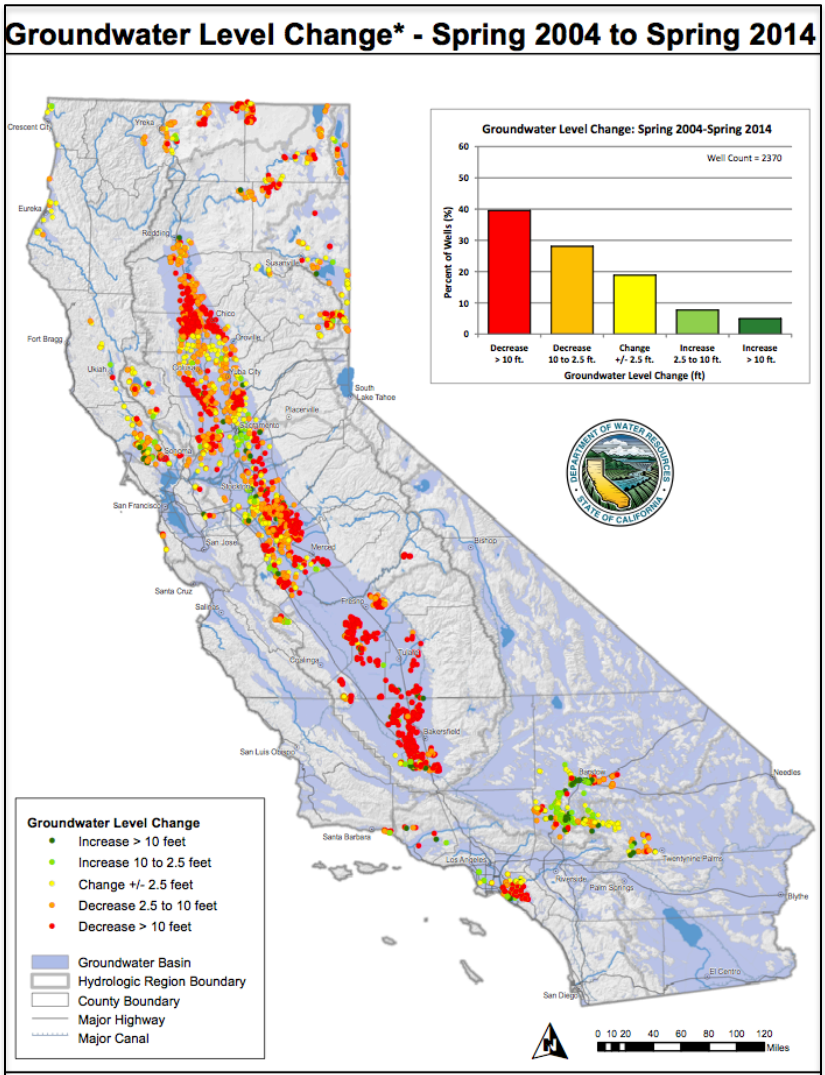
Source: California Department of Water Resources

[7] United States Geological Survey. 2013. Groundwater Depletion. The USGS Water Science School. 2013. Available at http://ga.water.usgs.gov/edu/gwdepletion.html

[8] Sacramento Bee. July 8th, 2013. Drained Well Leaves Stanislaus County Couple Begging For Water Available at http://sacramento.cbslocal.com/2013/07/08/drained-well-leaves-stanislaus-county-couple-begging-for-water/

groups to try to reduce, recharge, and re-use water in the basin, as well as the rewriting of the basin management plan by the Pajaro Valley Water Management Authority.

- In the San Joaquin Valley, nearly 30 feet of land subsidence was reported in the 1970s due to the consistent over-pumping of the aquifer. This occurred before imported water from the Delta became available through the State Water Project for irrigation. Although the rate of land subsidence since then has decreased and groundwater levels have begun to replenish, in the 1987-1991 drought, farmers renewed pumping, as imported water levels could not meet This caused land across the valley, indicating that the aquifer was still sensitive to pumping.[9] studies indicate that 2004-2014, water levels in wells in the San Joaquin Valley have declined by 10 feet (*fig. 2).*



*Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Water Data Library as of 04/28/2014. Document Name: S2014-S2004_20140428 Updated: 04/28/2014 Data subject to change without notice.

***Fig 2:* Groundwater Level Change- Spring 2004 to Spring 2014**

Source: California Department of Water Resources

- Due to concerns over declining groundwater, in late 2013, the San Luis Obispo County Board of Supervisors announced a moratorium on all new or expanded irrigated agriculture and development in the north county basin for the next two years unless water use is offset by other conservation methods to slow overdraft and develop solutions.[10]

2.1.2 Groundwater Regulation and Management

Although the State of California regulates surface water rights, the legislature has continually maintained

[9] Galloway, D. & Riley, F. N.D. San Joaquin Valley, California: Largest Human Alteration of the Earth's Surface. United States Geological Survey, Menlo Park.

[10] Ordinance No. 3246. 2013. Available at http://www.slocounty.ca.gov/Assets/PL/PR+Groundwater/prfinalord.pdf

that groundwater management is a local responsibility. The state has been collecting some data on groundwater levels since the beginning of the 20th century, but comprehensive data are still not available. In the early 2000s, the California legislature renewed a focus on groundwater, providing some funding for local management and monitoring of groundwater. AB 3030 (1992) amended the California Water Code to provide a procedure for existing local agencies to develop groundwater management plans. Further, in 2009, the State Legislature amended the water code with SBx7-6 to mandate the creation of the California Statewide Groundwater Elevation Monitoring (CASGEM) program to collect and monitor groundwater levels statewide. In 2012, the CASGEM status report was released indicating that preliminary groundwater level data were submitted in 2011, and, provided that funding continues, the next report will be released in 2015.[11]

DWR has identified 515 basins and sub-basins throughout the state; these are diverse and unique groundwater systems necessitating individual management.[12] Depending on the state of the basin, local authorities have employed various management strategies; many have commissioned groundwater studies and started their groundwater management plans, some are already monitoring individual water use, while others have had to adjudicate the basin to legally divide up groundwater among users.

Local solutions to groundwater overdraft vary as well. Some severely overdrafted basins are working to recharge the aquifers. While recharging aquifers has been successful in areas such as the San Joaquin Valley and the Coachella Valley, these projects rely on imported water from the Sacramento Delta and the Colorado River,[13] [14] hydrologic systems that are suffering from their own water quantity issues and therefore these are not sustainable solutions. In those areas with irrigated agriculture, on-farm water stewardship and water optimization can translate to significant and sustainable reductions in groundwater pumping to either prevent or slow overdraft. The Tulare County General Plan estimates that a modest 5% reduction in agricultural water use would result in 120,000 acre-feet of water saved per year from their groundwater system. [15] In the Pajaro Valley, Driscoll's has reduced water use on berries by an average of one foot per acre through soil moisture monitoring.

[11] California Department of Water Resources. 2013. California Statewide Groundwater Elevation Monitoring (CASGEM). Available at http://www.water.ca.gov/groundwater/casgem/

[12] California Department of Water Resources. 2003. California's Groundwater: Bulletin 118, Update 2003. Available at http://www.water.ca.gov/groundwater/bulletin118/update2003.cfm

[13] Galloway, D. & Riley,F. N.D. San Joaquin Valley, California: Largest Human Alteration of the Earth's Surface. United States Geological Survey, Menlo Park.

[14] Coachella Valley Water District. 2013. Agricultural Irrigation and Drainage. Available at http://www.cvwd.org/about/agricultural.php

[15] Tully & Young. 2009. Tulare County: General Plan Update. Phase 1: Water Supply Evaluation.

Pajaro Valley[16]

California's Central Coast is a unique agricultural region where most farms rely primarily on groundwater. However, most of the coastal areas have experienced seawater intrusion into the freshwater aquifers. As agriculture has intensified, innovative solutions such as water recycling, groundwater recharge, and on-farm stewardship practices have all come into play.

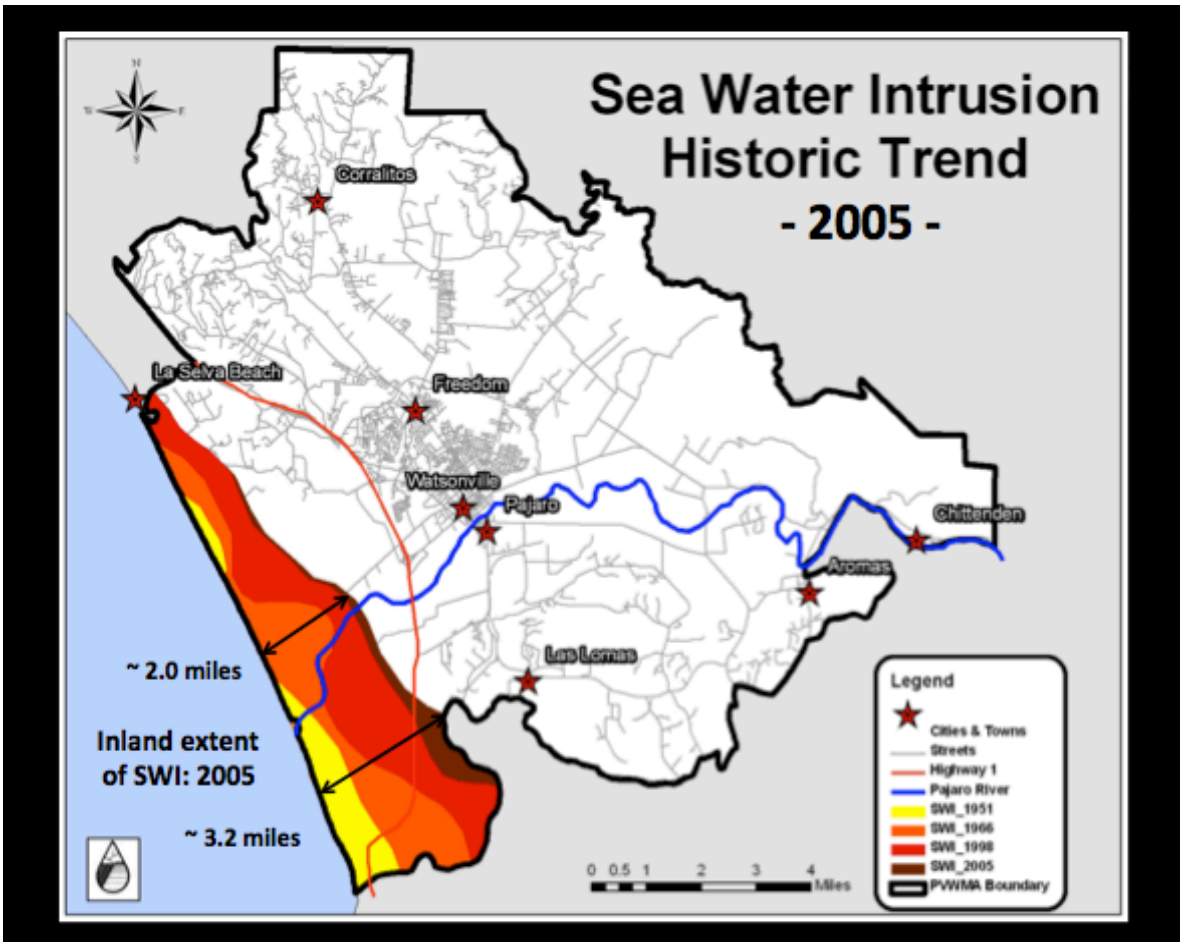
While at one time the Pajaro Valley was characterized by artesian wells and lakes, already by the 1950s the valley was suffering from overdrafting of groundwater and saltwater intrusion. The Pajaro Valley Water Management Agency (PVWMA) was created by state legislation in 1984 to manage groundwater. For the next 25 years, the focus was on building a pipeline to the Federal/State Water Project at Hollister, about 25 miles away, in order to bring supplemental water to the valley. In 2009, the pipeline was taken out of the local plan by the PVWMA after years of opposition by certain farmers who feared the cost and by environmentalists who feared the end result would be more urban development. Though the PVWMA had been "promised" 13-20,000 acre-feet per year of federal water, there was also the realization that this water was unlikely to materialize.

The best current estimate is that there is an average overdraft of about 12,000 acre-feet per year in the valley, although to truly halt the saltwater intrusion there is a need to reduce groundwater pumping/increase recharge by approximately 20,000 acre-feet per year. The landward movement of seawater into the aquifer averages 200 feet per year, and this rate increased 100% between 1990 and 2005 (*Fig 3*). Seawater intrusion has moved further inland over the past 25 years, now over three miles, and even more inland seawater intrusion is expected, especially during drought events as groundwater recharge declines due to reduced precipitation and stream runoff. Many wells out by the coast have become too salty to use.

The amount of water being pumped continues to increase. Agriculture accounts for 84% of water use and is principally due to the increase in berry production. After the late 1970s, per acre yields of strawberries did not rise until very recently. As a result, the only way to expand strawberry production was to plant more acres. The use of drip irrigation allowed for the expansion onto hillsides. Since 1980, strawberries have increased more than 10,000 acres in the region, and there has also been a significant increase in bushberries. Berries have replaced apples, some vegetables, and other crops that used less water. Apples use about 0.75 acre-feet per year, and strawberries about 2.5 acre-feet; the shift of 3-4,000 acres of apples to strawberries has accounted for a significant amount of the increased pumping. The lucrative nature of the berry crops has led to increased rents, which in turn causes more land to be devoted to berry production to support these ever inflating land rents. About 75% of the land is leased, so farmers and landowners are mostly not the same people.

[16] This section is based on David Runsten's participation in the Pajaro Valley Community Water Dialogues and research that he conducted for that purpose, as well as various documents from the PVWMA, the US Geological Survey, Reiter Affiliated Companies, and the Santa Cruz RCD.

Fig 3:



After the pipeline was taken off the table, agricultural landowners, led by a group associated with the Driscoll's company, decided that if they were going to leave anything to their children and grandchildren, they had better confront the overdraft situation. They are the ones profiting from the high rents of intensive berry cultivation, and it is in their power to reduce water use. A group of the largest landowners wrote an op-ed in the Santa Cruz newspaper saying it was time to forget the pipeline battles and start over:

> "Landowners, farmers and citizens of this valley will all need to make changes in order to secure the long-term agricultural viability of this precious resource. There are a number of reasons to act now: The slow, steady decline in water quality and quantity is continuing. Farming practices are intensifying and could exaggerate the water issues unless they are addressed soon. Ultimately, agricultural land values in the valley are likely to be impacted because of water concerns. If adjudication were to occur, it would take a long time, involve massive legal expenses and would be unlikely to produce a result as appropriate as one designed by local people.

> "As landowners and land users benefiting greatly from the uniqueness of this beautiful Valley, we recognize that we are contributors to the issue and must be ready to make very significant changes to "business as usual." We are prepared to step forward and make those changes in partnership with our colleagues across the valley. It is time for us to guide our future and not just let it happen."[17]

Community Water Dialogues

Driscoll's led an effort to construct a plan apart from the water agency, bringing together a variety of local stakeholders and the local governments in group meetings called the Pajaro Valley Community Water Dialogues. Subcommittees were formed to look at different potential solutions to the overdraft. It was agreed that no one solution was possible rather many different actions would have to be taken in order to bring the aquifer into balance. Eventually many of the participants in the Dialogues came to make up the ad hoc planning committee for a new Basin Management Plan for the PVWMA, resulting in the agency adopting many of the solutions proposed by the Dialogues. Because the funding for that plan will need to be voted on, it will roll out over a number of years in the future. In the meantime, the Dialogues have pushed ahead with the proposed solutions.

Groundwater Recharge

As the local people came to grips with having to live within the water budget of their local watershed, they gained a new appreciation for groundwater recharge and realized they lacked data on how and where the aquifer recharged. Professor Andy Fisher at UC Santa Cruz built a mobile testing unit to field test absorption rates in places people thought would be good for recharge. He also built a GIS model to identify areas likely favorable for recharge, so that people could see on a map the best recharge areas. Many of these areas were at the base of the mountains, and the local land trust began a campaign to save the upper watershed on these mountains.

Recycled Water

Because Monterey Bay is a federal marine sanctuary, the city of Watsonville had to upgrade their sewage treatment facilities, for which they lacked funding. The community decided to treat the sewage to recycled water standards and use it to irrigate fields near the ocean where wells had salted up. A new treatment plant was built along with a distribution system on the coastal plain. All water users in the basin joined in paying for this system. This system had been constructed by the time the Community Water Dialogues were started, however it was clear that it could be improved in various ways.

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[17] Santa Cruz Sentinel. May 2010. Solving PV Water Problems Will Require Sacrifice—and Unity.

The Watsonville recycling plant has to use pumped groundwater to dilute the salts in the recycled urban water so that farmers can use it. This water is being pumped right in the middle of the basin and is contributing to the saltwater intrusion. College Lake is an area east of Watsonville that fills seasonally but that has been pumped out for farming for over 100 years. A whole reclamation district was formed just to pump the water down the river. A plan has been created to pipe the College Lake water to the city's recycling plant in order to replace the pumped groundwater.

A plan is also being developed to increase water storage at the plant in order to retain water that could be used for agriculture but that is not needed at particular times, such as during winter rains.

Soil Moisture Monitoring

The Driscoll's organization has been leading a series of pilot efforts to optimize the use of drip irrigation. All of the berries are on drip, but drip is not necessarily a water-saving technology. It has to be managed carefully. There is a general impression that most berries are being over-irrigated, and this is true not only for under-resourced immigrant growers, but even for an organization like Driscoll's.

After testing half a dozen approaches, Driscoll's settled on the soil moisture monitoring system of Hortau to measure soil moisture tension and so schedule irrigation when it is truly needed. The system uses wireless probes buried in the soil at 8" and 18" depth. The probes send signals to a tower that communicates with a satellite so that users can get real time data on a cell phone or computer. This allows the grower to precisely schedule irrigation, and might even allow automation of irrigation. It could be combined with ET information.

By requiring farmers to measure their water use and utilizing this system, Driscoll's has been able to save on average an acre-foot of water on each acre of berries. It is significant that the trials have shown no loss of yield with reduced irrigation and it appears that the quality of the berries improves as well.

The challenge will be to convince everyone to adopt such technology. A system of Hortau towers, managed by the Santa Cruz RCD, was set up across the valley so that farmers could tap into the system at low cost; a program to allow small growers to rent soil moisture probes was created. Most strawberry growers and virtually all irrigators are Mexican immigrants. There has to be an entire Spanish language outreach program designed to explain the overdraft problem and the advantages of this technology. And the other berry shippers need to emulate Driscoll's and require it of their contracted growers. But new connections must be established with this immigrant community for the plan to succeed.

Other On-Farm Water Stewardship Practices

The Community Water Dialogues have increased awareness of several on-going water conservation efforts including increased irrigation efficiency, rotational fallowing, and a pilot program on performance-based conservation incentives. The Dialogues are coordinating trainings in irrigation scheduling, including using evapotranspiration data and understanding measurements of distribution uniformity, which are critical for optimizing irrigation efficiency. The mobile irrigation labs that tested the irrigation systems for distribution uniformity and proper maintenance had faded away due to lack of funding. Now the Santa Cruz RCD has started the program up again.

A recent "Drought and Irrigation Conference" hosted by the Community Water Dialogues and partner organizations in April 2014 exemplifies the type of discussion occurring in the Pajaro Valley. Workshops included the following:

- Irrigation Scheduling, Michael Cahn, UCCE
- Soil Moisture Monitoring, Ben Burgoa, RCD of Monterey County
- Distribution Uniformity and System Evaluations—Drip or Sprinkler, Tom Lockhart, UCCE
- Water Harvesting, Rich Casale, NRCS
- Salt Management, Stuart Styles, ITRC Cal Poly
- Maximizing infiltration and water holding capacity in your soil, Karen Lowell, NRCS
- Water Use Tracking and Record Keeping, Dan Johnson, NRCS

Lessons Learned in the Pajaro Valley

The key lesson so far in the Pajaro Valley is the need for the involvement of the agricultural landowners and the shippers. Both of these groups can require change from the growers and both have a financial stake in the economics of on-farm practices: land rents are determined by the profitability of what you can grow on the land; sales depend on the costs of production. These people have to take a financial hit to solve the problem.

The Pajaro Valley Community Water Dialogues started by Driscoll's were able to involve a wide array of stakeholders, including landowners, farmers, farm organizations, environmentalists, government, the water agency, university researchers, and the real estate industry. By creating connections among these groups, practical solutions to the groundwater overdraft could be proposed and tested away from the formal venue of the water management agency. This was so successful that the water management agency adopted these solutions as their own plan.

Groundwater overdraft is a classic case of the tragedy of the commons. Because there is no statewide control of groundwater use in California, solutions must necessarily be local. One can divvy up the sustainable yield by adjudicating in court, build a pipeline to some distant source of more water, or a community can pursue the development of the solutions needed to balance local water demand with the available water in the watershed.

Paso Robles Groundwater Basin

The Paso Robles Groundwater Basin is located in the northern section of San Luis Obispo County. The basin supplies water to 29% of the county's population and 40% of the county's agriculture. In the 2000s, a series of studies were done to determine the state of the groundwater levels. The Basin Study in 2002 was used to determine a hydrologic budget based on inflows and outflows; the safe yield was set at 94,000 acre-feet per year, but was then increased to 97,700 acre-feet per year in 2005. Additional monitoring in 2007 indicated that even though the basin was not yet at safe yield estimates, groundwater levels were declining significantly in certain areas of the basin. Between 1997 and 2006, groundwater storage in the basin declined about 29,800 acre-feet. In 2010, a Resource Capacity Study prepared by the San Luis Obispo County Planning Department declared the basin to be at or approaching safe yield, necessitating the development of the Paso Robles Basin Groundwater Management Plan.[18]

The Paso Robles Basin Groundwater Management Plan was released in February 2011, with the purpose of protecting the basin from unacceptable water depletion, land subsidence, and water quality degradation. Agriculture is estimated to pump 67% of the water from the Paso Robles Basin. The Management Plan has three targeted projects that would address agricultural water use:

- Reduce agricultural pumping
- Implement agricultural water reuse program
- Land-use planning policies that do not increase net groundwater pumping

The first two projects are directed towards individual growers and would be implemented on-farm, while land-use planning is the purview of county and city planners and officials, and has currently culminated in the 2013 Moratorium placed on all new or expanded irrigated agriculture and urban development in the basin. No additional irrigated agriculture can be planted unless water use is offset by reductions elsewhere. The management plan indicates that an agricultural reuse program would likely not result in any net water savings, because of the widespread use of drip irrigation.[19]

In order to address and reduce agricultural pumping, the plan recommends implementing on-farm best management practices and partnering with the Vineyard Team, as the majority of Basin agriculture is comprised of vineyards. The Vineyard Team has a sustainability handbook and certification program with sections on Vineyard Water Use and conducts on-farm educational workshops and training. The plan does not address outreach to other types of agriculture.

Two years after the plan was released, Larry Werner, Chairman of the Paso Robles Basin Blue Ribbon Water Committee, indicated that focusing on solutions and real water savings is essential. With the majority of basin water use going directly to agriculture, even small individual on-farm water savings could collectively result in significant positive impacts on the basin as a whole. To this end, he supports continued outreach to promote on-farm water

[18] Paso Robles Basin Groundwater Management Plan. March 2011. Available at http://www.prcity.com/government/departments/publicworks/water/groundwater.asp
[19] Ibid

stewardship throughout the basin.[20] Especially after the 2013 Moratorium, outreach and assistance to support on-farm water stewardship can play a key role in the future of the basin.

2.1.3 Conclusion

Best management practices for agricultural water use are highly specific to location, soil, crop, water source, and other factors, and so are solutions to groundwater overdraft. The examples of the Pajaro Valley and the Paso Robles Basin show us that local control and solutions that include agricultural water stewardship are able to address problems such as groundwater overdraft. Solutions should be collaborative, without blaming agriculture, threatening water rights, raising water prices, or forcing farmer to change crops. Local groups need to work together to devise processes that involve farmers, landowners, and shippers in a region to produce solutions that make economic sense.

Outreach to farmers is necessary to complement these local solutions and optimize agricultural water use. However, with budget cuts to universities, Extension services, and Resource Conservation Districts, the outreach will not be adequate. California needs to allocate more funding to outreach and assistance if we are to optimize water stewardship in agriculture, halt groundwater overdraft, and balance demands for water in the state.

2.2 Water Quality

Water quality issues vary across the state of California and not all are related to agriculture or can be mitigated by on-farm water stewardship. Although certainly not responsible for all water contamination, runoff from agricultural lands does contribute to nitrate, nutrient, pesticide, phosphorus, and sediment surface and groundwater quality issues, which are prevalent across California (*Fig. 4)* Runoff occurs naturally during rain events, but can also be related to irrigation events. Especially if growers over-irrigate, nutrient rich water will leave the root zone and infiltrate into groundwater or run off the soil surface into streams. In order to reduce agricultural runoff, growers can implement on-farm water stewardship methods such as cover crops, buffer strips, and also improve the timing and frequency of irrigation events.[21]

In the following sections, nitrate contamination will be discussed to illustrate how irrigation efficiency can be used to mitigate runoff from irrigated agriculture. The Irrigated Lands Regulatory Program will also be discussed to demonstrate how outreach to farmers can help comply with water quality regulations.

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[20] Werner, L. 2013. Personal Communication. K. Lambert. In person conversation with Larry Werner, Chairman, Paso Robles Basin Blue Ribbon Committee.

[21] Nutrient Management. 2013. California Agricultural Water Stewardship Initiative. Available at http://agwaterstewards.org/index.php/practices/nutrient_management

2.2.1 Nitrates

Nitrate is the most widespread groundwater contaminate in California. Nitrates in drinking water are harmful to human health, and the California Department of Public Health (CDPH) has determined that the maximum contaminate level (MCL) of nitrate in drinking water is 45 milligrams per liter.[22] Nitrate exposure can cause respiratory and reproductive conditions, cancer, impairment of the spleen, kidney, and thyroid function, and may be fatal to infants.[23]

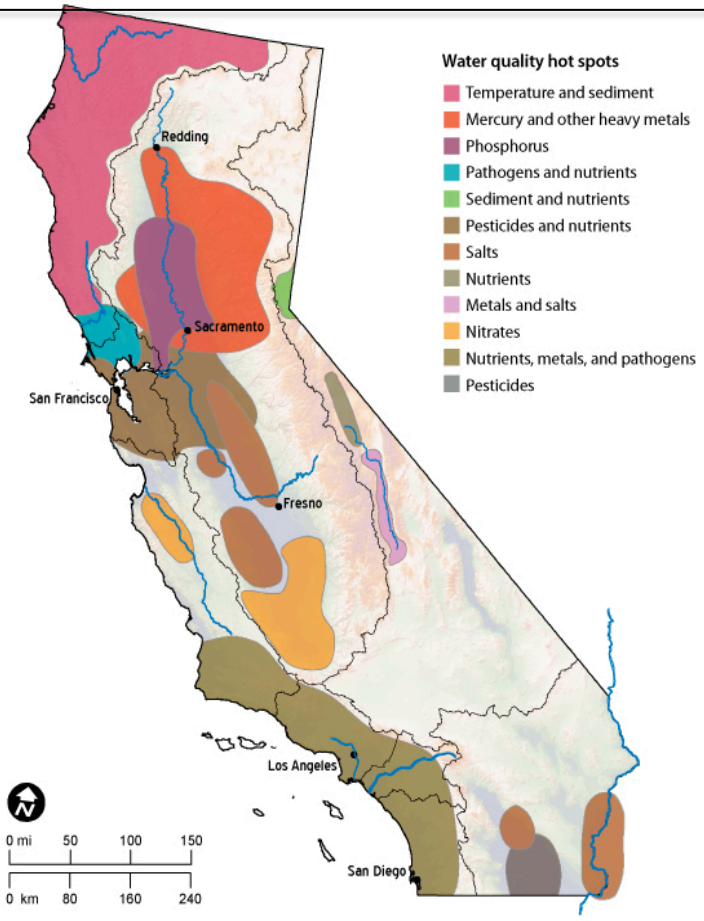

***Fig 4*: Water Quality Hotspots in California**

Source: Public Policy Institute of California, http://www.ppic.org/main/mapdetail.asp?i=1094

Unfortunately, many groundwater basins in California currently exceed the MCL set by the CDPH, with over 75% of nitrate exceedances occurring in the San Joaquin Valley alone.[24] The cost of groundwater remediation for community systems is high, with projects ranging between $100,000 to $7.5 million from CDPH's Drinking Water State Revolving Fund. Individual homeowners are often forced to purchase filters or bottled water, dig deeper wells to avoid contamination, or even worse, are unaware that their water is contaminated.[25]

In 2012, UC Davis released a report and technical papers for the State Water Resource Control Board in accordance with SBX2 1, which required the state to contract a study to identify the causes of nitrate groundwater contamination and present remediation solutions to ensure safe drinking water to all communities. The report focused on the Tulare Lake Basin and Salinas Valley groundwater. The findings indicate that agricultural fertilizers and animal wastes represent the largest source of nitrate contamination, with 93.7% of the nitrate leaching coming from cropland

[22] UC Davis. Addressing Nitrate in California's Drinking Water: With a Focus on the Tulare Lake Basin and Salinas Valley Groundwater. January 2012. Available at http://groundwaternitrate.ucdavis.edu/files/138956.pdf
[23] Pacific Institute. The Human Costs of Nitrate-contaminated Drinking Water in the San Joaquin Valley. 2011. Available at http://www.pacinst.org/publication/human-costs-of-nitrate-contaminated-drinking-water-in-the-san-joaquin-valley/
[24] Ibid.
[25] Ibid.

(excluding alfalfa cropland) in the study area.[26]

Nitrogen is essential for crop production, and synthetic fertilizers play a key role in agricultural production. However, over-fertilization and over-irrigating crops will lead to nitrogen leaching into groundwater or run off into surface waters. To address nitrate contamination, UC Davis recommends improving the timing of nitrogen fertilizer application, animal manures, and irrigation events. By improving irrigation efficiency and timing, growers will reduce the amount of water with nitrogen that percolates into the groundwater, as water in excess of plant needs will move beyond the root zone, taking nitrogen with it.[27] Effective irrigation and nutrient management require individualized on-farm solutions.[28]

UC Cooperative Extension (UCCE) Advisors and UC researchers are currently working to develop optimum irrigation and fertilizer amounts for the most common California crops. UC is also working with the California Department of Food and Agricultural (CDFA) to enhance the Fertilizer Research and Education Program (FREP) to conduct research, provide an online database of the latest nutrient research, and collaborate on outreach to farmers.[29] Through these measures, organizations are working to provide the latest information to growers on nutrient management.

2.2.2 Irrigated Lands Regulatory Program

State and Regional Water Boards are able to waive waste discharge requirements (WDRs) under the California Water Code for over 40 categories of discharges. Many of these waivers target discharge from irrigated agricultural lands in what are known as "Ag Waivers." Agricultural discharge includes irrigation return flow, storm water runoff, and flow from tile drains.[30] In enacting Ag Waivers, regions are able to better regulate discharges to protect local water quality. Ag Waivers require specific conditions to protect and address local water quality issues. The waivers are conditional and may not exceed five years, but can be renewed.

DWR indicates that around 9,493 miles of streams and rivers, as well as nearly 513,130 acres of lakes and reservoirs have been listed at impaired by agricultural discharge, with 2,800 miles of stream being impaired by pesticides alone.[31] For these reasons, regional water boards in Los Angeles, Central Coast, Central Valley, San Diego, North Coast, Santa Ana, and Colorado River

[26] UC Davis. Addressing Nitrate in California's Drinking Water: With a Focus on the Tulare Lake Basin and Salinas Valley Groundwater. January 2012. Available at http://groundwaternitrate.ucdavis.edu/files/138956.pdf
[27] Ibid.
[28] The California Roundtable on Agriculture and the Environment. 2013. Policy Considerations for Managing Agricultural Nitrogen to Reduce Groundwater Contamination in California. Available at http://aginnovations.org/articles/view/agricultural_nitrogen/
[29] California Department of Food and Agriculture. 2012. Nitrogen Management Initiatives. Available at http://www.cdfa.ca.gov/is/ffldrs/frep/index.html
[30] Department of Water Resources. Irrigated Lands Regulatory Program. 2013. Available at http://www.swrcb.ca.gov/water_issues/programs/agriculture/docs/about_agwaivers.pdf
[31] Ibid.

Basin either have or are in the process of creating varying levels of conditional prohibitions on agricultural discharge.[32]

For example, the Central Coast Ag Waiver outlines conditions that must be met by agricultural dischargers to protect area surface and ground water from pollutants, most notably certain pesticides and nitrates. Agricultural dischargers are placed into three Tier categories: Tier 1 dischargers are exempt from regulation, and Tier 2 and Tier 3 dischargers need to comply with the conditions of the document. The Ag Waiver indicates that farmers in the Tier 1 category may belong to on-farm sustainability programs, such as the Vineyard Team's Sustainability in Practice (SIP) certification for vineyards. SIP is a series of on-farm sustainable practices, including irrigation efficiency that allows farmers to reduce their environmental impact. For Tier 2 and Tier 3 dischargers, the waiver lays out requirements for reporting agricultural discharge, as well as the development of management plans to reduce discharge, including improving irrigation efficiency and timing.[33]

The Central Coast Ag Waiver, along with others, demonstrates the need for outreach to farmers regarding on-farm water stewardship to not only decrease agricultural discharge but to assist farmers in meeting the requirements of the Ag Waivers. Outreach and training programs, such as the Vineyard Team's and CDFA's programs help farmers reduce their agricultural discharge to protect the environment and comply with Ag Waivers and water quality regulations across the state.

2.3 Climate Change

Climate change is expected to increase average temperatures, cause precipitation variability, and increase the frequency of extreme weather events. Uncertainty does exist over the timing and magnitude of climate change effects across California, due to the temporal and geographical climate variability of the state and the inherent uncertainty in modeling future climatic trends. Despite the uncertainly, there is widespread consensus among scientists and many government agencies, such as DWR, that human induced climate change is already occurring and will continue into the future. [34] Especially in California's semi-arid Mediterranean climate, climate change is expected to threaten the reliability and quality of fresh water, necessitating careful management and planning to protect all water users into the future.

The effects of climate change have already been observed across California. Average temperatures have increased 1°F over the last century across the state, with some regional areas experiencing greater increases (*fig. 5)*.[35] Snowpack in the Sierra Nevada Mountain Range has decreased by 10% over the same period.[36] Future climate predictions indicate that snowpack may

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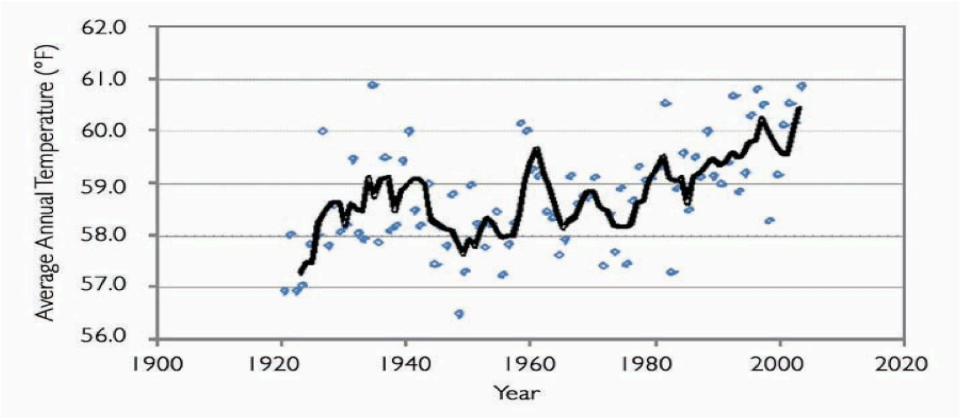
[32] Ibid.
[33] California Regional Water Quality Control Board Central Coast Region. Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. 2012. Available at http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/ag_order/final_agorder_atta_032612.pdf
[34] The California Department Of Water Resources. 2008. Managing an Uncertain Future: Climate Change Adaptation Strategies For California's Water.
[35] Ibid.

decrease by 25 to 40% by 2050[37] with precipitation patterns become more variable; average precipitation rates are predicted to decrease by as much as 8% in some areas. Average temperatures may increase by 2.7 °F across the state.[38] The increases in average temperature will likely increase water demand across agricultural and urban sectors. Unfortunately the decrease in precipitation and snowpack is expected to decrease water supply, resulting in prolonged periods of drought [39] and increased competition among sectors for fresh water resources.

Fig 5:

Historical Annual Average Temperature for California



Source: California Energy Commission. 2009.

California is a large and diverse state, and uncertainty does exist as to how climate change will affect the state and its microclimates, but it is clear that all sectors need to prepare for future changes in water supply. To meet these new challenges, DWR recommends increased drought preparedness, increased water use efficiency, and implementation of water conservation measures in agriculture.[40] By implementing on-farm stewardship measures, growers will enhance their resiliency to climate shocks. Through on-farm measures, growers can reduce their dependency on fresh water supplies and their vulnerability to changes in supply. Further, optimizing on-farm water use will lead to water savings, which can be allocated to other agricultural, urban, or environmental purposes. Additional direct assistance to farmers to promote adoption of new practices will be necessary to prepare for this future.

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[36] California Climate Change Center. 2012. Our Changing Climate 2012: Vulnerability & Adaptation to the Increasing Risks of Climate Change in California.
[37] Ibid.
[38] California Climate Change Center. 2012. Our Changing Climate 2012: Vulnerability & Adaptation to the Increasing Risks of Climate Change in California.
[39] Micheli et al. 2010. Adapting to Climate Change: State of Science for North Bay Watersheds. Pepperwood Preserve.
[40] The California Department Of Water Resources. 2008. Managing an Uncertain Future: Climate Change Adaptation Strategies For California's Water.

Chapter 3. Non-Governmental Organizations

Non-governmental organizations play an important role in providing outreach, education, and assistance to farmers regarding on-farm water stewardship in California. Programs across these organizations vary, but collaboration is common. Many of these organizations are non-profits, requiring funding from State and Federal Government grants, as well as private foundations, to support their work. Finding secure funding sources is an ever-present challenge. This chapter presents an overview of some of the innovative work that non-governmental organizations are conducting in California, and concludes that additional funding sources are needed to expand and continue these efforts.

3.1 Resource Conservation Districts

3.1.1 Introduction

In 1937, the federal government, in response to the Dust Bowl, created the Soil Conservation Service (SCS). However, by the late 1940s in California, local Soil Conservation Districts were developed following the SCS boundaries to more adequately address local needs. These districts originally managed soil and water. As responsibilities expanded to related areas, such as habitat improvement and fire prevention, districts were renamed Resource Conservation Districts (RCDs) in 1971.There are currently 100 RCDs and 3 Tribal RCDs in California (Figure 2).[41] [42]

RCDs are set up under Division 9 of the California Public Resources Code; they are locally governed agencies and established by the county's Local Agency Formation Commission. The RCDs are unified through the California Association of Resource Conservation Districts (CARCD), a non-profit housed in the state Department of Conservation that provides assistance, information, and coordinated governmental representation. RCDs work closely with government agencies, especially the Natural Resource Conservation Service (NRCS). Each RCD is responsible for its own funding, though CARCD assists with this process; RCDs are mainly funded through grants and contributions.[43]

RCDs work to promote resource conservation and stewardship in agriculture through projects on public and private lands. With over 100 districts throughout California, agricultural water-use efficiency projects vary depending on the need of the district. RCD staff indicated that on-farm water stewardship projects are extremely valuable, producing multiple benefits related to improving water quality and quantity, and economically benefitting growers.[44] RCDs may assist

[41] California Association of Resource Conservation Districts. 2012. California Association of Resource Conservation Districts Strategic Plan.
[42] California Association of Resource Conservation Districts. 2014. California Resource Conservation Districts Boundaries. Available at http://www.carcd.org/rcd_directory0.aspx
[43] California Association of Resource Conservation Districts. 2012. California Association of Resource Conservation Districts Strategic Plan.
[44] Bates. JW. 2013. Personal Communication. K. Lambert. Telephone conversation with JW Bates, District Engineer, Coastal San Luis Obispo RCD.

with upgrading and improving irrigation systems, reducing runoff, and tracking water use through providing technical assistance and education to growers.

Projects range from informal phone calls for irrigation assistance and assessment, to a more systematic Tailwater Education Program that works to reduce runoff during irrigation events offered by the Imperial Irrigation District.[45] RCDs may coordinate across regions. For example, the RCDs across the central coast of California are currently coordinating a network of Mobile Irrigation Labs (MILs) and Irrigation and Nutrient Management labs (INM). The goal is to align outreach efforts and work collectively to improve irrigation efficiency and track nutrient applications to improve water quality and quantity. Funding for these projects will be coming from multiple government grants, as well as Western SARE, to assist current INM and MILs and set up new labs. It should be noted that the procurement of one grant from the State Water Board to develop and coordinate an INM program took nearly 8 years to obtain.[46]

Although the RCDs are successfully engaged in many projects across California, CARCD indicates that the RCDs face many challenges; building the capacity of local RCDs is "critically important". Surveys of RCD staff indicate that the following are major concerns:

- Lack of base funding
- Constrictive grant funding requirements
- Limited, and in some cases, dwindling resources
- Additional need for staff training and technical support[47]

Through conducting interviews with RCD officials, it is clear that the size, staff, and capacity of RCDs vary greatly across the state, and some RCD offices are currently inactive. In order to address these concerns, CARCD is currently working to procure baseline funding from California for the RCDs and to merge RCDs where possible to provide adequate resources across the state. Until RCDs receive steady and sufficient funding, they will be unable to maintain the staff and resources necessary to conduct their valuable outreach. The following section uses the Mobile Irrigation Labs (MIL) as a case study to highlight both the need for these types of projects and the lack of resources for execution.

3.1.2 Mobile Irrigation Labs (MILs)

Mobile Irrigation Labs (MILs) provide farmers with an on-site evaluation of their irrigation system and recommend improvements to reduce run-off while saving water, energy, and money. This may mean conversion from furrow irrigation to sprinklers or drip systems. If a grower is already using drip/micro-irrigation systems, an evaluation can identify blocked or damaged equipment that prevents the targeted delivery of water. MILs were developed at Cal Poly's Irrigation Training and Research Center (IRTC), and first were launched in the 1980s with

[45] Bradshaw, D. 2013. Personal Communication. K. Lambert. Telephone conversation with David Bradshaw, Assistant Water Manager, Imperial Irrigation District.

[46] Hoover, B. 2013. Personal Communication. K. Lambert. Telephone conversation with Bridget Hoover, Director, Water Quality Protection Program, Monterey Bay National Marine Sanctuary.

[47] California Association of Resource Conservation Districts. 2012. California Association of Resource Conservation Districts Strategic Plan.

CALFED Water Use Efficiency grant funds administered by DWR.[48] RCDs may partner with neighboring irrigation districts or water purveyors and may receive support from NRCS through Farm Bill conservation funds.[49]

Distribution uniformity (DU), or the degree to which water is evenly spread throughout a given field, is a standard, overall measure of irrigation efficiency.[50] Improving DU is a primary objective of irrigation evaluations, ensuring that water is getting where it is intended to be. Optimizing irrigation efficiency (IE) is another goal of irrigation evaluations. This is done in part by promoting the use of weather and crop data to enable targeted irrigation scheduling.

On-site irrigation system evaluations allow for individualized assessments, identifying farm-specific problems and solutions. No irrigation system is categorically superior in achieving optimum DU and IE for every farm type in California.[51] Land contours, microclimates, and soil types can all affect DU and IE. Further, consistent upkeep of any irrigation system is required to maintain optimum DU and IE.[52] By addressing these nuisances, Dr. Charles Burt, head of the IRTC and developer of the MILs, echoes the assertions of irrigation specialists and farmers that MIL recommendations have led to:

- Increased application efficiency
- Increased yields
- Increased profits
- Improved water quality
- Decreased amount of water applied
- Decreased energy usage
- Decreased nutrient leaching
- Decreased tail water runoff[53] [54]

Unfortunately, the individual on-farm assessment that makes the MIL program so effective also makes it resource- and time-intensive, necessitating adequate funding to continue and expand the MIL program.

Of the 100 RCDs in California, only 15 indicated that they are currently operating an MIL. Four additional RCDs secured funding in 2013-2014 and plan to start MILs as soon as that funding is

[48] Eching, S. 2011. Personal Communication. J. Elhayek: Email Correspondence with Simon Eching, Office of Water Use Efficiency, California Department of Water Resources.
[49] Dawley, V. 2011. Personal Communication. J. Elhayek: Phone conversation with Vicky Dawley, District Manager, Tehama County Resource Conservation District.
[50] Center for Irrigation Technology. 2011. Irrigation Performance Measurements - Distribution Uniformity and Irrigation Efficiency. Online tutorial. Available at: http://www.wateright.org/duie.asp#relations
[51] Center for Irrigation Technology, CSU Fresno. 2011. Agricultural Water Use in California: A 2011 Update. Available at: http://www.californiawater.org/docs/CIT_AWU_Report_v2.pdf
[52] Tehama County RCD. 2011. Potential Water Savings Trough Improved DU.
[53]Burt, C. PhD. 2011. Personal Communication. J. Elhayek: Email Correspondence with Dr. Charles Burt, Chairman and Founder, Irrigation Training and Research Center, California Polytechnic University, San Luis Obispo.
[54] California NRCS. 2008. Mobile Irrigation Laboratory. Available at: ftp://ftp-fc.sc.egov.usda.gov/CA/news/Stories/area_1/mobile_lab.pdf

released. 65 RCDs state that they do not operate an MIL. The remaining RCDs appear to be inactive or were unresponsive. This does not include tribal RCDs. (*Table 1*)

***Table 1*: Number of Mobile Irrigation Labs across 98 RCDs**

	Operate an MIL	Starting MIL 2013-2014	Do Not Operate an MIL	Inactive or unresponsive
Number of RCDs	15	4	64	15

Reasons for not operating an MIL include:

- Not enough irrigated agriculture or demand for an MIL in the district
- Focus on other irrigation efficiency programs
- Use of MILs from other RCDs
- Lack of funding

Funding for MILs comes from multiple sources, including state and regional government and organizations. For example, Loma Prieta RCD secured funding in 2013 to start an MIL in part from the Santa Clara Water District.[55] Other RCDs receive support from PG&E energy efficiency grants. Part of the cost of MIL services also may be passed on to growers. Columbia RCD runs a self-financed MIL that has successfully converted the district to 90% micro/drip irrigation over a 10-year period; since the conversion, there has been little need for a MIL in the area.[56] Coastal San Luis Obispo RCD currently charges a fee for MIL services, although the cost to the grower can be partially covered by the NRCS and farm bill conservation funds. Staff cites these fees as an impediment for expanding the program.[57]

RCDs along the Central Coast in Santa Clara, San Benito, Santa Cruz, and Monterey counties are working to start a Irrigation and Nutrient Management Lab to provide on-site irrigation system evaluation, as well as nutrient management assistance. These labs is not included in the MIL analysis, but serves a similar and expanded function for those counties.

DWR stopped regular funding to the MIL program in the 1990s.[58] In 2013, DWR did allocate funding for two MILs in the Tehama and Napa districts from the Agricultural Water Use Efficiency Grants supported by Prop 50.[59] DWR also released final funding decisions from Prop

[55] Meyers, S. 2013. Personal Communication. K. Lambert: Phone conversation with Susan Meyers, Executive Director, Loma Prieta RCD.

[56] Houk, R. 2013. Personal Communication. K. Lambert: Phone conversation with Randall Houk, General Manager, Columbia Canal Company and RCD.

[57] Bates. JW. 2013. Personal Communication. K. Lambert: Phone conversation with JW Bates, District Engineer, Coastal San Luis Obispo RCD.

[58] Eching, S. 2011. Personal Communication. J. Elhayek: Email Correspondence with Simon Eching, Office of Water Use Efficiency, California Department of Water Resources.

[59] California Department of Water Resources. 2013. Notice of Final Funding Decision, 2013 Agricultural Water Use Efficiency Proposal Solicitation. Available at http://www.water.ca.gov/wateruseefficiency/docs/Notice-Final_Funding_Awards-7-26-13_FINAL.PDF

84 IRWMP Grants, which include funding for a Santa Cruz RCD MIL.[60] However, this DWR funding is limited compared to the needs across RCDs for MILs.

A lack of funding to maintain adequate staff where MILs exist, or to create MILs where they are needed, is the main factor limiting the expansion of this popular and successful program. A few RCDs interviewed have been forced to discontinue their MIL due to funding constraints, while still others would like to have a program, but are unable to secure funding for labs and staff. Some RCD specialists have indicated that they even hold back their outreach efforts, because they would not be able to meet subsequent demand for evaluations—which cost from $1,000-$2,000 each.[61]

3.1.3 Conclusion

State and local government budget cuts have hurt staffing levels of the RCDs. The California Department of Conservation, which provides training and funding for the RCDs, ended its RCD grant program in 2003. Today, budget cuts and inconsistent sources of funding have left some RCDs with greatly reduced staffing levels and programming, leaving them trying to rebuild and find new funding sources to maintain their projects and technical expertise. A designated and reliable base funding stream should be provided by the state for the creation, maintenance, and promotion of RCDs and their projects.

3.2 Industry Sustainability Groups

3.2.1 Introduction

There are many commodity organizations within California that offer outreach, education, resources, and sustainable certification to growers. These programs can unify and encourage the adoption of on-farm best management practices, as well as provide crop valuable crop-specific data to growers. This section focuses on wine grape programs as an example.

3.2.2. Wine grape sustainability programs

There are currently four wine grape programs that provide education, training, and have developed industry sustainability standards that have been codified into workbooks and third-party certification programs, namely:

- **The California Sustainable Winegrowing Alliance (CSWA):** This is a statewide organization created by the Wine Institute and the California Association of Winegrape Growers in 2001. CSWA offers Certified California Sustainable Winegrowing.

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[60] California Department of Water Resources. 2014. Final Awards, Proposition 84, Round 2 Implementation Grant February 4th, 2014.. Available at http://www.water.ca.gov/irwm/grants/docs/ImplementationGrants/FinalAwardP84Rnd2IG_2014_0204.pdf

[61] Dawley, V. 2011. Personal Communication. J. Elhayek: Phone conversation with Vicky Dawley, District Manager, Tehama County Resource Conservation District.

- **Vineyard Team:** A regional sustainability group with members in the Central Coast was established in 1994. Their sustainability certification program, Sustainability in Progress, is offered statewide and was started in 2008. They developed the first vineyard self-assessment tool in 1996.

- **Lodi Rules:** Promotes sustainable wine grape growing mainly in the Lodi region. Their third-party sustainable winegrowing program, Certified Green, was launched in 2004, and is available outside of the Lodi wine region.

- **Napa Valley Vintners:** Has developed Napa Certified Green Lands for vineyards and other lands to support sustainable practices, as well as protect and restore the Napa Valley Watershed.

Each program's workbook has chapters for sustainability topics, such as vineyard water management, pest management, habitat conservation, and/or energy use. Each chapter is divided into practices, such as irrigation design, irrigation scheduling, and irrigation system maintenance. Growers are able to self-asses their operations by using a rubric system for each practice describing various levels of sustainability, which also allows for practice improvement. Growers must score a certain level to be certified sustainable by a third party auditor.

These organizations also hold targeted educational, training, and outreach events. For example, from 2004 to 2012, CSWA held 232 workshops reaching 10,737 individuals. It is not stated how many of the workshops were directly related to water stewardship, but workshop topics included: sustainability self-assessment and certification, irrigation management, and winery water management.[62] The workbooks are also available online to be used as a free tool by growers at any time, even if they are not applying for certification.

3.2.3 Current Status and Outlook:

In 2012, there were 535,000 total acres of wine grapes in California.[63] From the statistics available, this means that roughly 27% of California's vineyards are certified by these programs.[64] This breaks down to:

- CSWA: 62,455 certified acres[65]
- Vineyard Team: 27,000 SIP acres[66]
- Lodi Rules: 26,000 Certified Green acres[67]
- Napa Valley Vintners: 26,000+ Napa Green Certified Land Acres[68]

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[62] California Sustainable Winegrowing Alliance. 2012. 2012 Progress Report.
[63] California Sustainable Winegrowing Alliance. 2012. 2012 Progress Report.
[64] Statistics from 2011-2013
[65] California Sustainable Winegrowing Alliance. 2014. Certified California Sustainable Winegrowing Participants. Available at http://www.sustainablewinegrowing.org/CCSW-certifiedparticipants.php
[66] Vineyard Team. 2013. SIP Certified FAQ. Available at: http://www.vineyardteam.org/sip/faqs.php
[67] Lodi Rules. 2013. What are the Lodi Rules? Available at: http://www.lodiwine.com/certified-green/lodi-rules-for-sustainable-winegrowing
[68] Napa Valley Vintners. 2013. What is Napa Green? Available at: http://napagreen.org/about/

Given the age of these programs, this is a significant amount of certified acreage; however, these statistics do not necessarily represent all the wine grape growers in California that are using on-farm water stewardship methods. Many growers have chosen not to be certified for various reasons.

It takes a commitment of resources, time, and money from growers to achieve and maintain certification. There are a few components of these programs that may be barriers to entry for smaller growers:

- **Time consuming:** growers need to initially self-assess their operations with the workbooks and then must reassess their operations periodically.

- **Certification fees:** Third party certification fees are generated by the auditors and will vary in price accordingly. With various approved auditors, growers are able to shop around for the least expensive option. It is not known if certified grapes or wine command a price premium that could offset these costs.

- **Show self-improvement:** In some cases, especially with CSWA's program, growers need to show continual self-improvement, indicating that growers must implement new techniques or improve current ones. Although this is one of the highlights of the program and promotes continual adoption and improvement of practices, it also may be too great a commitment for some growers to take on.

The number of growers who have not sought certification because of these barriers is not known. Growers who are not certified still have access to the Code of Sustainable Wine grape Growing and other manuals, allowing them to work with the materials without seeking certification. However, concerns have also been raised that program standards for many of the sustainability groups may be set too low or are too out-of-date to be considered "sustainable." This was done to allow for more growers to participate in the programs.[69] CSWA and other organizations are continually working to update their programs and reduce the burden of time and money to address these concerns.

Sustainable certification programs are also providing assistance for growers seeking regulatory compliance. In areas such as the Central Coast, where Ag Waiver regulations are impacting agricultural water users, SIP certification from the Vineyard Team exempts Tier 1 growers from the regulations, as they have already implemented best management practices. CSWA is currently working on similar ways to help grape growers comply with regulations.[70]

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[69] Bonne, J. 2013. The New California Wine: A Guide to the Producers and Wines Behind a Revolution in Taste. Ten Speed Press, Berkeley, CA.

[70] Wilson, J. 2013. Personal Communication. K. Lambert. In person conversation with Jody Wilson, Project Coordinator, California Sustainable Winegrowing Alliance.

3.2.4 Conclusion

Although not without their faults, the sustainable programs for wine grape growers provide information, tools, and educational outreach to promote the on-farm adoption of water-use efficiency and other sustainable practices. The industry-specific standards are uniform, providing growers with relevant and in-depth information for practice adoption. The model of commodity-specific sustainability standards, certification, and materials is a valuable one that has been adopted by other crop industries, such as the Almond Board. Where appropriate, this model can be expanded to help other growers and other industries, provided that funding and support is available to these organizations to develop and research industry and crop-specific sustainability standards and then reach out to their growers.[71]

3.3 Other Non-Governmental Organizations

3.3.1 American Farmland Trust

American Farmland Trust (AFT) is a nationwide non-profit that works to protect and support farmland and farmers. AFT employs farmers, researchers, policy experts, and scientists to support local farmers, conserve farmland, and support on-farm resource conservation and environmental stewardship. AFT has regional offices and state offices; the California office is located in Davis.

AFT's California office supports multiple programs for on-farm resource conservation. Projects range from financial and technical assistance for farmers and ranchers, to the production of educational materials, guides, case studies, and surveys for resource conservation. Through their efforts to promote sustainable and environmentally friendly farming, AFT is assisting farmers in their adoption of a broad suite of practices including water use efficiency, water quality, nutrient management, pesticide use, conservation tillage, and others.[72] The California AFT has recently sponsored the following relevant projects:

- *Best Management Practice (BMP) Challenge:* This program encourages farmers to participate in field trials for BMPs related to nutrient management or conservation tillage by offering to compensate farmers for any yield and income loss. By reducing fertilizer applications and tillage, these BMPs support water quality goals and reduce erosion.

- *Profiles in Stewardship:* In 2014, AFT released 45 case studies of California farmers to highlight the various environmentally beneficial management practices. Water related topics include on-farm water stewardship, groundwater management, irrigation water management, dry farming, and water management and conservation.

[71] For a broader history of these sustainability efforts, see Keith Warner, Agroecology in Action: Extending Alternative Agriculture through Social Networks, MIT Press, 2006

[72] American Farmland Trust. 2014. California, What's New? Available at: http://www.farmland.org/programs/states/ca/default.asp

- *Guide to Beneficial Management Practices for Specialty Crops:* AFT has published their first of many guides to help farmers adopt sustainable practices on-farm. This guide is geared towards California Specialty Crop Grower and spans multiple topics in sustainability identifying BMPs that growers can adopt. The guide also offers links to USDA/NRCS practice manuals and directs farmers to state and federal financial assistance programs.

- *Encouraging California Specialty Crop Growers to Adopt Environmentally Beneficial Management Practices for Efficient Irrigation and Nutrient Management:* In 2013, AFT held a series of focus groups and administered surveys to California specialty crop growers to understand the factors that lead growers to adopt BMPs. On a whole, growers indicated that financial concerns, lack of knowledge, and perceived risk of yield losses were the largest barriers to adopting new BMPs. The report concludes that new tactics are needed to increase the adoption of BMPs in California. [73]

3.3.2 California Agricultural Water Stewardship Initiative

The California Agricultural Water Stewardship Initiative (CAWSI) is an online resource center that aims to raise awareness about approaches to agricultural water management that support the viability of agriculture, conserve water, and protect ecological integrity in California. The site currently has 11 practice pages, 68 case studies, a YouTube Channel, and a technical resource library for farmers, ranchers, water suppliers, and all those interested in sound on-farm water management.

CAWSI was launched in 2008 at the initiative of Katy Mamen of Ag Innovations Network (AIN) and Renata Brillinger, now the Executive Director of CalCAN, through a collaboration of various organizations including CAFF, the Ecological Farming Association, Wild Farm Alliance, OAEC Water Institute, and others. CAWSI was managed by AIN from 2011-2014, as a project of the Roundtable on Water and Food Supply, a forum for leaders working to assure a reliable, long-term supply of water to California's agricultural producers while optimizing other beneficial uses of water. An Editorial Board Subcommittee of the Roundtable was appointed to guide the content on the site. In 2014, Community Alliance with Family Farmers became the managers of the site.

CAWSI is a dynamic resource tool that is continually updated to reflect innovative practices by farmers across the state of California. Different sections have been written by professors at UC Davis, UC Santa Cruz, and Fresno State, as well as applied practitioners. CAWSI is currently working on methods to increase dissemination of the information to farmers and agricultural stakeholders, as well as increasing the numbers and geographical coverage of case studies of water stewardship on farms.

[73] California. 2014. American Farmland Trust. Available at: http://www.farmland.org/programs/states/ca/Enviro-Stewardship-CA-Farmers-Ranchers.asp

3.3.3 Community Alliance with Family Farmers

Community Alliance with Family Farmers (CAFF) is a non-profit organization comprised of California's family farmers and their communities. CAFF has been advocating for sustainable agriculture for the past 30 years, connecting farmers, businesses, and consumers to support vibrant food systems. CAFF has five main program areas:

- Policy/Advocacy
- Biological Agriculture
- Farm to School
- Buy Fresh Buy Local Campaigns
- Farmer Marketing Assistance

Over the past 30 years, CAFF has developed multiple on-the-ground programs, providing education, outreach, and assistance to California farmers on various resource concerns. CAFF's water programs have related both to protecting water quality and promoting on-farm agricultural water stewardship.

CAFF's initial water program in the 1990s focused on water quality concerns by working to reduce agricultural chemical runoff through IPM programs and also on on-farm conservation plantings to slow erosion, especially in the CALFED zone. More recently, CAFF has focused on water quantity related issues. Since 2009, CAFF has been working with a group of organizations including Driscoll's Strawberries and the RCD of Santa Cruz County on outreach and education efforts to berry farmers in the Pajaro Valley. These outreach initiatives have focused on reducing water use to slow groundwater overdraft and stop salt-water intrusion into the aquifer.

CAFF also works to facilitate on-farm workshops and demonstrations on water stewardship topics. Since 2009, CAFF has been working with wine grape growers, holding workshops to promote dry farming to balance agriculture and environmental water demand in wine growing regions. In 2012, CAFF launched a dry-farming web page with resources and educational material to complement the workshop series. Further, in 2013, CAFF was awarded a Prop 50 Agricultural Water Use Efficiency Grant from DWR to hold technical assistance workshops related to dry farming and irrigation efficiency for wine grape growers across the North and Central Coasts, Lodi Region, and Sierra Foothills. This grant also supports the creation of additional educational resources for growers, including improved chapters on on-farm water stewardship for the various sustainability programs.

3.3.4 Ecological Farming Association

The Ecological Farming Association (EFA) is a non-profit organization that was established in 1981. Over the past three decades, EFA has worked to support sustainable agriculture, the environment, and local food systems through educational events, conferences, training programs, and on-farm workshops. EFA has had over 60,000 participants in their educational programs; these participants are not just farmers, but a diverse group of stakeholders and community members related to agriculture and food systems.[74] Their largest event is the Annual EcoFarm Conference, now in its 34th year. The conference has evolved into 4 days of workshops and events covering topics related to sustainable agriculture, the environment, and food systems. [75]

EFA's mission supports education on a wide array of concerns, including: soil, air, ecosystem health, rural communities, and water. The Water Stewardship Project was created to develop educational and outreach materials for on-farm water conservation practices. Through this project, EFA has developed an online resource of videos about:

- Farm Ponds
- Dry Farming
- Precision Irrigation
- Rainwater Catchment and Water Recycling
- Keyline Design
- Water Reuse and Methane Digestion[76]

EFA also organizes field days with presentations from technical assistance advisors and includes water stewardship events and workshops at their annual eco-farm conference.

3.3.5 Pacific Institute

The Pacific Institute is one of the world's leading independent nonprofits conducting research and advocating for a healthier planet and sustainable communities. Based in Oakland, California, since 1987 they have conducted interdisciplinary research and partnered with stakeholders to produce solutions that advance environmental protection, economic development, and social equity— regionally, nationally, and internationally. They work to change policy and find real-world solutions to problems like water shortages, habitat destruction, global warming, and environmental injustice.

The Pacific Institute is widely recognized as a leading independent policy research organization addressing global and local water issues. Their work on agricultural and municipal water use efficiency and on broader concepts of sustainable water planning and management has greatly influenced water policy and perceptions worldwide. The Institute has published extensively on agricultural water conservation opportunities and success stories in California, including:

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[74] EcoFarm. 2013. About Us. Available at: http://www.eco-farm.org/about/
[75] EcoFarm. 2014. EcoFarm Conference. Available at: http://www.eco-farm.org/programs/efc/
[76] EcoFarm. 2014. The Water Stewardship Project. Available at: http://agwater.wordpress.com/

- *California Water 2020: A Sustainable Vision* presents a unique vision of a truly sustainable water future and discusses way to realize this vision. Although originally published in 1995, the report's overall conclusion — that California water use is unsustainable and requires a new approach — is as true today as it was the day it was published.

- *Sustainable Use of Water: California Success Stories* presents 28 successful, informative, and educational examples of collaborative water planning, effective institutional and governance structures, intelligent use of technology or economic incentives, and environmental protection and restoration in areas where deadlock and litigation used to be the norm.

- *Investing In Clean Agriculture: How California Can Strengthen Agriculture, Reduce Pollution and Save Money* describes how farmers can be rewarded for learning voluntarily about sustainable agricultural practices. A modest increase in the statewide "mill" fee, now levied on pesticides, could be returned to farmers who take a short course on sustainable agriculture techniques and storm runoff management, helping farmers stay competitive while reducing pesticide use – which will protect human health, preserve the environment, and eventually save taxpayers money by reducing medical costs.

- *More with Less: Agricultural Water Conservation and Efficiency in California – A Special Focus on the Delta* offers a comprehensive analysis of how to maintain a strong agricultural economy while improving the efficiency of water use and reducing groundwater overdraft and water withdrawals from the critically threatened Sacramento-San Joaquin Delta. The study finds agricultural water-use efficiency can be improved through careful planning, adopting existing, cost-effective technologies and management practices, and implementing feasible policy changes. The report also provides recommendations to overcome some of the financial, legal, and institutional barriers that can hinder farmers from implementing such adaptations and investments.

- *Sustaining California Agriculture in an Uncertain Future* shows that California agriculture can flourish despite diminishing water supply and future uncertainty from climate change, but it will require great strides in increasing the water efficiency of the agricultural sector. While many farmers and irrigation districts have already been making water-use efficiency improvements, the analysis finds that potential water savings of 4.5 – 6 million acre-feet each year can be achieved by expanding the use of efficient irrigation technologies and management practices.

- *California Farm Water Success Stories* documents how agricultural water stewardship practices are at work on-the-ground, at the farm and irrigation district level. Ten short video interviews offer first-person insights from these innovative water managers. In addition to the success stories, the Pacific Institute and other members of the California Roundtable on Water and Food Supply have launched an Interactive Database

and Map which contains more than 30 case studies, including the Pacific Institute's success stories, and is searchable by location, production type, irrigation method, and stewardship practice.

- *California's Next Million Acre-Feet: Saving Water, Energy, and Money* quantifies more than one million acre-feet of water that can be conserved through improved efficiency, with savings coming from the urban and industrial sectors and improvements in agriculture. These savings would not only save water, they would also reduce energy use and save money.[77]

[77] Contributed by Heather Cooley, Water Program Co-Director, Pacific Institute. 2013. Email Communication, K. Lambert.

Chapter 4. University Programs

There are many university programs in California that support outreach, education, and assistance to farmers regarding on-farm water stewardship and/or support the development of efficient irrigation systems, practices, and technologies. In this chapter, programs at the University of California's Cooperative Extension, California State University Fresno, and California Polytechnic State University are discussed. Each program contributes valuable research, but it is clear that additional funding and support is needed to expand outreach, on-farm demonstrations, and farmer education.

4.1 University of California Cooperative Extension

4.1.1 Introduction

University of California Cooperative Extension (UCCE) was established in 1897. The program was designed to institutionalize agricultural research at the University level, as well as to disseminate knowledge and technology to agricultural producers. The department operates under the auspices of the University of California's Division of Agriculture and Natural Resources (UCANR).

UCANR and UCCE faculty and staff conduct and publish crop-specific academic and field research related to resource-efficiency, yield optimization, and environmentally sustainable production methods. Primary research related to water use efficiency centers on the determination of crop water needs, irrigation best management practices, and the ecosystem effects of agricultural water use.[78] UCCE has about 130 research specialists across the Berkeley, UC Davis, and UC Riverside Campuses.[79] UCCE also has county field offices across the state, through which Farm Advisors and staff disseminate the knowledge and information generated by both UCANR and UCCE.[80]

The development of the California Irrigation Management Information System (CIMIS) is one of UCANR's major contributions to irrigation management. CIMIS is a network of over 120 automated weather stations that also generate reference evapotranspiration data to allow for precise irrigation scheduling developed in partnership with the Department of Water Resources (DWR)[81]. CIMIS data are free and available online to registered users. Over 6,000 growers, water agencies, and irrigation consultants are registered as primary CIMIS users, although many

[78]University of California, Division of Agricultural and Natural Resources. 2008. Drought Management. Available at http://ucmanagedrought.ucdavis.edu/IrrigationSched.cfm

[79] California Water Foundation. 2013. An Inventory of Organizations and Activities Influencing Agricultural Irrigation Innovation and Water Use Efficiency in California.

[80] Fulton, A. 2011. Personal Communication. J. Elhayek: Email correspondence with Allan Fulton, Irrigation and Water Resource Advisor, UCCE.

[81] California Water Foundation. 2013. An Inventory of Organizations and Activities Influencing Agricultural Irrigation Innovation and Water Use Efficiency in California.

more are assumed to access the data through these primary users.[82] A major role of UCANR is the constant improvement of CIMIS data, through better understanding of crop water needs. [83]

UCCE Farm Advisors are stationed in key agricultural areas throughout the state to conduct outreach, education, and technology transfer that addresses specific needs of agricultural producers in their regions. This is achieved through newsletters, the production of white papers, field days, seminars, lectures, attendance at conferences, and one-on-one consultation.[84] [85] These outreach services are vital to disseminating research results from UCCE and UCANR projects and to encourage on-farm adoption of water management techniques. Unfortunately, UCCE staff report that a lack of funding, decreasing staff levels, and lack of coordination across the state are major impediments to achieving their outreach and education goals.

4.1.2 Current status and challenges

UCCE Extension Agents and Researchers work on various projects across their offices to meet the needs of their growers. In regards to on-farm water stewardship, UCCE supports research on irrigation and farming practices, as well as the creation of educational materials and online tools. Examples of innovative projects and technical resources include:

- Farm Advisors from Santa Cruz and Monterey and UC Davis researchers are working to determine the optimum amount of water required to grow lettuce, spinach, broccoli, and strawberries while limiting nitrogen leaching. This work seeks to reduce water use, nitrogen application, and reduce nitrogen losses, while improving yields.

- Mark Battany, Farm Advisor with the UCCE San Luis Obispo County has been conducting trials to monitor vineyard irrigation in the Paso Robles Groundwater Basin in order to more accurately determine vineyard water use, potentially improve management practices, and address groundwater overdraft concerns.

- UCCE staff develop resource tools, such as irrigation scheduling spreadsheets, guides for irrigation system maintenance, and the CIMIS database that are available online to growers.

Although California has invested heavily in developing water-saving technology and knowledge through the UC system, there is a lack of investment in effective dissemination of this information. Too few growers have access to the knowledge and technology through which they could become effective water stewards. For example, surveys of growers in the San Joaquin Valley in 2010 indicated a lack of familiarly with the technologies such as CIMIS stations as a reason for not being able to use the system. It is clear from data like these, that further outreach

[82] California Department of Water Resources, Office of Water Use Efficiency. 2011. CIMIS Data Uses. Available at http://wwwcimis.water.ca.gov/cimis/infoGenCimisDataUse.jsp
[83] California Department of Water Resources, Office of Water Use Efficiency. 2011. CIMIS Overview. Available at http://wwwcimis.water.ca.gov/cimis/infoGenCimisOverview.jsp
[84] Munk, D. 2011. Personal Communication. J. Elhayek: Email correspondence with Daniel Munk, Farm Advisor, UCCE.
[85] Faber, B. 2011. Personal Communication. J. Elhayek: Email correspondence with Ben Faber, PhD, Farm Advisor, UCCE.

to farmers is necessary to disseminate the innovative research and resources from UCCE and UCANR to farmers.

However, ongoing budget constraints have greatly reduced UCCE's capacity to conduct its mission. UCCE has 64 offices in over 50 counties across the state.[86] In 2010, staff levels were down by 40% compared to what they were in the early 1990s, with only 200 on-farm advisors.[87] The number of Extension Agents limits on-the-ground technical assistance. It is widely acknowledged that funding and staffing levels are disproportionately low, given the importance — and environmental impact — of agriculture in California.

Extension Agents have indicated that more funding is needed in order to perform work that goes beyond researching and to ensure that new practices are adopted on-farm. With more funding, they could better meet the most immediate needs of growers, such as:

- Turning research findings into educational materials — such as crop-specific water management guidebooks — that can be used by growers on the ground, and can be used independently of workshops and lectures

- Conducting long-term follow-up to ensure that growers who have adopted efficient irrigation technology continue to manage the systems properly

- Increasing the frequency, scope, and locations of field-day demonstrations

Decreased funding is not the only challenge UCCE faces in promoting water stewardship. It has been suggested that improved coordination across the UCCE system could expand the breadth and quality of resources available to growers. For example, an agent with technical expertise in irrigation management may lack the multimedia skills necessary to offer assistance in multiple formats, thereby missing opportunities to reach certain segments of the target population. Better coordination could address this gap by finding a collaborator, who may not necessarily be an irrigation expert, but is capable of translating the information into useful multimedia tools, or creating a handbook or web presence that expands the channels by which growers are reached.[88] [89] [90]

[86] University of California, Division of Agricultural and Natural Resources. 2011. County Offices. Available at: http://ucanr.org/County_Offices/

[87] Merrill, J., Brillinger, R., and Heartwell, A. 2011. Ready… or not? An assessment of California agriculture's readiness for climate change. California Climate & Agricultural Network.

[88] Munk, D. 2011. Personal Communication. J. Elhayek: Email correspondence with Daniel Munk, Farm Advisor, UCCE.

[89] Fulton, A. 2011. Personal Communication. J. Elhayek: Email correspondence with Allan Fulton, Irrigation and Water Resource Advisor, UCCE.

[90] Faber, B. 2011. Personal Communication. J. Elhayek: Email correspondence with Ben Faber, PhD, Farm Advisor, UCCE.

4.1.3 Conclusion

Within the UCCE are the dual roles of research and educational outreach to farmers. The development of on-farm water management tools, such as CIMIS, will only be effective in managing water if adopted by growers. Taken together, slashed budgets and skeletal staffs have resulted in an agency that is effectively prevented from fulfilling its dual mission. More funding is needed if UCCE is going to extend water-saving knowledge and technology to farmers. If it is necessary for UCCE to pursue improved outreach and education within their current budget constraints, then continued and increased collaboration within the UC system and with other agricultural non-profits may help UCCE share the burden of the education and outreach process. But only by receiving adequate funding from the government can UCCE provide the full spectrum of sustained, hands-on outreach and assistance that is required to address resource management challenges faced by California agriculture.

4.2 California State University – Fresno

4.2.1 Introduction

California State University, Fresno's California Agricultural Technology Institute operates an irrigation research center that consists of three different water units with mutually supportive roles:

- **The California Water Institute**. Initially funded through Prop. 13, its mission is to conduct research and disseminate information related to "better use of the state's water." They have conducted research on reuse of agricultural drainage water, seepage from conveyance structures, and the use of Geospatial Information Systems (GIS) for improved water management. They also offer an accreditation from the Irrigation Association (IA) through their IA Certification Course.[91]

- **The Center for Irrigation Technology** assists designers, manufacturers, and users of irrigation equipment. The *Advanced Pumping Efficiency Program (APEP), Agricultural Water Energy Center,* and *Wateright* - technical assistance programs - are based here.[92]

- **The International Center for Water Technology** (ICWT) conducts research, education, and policy development related to irrigation and water use efficiency. Specific research projects include the determination of evapotranspiration rates and irrigation requirements for various crops grown in the San Joaquin Valley. They also host an International Water Technology Conference. [93] ICWT is a collaborative partnership between Fresno State and private water-technology companies.[94]

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[91] California Water Institute. 2005. Welcome to CWI. Available at http://www.californiawater.org/index1.htm
[92] Center for Irrigation Technology. 2010. Welcome to CIT. Available at http://cit.cati.csufresno.edu/
[93] International Center for Water Technology. Welcome to ICWT. Available at http://www.icwt.net/
[94] California Water Foundation. 2013. An Inventory of Organizations and Activities Influencing Agricultural Irrigation Innovation and Water Use Efficiency in California.

Through these three entities, Fresno State has positioned itself as a key player in advancing irrigation technology and agricultural water management in California. The center employs 27 full-time staff with a total budget of $3 - 4 million annually. [95] It is primarily through the Advanced Pumping Efficiency Program (APEP), *Wateright,* and the new Agricultural Water Energy Center that Fresno's Center for Irrigation Technology (CIT) provides incentives, education, and technical assistance to growers. Fresno State's water programs reach growers primarily in the Central Valley of California due to geographic and funding constraints. Successful outreach and educational programs such as APEP, the Agriculture Water Energy Center, and *Wateright* highlight the need for additional funding to provide similar program across the state of California.

4.2.2 Center for Irrigation Technology Programs

Wateright

Wateright was initiated in 1997 with funding from the US Bureau of Reclamation. It is a free, web-based water budget irrigation-scheduling tool that interfaces with CIMIS. This approach "tries to model the physical process of water movement into the soil, through the soil, and through the plant".[96] This allows water managers and farmers to make precise determinations regarding crop water needs at a given time. Essentially, this approach seeks to eliminate guesswork regarding soil moisture levels, thereby reducing unnecessary irrigation events.

Faculty at CIT estimate that there were 30-35,000 unique visitors to *Wateright* in 2010, although it is unclear what this means in terms of active users. Effective utilization of *Wateright* requires users to have predetermined knowledge of specific characteristics of a given field, such as:

- Soil moisture holding capacity
- Plant root zones; and the degrees to which rain and irrigation water reach the root zones.
- Crop water needs at various stages of development
- The potential for groundwater to seep upwards into the root zone

These data are input into a model that utilizes weather and crop water-use data from CIMIS. The results provide a suggested next best date for irrigating.

It is the determination of these site-specific characteristics that may present a significant challenge to smaller growers wishing to utilize *Wateright*. Direct assistance is not offered through the program; the *Wateright* brochure refers users to UCCE and NRCS for assistance. However, due to budget cuts discussed previously this is problematic; the adequacy of available on-farm assistance from these agencies is questionable at best.

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[95] Zoldoske, D. 2013. Personal Communication. K. Lambert: Email correspondence with David Zoldoske, Executive Director, Water Resources and Policy Initiatives, CSU Fresno.

[96] Center for Irrigation Technology. 2005. Summary of Water Budget and Irrigation Scheduling Process; Online Brochure. Available at: http://www.waterright.org/sched1.asp#steps

Advanced Pump Efficiency Program (APEP)

Through APEP, CIT makes the connection between water use and energy use, further legitimizing the importance of irrigation efficiency. Irrigation pumps use energy to move water into the field. Inefficient or damaged systems require relatively more energy to pump the required amount of water. Likewise, excessive watering results in unnecessary energy use.

The main objectives of APEP are to ensure that efficient pumping systems are properly maintained; water flow rates are adequate, but not excessive; and that irrigators know how much water to use during a scheduled irrigation. This was achieved on-farm through irrigation pump tests subsidized by Pacific Gas & Electric (PG&E), allowing irrigators to reduce both their energy and water consumption, subsequently cutting their operational costs.[97]
APEP has four main components:[98]

1. Education, in the form of seminars, written materials and pump demonstrations that illustrate what a pump test is, why it is important, and why proper irrigation management is important.

2. Technical assistance to program participants regarding program applications and requirements, as well as on general aspects of pumping plant design and operation.

3. Subsidized pump tests performed by certified consultants trained in the use of APEP software developed at CIT to ensure pump efficiency. APEP covers anywhere between $100-200 of the cost of a test, which is about $250.[99]

4. Subsidized pump retrofits and upgrades. The program covers 20-25% of the cost should a test indicate the need for a pump retrofit or upgrade.

The program website indicates that APEP provides subsidies for 2,700 pump tests and 300 upgrades, as well as 10 educational seminars per year. Energy savings from the program during 2001-2003 are estimated at 88.6 gigawatt-hours per year. There are no estimates of water-savings achieved through the program. [100]

Active since 2002, APEP is currently funded through PG&E with Public Purpose Programs Funds under California Public Utilities commission. PG&E customers pay a Public Purpose Programs Charge on their utility bills. APEP has received funding in the past from the Federal

[97] Center for Irrigation Technology, CSU Fresno. 2011. Advanced Pumping Efficiency Program. Available at: http://www.pumpefficiency.org/
[98] Center for Irrigation Technology, CSU Fresno. 2011. Advanced Pumping Efficiency Program: Four Main Education Message. Available at: http://www.pumpefficiency.org/Education/fourpoints.asp
[99] Center for Irrigation Technology, CSU Fresno. 2011. Advanced Pumping Efficiency Program. Available at: http://www.pumpefficiency.org/
[100] Canessa, P. 2011. Personal Communication. J. Elhayek: Email correspondence with Peter Canessa, PE, Agricultural Engineer, CSU Fresno Center for Irrigation Technology.

Environmental Protection Agency (EPA), the California Energy Commission, and the California Public Utilities Commission.

In addition, APEP has expanded to launch a pilot diesel-powered pumping plants test program on behalf of the Federal Environmental Protection Agency (EPA). Although this program is geared towards air quality concerns, it also has important implications for water management by improving irrigation efficiency. So far, this program has evaluated 69 pumps, provided 11 pump upgrades, and has developed a diesel-pump tester kit.

Agricultural Water Energy Center

In 2013, CIT received a grant from PG&E to establish the Agricultural Water Energy Center. With this center, CIT is able to expand their work beyond the pump and well efficiency work supported by APEP to include efficiency evaluations of the entire irrigation system.

Although APEP is a valuable program, on its own, pump testing may not ensure an efficient irrigation system or that the system is operated efficiently. The APEP program has resulted in on-farm energy and water savings, but through upgrading or improving pumps and wells on-farm, growers may find that the rest of their system—drip line or emitters, for example—may be out of date, poorly maintained, or no longer compatible with the new or improved pumps, meaning that the efficiency upgrades to the pumps and wells are not fully realized. Through the Agricultural Water Energy Center, CIT can assess the entire system to resolve all inefficiencies. The Agricultural Water Energy Center also provides seminars and training programs on topics such as fertigation and irrigation scheduling for various crop types. With this new program, CIT and PG&E are able to assist growers with energy and water efficiency in every aspect of their irrigation systems and operations.[101]

Other programs and projects at CSU Fresno

Discussions with CIT faculty and staff suggest that, although budget constraints present some uncertainty, other commitments to promoting agricultural water stewardship across the CSU system are going forward.[102] These include:

- A new Professional MS in Water Resource Management that started in August, 2013.
- An initiative funded by USDA to provide internships for up to 200 students who are interested in careers in water management at the 14 Hispanic-serving CSU institutions.[103]

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[101] Green. S. 2013. Personal Communication. K. Lambert: Phone Conversation with Sargeant Green, Project Director, the California Water Institute, UC Fresno.
[102] Zoldoske, D. 2011. Personal Communication. Phone conversation with David Zoldoske, Executive Director, Water Resources and Policy Initiatives, CSU Fresno.
[103] Zoldoske, D. 2013. Personal Communication. K. Lambert: Email correspondence with David Zoldoske, Executive Director, Water Resources and Policy Initiatives, CSU Fresno.

- Development of the Water Resources and Policy Initiative. Headed by Fresno State's David Zoldoske, the Initiative is an effort to coordinate water work across the 23 CSU campuses

- Federal economic stimulus package funds to develop an Integrated Regional Water Management Plan for the 8-county region of the San Joaquin Valley. This effort would integrate preexisting IRWMPs in order to better coordinate the efforts of various stakeholders with common interests in both the northern and southern portions of the San Joaquin Valley hydrological region.

4.2.3 Outlook and Conclusion

While some funding has been secured for these programs and projects, long-term financial stability remains elusive. In addition to developing the programs and projects listed above, CIT faculty needs funding to advance their agricultural research programs. David Zoldoske discussed the need to identify the biggest water management challenges facing San Joaquin Valley agriculture and to formulate research projects to address those challenges.

UC Fresno offers valuable programs to assist growers with irrigation efficiency in terms of water and energy use. Specifically through the CIT programs of APEP and the new Agricultural Water Energy Center, CIT is providing on-farm assistance and educational seminars for growers. CIT staff indicates that the target of their programs are larger growers in the San Joaquin Valley. Although these are some of the largest water users, CIT could work to target smaller growers in their regions who need irrigation assistance. Further, although Fresno State is limited by its geographic scope, the funding for APEP and the Agricultural Water Energy Center is PG&E, a statewide public utilities company. Through PG&E, similar programs could be established in other areas of California with similar needs to generate similar benefits.

4.3 California Polytechnic University

4.3.1 Introduction

A division of California Polytechnic University, San Luis Obispo's Department of BioResource and Agricultural Engineering (BRAE), the Irrigation Training and Research Center (ITRC) is a premiere institution for the development of irrigation technology and techniques. Founded in 1989, ITRC specializes in hands-on training for students seeking to become irrigation specialists. ITRC also conducts research and publishes papers related to various aspects of irrigation system performance, including research on:

- Improving the usefulness of satellite weather data for irrigation scheduling;
- Determination of crop evapotranspiration rates to allow for efficient water use
- Calculation of basin-wide and farm-wide water balances for an improved understanding of the effects of irrigation management decisions at the basin scale.

Students at ITRC earn advanced degrees in agricultural management and irrigation. Graduates pursue careers as irrigation specialists with private companies as well as government agencies, agricultural educators at secondary schools and community colleges, and/or continue on as doctoral students.

4.3.2 Programs

The primary goal of Cal-Poly ITRC is to enhance the teaching programs at the center to both bring new knowledge into the classroom and to turn out graduates who can be leaders in irrigation management and technologies. ITRC is run by a board of tenure track professors who make decisions and manage the institution.

Dr. Charles Burt, founder and executive director at Cal-Poly ITRC, explains that the technical support to growers is primarily achieved through a "multiplier effect:" ITRC teaches students, develops efficient irrigation systems and technologies, and works directly with the Irrigation Districts.[104] It is the graduates who primarily pass on technologies and provide assistance directly to growers. For example, if graduates from Cal-Poly ITRC work to develop and sell irrigation systems to growers, the graduates will have the knowledge to sell the grower the best and most water efficient system for his land and crop.

Irrigation-district modernization projects are also a major feature of ITRC's work in California. Many irrigation districts in California cannot provide on-demand water to growers because of the design of the water delivery systems. Growers without access to on-demand water are unable to use many on-farm water management techniques, such as irrigation schedules and in some cases, even drip/micro irrigation. ITRC works with irrigation districts throughout California to upgrade and automate the canal systems to increase the flexibility of water delivery, which will eventually allow growers in the Irrigation Districts to utilize various water management techniques.

In all, ITRC allocates about 65% of its resources on "direct technical assistance."[105] This includes the work with the irrigation districts, development of irrigation technology, and education of professionals. ITRC is funded through contracts with customers for these services. In addition, Cal-Poly ITRC conducts about 60 short-courses and seminars for irrigation professionals and irrigation districts for a tuition fee. These courses cover topics such as

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[104] Burt. C. PhD. 2013. Personal Communication. K. Lambert: Phone conversation with Dr. Charles Burt, Chairman and Founder, Irrigation Training and Research Center, California Polytechnic University, San Luis Obispo

[105] Cal-Poly Irrigation Training and Research Center. 2013. About IRTC. Available at: http://www.itrc.org/about.htm

irrigation system evaluation; utilization of irrigation scheduling technology; and irrigation system design.

ITRC also procures research contracts in part to develop on-farm water management solutions for growers. In addition to research on basin-wide water balance, ITRC conducts research on the efficacy and environmental impacts of micro-irrigation systems on specific cropping systems such as strawberries, peppers, and orchards. Another current research and demonstration project includes trials to decrease the amount of pressure and energy needed to operate field pumps or an irrigation system. ITRC will also hold field days and invite growers and other irrigation professionals to this demonstration site. It is through these applied research projects that ITRC is able to develop best management practices to be disseminated to growers via their graduates and short-courses. The Mobile Irrigation Labs (MIL) and Distribution Uniformity tests for irrigation systems discussed in the RCD section of this paper were developed at ITRC.

4.3.3 Conclusion

Although direct outreach to growers is not the main objective of Cal-Poly ITRC, the center is involved in vital work related to on-farm water management. Currently, advanced degree programs for irrigation specialists are dwindling; Dr. Burt indicated that universities in California, Oregon, Washington, and Colorado have either discontinued or downscaled irrigation-related degrees within the last 20 years. Without irrigation professionals, the development of new irrigation technologies, as well as outreach to farmers, would face even greater challenges. ITRC is fulfilling a vital role of producing irrigation specialists to work in development and outreach positions after graduation.

Cal-Poly ITRC also focuses on applied research projects, allowing the center to develop systems and technologies that can be used on-farm to manage water resources. This means that graduates have both the knowledge and the tools to assist growers with water management. Further, working with Irrigation Districts to improve the flexibility of the water delivery system is a critical step allowing for on-farm adoption of water savings techniques.

However, although ITRC is producing tools and professionals for on-farm water management, the rate of adoption or impacts of these techniques on-farm is not known. A greater emphasis on outreach to growers may be needed. For example, MIL technology was developed at ITRC, but, as the RCD section explained, the funding, staffing, and resource limitations of RCDs have been a major barrier to widespread implementation of MIL farm visits. Even if institutions like ITRC develop new irrigation technologies and produce specialists, on-farm adoption of techniques is the only method to realize the benefits of water management. [106][107]

[106] Burt. C. PhD. 2013. Personal Communication. K. Lambert: Phone conversation with Dr. Charles Burt, Chairman and Founder, Irrigation Training and Research Center, California Polytechnic University, San Luis Obispo

[107] Section based on conversation with Charles Burt, PhD.

Chapter 5. Private Industry

Surveys of growers indicate that private crop consultants are a preferred source of technical information for on-farm water use and nutrient best management practices (BMPs). Further, that the majority of these BMPs were self-financed by the grower. [108] Growers are reaching out to the private industry to find advice and technologies to manage water resources on-farm, and this suggests that private industry, in the form of consultants and irrigation equipment designers, manufacturers, and dealerships, has a significant influence on water use in California. This chapter will look at private irrigation equipment companies and consultants, as well as the California Certified Crop Advisers program.

5.1 Private Irrigation Companies

5.1.1 Introduction

There are numerous private irrigation equipment companies that operate in California, and they all can have influence over on-farm water stewardship through the products and services that they sell. As these are private companies, they charge for services and products. Depending on the budget of the farmer, he/she can receive varying levels of assistance and quality. For example:

- Farmers can purchase irrigation equipment from a retailer, such as Ewing Supply, and receive in-store customer service and assistance. Farmers can then install the system themselves or contract that work out. Ewing also offers educational courses, generally ranging from $39-$75.[109]

- Farmers can approach a company like Wyatt Irrigation Supply to contract out the design of a custom irrigation system, purchase necessary equipment from them, and then install the system themselves or contract out installation.[110]

- Farmers can work with a "full service" irrigation dealership that will provide design, installation, and training for growers to use systems. An example is Pacific SouthWest Irrigation, a full service dealership specializing in irrigation design, sales, and installation that was started by Jim Clare, the former Director of IRTC at Cal Poly. [111]

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[108] Shaffer, S. & Thompson, E. Jr. 2013. Encouraging California Specialty Crop Growers to Adopt Environmentally Beneficial Management Practices for Efficient Irrigation and Nutrient Management: Lessons from a Producer Survey and Focus Groups American Farmland Trust. Available at http://www.farmland.org/documents/SpecialityCropGrowersBMPs.pdf

[109] Ewing. 2013. Expand your opportunities. Available at http://www.ewingeducationservices.com/cgi/EDRCA000.php

[110] Wyatt Irrigation Supply. 2013. Get Connected. Available at http://wyattsupply.com/

[111] Pacific SouthWest Irrigation. 2013. Jim Clare, CEO. Available at http://www.pacsouthwestirr.com/index.php?option=com_content&view=article&idItemid=98

Prices for services and products will vary across companies, but it is clear that, as with most private industry, the more the farmer can pay, the more services he/she will receive. Installing drip irrigation systems can cost from $1,000-$3,000 per acre,[112] indicating a significant price range and financial burden for growers. To achieve sound on-farm water management, irrigation systems must be tailored to the farmland and crop type, as well as installed correctly, maintained, and operated efficiently. Many farmers are unable to afford this level of service from the private industry.

Many companies include on-farm water stewardship as a part of their business model. Wyatt Irrigation Supply, for example, is committed to sustainable irrigation practices and design.[113] Toro, a manufacturer and retailer, advertises its micro-irrigation systems as a tool to reduce on-farm water usage and runoff, as well as improving crop quality and reducing production costs.[114] Through the conversion to drip irrigation and the use of quality products, such as durable drip tape that reduces breakage and leakage, Toro is hoping to reduce on-farm water use.[115]

In addition to the irrigation system retailers and designers, there are companies that design, manufacture, and install irrigation management technologies that can have significant influence over water usage. These companies provide systems that help growers know when and how much to irrigate. One company, Pure Sense, has patented equipment to track weather patterns, soil moisture, and monitor irrigation flow to allow farmers to precisely irrigate to meet crop water needs.[116] Farmers are able to track these factors on computers and remotely irrigate. Another company, Hortau, has developed technology to monitor soil tension in real time, allowing growers to manage water stress on the crop, and determine when and for how long to irrigate.[117]

Jeremy Otto, a sales representative for Hortau in California, indicates that their system allows for farmers to increase crop quality and yields, as well as use water efficiently. It should be noted that efficient water use does not necessarily mean less water is used on farm. On occasion, once growers start monitoring water use, they learn that crops have been under-watered. Otto indicated that his clients are predominately larger farmers with the upfront money to spend on new technologies, whereas smaller farmers are more cautious and unable to make that investment. Hortau has been developing payment options, such as rent to own, aimed at reducing the initial financial burden of their product.[118] The effort in the Pajaro Valley to balance the aquifer is using Hortau technology through the Santa Cruz RCD with low-cost options available to smaller berry growers.

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[112] Weiser, M. 2014. Flood irrigation still common, but drip method is gaining ground. Sacramento Bee. Available at http://www.sacbee.com/2014/02/16/6161797/flood-irrigation-still-common.html
[113] Wyatt Irrigation Supply. 2014. Sustainable Living. Available at http://wyattsupply.com/
[114] Toro. (N.D.) Irrigation Solutions: What is Drip Irrigation, Conserve Water and Irrigate Intelligently.
[115] Toro. (N.D.) Grower Solutions: Quality Take Yields Quality Onions, Standage Farms, Inc., Vale, Oregon.
[116] Pure Sense. 2014. Available at http://www.puresense.com/
[117] Hortau. 2014. Available at http://www.hortau.com/en/home/
[118] Otto, J. 2013. Personal Communication. K. Lambert. Phone conversation with Jeremy Otto, Sales Representative California, Hortau INC.

5.1.2 Challenges and outlook

Private irrigation manufacturers and dealers can have significant influence on on-farm water use and can be a driving force for product innovation. As Charles Burt, the Chairman of the IRTC at CalPoly indicates, the graduates from his programs often work in the private sector, as consultants, in irrigation dealerships, and as developers of new irrigation technologies. With the knowledge from IRTC, these graduates often promote on-farm water stewardship by individualizing services and providing innovative technologies, as well as improving yields and crop quality for the farmers. In such instances, private industry can serve as a powerful source of knowledge and support for on-farm water stewardship.[119]

However, farmers must have the financial capacity to afford the services of the private industry to purchase the best assistance and products to realize on-farm water stewardship. For many farmers, this is financially prohibitive. This is why outreach, assistance, and education from University and non-profit sources are necessary to complement private sector work. Technical assistance advisors are able to recommend the use of a variety of practices and technologies without the need to sell products, whereas private companies are geared towards selling their products.

An example of such flexibility would be soil moisture monitoring, which is used to help growers determine when to irrigate their crops, and is a tool commonly used by irrigation management companies. A publication from the National Sustainable Agriculture Information Service (ATTRA) outlines a variety of methods to monitor soil moisture levels at varying levels of cost and technical expertise. Techniques range from direct inspection of the soil, for the cost of a shovel or auger, to tensiometers which use a vacuum gauge to measure soil water tension and range from $45-$80 per tensiometer, to more expensive remote sensing systems that cost $1,000+ per sensing device.[120] Without the obligation to sell any of these technologies, ATTRA specialists are able to recommend the suite of technologies and assist growers with identifying the right system for their budget and farm, while providing excellent technical assistance.

The installation of efficient or new irrigation equipment is also not enough to ensure on-farm water stewardship; it is through a combination of best management practices and proper maintenance that farmers are able to best manage water on-farm. If farmers are unable to pay for design, installation, training, or yearly services packages from irrigation equipment companies, then the true efficiency of the system may not be realized. Some companies, such as Toro, will offer free or discounted equipment to growers who will demonstrate or test new equipment, which can help with the financial burden of purchasing the system and provide training for use. But additional outreach and assistance from the public sector is necessary to provide farmers with tools to maintain and properly use their irrigation systems, as well as implement holistic management techniques, such as proper soil management and irrigation scheduling, to realize on-farm water stewardship.

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[119] Burt, C. PhD. 2013. Personal Communication. K. Lambert: Phone Conversation with Dr. Charles Burt, Chairman and Founder, Irrigation Training and Research Center, California Polytechnic University, San Luis Obispo

[120] Morris, M. 2006. Soil Moisture Monitoring: Low-Cost Tools and Methods. National Sustainable Agriculture Information Service.

5.2 Private Consultants

California has a multitude of private crop advisers and consultants whom growers can hire to provide assistance with a variety of on-farm management issues, including irrigation. Many of these companies and individuals provide quality services to growers, helping promote sound on-farm practices and water stewardship. However, the services and quality of private consultants and crop advisers varies greatly. One national program, the Certified Crop Adviser, is a professional certification program that works to provide crop advisers with the necessary training and education to guarantee a level of expertise, environmental stewardship and professionalism to farmers.

5.2.1 California Certified Crop Advisers

The California Certified Crop Adviser (CA CCA) program is an industry certification for individuals interested in providing advice to farmers on crop production and management. To become a CA CCA, individuals must have experience as a crop adviser and may hold a degree in agriculture. To demonstrate knowledge of crop production and management, individuals must meet the standards set forth by the International CCA program as administered by the American Society of Agronomy and the California CCA Program. CA CCAs must pass the International CCA exam on Nutrient Management, Soil and Water Management, Crop Management, and Pest Management, as well as the California exam on Nutrients, Soil, and Water, and the California Crop Management Exam.[121]

There are currently over 500 CCAs in California.[122] These are independent advisers who may work as crop advisers, consultants, agricultural specialists, or even in agricultural retail. Once certified, each CCA must complete 40 hours of continuing education every 2 years to ensure that he/she is apprised of the latest government regulations and mandates, and crop management techniques.[123] The uniformity of the exams as well as the continuing education regulates the knowledge for the CCAs in their various jobs across the state, which can be very helpful to farmers seeking the advice of a CCA, allowing farmers to assume a certain level of knowledge and competence from a CCA

Building the capacity of CA CCAs and increasing participation in the program has been a challenge.[124] The testing and continuing education is time consuming and may discourage participation. However, CA CCA has been working to increase the level of training and programs. Currently, the California Department of Food and Agriculture (CDFA) is working with University of California, Agriculture and Natural Resources (UC ANR) on a large-scale Nutrient Management Training Program (NMTP) as a part of the Fertilizer Research and Education Program (FREP). These two-day programs were offered from January 2014 to March

[121] California Certified Crop Advisers. 2014. Available at: www.cacca.org
[122] California Department of Food and Agriculture. 2014. CDFA Training & Certification on Nutrient Management Plans. Available at http://www.cdfa.ca.gov/environmentalstewardship/NUTRIENT_MANAGEMENT_PLANS.html
[123] California Certified Crop Advisers. 2014. Available at www.cacca.org
[124] Romander, A. 2008. A View Towards the Future. Available at http://www.cacca.org/files/file_gallery/230-aviewtowardsthefuturearticlepdf-2010-09-24-15-195810.pdf

2014, with the possibility of adding additional sessions if needed.[125] The course provides CA CCAs with additional training to assist farmers in developing nitrogen management plans for compliance with water quality regulations and these regulations will likely encourage others to seek CA CCA Certification.

5.3 Conclusion

Through their training, the CCA program promotes agronomic resource management to protect the environment,[126] and with the new emphasis on water management and the NMTP, CA CCAs will also be making the connection between irrigation and nutrient management. Professional certification programs like the CA CCAs are extremely important to provide a level of knowledge to private industry consultants, agricultural specialists, and retailers. However, CA CCAs need to continue to build capacity, and by partnering with agencies like CDFA and UC ANR, CA CCAs are benefiting from the research and expertise of these programs, as well as building value for the CA CCA program.

Though private sector consultants, advisors, and irrigation equipment companies provide valuable information and technologies to growers, these are still for-profit companies, and their services and products may be too expensive for smaller California farmers. A full-blown soil moisture monitoring system with real-time data on an IPad through telemetry and software costs over $20,000. Although growers turn to the private industry for technical assistance and technologies, growers also cite cost as one of the largest barriers to adopting new technologies.[127] For these reasons, university and non-profit outreach and assistance is extremely valuable to make sure that on-farm water stewardship is not limited to those farmers who can afford the best systems and services from the private sector. The companies say their customers are the larger farms, but it is in society's interest to see that all farmers have access to best practices in water stewardship.

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[125] Maan, A.A. 2013. CDFA Nitrogen Management Training Program. Available at http://www.cacca.org/files/file_gallery/230-cdfanitrogenmanagementtrainingprogram-2013-10-04-16-885091.pdf

[126] Romander, A. 2008. Yesterday, Today, and Tomorrow. Available at: http://www.cacca.org/files/file_gallery/230-capcaadviserarticleaugust2007pdf-2010-09-24-15-388962.pdf

[127] Shaffer, S. & Thompson, E. Jr. 2013. Encouraging California Specialty Crop Growers to Adopt Environmentally Beneficial Management Practices for Efficient Irrigation and Nutrient Management: Lessons from a Producer Survey and Focus Groups American Farmland Trust. Available at http://www.farmland.org/documents/SpecialityCropGrowersBMPs.pdf

Chapter 6. Federal Programs

The Soil Conservation Service - originally the Soil Erosion Service - was created by the federal government in the 1930s as a response to the Dust Bowl. During a major reorganization of the USDA in 1994, the agency was renamed the Natural Resources Conservation Service to better reflect its wide range of activities related to agriculture and natural resources.[128] From federal headquarters in Washington DC, to local field offices in nearly every US county, NRCS is the primary USDA agency involved in technical assistance to agricultural producers. In 2012, the USDA provided roughly $14.7 million to support NRCS staff in providing free technical assistance to farmers and landowners.[129]

In addition to providing materials and hands-on assistance on a wide variety of agricultural resource management issues, NRCS is also responsible for administering Farm Bill conservation programs, of which there are currently fifteen. The major Farm Bill conservation programs include:

- The Conservation Reserve Program (CRP), which compensates landowners for retiring ecologically sensitive farmland.

- The Conservation Stewardship Program (CSP), which provides financial incentives for maintaining and improving on-farm conservation systems.[130]

- The Environmental Quality Incentives Program (EQIP), which provides financial incentives for adopting and implementing best management practices.[131]

Of these three, EQIP is the largest, and is in fact the largest conservation program for working agricultural lands. In 2011, roughly $75 million in EQIP funds were allocated to California.[132] Because of the scope and intent of EQIP, as well as the availability of expenditure data, this section will largely focus on EQIP in California.

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[128] USDA NRCS. 2011. Seventy-five years helping people to help the land: A brief history of NRCS. Available at http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/about/history/?&cid=nrcs143_021392

[129] USDA NRCS. 2011. Conservation Technical Assistance Cumulative 2012. Available at http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/technical/?cid=stelprdb1048616

[130] USDA NRCS. 2009. Fact Sheet: Conservation Stewardship Program. Available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/farmbill/?&cid=nrcs143_008208

[131] CA NRCS. 2011. California 2011 Environmental Quality Incentives Fact Sheet. Available at http://www.ca.nrcs.usda.gov/programs/eqip/2011/index.html

[132] Ibid.

6.1 EQIP

Authorized in 1996, the Environmental Quality Incentives Program (EQIP) incentivizes farm-level best management practices to prevent or mitigate environmental degradation. There are hundreds of practices (individually designated as *practice codes* by NRCS) eligible for EQIP funding, such as the installation of precision irrigation systems, the establishment of buffer strips to reduce runoff, and the implementation of animal waste management plans. EQIP allocates federal funds to states based on a complex ranking system designed to take into account the various conservation goals of the program.

Major areas of environmental concern, such as soil erosion or air quality, are identified and prioritized at the federal level. The initial allocation of funds is determined by the degree to which states exhibit, and are able to address, these resource concerns.[133] State and local priorities are identified through the State Technical Advisory Committee (STAC) and Local Working Groups (LWG). State NRCS officials together with the STAC and LWGs award contracts to individual farmers to execute conservation plans that consist of several approved practices and that satisfy state, regional, and federal priorities.[134]

In order to receive EQIP funding, individual farmers submit a conservation plan that addresses identified priority resource concerns. EQIP funding is delivered in two ways: 1) as incentive payments for contracts that guarantee the implementation of best management practices (BMPs), or 2) as contracts to share the costs of capital investments in conservation technology. Contracts can last several years depending on the project type.

6.1.1 California EQIP program priorities

In California, the distribution of funds at the state and regional level begins by ranking applications based on satisfaction of four broad categories: *cost-effectiveness, local priorities, state priorities, and federal priorities*.[135] In 2010, priorities were translated into the following EQIP conservation initiatives:

- Water Quality/Animal Feeding Operations
- California Air Quality Initiative
- Wildlife Habitat Initiative
- Organic Production/Transition Initiative
- Conservation Innovation Grant Air Quality Program
- Drought Initiative
- Cooperative Conservation Partnership Initiative
- Regular EQIP Priority Projects.

[133] NRCS uses a weighted, 31-factor formula to determine allocations to states.
[134] USDA NRCS. 2008. Fact Sheet: Environmental Quality Incentives Program. Available at http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_007742.pdf
[135] USDA NRCS. 2011. Environmental Quality Incentives Program: Regular EQIP - FY 2011. Available at ftp://ftp-fc.sc.egov.usda.gov/CA/programs/EQIP/2011/2011_eqip_regular_progdesc.pdf

Priorities changed slightly for 2011, though mostly in name:

- Animal Feeding Operations - State Priority
- California Air Quality - State Priority
- European Grapevine Moth Initiative
- EQIP Conservation Innovation Grant (b) Air Quality - National Priority
- EQIP Conservation Activity Plans
- EQIP Wildlife - State Priority
- Organic Initiative
- Regular EQIP Locally Led Program

Each initiative has a designated funding pool. Total state funding for Fiscal-Year 2011 was $75 million.[136] Outside of Regular EQIP Priority Projects, which received $13.6 million in 2009, the two air quality initiatives received the greatest amount of funding with a combined $21 million. The Water Quality/Animal Feeding Operation initiatives received $6 million in 2009, making it the second largest initiative. In comparison, the Organic Production and Wildlife Habitat initiatives received $3 million and $1 million, respectively.[137] [138]

Additionally, EQIP offers contracts for the development of Conservation Activity Plans (CAP).[139] These plans are designed to address comprehensively a significant resource management challenge by systematically combining a set of preexisting practices. The following CAPs are currently eligible for EQIP funding in California:

- Comprehensive Nutrient Management Plan
- Forest Management Plan
- Integrated Pest Management Plan
- Agricultural Energy Management Plan for Headquarters
- Conservation Plan Supporting Organic Transition
- Nutrient Management Plan
- Irrigation Water Management Plan
- Comprehensive Air Quality Management Plan
- Conservation Plan Supporting Transition Plan
- Spill Prevention, Control and Countermeasure Plan

Of these CAPs two are primarily intended to address irrigation management and water scarcity: Irrigation Water Management Plan (IWMP CAP) and Conservation Plan Supporting Transition Plan. The latter is focused on assisting growers who transition from irrigated to non-irrigated

[136]USDA NRCS. 2011. Fiscal-Year 2010 EQIP Contracts and Dollars Obligated. Available at http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/financial/eqip/?&cid=stelprdb1044131
[137] California NRCS (2009-A). 2009 EQIP Program and Application Information. Available online at http://www.ca.nrcs.usda.gov/programs/eqip/2009/index.html
[138] California NRCS (2010-A). 2010 EQIP Program and Application Information. Available online at http://www.ca.nrcs.usda.gov/programs/eqip/2010/index.html
[139] USDA NRCS. 2014. Fiscal-Year 2014 EQIP Conservation Activity Plan. Available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/eqip/?cid=stelprdb1193480

agriculture, and contracts for this CAP are only offered in California in Tehama and Merced Counties.[140] According to EQIP CAP guidelines: "the objective of Irrigation Water Management is to control the volume, frequency, and rate of water for efficient irrigation." Contracts for the development of an IWMP are only offered in Mendocino, Shasta, Tehama, Trinity, Ventura, San Diego, Riverside, and Imperial Counties.[141] Based on the success of the initial projects, these CAPs will be made more widely available throughout the state.

In addition to these initiatives, there are several EQIP subprograms that make funds available for targeted constituencies or specific resource concerns. The program most relevant to this report—Agricultural Water Enhancement Program—is discussed in Section 6.6.

6.1.2 Methodology of EQIP expenditure data analysis

In order to assess the extent and nature of EQIP expenditures on irrigation and water supply management, data from Fiscal Years 2002-2010 were analyzed. The "amount obligated"— the maximum amount which NRCS has allotted for each practice — is used to estimate intended expenditures and understand spending priorities within EQIP. These figures do not represent precise expenditures; rather, they are an estimate of the costs associated with implementing these practices in the specific context of each contract. The amount ultimately paid could vary from the obligated amount for a variety of reasons, including:

- Failure to implement practices/fulfill the terms of the contract
- Changes in the land-area to which the practices are ultimately applied
- Changes in the total funding allocated by the US Congress

The amount obligated does provide some measure of the degree to which practices are implemented, as well as an estimate of the cost of implementing these practices. In this report, the obligated amounts are used as proxies for estimating the relative value of each practice, rather than actual expenditures on those practices.

Because some EQIP practices can be used to achieve more than one resource conservation objective, it is not possible to say precisely how much was spent on water conservation. However, it is possible to identify some practices that can be reasonably assumed to be primarily, if not exclusively, intended for purposes of water conservation.

The sets of practice codes included in the Irrigation Water Management Plan (IWMP) and Transition from Irrigated to Dry Land Conservation Activity Plans (CAPS) were used to identify those practices associated with water conservation. Practices not primarily related to water conservation were excluded, such as pest control. Additionally, some practices — such as water well and irrigation regulating reservoir — not eligible under these CAPs were included in the analysis. (See the appendix for a full list of practices and data included in the analysis).

[140] Ibid.
[141] Ibid.

The dollar amounts obligated to each EQIP practice in each county were totaled for the time period 2002-2010. Total expenditures for each practice were compared to understand:

- The degree to which EQIP prioritizes water conservation in comparison to other resource concerns

- The varying degree to which EQIP funds were dedicated to certain types of practices within the water conservation category

Two limitations of this analysis should be noted: first, to some extent, state and local level decisions are precluded by national priorities. For example, mandates stipulate that 60% of all EQIP program funds must be dedicated to environmental resource concerns related to livestock.[142] Second, expenditure data might not necessarily reflect conservation benefits. For example, the $84,000 spent on *precision land forming*, could have benefits comparable to the $264 thousand spent on *land smoothing*. Further, this analysis does not capture outreach and assistance that NRCS staff conducts outside of the EQIP funding structure. NRCS provides technical assistance and support for the adoption of technologies and practices without EQIP funds. However, it is still valuable to analyze expenditure data, as it sheds light on how California NRCS and Local Working Groups prioritize resource concerns.

6.1.3 EQIP data analysis results

Data obtained from California NRCS indicates that total planned expenditures for the years 2002-2010 were $326 million statewide. Taken together, total expenditures on the selected range of water conservation practices were $162 million, or nearly 50% of total planned expenditures. This breaks down to $13.4 million for Transition to Dryland Farming CAP, $145.3 million for IWMP CAP, and $3 million for water conservation practices not included in either CAP *(Fig. 6)*. A number of practices in Transition to Dryland Farming and Ranching CAP that could not be reasonably associated with water conservation are removed, such as pasture and hay planting, or filter strip. Please download the appendix for the data and the list of practice codes used.

Water conservation and irrigation management are given considerable priority in terms of total EQIP allocations. However, the specific question remains as to how funds are allocated within the water conservation category and within each category, how funds are distributed.

A total of $64 million was spent on *micro-irrigation systems*, more than on any other EQIP practice (*Table 2*). Of the water conservation practices, the top four practices account for 62.4% of all spending in that category, and are all irrigation system improvements found in the IWMP CAP (*Table 3*).

[142] Stubbs, M. 2010. Environmental Quality Incentives Program (EQIP): Status and Issues. Report for the Congressional Research Service. Available at: http://www.nationalaglawcenter.org/assets/crs/R40197.pdf

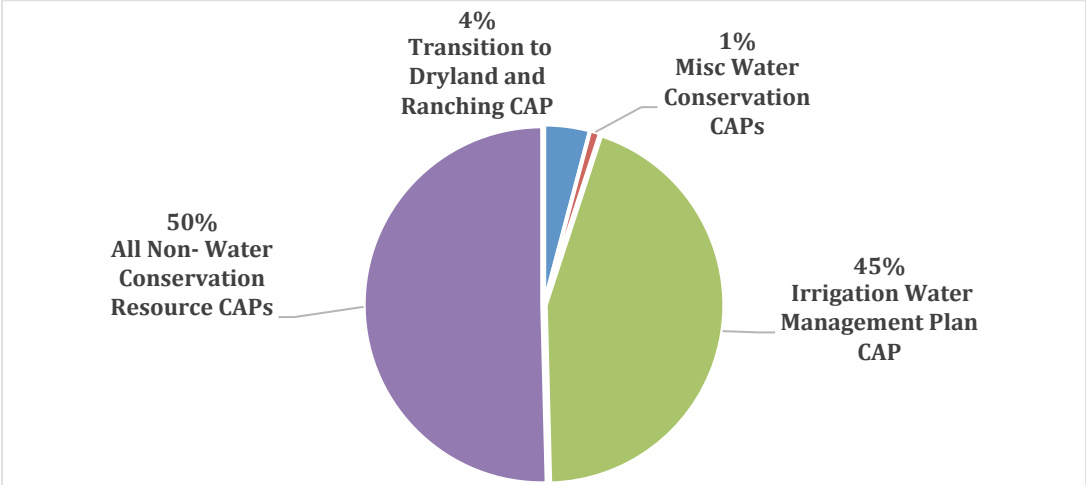

Fig. 6: California EQIP Expenditures 2002-2010

***Table 2*: Top 20 Overall EQIP Practices by Expenditure**

Practice Code	Practice Description	Total Expenditure 2002-2010
441	Irrigation System, Microirrigation	$63,899,909.08
723	Engine Replacement	$28,914,725.00
442	Irrigation System, Sprinkler	$23,305,580.20
430EE	Irrigation Water Conveyance, Pipeline, Low-Pressure, Underground, Plastic	$17,647,959.62
382	Fence	$16,143,433.00
313	Waste Storage Facility	$12,101,993.31
666	Forest Stand Improvement	$9,601,853.49
370	Atmospheric Resource Quality Management	$8,621,110.66
430DD	Irrigation Water Conveyance, Pipeline, High-Pressure, Underground, Plastic	$8,422,789.25
345	Residue and Tillage Management, Mulch Till	$7,206,003.92
516	Pipeline	$6,914,290.24
533	Pumping Plant	$6,410,851.93
314	Brush Management	$6,275,176.77
561	Heavy Use Area Protection	$5,786,639.49
447	Irrigation System, Tailwater Recovery	$5,426,346.31
464	Irrigation Land Leveling	$5,086,450.27
595	Pest Management	$5,057,613.44
634	Manure Transfer	$4,801,759.38
705	Air Management	$4,644,554.15
587	Structure for Water Control	$4,084,251.85

***Table 3*: Top 20 Water Conservation EQIP Practices by Expenditure**

Practice Code	Practice Description	Total Expenditures 2002-2010	Water Conservation Category
441	Irrigation System, Microirrigation	$63,899,909.08	IWMP CAP
442	Irrigation System, Sprinkler	$23,305,580.20	IWMP CAP
430EE	Irrigation Water Conveyance, Pipeline, Low-Pressure, Underground, Plastic	$17,647,959.62	IWMP CAP
430DD	Irrigation Water Conveyance, Pipeline, High-Pressure, Underground, Plastic	$8,422,789.25	IWMP CAP
345	Residue and Tillage Management, Mulch Till	$7,206,003.92	Dryland CAP
533	Pumping Plant	$6,410,851.93	IWMP CAP
447	Irrigation System, Tailwater Recovery	$5,426,346.31	IWMP CAP
464	Irrigation Land Leveling	$5,086,450.27	IWMP CAP
587	Structure for Water Control	$4,084,251.85	IWMP CAP
449	Irrigation Water Management	$3,489,947.69	IWMP CAP
340	Cover Crop	$2,373,179.64	Dryland CAP
642	Water Well	$1,711,389.74	Misc.
484	Mulching	$1,181,440.03	Dryland CAP
327	Conservation Cover	$946,850.30	Dryland CAP
443	Irrigation System, Surface and Subsurface	$930,640.51	IWMP CAP
521A	Pond Sealing or Lining, Flexible Membrane	$758,182.20	Misc.
380	Windbreak/Shelterbelt Establishment	$625,936.70	Dryland CAP
344	Residue Management, Seasonal	$538,087.47	Dryland CAP
328	Conservation Crop Rotation	$383,899.06	Dryland CAP
436	Irrigation Storage Reservoir	$338,279.91	IWMP CAP

The data indicate that EQIP funds are spent overwhelmingly on assisting producers with irrigation systems and equipment upgrades to irrigation efficiency, as opposed to the adoption and implementation of BMPs. The *irrigation water management* (IWM) practice, which incentivizes BMPs that do not involve equipment upgrades, received only $3.5 million from 2002-2010. Overall, water conservation practices that entail equipment/systems upgrades received $141 million (*Table 4*). By comparison, practices that implement BMPs received nearly $21 million (*Table 5*). It should be noted that BMPs cost less per acre than equipment upgrades, which accounts for some of the spending differences between categories.

Table 4: **Total Expenditures on Water Conservation Codes Related to System Upgrades**

Practice Code	Practice Description	Total Expenditures 2002-2010	Water Conservation Category
441	Irrigation System, Microirrigation	$63,899,909.08	IWMP CAP
442	Irrigation System, Sprinkler	$23,305,580.20	IWMP CAP
430EE	Irrigation Water Conveyance, Pipeline, Low-Pressure, Underground, Plastic	$17,647,959.62	IWMP CAP
430DD	Irrigation Water Conveyance, Pipeline, High-Pressure, Underground, Plastic	$8,422,789.25	IWMP CAP
533	Pumping Plant	$6,410,851.93	IWMP CAP
447	Irrigation System, Tailwater Recovery	$5,426,346.31	IWMP CAP
587	Structure for Water Control	$4,084,251.85	IWMP CAP
428A	Irrigation Water Conveyance, Ditch and Canal Lining, Plain Concrete	$3,078,592.91	IWMP CAP
430CC	Irrigation Water Conveyance, Pipeline, Nonreinforced Concrete	$2,226,683.18	IWMP CAP
642	Water Well	$1,711,389.74	Misc.
327	Conservation Cover	$946,850.30	Dryland CAP
443	Irrigation System, Surface and Subsurface	$930,640.51	IWMP CAP
521A	Pond Sealing or Lining, Flexible Membrane	$758,182.20	Misc.
380	Windbreak/Shelterbelt Establishment	$625,936.70	Dryland CAP
430AA	Irrigation Water Conveyance, Pipeline, Aluminum Tubing	$437,721.90	IWMP CAP
436	Irrigation Storage Reservoir	$338,279.91	IWMP CAP
552	Irrigation Regulating Reservoir	$238,906.46	Misc.
320	Irrigation Canal or Lateral	$214,402.38	IWMP CAP
521C	Pond Sealing or Lining, Bentonite Sealant	$201,642.20	Misc.
521D	Pond Sealing or Lining, Compacted Clay Treatment	$43,891.50	Misc.
428B	Irrigation Water Conveyance, Ditch and Canal Lining, Flexible Membrane	$35,477.00	IWMP CAP
430FF	Irrigation Water Conveyance, Pipeline, Steel	$26,437.90	IWMP CAP
388	Irrigation Field Ditch	$24,624.75	IWMP CAP
521B	Pond Sealing or Lining, Soil Dispersant	$4,234.00	Misc.
	Total System Upgrade Spending	**$141,041,581.78**	

***Table 5*: Total Expenditures on Water Conservation Codes Related to Best Management Practices**

Practice Code	Practice Description	Total Expenditures 2002-2010	Water Conservation Category
345	Residue and Tillage Management, Mulch Till	$7,206,003.92	Dryland CAP
464	Irrigation Land Leveling	$5,086,450.27	IWMP CAP
449	Irrigation Water Management	$3,489,947.69	IWMP CAP
340	Cover Crop	$2,373,179.64	Dryland CAP
484	Mulching	$1,181,440.03	Dryland CAP
344	Residue Management, Seasonal	$538,087.47	Dryland CAP
328	Conservation Crop Rotation	$383,899.06	Dryland CAP
610	Salinity and Sodic Soil Management	$258,866.50	IWMP CAP
329	Residue and Tillage Management, No-Till/Strip Till/Direct Seed	$124,188.67	Dryland CAP
636	Water Harvesting Catchment	$57,577.50	Dryland CAP
600	Terrace	$9,150.00	Dryland CAP
640	Waterspreading	$180.00	Misc.
	Total BMP Spending	**$20,708,970.75**	

NRCS staff indicate that "replacing less efficient irrigation conveyances and systems with more efficient equipment builds the infrastructure that makes good IWM possible."[143] Thus, producers are expected to implement the *irrigated water management* practice subsequent to receiving EQIP payments for systems upgrades. It is unclear to what extent this occurs and what water efficiency measures are actually realized by the technology upgrades.

However, irrigation efficiency via micro-irrigation systems does not necessarily result in water conservation. Once a new efficient irrigation system is installed, what happens to the saved water is extremely important. A recent study from UC Davis found that when farmers upgraded to more efficient sprinkler systems in Kansas with EQIP funding, there was actually an increase in groundwater extractions.[144] As farmers saved water with their new irrigation systems, they were more inclined to 1) expand irrigated acreage, 2) plant more water-intensive crops with higher market values, or 3) increase irrigation to increase yields.[145] The result of this was an increase in water usage via groundwater pumping for the study area.

[143] Beardsley, E. 2012. Personal Communication. J. Elhayack. Email correspondence with Erik Beardsley, California USDA-NRCS.

[144] Pfeiffer, L & Lin, CC. (2013). Does Efficient Irrigation Technology Lead to Reduced Groundwater Extraction? Empirical Evidence. (UC Davis working paper). Available at: http://www.des.ucdavis.edu/faculty/Lin/PfeifferLin_irrigationtechnology.pdf

[145] Ibid.

There is currently no evidence that a similar situation is occurring in California; however, this has not yet been studied in California, and it may be that EQIP funds are in effect subsidizing groundwater pumping. Although EQIP is not authorized to assist in water supply augmentation or expansion of acreage, this may nevertheless be an outcome of the funding decisions. More work needs to be done to determine the impact of new EQIP irrigation systems on water supply in California.

Simply purchasing new irrigation systems may not result in water savings because of land and irrigation management techniques. Proper system maintenance and management are necessary to promote water savings. Further, other farming techniques, such as cover cropping, composting, or tillage regimes, can work to reduce on-farm water use as well. As such, using a combination of BMPs, correct irrigation system management, and an efficient irrigation system is the best method to reduce on-farm water use. Unfortunately, the data show that BMPs are not being prioritized by EQIP contracts, and NRCS offices are understaffed and without the resources to allow them to provide the necessary outreach and holistic management planning farmers need. A recent report from the Environmental Working Group indicated that NRCS staff often skip the nine-step holistic management plan.[146] The concern that system upgrades may not address water supply problem highlights the need for additional training and outreach to ensure that irrigation systems are maintained, used efficiently, and that system upgrades result in water savings.

It is also important to consider the types of practices that are not generously funded or are not eligible under EQIP. For example, *water spreading* is not eligible under either of the water supply management CAPs, even though ponds can address water supply challenges and groundwater recharge is a major issue. Water-harvesting catchment has not received considerable funding, with only $57,000 being allocated over eight years. Further, some alternative practices, such as keyline design - a landscape design that improves infiltration and soil water retention – is not an approved EQIP practice, nor is soil moisture monitoring or planting of un-irrigated acreage. It is unclear why practices such as these are not eligible under EQIP, although Conservation Innovation Grants are available to research and add practices to EQIP.

[146]Environmental Working Group. (2013). Untapped: How Farm Bill Conservation Programs Can Do More To Clean Up California's Water. Available at: www.ewg.org.

6.2 Agricultural Water Enhancement Program (AWEP)

The Agricultural Water Enhancement Program is administered under EQIP. Whereas regular EQIP contracts are between NRCS and individual producers, AWEP funds are granted to organizations for water improvement projects that involve multiple producers. Eligible organizations are governmental, tribal, or agricultural organization including irrigation districts and NGO's involved in agricultural issues. Recent examples of AWEP projects include:

- Projects by both Tulare Irrigation District and Sutter Resource Conservation District to improve water quality and quantity by facilitating the transition from high to low-pressure irrigation systems.
- Coalition for Urban/Rural Environmental Stewardship's project to reduce sedimentation and polluted agricultural discharge to the northern San Joaquin River
- Western United Dairymen's project to improve wastewater recovery systems on 550,000 acres over three years.

The level of funding for each project varies considerably. However, because total allocations ultimately vary over time, precise expenditure data for each project could not be determined. Total AWEP funding has decreased only slightly over the 2009-2013 period (*Table 6)*.

Table 6: **Total California AWEP Obligated Funding 2009-2013**

Year	2009	2010	2011	2012	2013
Total Spending (Millions)	$15.9	$18.7	$16.5	$11.5	$11.1

Based on project descriptions, on-farm water conservation and irrigation best management practices feature prominently in AWEP funding decisions. However, detailed information on individual projects was not examined further to determine the nature of these projects. It is important to note that the program provides no overhead or administrative funds to the organizations that administer the grants. This discourages many irrigation districts or NGOs that might otherwise attempt such programs. One staffer at an irrigation district told us that he had to write the grant proposal on his own time at home because of this stipulation.

6.3 Environmental Working Group EQIP Report

In 2013, the Environmental Working Group (EWG) released a report entitled: *Untapped: How Farm Bill Conservation Programs Can Do More to Clean Up California's Water*.[147] This report looks at EQIP and AWEP funding in California to determine how much is being spent and if money is being spent in the most effective manner. The report focuses on water quality concerns and nutrient management, but draws similar conclusions to the water stewardship analysis presented in our report.

EWG's report indicates that from 2009-2012 the majority of EQIP and AWEP funding went directly to structural projects and equipment, with 81% of funding supporting Structural Practices. From 2009-2012, 49% of EQIP and AWEP funding was allocated to irrigation hardware and systems. EWG also found that low tech and less costly land management and vegetative practices, which are more effective at reducing nutrient pollution, are underfunded, with only 11% of funding allocated to these practices.

The EWG report lists funding for the top 15 EQIP practices from 2009 to 2012. Although not directly comparable due to time series, Table 7 compares funding for the Top 15 practices in 2009-2012 to the Top 15 EQIP practices from 2002-2010, the period that we analyzed. Results of the comparison indicate that funding priorities for California EQIP have not changed significantly. Micro-irrigation still received the most funding. Further, the top three practices are all technology system upgrades, and low-tech BMPs remain largely underfunded. It should also be noted that total EQIP funding has been increased over the past few years.

The EWG report concludes with recommendations for the California NRCS office to encourage the adoption of "high-impact management practices" instead of equipment and system upgrades, including: revising the ranking system for funding applications to promote applications that have a suite of management and vegetative practices; increase cost-share rates; increase focus on low cost, high impact practices; increase outreach and promotion of the program; and make sure the irrigation investments result in water savings.

[147] Report available at: www.ewg.org

***Table 7*: Comparison of California EQIP Funding: Top 15 Practices, 2002-2010, 2009-2012**

2002 -- 2010		2009 -- 2012	
Practice Description	**Obligated Funding**	**Practice Description**	**Obligated Funding**
Irrigation System, Microirrigation	$63,899,909	Irrigation System, Microirrigation	$45,536,339
Engine Replacement	$28,914,725	Combustion System Improvement	$44,172,724
Irrigation System, Sprinkler	$23,305,580	Engine Replacement	$43,161,994
Irrigation Water Conveyance, Pipeline, Low-Pressure, Underground, Plastic	$17,647,960	Fence	$15,410,790
Fence	$16,143,433	Heavy Use Area Protection	$15,347,372
Waste Storage Facility	$12,101,993	Forest Stand Improvement	$11,528,159
Forest Stand Improvement	$9,601,853	Pipeline	$7,794,296
Atmospheric Resource Quality Management	$8,621,111	Irrigation System, Sprinkler	$7,032,237
Irrigation Water Conveyance, Pipeline, High-Pressure, Underground, Plastic	$8,422,789	Shallow Water Development and Management	$6,871,690
Residue and Tillage Management, Mulch Till	$7,206,004	Brush Management	$6,750,886
Pipeline	$6,914,290	Irrigation Pipeline	$6,740,631
Pumping Plant	$6,410,852	Irrigation Water Conveyance, Pipeline, Low-Pressure, Underground, Plastic	$5,276,357
Brush Management	$6,275,177	Dust Control on Unpaved Road and Surfaces	$5,149,234
Heavy Use Area Protection	$5,786,639	Manure Transfer	$5,013,839
Irrigation System, Tailwater Recovery	$5,426,346	Pumping Plant	$4,542,496

6.4 Bureau of Reclamation and NRCS Collaborative Projects

The U.S. Bureau of Reclamation (BoR) of the Department of the Interior was established in 1902 to manage water projects in the western part of the United States. BoR is best known for the construction of dams, canals, and power plants across the West, including the Hoover Dam. BoR is also the largest wholesaler of water in the country, providing water for 31 million people and 10 million acres of irrigated agriculture. BoR's mission is to help western states meet their increasing water needs, while protecting the environment, supporting conservation measures, water recycling, and reuse.[148]

[148] Bureau of Reclamation. 2014. About us. Available at: http://www.usbr.gov/main/about/

In California, BoR has multiple projects that involve working with state and local entities to improve water supply and address state water concerns. The federal government currently has the capacity to store 17 million-acre feet of water, making them the largest owner of surface water storage in the state. Through BoR, the federal government has developed a series of canals, reservoirs, dams, and pumps to deliver this water to California farmers largely through the Central Valley Project (CVP). With its 22 reservoirs, the CVP provides storage for 11 million acre-feet of water and delivers irrigation water to over 2.6 million acres of agricultural land.[149]

Much of California's water infrastructure was built prior to 1975, and to truly optimize water use, updating the water infrastructure is necessary. For example, many irrigation districts are unable to provide on-demand water to their growers. This limits the on-farm water stewardship methods that can be used, since growers are unable to create flexible irrigation schedules and to use pressurized irrigation systems with surface water. At the district level, infrastructure efficiency upgrades, water recycling, and water reuse programs can provide critical water savings.

BoR and the NRCS have recognized the interconnectivity of water purveyors and on-farm water use in addressing agricultural water stewardship to increase water supply. Since 2011, BoR has been providing funding for projects at the water purveyor or Water District level that created new water supplies for agriculture and improved water management and conservation. Concurrently, NRCS has been providing technical and financial assistance through EQIP to farmers to complement BoR's infrastructural improvement projects in the targeted irrigation districts.

Since 2011, BoR and NRCS have spent $20.79 million on projects in seven water districts (*Table 8*). The USDA reports that in that time, on-farm water use efficiency was increased by an average of 25% and the Water Districts saved 38,223 acre-feet per year; by restructuring the districts' infrastructure to provide on-demand water, farmers were able to use pressurized irrigation systems and create flexible irrigation schedules.[150]

Table 8: **Funding for BoR-NRCS Agricultural Water Conservation and Efficiency Projects**[151]

	2011	**2012**	**2013**	**2014**	**Total**
Bureau of Reclamation	$4.1 million	$1.7 million	$414,000	-	**$6.21 million**
USDA-NRCS	$6.46 million	$4.3 million	$1.67 million	$2.15 million	**$14.58 million**
Total	$10.56 million	$6 million	$2.08 million	$2.15 million	**$20.79 million**

In the South San Joaquin Irrigation District, BoR funding allowed for the installation of a pressured irrigation system, which replaced the open channel system, saving 3,498 acre-feet of water at the irrigation district level. The NRCS assisted 32 growers who were previously flood

[149] Freeman, C.B. 2008. California's Water: An LAO Primer. The Legislative Analyst's Office. Available at: www.lao.ca.gov.
[150] United States Department of Agriculture. 2014. Collaborative BOR-NRCS Agricultural Water Conservation & Efficiency Projects.
[151] Ibid.

irrigating their fields with the installation of micro-irrigation systems and flow meters, realizing, on average, a 25% increase in on-farm water use efficiency.[152] The district was able to sell the water it saved to other irrigation districts. It is through collaborative projects such as these that water use efficiency and stewardship practices can be realized by all those who handle water in California.

A comparable state project needs to be created to retrofit all of the irrigation districts that do not receive federal water, as this would allow more farmers to adopt pressurized systems and so create more flexibility in the water delivery system. While some such irrigation districts are engaged in such retrofits, many are not.

6.5 Conclusion

Providing financial assistance to farmers for on-farm water management techniques can encourage adoption. Results from focus groups and surveys of California specialty crop growers by American Farmland Trust indicate that the greatest barrier to adoption of on-farm water and nutrient BMPs is upfront cost. [153] For this reason, EQIP is a valuable resource for growers. However, based on the analysis presented in this paper, the following recommendations are made to reform the EQIP program to expand the services and ensure on-farm water savings.

- **Increased Federal funding is needed for NRCS offices to increase staff levels and provide resources.** EQIP contracts and technical assistance are resource intensive, requiring significant staff time and travel. Additional funding for staff and resources would allow for:
    - Increased and continued outreach and technical assistance to help farmers execute and maintain new technologies and practices, as well as address problems as they arise.
    - Allow NRCS staff the time and ability to follow the nine-step EQIP conservation plan protocol for every contract, ensuring holistic on-farm water management.
    - Allow NRCS staff the ability to encourage and recommend the adoption of low-tech, high impact management strategies, such as irrigation scheduling, that will increase on-farm water stewardship beyond the installation of an irrigation system. These practices may or may not be a part of the EQIP contract.
    - Allow NRCS the staff to increase participation in the EQIP program.

[152] Natural Resources Conservation Service. 2013. NRCS helps fund irrigation improvements to keep water clean and abundant.
[153] Shaffer, S. 2013. Encouraging California specialty crop growers to adopt environmentally beneficial management practices for efficient irrigation and nutrient management: Lessons from a producer survey and focus groups. American Farmland Trust. Available at http://www.farmland.org/documents/SpecialityCropGrowersBMPs.pdf

- **Expand on-farm water stewardship practices eligible for EQIP funding.** Practices eligible for EQIP funding should be continually expanding to represent the suite of on-farm techniques that farmers may use to conserve water. This analysis found 36 EQIP practice codes strongly related to water conservation and the majority of these codes support technology upgrades. Practice codes need to expand to include more alternative and low-tech practices, such as Keyline Design, dry farming, or soil moisture monitoring.

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Chapter 7. Integrated Regional Water Management Plans

7.1 Introduction

Prompted by the passage of Proposition 50 in 2002, The Integrated Regional Water Management Act (SB 1672) invests coalitions of stakeholders and government agencies with the authority to develop and implement Integrated Regional Water Management Plans (IRWMPs).[154] This Act recognizes the importance of cooperative and regional governance of water resources, as California's vast and diverse socioeconomic and physical landscape presents significant barriers to centralized, one-size-fits-all water resource management strategies.

The Department of Water Resources (DWR) defines IRWM regions, sets guidelines for and approves IRWMPs, and grants funding for IRWMP planning and implementation projects. There are currently 48 IRWM regions within 11 larger Funding Areas (based on hydrologic regions).[155] throughout the state. Most of California is covered by one or more IRWM Regions, with the goal of covering the entire state by IRWMPs.

While regionally based management strategies are the hallmark of the plans, guidelines for IRWMP grant proposals also emphasize the importance of coordinating across regions when stakeholders have shared resources and common interests. Such inter-regional and statewide goals include Delta restoration and the resolution of conflicts over water rights. In this manner, IRWMPs can collectively address regional and statewide resource concerns, recognizing common interests in ensuring a safe, clean, and ample water supply.

Although IRWMPs are emerging as master water plans, purporting to deal with all aspects of water resource management in urban and rural settings, the role of agricultural water stewardship in addressing water scarcity is not prioritized by the plans. IRWMPs are only required to *consider* agricultural water use efficiency in order to be eligible for bond funding. In part because of this lax requirement, outreach to growers and projects to promote on-farm adoption of best management practices for water stewardship (BMPs) are not emphasized. The opportunity for on-farm water management to improve water quality and quantity is too great to be over looked; until IRWMPs adequately include agriculture water stewardship projects, they cannot be considered comprehensive regional water management plans.

7.2 Funding and guidelines

The development and implementation of Integrated Regional Water Management Plans (IRWMPs) are funded thus far through three bond measures:

[154] California Water Code Sec. 10530-10550: Integrated Regional Water Planning Act of 2002. Available at http://www.water.ca.gov/irwm/integregio_legis.cfm

[155] California Department of Water Resources. 2014. What is IRWM? Available at http://www.water.ca.gov/irwm/index.cfm

Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, which provides $500 million in competitive grant funds for projects consistent with an adopted IRWMP.[156]

Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, River and Coastal Protection Bond Act of 2006, which provides $1 billion for IRWM planning and implementation. [157]

Proposition 1E, the Disaster Preparedness and Flood Prevention Bond Act of 2006, which provides $300 million for IRWM Stormwater Flood Management.[158]

Combined, these propositions represent $1.8 billion in bond funds for IRWM planning and implementation - some of which is dedicated program administration at the state level. While the funds from Prop 1E are tied to Storm Water Flood Management (SWFM), the remaining funds cover water quality and supply reliability in the broadest sense. Various amounts of the total allotments are dedicated to specific water management goals, such as improved drinking water quality, reduced urban water demand, and inter-regional coordination.

There are some limits on the amount of funding available for different aspects of IRWMP planning and implementation:

- No more than $1 million for planning
- No more than $30 million per SWFM project (Prop 1E)
- A schedule-based, varying maximum for implementation proposals

In most cases, there is a minimum matching funds requirement. The requirement varies based on the type of project. In some cases, the requirement can be waived.[159]

7.3 Program administration and implementation

The program is currently administered by the Department of Water Resources (DWR), which has the authority to officially recognize IRWM regions, review and approve IRWMPs, and grant funds for both planning and implementation of IRWMPs. This process is ongoing, with various IRWM regions in different stages of development, meaning that all regions may not be participating in a given round of bond funding.

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[156] California Water Code Sec. 79560-79565: Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002. Available at http://www.water.ca.gov/irwm/integregio_legis.cfm

[157] California Public Resources Code Section 75001-75130: the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006. Available at the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006.

[158] California Public Resources Code Division 5, Ch. 1.699, Section 5096.800-5096.967: Disaster Preparedness and Flood Prevention Bond Act of 2006. Available at the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006.

[159] California Department of Water Resources. 2010. Prop. 84 and Prop. 1E Integrated Regional Water Management Guidelines.

Each IRWMP follows guidelines for satisfying criteria developed by DWR, per the requirements of the relevant bonds. The plans must be consistent with other ongoing state and regional water management efforts.

Once a region is officially recognized, a Regional Water Management Group (RWMG) is formed to develop and implement the IRWMP. The Act defines a "regional water management group as three or more local agencies, at least two of which have statutory authority over water supply or water management, plus those other persons who may be necessary to develop and implement an IRWMP."[160] Efforts must be made to engage other stakeholders. While several IRWMPs boast a wide and varied list of participating stakeholders, it is unclear to what extent any particular interest group has been able to influence the content of an IRWMP.

7.4 Structure and Content of IRWMPs

All IRWMPs follow a similar format and address common themes. IRWMPs must contain a detailed hydrologic and socioeconomic description of the region, including water use patterns and major water resource challenges, as well as the impact of climate change. Goals and objectives are outlined, and specific resource management strategies (RMS) are chosen to achieve those goals. Ultimately, projects are chosen to support each RMS. Program evaluation, stakeholder involvement, consideration of disadvantaged communities, and data and financial management are all discussed as well. Projects are then submitted for funding for the current grant cycle.

DWR states a strong preference for proposals that:

- Include regional projects or programs
- Effectively integrate water management programs and projects within a hydrologic region identified in the California Water Plan; the Regional Water Quality Control Board (RWQCB) region or subdivision; or other region or sub-region specifically identified by DWR
- Effectively resolve significant water-related conflicts within or between regions
- Contribute to attainment of one or more of the objectives of the CALFED Bay-Delta Program
- Address critical water supply or water quality needs of disadvantaged communities within the region
- Effectively integrate water management with land use planning
- For eligible SWFM funding, projects which: a) are not receiving State funding for flood control or flood prevention projects pursuant to PRC §5096.824 or §75034 or b) provide multiple benefits, including, but not limited to, water quality improvements, ecosystem benefits, reduction of in stream erosion and sedimentation, and groundwater recharge.
- Address Statewide priorities:
    - Drought preparedness
    - Efficient use and reuse of water

[160] California Water Code Sec. 10530-10550: Integrated Regional Water Planning Act of 2002. Available at: http://www.water.ca.gov/irwm/integregio_legis.cfm

- Climate change response actions
- Expand environmental stewardship
- Practice integrated flood management
- Protect surface water and groundwater quality
- Improve tribal water and natural resources
- Ensure equitable distribution of benefits[161]

In the selection of RMS, planners are required to consider a suite of strategies identified by DWR in the 2009 update of the California Water Plan. A 2013 California Water Plan update has been released. The 2009 Plan features seven broad approaches to water resource management, under which there are roughly 30 resource management *strategies*. Of those 30 strategies, 11 are most directly relevant to agricultural water stewardship. The seven approaches from and the eleven strategies the 2009 California Water Plan relevant to agriculture are:

1. **Reduce Water Demand**
    - Agricultural Water Use Efficiency
2. **Increase Water Supply**
    - Regional/Local Storage
    - Conjunctive Management and groundwater
3. **Improve Operational Efficiency and Transfers**
    - Regional/Local Conveyance
4. **Improve Water Quality**
    - Pollution Prevention
    - Salt and Salinity Management
5. **Practice Resource Stewardship**
    - Agricultural Lands Stewardship
    - Economic Incentives (loans, grants, and water pricing)
6. **Improve Flood Management**
7. **Other**
    - Crop Idling
    - Irrigated Land Retirement
    - Rainfed Agriculture[162]

Though each strategy must be considered, no IRWMP will employ all of them. For example, a desalination strategy under the Increase Water Supply category is generally inapplicable to inland regions. However, the application of the relevant strategies above would have considerable benefits in IRWM Regions where agricultural activity places significant demands on limited water supplies. The potential role of agriculture in addressing water supply challenges makes properly integrating agricultural stewardship into IRWMP increasingly important. Nevertheless, our research found that — for various reasons — agricultural water stewardship is not a primary feature of IRWMPs.

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[161] Department of Water Resources. 2010. Prop. 84 and Prop. 1E Integrated Regional Water Management Guidelines.

[162] Department of Water Resources. 2009. California Water Plan: Update 2009. Volume 2: Resource Management Strategies. Available at file:///Volumes/CWPU%202009%20CD/content.html#volume2

7.5 Role of IRWMPs in facilitating on-farm agricultural water stewardship

In order to assess the degree to which IRWMPs address agricultural water stewardship, 12 IRWMPs in the Sacramento River, San Joaquin River, and Tulare/Kern Funding Areas were reviewed.[163] These IRWM Regions were chosen due to the prevalence of irrigated agriculture and water supply reliability concerns. Although not all Regions in these Funding Areas are primarily agricultural, all completed IRWMPs were reviewed in order to get a sense for the variety of approaches, structures, and contents of IRWMPs.

The IRWMPs reviewed do not emphasize or prioritize strategies that facilitate agricultural water stewardship; neither in terms of outreach to growers nor through the promotion of projects that help growers to implement BMPs. Overall, there is a disconnect between the acknowledged role of agriculture in water scarcity and the potential role of agricultural water stewardship in addressing such scarcity.

Of the 12 IRWMPs reviewed all but one explicitly stated water supply reliability as a primary resource concern. However, and despite significant agricultural activity, three IRWMPs — American River Basin (ARB); Merced; and Upper Kings — were absent of any projects that would address on-farm agricultural water use.[164] The remaining nine IRWMPs address agriculture to varying degrees, including:

- CABY IRWMP supports multiple projects that would improve irrigation scheduling through better understanding of crop water needs.[165]
- Upper Feather River Watershed IRWMP plans to increase funding to two Resource Conservation Districts (RCDs) in the region.[166]
- Sacramento Valley IRWMP supports water agency efforts to convert growers from furrow to sprinkler and drip irrigation systems.[167]
- Yolo County IRWMP discusses plans to work with water agencies to develop a "state of the art agricultural water use efficiency program."[168] [169]
- Yuba County IRWMP includes a program to offer agricultural water conservation evaluations.[170]

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[163] IRWMPs reviewed: American River Basin; Upper Feather River Watershed; CABY; Sacramento Valley; Yolo County; Yuba County; Merced; Madera; Eastern San Joaquin County; Poso Creek; Westside San Joaquin; Upper Kings Basin.

[164] Planners for the ARB IRWMP stated that the initial IRWMP focused on urban water use, while the current revision will better incorporate agriculture. Planners for the Upper Kings IRWMP point out that they already have robust agricultural water use efficiency programs in place.

[165] CABY Regional Water Management Group. 2007. CABY Integrated Regional Water Management Plan.

[166] Feather River Watershed Authority. 2005. Upper Feather River Waters Integrated Regional Water Management Plan.

[167] Northern California Water Association. 2007. Sacramento Valley Integrated Regional Water Management Plan.

[168] Yolo County's IRWMP also discusses irrigation management in the context of water quality.

[169] Yolo County Water Resources Agency. 2007. Yolo County Integrated Regional Water Management Plan.

[170] Yuba County Water Agency. 2008. Yuba County Integrated Regional Water Management Plan.

- Eastern San Joaquin IRWMP includes a program that reimburses growers who convert to drip irrigation systems.[171]
- West Side San Joaquin IRWMP highly prioritizes a plan to convert 30,000 acres of agricultural land to "micro-irrigation" systems.[172]
- Madera IRWMP considers metered rates for groundwater pumping.[173]
- Poso Creek IRWMP supports ongoing Mobile Irrigation Labs.[174]

The level of importance assigned to these projects in some IRWMPs remains unclear, as further information on these programs has been somewhat difficult to obtain. For example, the Eastern San Joaquin IRWMP merely mentions the program listed above. There are no plans to expand or support the program via IRWMP grant funds, since the program is adequately funded through other sources.[175] Further, increased funding to RCDs in Upper Feather River's IRWMP is actually part of a preexisting regional plan that was incorporated into the IRWMP. The multiple irrigation efficiency projects in the CABY IRWMP are ranked as middle and bottom tier priorities, for reasons that are not clear.

In reviewing IRWMPs and speaking with IRWMP planners, it appears that in most cases, agricultural water stewardship is given some consideration. The degree to which agriculture is incorporated into IRWMPs varies, though not necessarily in proportion to the significance of agriculture in the region or in proportion to the full potential of agricultural to address water resource problems. There are many factors — some of which are discussed above — that present barriers to incorporating agricultural water stewardship. However, there is nothing to suggest that it cannot or should not be done.

The statutes related to IRWMP planning and implementation are not biased against projects that feature efforts to improve agricultural water stewardship. The Integrated Water Management Planning Act states, "all plans shall address…protection and improvement of water supply reliability including identification of feasible agricultural and urban water use efficiency strategies."[176] Further, the *consideration* of agricultural water use efficiency and agricultural land stewardship strategies are minimum requirements of eligibility for IRWMP-related bond funding.[177] DWR staff have also pointed out that agricultural water stewardship projects are particularly well-suited to meet criteria for IRWMP project preferences, given that they achieve multiple benefits and address multiple resource concerns.[178]

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[171] Northeastern San Joaquin Groundwater Banking Authority. 2007. Eastern San Joaquin Integrated Regional Water Management Plan.
[172] San Luis & Delta-Mendota Water Authority. 2006. Westside Integrated Water Resources Plan.
[173] Madera County Resource Management Agency. 2008. Madera Integrated Regional Water Management Plan.
[174] Poso Creek Regional Management Group. 2007. Poso Creek Integrated Regional Water Management Plan.
[175] Nakagawa, B. 2011. Personal communication. J. Elhayek: Telephone conversation with Brandon Nakagawa, Senior Civil Engineer, San Joaquin County Public Works.
[176] California Water Code Sec. 10530-10550: Integrated Regional Water Planning Act of 2002. Available at http://www.water.ca.gov/irwm/integregio_legis.cfm
[177] California Department of Water Resources. 2010. Prop. 84 and Prop. 1E Integrated Regional Water Management Guidelines.
[178] BenJemaa, F. Ph.D. 2011. Personal communication. J. Elhayek: Email correspondence with Dr. Fethi BenJaama, Chief Agricultural Water Use Efficiency, DWR, CA.

The IRWMPs reviewed feature numerous projects that improve storage, conveyance and delivery infrastructure. While such projects have considerable benefits in terms of supply reliability, a comprehensive approach must also include on-farm water stewardship projects. This disparity seems to indicate a preference for meeting current demand through increased supply, rather than through improved resource management and/or reduced demand.

7.6 Barriers to inclusion of agricultural water stewardship projects in IRWMPs

There are several potential explanations for the lack of emphasis on agricultural water stewardship in the IRWMPs reviewed, including:

- Lack of representation or participation on behalf of growers and stakeholders with an interest in agricultural water stewardship and the degree to which RCDs were able to participate
- Difficulty quantifying water saving benefits and/or guaranteeing results
- Difficulty implementing programs targeted at many individual farmers
- The relegation of such activity to preexisting agencies and programs such as Resource Conservation Districts, Irrigation Districts, Agricultural Water Management Plans, and Natural Resources Conservation Service (NRCS)/Farm Bill conservation programs

The role of these factors in the lack of emphasis on agricultural water stewardship in IRWMPs was discussed with DWR staff and regional IRWMP officials. It appears that, while IRWMPs do often list agricultural agencies like RCDs and NRCS as stakeholders and participants, their relative influence on the process varies. In at least one case, a lack of participation from agricultural stakeholders was acknowledged as a reason why on-farm water stewardship projects were not featured in the IRWMP. This lack of participation was attributed to inactive and underfunded RCDs, which has resulted in a poorly organized and underrepresented agricultural community.[179]

There is nothing to suggest bias against on-farm water stewardship projects in state-level criteria for IRWMP bond funding. However, analysis of DWR Prop 50 and Prop 84 IRWMP grant awards indicate that, overwhelmingly, DWR has funded urban and agricultural infrastructure and supply projects, not education, outreach, or assistance to farmers. This is undoubtedly due to many reasons. Agricultural water stewardship projects are largely absent from IRWMPs, making it difficult for programs and project to be eligible for IRWMP funding. It has also been suggested that DWR's funding criteria related to cost-benefit analysis may not be flexible enough to recognize the potential benefits the proposal of on-farm projects.[180] It is difficult, though not impossible, to guarantee results and quantify water savings from on-farm workshops, demonstrations, and educational materials.

Difficulty quantifying the benefits of on-farm water use efficiency projects may be a persistent disadvantage when compared to supply-increasing infrastructural improvements. DWR has

[179] Maytac, S. 2011. Personal Communication. J. Elhayek: Email correspondence with Scott Matyac, Water Resources Manager, Yuba County Water Agency.
[180] Azhderian, A. 2011. Personal Communication. J. Elhayek: Phone conversation with Ara Azhderian, Water Policy Administrator, San Luis & Delta-Mendota Water Authority.

recognized this problem and in 2013 revised its IRWMP project solicitation process for Prop 84 and Prop 1E funding. Applicants can choose from four DWR methods for the cost/benefit analysis or may choose their own method within DWR requirements; one of the four DWR methods is specifically for non-monetized benefits.[181]

Several IRWMP planners identified the need to address other, more immediate, regional water resource concerns instead of agricultural water stewardship projects. Still other planners state that on-farm water stewardship is being adequately addressed outside of the scope of IRWMPs. Some of the irrigation districts involved in IRWMP planning conduct their own on-farm water use efficiency programs;[182] however, these are limited programs that largely occur when the irrigation district is trying to optimize water use or the cost of water is increasing. An analysis of how on-farm water stewardship is being managed by other programs would give a more comprehensive sense of water management initiatives, explain why they are not addressed in the IRWMPs, and explain the benefits that directly relate to IRWMP goals, even if no funding is being requested.

7.7 Conclusion

If IRWMPs are going to serve the purposes envisioned by water managers in California, it is necessary to adequately address on-farm water use in addition to water supply projects. Significant amounts of water can be freed up through the combined adoption of precision irrigation technology, agroecological farming techniques, and best management practices. The inclusion of projects to improve agricultural water stewardship can be achieved through several changes:

- **Strengthen IRWMP planning and implementation statues, as well as requirements for bond funding.** IRWMPs should be required to incorporate feasible agricultural water stewardship strategies in proportion to the degree to which irrigated agriculture impacts water supply in their region.

- **More direct participation in IRWMP planning from conservation and agricultural stakeholders and farmers at the regional and the state level.** At the regional level, stakeholders will help develop and include agricultural water stewardship projects in IRWMPs. At the state level, stakeholders can craft criteria that determine the extent to which agriculture is included in IRWMPs.

- **DWR needs to continue to increase flexibility related to the cost-benefit reporting for grant benefits.** Allowing for qualitative or non-monetized benefits will allow for more flexibility in grant applications and eligibility of on-farm water stewardship projects.

[181] California Department of Water Resources. 2012. IRWM Grant Program Draft 2012 Guidelines and Round 2 PSPs. Available at: http://www.water.ca.gov/irwm/grants/archive.cfm

[182] Oshel, P. 2011. Personal Communication. J. Elhayek: Email correspondence with Paul Oshel, District Engineer, Semitropic Water Storage District.

Chapter 8. California Water Policy

8.1 California Water Bonds

"Water Bond" is the generic term for a proposition crafted by the California Legislature that outlines various priorities for spending on water related projects and dedicates funds to those projects. Once the Legislature has approved the proposition, it is then placed on the ballot to be voted on by the general public. If the public also approves the amount and spending allocations outlined in the water bond, then the state has the authority to raise those funds by selling bonds. The funds are then distributed to the relevant state agencies who carry out projects or award grant funding to complete the projects outlined in the proposition.

No water bonds have been passed by the general public in California since 2006. In 2009, the Legislature crafted a bond measure, but general voting on this bond measure has been postponed twice. The Legislature has amended the 2009 Water Bond three times, and is currently debating the 2014 versions in both the Assembly and the Senate. If passed by the Legislature, then the general public may vote on a Water Bond in November 2014, unless voting is postponed again.

Even though no new water bonds have been passed since 2006, state agencies still have funds from previous bonds to spend on numerous projects. According to the California State Assembly Committee on Water, Parks, and Wildlife, in 2014 there were still remaining balances on the following Water Bonds, although some of the funds have since been committed to emergency drought relief:

- Proposition 25: Clean Water Bond Law of 1984
- Proposition 44: Water Conservation & Water Quality Bond Law of 1986
- Proposition 81: California Safe Drinking Water Bond Law of 1988
- Proposition 82: Water Conservation Bond Law of 1988
- Proposition 204: Safe, Clean, Reliable Water Supply Act of 1996
- Proposition 12: Safe Neighborhood Parks, Clean Water, Clean Air, & Coastal Protection Bond Act of 2000
- Proposition 13: Safe Drinking Water, Clean Water, Watershed Protection, & Flood Protection Bond Act of 2000
- Proposition 40: Clean Water, Clean Air, Safe Neighborhood Parks & Coastal Protection Act of 2002
- Proposition 50: Water Security, Clean Drinking Water, Coastal, & Beach Protection Act of 2002
- Proposition 84: Safe Drinking Water, Water Quality & Supply, Flood Control, River & Coastal Protection Bond Act of 2006
- Proposition 1E: Disaster Preparedness & Flood Prevention Bond Act of 2006[183]

[183] California State Assembly Committee on Water, Parks, and Wildlife. 2013. Information on Previous Bonds for Water-Related Projects and Programs. Available at http://awpw.assembly.ca.gov/tablesofremainingbalancesfrompreviousbondsforwaterrelatedprojectsandprogramsinmillions

Water bonds allocate funds to a wide array of projects and programs related to water management. Projects have included: water storage and conveyance; ensuring safe drinking water through supporting treatment plants; groundwater cleanup or pollution prevention programs; watershed protection programs; urban and agricultural water use efficiency projects; and providing funding for Integrated Regional Water Management planning and implementation.

Water bonds can be an important source of funding for the outreach and assistance programs that we have discussed in this paper. This chapter presents an analysis of two recent bonds, Proposition 50 (2002) and Proposition 84 (2006), to understand how the money was allocated in the language of the propositions and how the funding has been spent on agricultural water stewardship projects, specifically outreach and technical assistance. From this analysis, Section 3.3 presents recommendations for the 2014 Water Bond to ensure adequate funding is allocated to on-farm agricultural water stewardship projects and the agencies that provide outreach and technical assistance to farmers.

8.1.1 Proposition 50 (2002)

Proposition 50 (Prop 50) was officially named the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002. In total, Prop 50 authorizes $3,440,000,000 in water related projects and programs with the goals of protecting the water supply, ensuring sufficient water for all users, and protecting the Bay-Delta area.[184]

Out of the numerous projects and the $3.4 billion, there are two funding pools that *could* be dedicated to agricultural stewardship projects, specifically outreach and technical assistance:

- Bay Delta Restoration: $180 million dedicated to "urban and agricultural water conservation, recycling, and other water use efficiency projects"

- Integrated Regional Water Management: $500 million dedicated to 10 priority areas, including the following which could include agricultural water stewardship projects:
    - Programs for water supply reliability, water conservation, and water use efficiency
    - Storm water capture, storage, treatment, and management
    - Groundwater recharge and management projects[185]

Prop 50 Water Use Efficiency Grants

The Department of Water Resource (DWR) has awarded four Prop 50 Water Use Efficiency (WUE) Grants since 2005 for both Urban and Agricultural WUE. Grant awards from 2005, 2007, 2008, and 2012 were analyzed to understand how funding for WUE is allocated across

[184] Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002. Available at http://www.waterboards.ca.gov/water_issues/programs/grants_loans/propositions/docs/prop50text.pdf
[185] Ibid

agricultural projects and how funding is divided between urban and agricultural water use efficiency.

Over the four funding cycles, $88.9 million was allocated to 223 projects. For Urban Grants, $52.30 million was allocated to 134 projects, whereas for Agricultural Grants, $36.60 million was allocated to 89 projects. This means that nearly 59% of the funding went to Urban Grants and 41% to Agricultural Grants (*Table 9*). Although Urban WUE projects are extremely important in managing California's water supply, taken together, these statistics indicate that urban projects are being prioritized over agricultural projects for Prop 50 funding. This may be a result of the language of Prop 50, which does not create separate funding streams for Urban and Agricultural WUE projects.

***Table 9*: Total Funding and Projects for Prop 50 WUE Grants Across Urban and Agricultural Projects**[186]

	Urban Grants		Agricultural Grants		Total Grants	
Grant Source	Funding (Million)	Number of Projects	Funding (Million)	Number of Projects	Funding (Million)	Number of Projects
2013 Prop 50	$0	0	$14.5	39	$14.5	39
2008 Prop 50	$17.2	53	$0	0	$17.2	53
2007 Prop 50	$18.2	35	$9.9	22	$28.1	57
2005 Prop 50	$16.9	46	$11.7	28	$28.6	74
Total	**$53.3**	**134**	**$36.6**	**89**	**$88.9**	**223**

Funding data within the Agricultural WUE grant program were analyzed to determine how funding has been allocated across project types. For each year, DWR separates Section A projects, which are "Implementation Projects," from Section B Projects, which are for some combination of Research, Studies, Demonstration, Outreach, Education, and Technical Assistance projects, depending on the year. Project descriptions were used to determine the *primary* focus of each project.[187][188] However, in 2007, DWR categorized projects in the final funding decisions.[189] DWR staff indicates that they do not have similar project categorization for 2005 or 2013.[190] It should be noted that implementation projects, and research, studies, and

[186]BenJamaa, F. PhD. 2013. Personal Communication. K. Lambert: Email Correspondence with Dr. Fethi BenJamaa, Chief, Agricultural Water Use Efficiency, California Department of Water Resources.
[187] California Department of Water Resources. 2013. Notice of Final Funding Decision, 2012 Agricultural Water Use Efficiency Proposal Solicitation. Available at http://www.water.ca.gov/wateruseefficiency/docs/Notice-Final_Funding_Awards-7-26-13_FINAL.PDF
[188] California Department of Water Resources. 2005. Table 6 Final Funding- Agricultural. Available at http://www.water.ca.gov/wateruseefficiency/docs/Table-6.pdf
[189] California Department of Water Resources. 2007. 2007 Proposition 50 Water Use Efficiency, Project Recommended for Funding-Final List. Available at http://www.water.ca.gov/wateruseefficiency/docs/2007-Prop50-FinalFunding.pdf
[190] BenJamaa, F. PhD. 2013. Personal Communication. K. Lambert: Email Correspondence with Dr. Fethi BenJamaa, Chief, Agricultural Water Use Efficiency, California Department of Water Resources.

demonstration projects may have outreach and education components that were not included in this analysis.

***Table 10*: Comparison of Grant Money Awarded by the Department of Water Resources to Agricultural Water Use Efficiency by Project Type**

Year	Outreach, Education, and Technical Assistance Funding (Million)	Research, Demonstration Sites, and Studies Funding (Million)	Implementation and Infrastructure Projects (Million)	Total (Million)
2012	$1.8	$2.7	$9.9	$14.4
2008	0	0	0	0
2007	$1.0	$1.0	$7.8	$9.8
2005	$0.22	$4.0	$7.5[191]	$11.7
Totals:	**$3.0**	**$7.7**	**$25.2**	**$35.9**

Results indicate that overall, nearly 70% of grant money has been allocated to Section A Implementation Projects, which are largely engineering and infrastructure projects such as canals, pumps, structures, and pipelines. It is estimated that about 8% was allocated to outreach, education, and technical assistance projects. Research and demonstration projects have received an estimated 22% of funding. It should be noted that spending on outreach, education, and technical assistance programs has increased substantially since 2005, from $223,000 to over $1.8 million (*Table 10)*.

Prop 50 IRWM Grants

The other source of potential funding from Prop 50 is the $500 million filtered through IRWM. There have been two rounds of funding for Prop 50 IRWM Implementation Grants. Together with the State Water Resources Control Board (SWRCB), DWR awarded $365 million in 2005 and 2006 combined.[192] There were 20 applications with 120 IRWM projects that were funded over the two years for both urban and agricultural grants.[193] DWR staff indicates that they are in the process of gathering and making available details of these grants and funding amounts.[194] DWR was able to provide a table with project descriptions for all 120 funded IRWM projects. Based off of the available data and project descriptions, only two of the funded projects include outreach or technical assistance for farmers:

[191] California Department of Water Resources. 2005. Table 5- Final Funding for Agricultural. Available at http://www.water.ca.gov/wateruseefficiency/docs/Table-5.pdf
[192] California Department of Water Resources. 2010. Proposition 50 IRWM Round 1 & 2 Implementation Grant Awards (2005-2006).
[193] California Department of Water Resources. 2013. List of Awarded Projects, Proposition 50, Rounds 1 & 2 Implementation Grants.
[194] Eusuff, M. 2013. Personal Communication. K. Lambert: Email Correspondence with Muzaffar Eusuff, Financial Assistance Branch, Division of Integrated Regional Water Management, Department of Water Resources.

- San Diego County Water Authority: Implementation of Integrated Landscape and Agricultural Efficiency Program. Program provides agricultural audits for irrigation, as well as urban audits. Funding amount: $2 million

- San Luis and Delta Mendota Water Authority: Irrigation Improvements. Project installs high efficiency irrigation systems and converts furrow irrigation to sprinkler or drip. Funding amount: unknown.[195]

Analysis of the available data for Prop 50 IRWM grant awards indicates that, overwhelmingly, funding was allocated to engineering and infrastructure projects.

8.1.2 Proposition 84 (2006)

Proposition 84 (Prop 84) was passed in 2006 as The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act, and awarded $5,388,000,000 across all of its projects and programs. Prop 84 does not specifically mention agricultural water use efficiency or stewardship. However, there is a total of $1 billion dedicated across 11 IRWMP priority areas, including "Water supply reliability, water conservation, and water use efficiency."[196] As already discussed in the context of Prop 50, channeling funds for agricultural water use efficiency through IRWM is problematic.

There have been two rounds of funding for Prop 84 IRWM Implementation Grants. One was completed in 2011, with DWR distributing $204 million.[197] Round 2 Final Funding decisions were released on February 4, 2014 in the amount of $131 million.[198]DWR staff has not categorized these grant awards by project type, but analysis of project descriptions indicate that in 2011, out of the $204 million, only 3 projects were *primarily* focused on outreach and technical assistance for on-farm water stewardship.

- County of Humboldt: Del Norte Agricultural Enhancement Program: Provides financial assistance to dairy farmers for water stewardship: $250,000 awarded

- Rancho California Water District: Agricultural Irrigation Efficiency Program: Provides assistance for adoption of new technologies, with the goal of reducing water use by 2,115

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[195] California Department of Water Resources. 2013. List of Awarded Projects, Proposition 50, Rounds 1 & 2 Implementation Grants.
[196] The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006. Available at http://bondaccountability.resources.ca.gov/P84Text.aspx
[197] California Department of Water Resources. 2011. Final Awards for Round 1 Implementation Grants, Proposition 84, Chapter 2, Integrated Regional Water Management. Available at http://www.water.ca.gov/irwm/grants/docs/Archives/Prop84/Awards/Round1Imp/FinalP84ImplementationR1Award080511.pdf
[198]California Department of Water Resources. 2014. Final Awards Proposition 84 Round 2 Implementation Grant, February 4th, 2014. Available at http://www.water.ca.gov/irwm/grants/docs/ImplementationGrants/FinalAwardP84Rnd2IG_2014_0204.pdf

acre-feet per year and reaching 2,000 acres of farmland. Requested $967,320, application only funded at 50%.

- Semitropic Water Storage District: On-Farm Mobile Lab, Water Use Efficiency Services. Expands current mobile lab program. Requested $300,240, application only funded at 64%.[199]

Analysis of the Final Funding Recommendations released in 2013 for Prop 84 Implementation grants presents a similar story. Based on project descriptions, only two projects are *primarily* focused towards outreach and technical assistance to farmers. Together, these two projects have requested $615,000 or about 0.46% of the total funding for the Round Two Implementation Grants.

- San Benito County Water District: Pajaro Agricultural Water Quality and Aquifer Enhancement Project. This would provide outreach and mobile irrigation lab services: $425,000

- County of Humboldt: California Land Stewardship Initiative, Fish Friendly Farming and Fish Friendly Ranching Environmental Certification in the Russian River, Navarro, and Gualala River Watersheds. Provides assistance with on-farm water conservation and water use efficiency, among other tools, to protect water ways: $190,000 [200]

The analysis of Round 1 and Round 2 of Prop 84 Implementation Grants indicate that an insignificant amount of funding is being directed towards outreach and technical assistance programs for on-farm water stewardship. This is likely due to a lack of agricultural water stewardship projects in IRWMPs or the low priority given to them by the agencies leading the IRWMPs.

8.1.3 2014 Water Bond

The California Assembly and the Senate are currently debating 2014 Water Bond Legislation for the November 2014 ballot. New water bond legislation offers the opportunity to direct money to the outreach, education, and technical assistance programs outlined in this paper, as well as to fund new programs to support on-farm water stewardship. The funding from the 2014 Water Bond could be used to support staffing, resources, and build the capacity of university programs and non-governmental organizations reviewed for this paper, and to provide direct technical assistance to farmers.

Water management does require investment across project types. Engineering projects to update irrigation districts to allow for flexible on-demand water delivery allows for farmers to use pressurized systems with new on-farm water stewardship methods, and research projects develop and inform BMPs. However, the emphasis on water infrastructure and engineering projects to the

[199] Information can be found at: http://www.water.ca.gov/irwm/grants/archive.cfm
[200] Information can be found at: http://www.water.ca.gov/irwm/grants/implementation.cfm

detriment of outreach, education, and assistance projects is too narrow a view of water management in California.

It is clear from the analysis of Prop 50 and Prop 84 spending that in order to fund on-farm water stewardship projects, clear language to direct funding to these projects is needed, otherwise, funding is overwhelming allocated to urban projects and agricultural water supply and infrastructure projects. Bond investors view these projects as able to guarantee water savings over a sustained period of at least 30 years, and it is difficult to quantify or guarantee water savings from on-farm water stewardship projects; it is only through collective adoption that these measures are able to result in significant water savings. However, as the NRCS/BoR collaborative projects that we discussed in Chapter 6 indicate, the water savings from on-farm stewardship practices are real and significant.

To reflect the importance of on-farm education, outreach, and technical assistance, as well as holistic water management, the 2014 California water bond should include funding for farmer outreach, education and assistance programs for on-farm water use best management practices. We recommend that $200 million be specifically dedicated to these projects. Despite demand, technical assistance programs for on-farm water management practices remain dismally under-funded. Important research is not making its way into implementation and water savings on most of the farms and ranches of California. The 2014 Water Bond should balance its approach to agricultural water use efficiency by combining infrastructure upgrades with support for farm-level BMPs and information dissemination to achieve the most lasting efficiency gains across farm scales.

8.2 California Cap-and-Trade Funding

In addition to water bond funding, state-level on-farm water stewardship programs could be funded, in part, with California cap-and-trade revenue. These funds could be used to set up a competitive grants program for third-party assistance programs and direct assistance to farmers. Currently, in a promising development, the California Department of Food and Agriculture (CDFA) is launching a Water Efficiency and Enhancement Program, a grants program that will provide drought emergency funds to farmers in the summer of 2014.

The CDFA's Water Efficiency and Enhancement Program is funded with $10 million from Governor Brown's drought legislation (SB 103). This funding is meant to provide direct assistance in the form of grants to farmers to implement water conservation and energy saving technologies on-farm. Preliminary program recommendations show an emphasis on irrigation technology and system upgrades—as such systems can result in immediately quantifiable water savings and practices that can be implemented over the 2014 growing season—but not the holistic management practices that are necessary for complete on-farm water stewardship. The program is slated to begin accepting grant applications on July 1st, 2014.[201] Because this program is intended to provide emergency drought funding, the timeline for implementation and

[201] Ross, K. 2014. Personal Communication. K. Lambert. In person meeting with Karen Ross, California Secretary of Food and Agriculture.

the total funding pool is inadequate to fully address statewide on-farm water resource concerns. However, with a longer time frame and additional funding for direct assistance to growers and for third-party assistance, the Water Efficiency and Enhancement Program could be expanded to provide competitive grants to support holistic on-farm stewardship practices and long-term management practices.

Sustained and long term funding for an expanded Water Efficiency and Enhancement Program could come from the California carbon cap-and-trade program that was established by the California Global Warming Solutions Act of 2006 (AB 32). The revenue generated from the quarterly auctions of carbon allowances, held in the Greenhouse Gas Reduction Fund (GGRF), has been budgeted to support reductions in greenhouse gas (GHG) emissions and avoid the impacts of climate change. Further, Governor Brown's three-year investment plan for the cap-and–trade funds (AB 1532) that was passed in 2012, made sustainable agriculture an eligible category to receive cap-and-trade funds. The California Legislature is currently debating the 2014-2015 budget, which includes spending decisions for $850 million that has already been collected from the cap-and-trade program.[202]

Some allocations from the GGRF could be used to support competitive grants through an expanded Water Efficiency and Enhancement Program, as these projects reduce GHG emissions as well as water use. Improved irrigation efficiency reduces applied water, energy use, and the GHG emissions associated with irrigation pumping. The reduction in irrigation frequency reduces nitrous oxide emissions associated with applied irrigation. For these reasons, cap-and-trade funds are well suited to provide support for on-farm water stewardship, and these funds could also provide a reliable source of funding for a grant program, as funds are raised each quarter through the auctions of carbon allowances.

8.3 Agricultural Water Management Council[203]

The Agricultural Water Management Council (AWMC), the state's efficient water management collaboration mandated by AB 3616 (1990)[204], was originally proposed in the legislation as an advisory group to DWR—a collaborative forum where DWR, the California Department of Food and Agriculture (CDFA), the universities, farm organizations, irrigation districts, and other interested parties including environmentalists could meet to discuss how to move forward on implementing water stewardship practices in all irrigation districts and all farms in the state. Coming on the heels of a serious drought, there was pressure on agriculture to use water more efficiently.

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[202] Merrill, J. 2014. State Legislature Debates First-Ever Climate Investments. Available at http://calclimateag.org/state-legislature-debates-first-ever-climate-change-investments/

[203] Information regarding the AWMC is based on Dave Runsten's observations from participating in the AWMC; on Juliet Christian-Smith's 2013 draft report prepared for the Roundtable on Water and Food Supply entitled "Collaborative Governance Approaches to Agricultural Water Stewardship: Lessons Learned from the Agricultural Water Management Council;" and on Roger L Reynolds and Tracy Slavin, "MOU on Efficient Water Management Practices by California Agricultural Water Suppliers—Can it Work?" in "Competing interests in water resources -- searching for consensus, Proceedings from the USCID Water Management Conference." USCID, December 1996.

[204] The AWMC was set up pursuant to AB 3616, the Agricultural Water Suppliers Efficient Water Management Practices Act.

Instead of DWR forming a broad advisory group, a lengthy negotiation ensued where the Farm Water Coalition—a representative of large agricultural water users—convened a series of workshops around the state to define just what agricultural interests were willing to do. An MOU was finally signed in 1998 by 50 organizations committing agricultural water suppliers to 17 "efficient water management practices…directed toward district-level water management activities that improve water conveyance and distribution."[205] The districts were to voluntarily write Agricultural Water Management Plans every five years. The Farm Water Coalition was put in charge of the AWMC.

However, the MOU also explicitly listed limitations on what issues could be considered by the group. They were *not* to address on-farm water management, land conversion, land retirement, crop selection or groundwater production. Also in the course of developing the AWMC, it turned into an "environmental groups" vs. "agriculture" forum, where the water suppliers constituted one voting group, the environmental organizations another, and everyone else was relegated to non-voting status. This discouraged participation by other farm organizations and the universities. The environmental groups mostly dropped out, focusing instead on CalFed and complaining that the Farm Water Coalition was not a neutral administrator of the AWMC. With the 2009 water legislation mandating many of the voluntary measures that the AWMC had supported, the AWMC was no longer seen as important by the water districts and it was disbanded in 2013. This provides DWR with another opportunity to create a forum where all issues related to agricultural water can be discussed, including on-farm water management, since the requirement from AB 3616 for such a group still exists. A more neutral convener would be a useful change as well.

[205] Agricultural Water Management Council, *Efficient Water Management: Irrigation District Achievements*, Sacramento.

Chapter 9. Conclusion

The result of the analyses presented in this paper is clear: current programs and state and federal funding streams have been unable to support the widespread adoption of on-farm water stewardship best management practices in California. Large farmers in the dryer regions of the state have adopted many sophisticated water efficiency technologies, but this is not true for most farms. Due to water quantity, quality, and climate change concerns, there is a critical need for the adoption of such practices. Our analysis found that:

Non-governmental organizations (NGOs) are understaffed and underfunded, unable to meet the demand for assistance from farmers across California. Resource Conservation Districts, for example, have lost regular base funding and cite limited and dwindling resources, as well as the need for additional staff and training, as hampering their ability to provide outreach and assistance to farmers. In the 1990s, DWR stopped regular funding for the on-farm irrigation assessment program known as the Mobile Irrigation Labs (MILs), forcing some RCDs to discontinue their program or reduce the number of on-farm assessments, so that only 19 RCDs now operate MILs. Other NGOs vary in their level of funding and outreach abilities, but as a whole, these organizations do not have the capacity to provide the resource intensive assistance required by farmers, relying on unpredictable funding from federal and state governments or private foundations.

University programs provide a wealth of information and research on water stewardship practices, but more funding needs to be made available for outreach and education to disseminate information to farmers. For example, the University of California Cooperative Extension (UCCE) budget cuts forced staff levels in 2010 to only 200 on-farm advisors, down 40% from 1990s staff levels. UCCE staff indicate that with more funding they could provide additional on-farm workshops and educational materials. Universities in California have produced information on crop water requirements, developed the Mobile Irrigation Labs, and created a network of over 120 automated weather stations used for irrigation scheduling. However, many farmers are unable to access or capitalize on these incredible resources without sufficient funding for outreach and education to provide them with the knowledge to use such resources.

Private Industry provides innovative technologies for farmers, but services are often cost prohibitive for smaller farmers. Private irrigation companies vary in the services and products that they provide, and the industry plays an important role in promoting on-farm water stewardship through developing and selling innovative technologies. But the most efficient and sophisticated technologies and consulting services are often the most expensive, and smaller farmers often find it financially prohibitive to purchase such technologies or hire consultants. To ensure equitable access to on-farm water stewardship technologies and practices, more investment in outreach and assistance programs from the government, universities and non-profits on BMPs and low cost technologies is necessary.

Through the Environmental Quality Incentives Program (EQIP), the USDA Natural Resources Conservation Service (NRCS) prioritizes equipment and system upgrades and underfunds best management practices. From 2002-2010, nearly $141 million was spent on

equipment and system upgrades under EQIP's water conservation practice codes in California, while only $21 million was spent on BMPs such as cover cropping and mulching. Although replacing less efficient equipment with more efficient systems is an important step in on-farm water stewardship, a new system alone does not guarantee water savings. Due to funding cuts for technical assistance, NRCS offices are understaffed and unable to provide farmers with the assistance they would like to complete holistic water management plans to complement new irrigations systems. NRCS recognizes this concern and is working to remedy it. More federal funding to increase staff capacity is necessary.

The NRCS and the Federal Bureau of Reclamation (BoR) have joined in a program that can serve as a model for California investment in irrigation districts and their farmers. Since 2011, BoR has been providing funding for infrastructure upgrades at the water purveyor or Irrigation District level. NRCS has been working to provide technical and financial assistance through EQIP to farmers in Irrigation Districts to complement BoRs upgrades. Together, these projects have increased on-farm water use efficiency by an average of 25%, and the seven water districts have saved 38,223 acre-feet of water per year. A comparable state program needs to be implemented to realize similar savings in districts that do not receive federal water.

Analysis of 12 Integrated Regional Water Management Plans (IRWMPs) in areas with significant irrigated agriculture indicated that agricultural water stewardship projects are not prioritized. There is a disconnect between the inclusion of agricultural water stewardship projects in IRWMPs and the proportion of irrigated agriculture in a region. In order to increase the inclusion of agricultural water stewardship projects in IRWMP and to direct bond funding to such projects:

- IRWMP planning and implementation statutes and bond funding requirements need to be strengthened to require the inclusion of feasible agricultural water stewardship strategies in proportion to the degree to which agricultural activity impacts water supply.

- The direct participation of agricultural stakeholders in IRWMP planning at the regional and state level needs to be increased.

California Water Bonds present an opportunity to provide funding to agricultural water stewardship outreach, education, and assistance programs; CAFF recommends that $200 million be allocated to such projects in the 2014 Water Bond. Previous water bonds have failed to adequately fund outreach and assistance programs; only an estimated 8% of DWR's Proposition 50 (2002) Agricultural Water Use Efficiency grants supported such projects. In the 2014 water bond, $200 million should be allocated specifically to support on-farm water stewardship programs and provide direct assistance to farmers.

California cap-and-trade proceeds should be used to fund an on-going competitive grants program for on-farm water stewardship project and direct assistance to growers. CDFA's current Water Efficiency and Enhancement Program provides grants for the installation of efficient irrigation systems and evaluations in 2014. This program could be expanded with additional funding to provide competitive grants for direct farmer assistance and third-party technical assistance to support long-term holistic water management practices. Sustained funding

for this program could come from the Greenhouse Gas Reduction Fund (GGRF), as water stewardship projects reduce GHG emissions and water use associated with irrigation applications and pumping.

Providing outreach, education, and technical assistance will increase the adoption of on-farm water stewardship practices and will result in immediate individual water savings, enhance the resiliency and self-sufficiency of California farmers to drought and an uncertain future water supply, and protect the current and future quality and quantity of the state's water. However, the programs that provide these services are unable to meet the need for outreach due to funding constraints. For these reasons, it is in the public interest that the state and federal governments increase their financial investment in these programs.