



# From the Field: **BOOSTING AGRICULTURAL PRODUCTION THROUGH WATER USE EFFICIENCY**

*Highlights from Western SARE's Project Portfolio*



**Water will be more important than oil this century.**

– Former United Nations Secretary General Boutros Boutros-Ghali

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Water's immeasurable value is not lost on Western producers. Farmers and ranchers throughout the West confront limited water supplies due to long-standing semi-arid and arid agro-climatic conditions, severe drought, over allocation, and increased competition from non-agricultural users. They also contend with rising numbers of policies and regulations and the need to manage for the protection of threatened and endangered species. To maintain profitability and yields, producers are looking to alternative irrigation methods or switching to low water-use crops. Water policy experts and producers together must review how current water policy might be revised to enhance agricultural water sustainability. Effective policies, along with proven Best Management Practices, will be required for agriculture to remain economically viable in a region facing further water scarcity over time.

Research presented at the American Geophysical Union Fall meeting in 2013 said the west has possibly been in a mega-drought for the past 13 years, and the likelihood is high that this century could see a multi-decade dry spell like nothing else seen over the past 1,000 years. Climate change further exacerbates the West's drought conditions and water uncertainty. Addressing climate change, the USDA states "today's climate is an important driver of current conservation program outcomes. Perhaps in no aspect of climate is this influence greater than in the risk of drought."

Western SARE has played a key role in addressing the water research needs of our region's farmers and ranchers by funding high quality research conducted in collaboration with producers. This publication highlights five Western SARE-funded initiatives in the areas of low water use crops, partial root zone drying techniques, efficient water use technologies, and linking farmer-friendly water use efficiency programs to achieve state water policy goals.

# PROJECT HIGHLIGHTS

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## Economic Evaluation of Alternative (low-water use) Crops for the Great Basin

EW09-007

Carol Bishop

### The Challenge

Farmers and ranchers in the Great Basin of the western region confront difficulty in remaining profitable with less water, as more water is allocated to residential, municipal, and industrial uses. Walker Lake in northern Nevada is one example. In the last one hundred and fifty years, water has been diverted from the lake's inflows for irrigation purposes at five major agricultural areas along

the tributary rivers. Results from these diversions include drops in lake level and increases in lake salinity. These outcomes are reducing the habitat and populations of various threatened and endangered species, as well as recreational uses of the lake. Agricultural water rights have been over allocated in the Walker River Basin. According to Carol Bishop, Extension Educator with the University of Nevada Cooperative

Extension, policies that have been used in arid climates in the west to enforce water conservation on agricultural producers utilizing irrigation are not always effective. Changes in water management are an alternative to imposing policy such as laws and taxes. To address these problems, producers can reduce the amounts of water applied to crops, change water delivery methods, or switch to alternative crops that use less water.

### Searching for a Solution

Bishop created the Western SARE Professional Development Program project Economic Evaluation of Alternative (low-water use) Crops for the Great Basin (EW09-007) to:

“Educate producers with pertinent information about alternative low-water-use crops and the associated decision-making tools developed to implement them.”

She anticipated disseminating the information through seminars, with all major learning methods covered, for ag professionals. The goal was that by the end of the project program participants would have increased knowledge and skills regarding sustainable

agriculture, as well as an enhanced ability to effectively deliver knowledge and skills to farmers and ranchers.

#### The project's objectives were for the participants to:

- Understand the economic, political, and environmental benefits of reducing water use in agriculture
- Understand the basic agronomy of alternative crops available to producers in the Great Basin
- Understand the components of evaluating the economic feasibility of low water use crops
- Have the ability to use the IRRIG-AID spreadsheet

- Create plans to introduce seminar curriculum and other SARE resources into producer programming
- Work one-on-one with producers to evaluate the economic feasibility of alternative low water use crops on their farm/ranch





- Have the ability to provide an overview of the benefits of utilizing the IRRIG-AID spreadsheet tool and demonstrate its use to producers
- Assist agricultural producers in implementing low water use crops on their farm/ranch
- Assist producers with the measurement of changes in water use and resulting environmental improvements such as water and soil quality
- Assist producers with the measurement of changes in profitability and economic sustainability of alternative crop use

Bishop and her team created a handbook of the curricula, a user manual for IRRIG-AID, and a CD containing the IRRIG-AID spreadsheet, copies of the PowerPoint presentations for the five modules, and a document with links to all websites cited in the curricula and links to further assistance. These were distributed to all participating educators. Workshops were held in various locations and were conducted by video in addition to the in-person workshops.

## What was Learned

### *According to Bishop:*

Ninety-seven percent of workshop attendees would attend future workshops on agricultural water management and/or alternative crops. On a scale of 1 to 5, the average rating for curriculum content was 3.84. The average increase in knowledge gained over all curriculum subjects was 44%.

Of those responding to the six month follow-up survey, 43% have introduced workshop curriculum and other SARE resources into producer programming, 39% have worked one-on-one with producers to evaluate the economic feasibility of alternative low water use crops on their farm/ranch, 35% assisted agricultural producers in implementing low water use crops on their farm/ranch, 35% assisted producers with the measurement of changes in water use and resulting environmental improvements such as water and soil quality, 35% assisted producers with the measurement of changes in profitability and economic sustainability of alternative crop use, and 82% have incorporated some of the material presented in the workshop into their operation/job



During the project, 1,250 copies of the curriculum were distributed. Eighty-six ag professionals participated in the project's official workshops. In addition, program summaries and posters were presented at events for educators, USDA agencies, private businesses, among other audiences.



## Impacts

The *Evaluating Alternative Low-Water-Use Crops for the Great Basin curriculum* was selected as a national communication award finalist for a bound book by the National Association of County Agricultural Agents.

## Testimonials from participants include:

*"I am better prepared to answer questions from producers and provide educational programs to help producers with water deficits."*

*"I am more knowledgeable about alternative crops that may be planted instead of alfalfa in low water years and how they may fit into FSA programs."*

*"The course helped me with crop selection and pricing."*

*"Alternative low H<sub>2</sub>O use crops will strongly be considered for my alfalfa operation."*

*"I can help to implement growing crops to use less water through pipes, sprinklers, and drip, depending on the crop."*



## Post-projects Activities and Impacts

Since the completion of her project, there has been such high demand for the curriculum that Bishop published another 250 copies. The continuing severe drought has created the high demand. Additional CDs have been distributed at regional workshops, especially those sponsored by beginning farmer/rancher and risk management programs, and on reservations in multiple states. The information has proven to be very useful. To reach out to even more ag professionals and producers the publications have been posted to the University of Nevada's Extension page on "Living with Drought." Spin-off products include more fact sheets,

such as determining profitability. Bishop is assisting with a \$4.5 million USDA-NIFA project, led by Staci Emm, entitled "Native Waters on Arid Lands" which brings together scientists, 1862 and 1994 land-grant institutions, and tribal communities of Great Basin and Southwest to address agricultural water challenges. All of these efforts have helped lead to an increasing amount of low water use crops being planted in place of higher water use crops, such as alfalfa, especially in northern Nevada.



## Where to Learn More

### Annual and Final Reports in SARE Database:

[mysare.sare.org/mySARE/ProjectReport.aspx?do=viewProject&pn=EW09-007](https://mysare.sare.org/mySARE/ProjectReport.aspx?do=viewProject&pn=EW09-007)

### Living with Drought Website:

[unce.unr.edu/programs/sites/drought/crops/](https://unce.unr.edu/programs/sites/drought/crops/)

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# PROJECT HIGHLIGHTS

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## Irrigation Alternatives for Sustainable Water Use of Processing Tomatoes

GW10-010

Felipe Barrios-Masias

### The Challenge

Agriculture in California uses at least 75% of the state's water supply. Furrow irrigation is the principal irrigation method in California. About 80% of tomato fields were furrow irrigated in 2010, and it was the largest cost of field operations before harvest in processing tomato production. University of California at Davis

graduate student Felipe Barrios-Masias saw promise in alternative irrigation methods that could use less water but still produce high yields, leading to increased agricultural sustainability and efficiency. One method is partial root drying (PRD). According to Barrios-Masias at the time he received his Western SARE

graduate student grant for Irrigation Alternatives for Sustainable Water Use of Processing Tomatoes (GW10-010), information was available on general crop physiological responses to the PRD technique, but strategies for reliable management needed to be tested for individual crops.

### Searching for a Solution

To improve crop water economy, this project looked at using the PRD technique to reduce the amount of water supplied and increase crop water use efficiency (yield/water applied) on tomatoes. The trials evaluated yield and cultivar response to alternate furrow irrigation (one furrow of a bed received water at each irrigation to every furrow irrigation).

#### The project's specific objectives were to:

- Conduct an on-farm case study to obtain data on a typical soil water budget and cultivar responses with alternate furrow irrigation
- Evaluate water use and physiological, phenological,

and morphological responses of different processing tomato cultivars to controlled full or alternate furrow irrigation regimes

- Increase understanding of PRD and alternate furrow irrigation management among producers as means of reducing total applied water, potential pollution, and production costs

Campbell Research and Development was a project collaborator and they, along with the Jackson Lab at UCD, assisted Barrios-Masias in outreach to producers. Field trials were held at the Campbell Research and Development Station and also on four farms in adjacent fields with three different field types.



### What Was Learned

Barrios-Masias was pleased with the results, saying he was surprised by how much reduction in water use they saw. The solid data demonstrated that higher water use efficiency is possible with water use reductions of at least 25% in on-farm trials, with no effect on yields and fruit quality. This reduction could help keep ag land in production providing food for people, especially in drought years.

## What Was Learned (Contd.)

Some tomato growers were previously using the irrigation technique to manage disease.

Barrios-Masias presented the results from his project at tomato growers' meetings to good reception.

## Post-project Activities and Impacts

Barrios-Masias and major professor Louise Jackson say that due to the potential shown by the research results and the data collected, they were able to leverage the funds in the form of a specialty crop grant and expand to do more research.

Right after the project's completion, most growers did not think they had to implement the practice in regard to

water use as they had access to water. However, now that California is facing a severe drought, with the data they have a choice; they can choose to plant less area or reduce their water use.

According to Jackson, "there was more use of alternate furrow irrigation last summer on furrow irrigated fields."

Processing tomatoes are even more on drip irrigation than before. The Executive Director of the California Tomato Research Institute, Chuck Rivara, estimates 85% of 288,000 acres of processing tomatoes is drip irrigated and inching higher all the time. SureHarvest provides the same estimate. One challenge to additional acreage using drip irrigation is the high cost of infrastructure that growers leasing land do not want to invest in if they do not own the land.



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## Where to Learn More

### Annual and Final Reports in SARE Database:

[mysare.sare.org/mySARE/ProjectReport.aspx?do=viewProj&pn=GW10-010](https://mysare.sare.org/mySARE/ProjectReport.aspx?do=viewProj&pn=GW10-010)

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### Research Lab's Website:

[http://ucanr.org/sites/Jackson\\_Lab/](http://ucanr.org/sites/Jackson_Lab/)





# PROJECT HIGHLIGHTS



## **Agriculture, Water, and Institutions: An Investigation of Water Management Policy and its Effects on Water Use by Agriculture in Arizona**

GW10-015

Haley Paul

### **The Challenge**

With limited supplies of water and increasing populations, communities face challenges in effectively managing water resources. The design of policies, regulations, and rules is one of these challenges. An example of regional water policy is the 1980 Groundwater Management Act (GMA) in central Arizona, designed to reduce groundwater overdraft.

The GMA included restrictions on irrigated agriculture in the five Active Management Areas (AMAs), which are managed groundwater areas. Haley Paul, graduate student at Arizona State University, was curious about how farmers in these AMAs make water use decisions and what consequences the GMA had for agricultural water conservation and

the viability of farming in the central Arizona desert. She wrote, “as demand rises for water in central Arizona, examining the rules pertaining to groundwater management allows for better insight to the incentives that either promote or impede water efficiency in irrigated agriculture.”

### **Searching for a Solution**

In her Western SARE-funded graduate student project, Agriculture, Water, and Institutions: An Investigation of Water Management Policy and its Effects on Water Use by Agriculture in Arizona (GW10-015), Paul analyzed the rules and components of the GMA and interviewed six farmers and eight water policy professionals with the intent to provide an initial policy recommendation on how current water policy might be revised to enhance agricultural water sustainability in central Arizona. She aimed to bridge the divide between regulators and farmers by interviewing both.

#### **The project’s objectives were to:**

- Develop a greater understanding of the GMA and its ensuing modifications on the decision-making of local farmers with rights to pump groundwater in the Phoenix and Pinal AMAs, all in the face of water scarcity and urbanization pressures
- Develop a list of strategies based off of interviews with farmers, as well as water policy professionals, concerning what they believe would encourage more efficient water use on farms
- Communicate and disseminate

the data with stakeholders in the water policy and agricultural communities

- Describe the back-and-forth struggle to implement and solidify specific institutions designed to reduce agricultural water use in AMAs





## What Was Learned

One finding from the analysis was the indication that there was not enough time to include farmers' knowledge about water efficiency into the writing of the GMA. Thus, farmers fought against the GMA's regulations. By the end of her project, Paul created an analysis of the GMA with specific suggestions on ways to boost water conservation on farms – suggestions gained from the interviews with farmers.

### Recommendations include:

- Recognition by NRCS of the temporary nature of farming in central Arizona. By recognizing that farmers move around the area and farm different plots of land depending on their specific situation, the NRCS could adjust their requirement necessitating proof of land tenure to receive funding for water conservation improvements. This would allow more farmers who are leasing land the opportunity to participate in NRCS grants and other opportunities.
- With such short time horizons and uncertainty about the duration that one will be farming due to temporary leases, investment in water savings technologies decreases. With greater access to incentives to install efficient irrigation systems, a farmer could recoup his or her investment faster and be more likely to invest in water saving technologies on the farm.
- An increased presence of the USDA's Environmental Quality Incentives Program (EQIP) in Arizona.
- Promote the leasing of portable irrigation systems, such as sprinklers and drip. By leasing portable water-savings technologies, farmers who do not want to purchase a permanent physical structure, because they are unsure of the duration that they will be farming on a specific plot of land, have another way of accessing efficient irrigation technologies.
- Continue to provide state tax credit opportunities for water conservation.
- Continue to promote and make farmers aware of the assistance from ADWR that is available to them.
- Increase farmer education.
- Although there would be implications on the economics of farming, raising the price of water would induce significant water savings on farms because if something is more expensive, people tend to use less.



## Post-project Activities and Impacts

Dr. Hallie Eakin, Associate Professor and Senior Sustainability Scientist at Arizona State University's School of Sustainability, states that Paul's project has spawned a productive area of research in the Phoenix area in collaboration with the University of Arizona Maricopa County Extension Service and with the Decision Center for a Desert City (Arizona State

University). The Decision Center for a Desert City is "conducting climate, water, and decision research and developing innovative tools to bridge the boundary between scientists and decision makers and put our work into the hands of those whose concern is for the sustainable future of Greater Phoenix." Activities looking at the agriculture-urban nexus are planned for 2015-16.



## Where to Learn More

### Annual and Final Reports in SARE Database:

[mysare.sare.org/mySARE/ProjectReport.aspx?do=viewProj&pn=GW10-015](https://mysare.sare.org/mySARE/ProjectReport.aspx?do=viewProj&pn=GW10-015)

### Policy Brief, Decision Center for a Desert City:

[azfarmersurvey.wordpress.com/](http://azfarmersurvey.wordpress.com/)

### Extension Fact Sheet, Technical assistance Programs for Agricultural Irrigation Improvements in Arizona

[extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1583.pdf](http://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1583.pdf)

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# PROJECT HIGHLIGHTS

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## Water Management in Sonoma County Grape Production

OW12-008

Karen Thomas

### The Challenge

As in all of California, water is a scarce resource in Sonoma County, a region in Northern California with more than 400 wineries and almost 60,000 acres of vineyards. Wine grape growers face increasing competition for

water from different interests, various regulations, and a need to protect threatened and endangered salmonids found in the local watershed. To meet these challenges, producers must improve their water use efficiency for

both frost protection and irrigation. If they can do so, they would be able to maintain grape production while at the same time minimizing impacts on stream flows critical to salmonid survival. The use of water

## The Challenge (Contd.)

for frost protection and seasonal irrigation specifically in vineyards has come under scrutiny by California's State Water Resources Control Board and the National Marine Fisheries. According to Karen Thomas of the Sonoma County Winegrape Commission, their regional wine grape growers needed "information on alternatives to frost protection using overhead sprinklers, on irrigation management strategies to reduce water use, and on Best Management Practices for water conservation when frost protecting and irrigating grape vines." In order to provide this information, Thomas designed the Western SARE Professional + Producer project *Water Management in Sonoma County Grape Production* (OW12-008).

## Searching for a Solution

To meet growers' needs, Thomas' project included a spring frost workshop along with other outreach and aimed to give guidance for the best decision-making for frost protection. The team worked with producers to fine-tune their irrigation scheduling and duration based on soil and plant water status data, vine observations, and overall strategies for wine grape production. Soil and plant moisture status were measured at vineyard sites, giving producers exposure to the technologies. The demonstration plots were located on two sites with very different soils. The team applied

different irrigation regimes to different blocks and made commercial-scale wines from each block to compare to one another in tastings. The project team shared the demonstration results through workshops and field days, newsletter articles, and on the Sonoma County Winegrape Commission's website.



Photo: Rhonda Smith

## What was Learned

According to Thomas, the project "demonstrated a water management technique for drip irrigation that relies on measurement, both of soil moisture and plant moisture status. The above and below ground measurements provide an excellent picture of the soil moisture dynamics of the vineyard. This gives us the confidence to push our vines further into levels of controlled stress that have benefits well beyond that of water conservation. It also allows us to produce riper fruit at lower brix while preventing excessive stress that could lead to reduced vineyard

productivity and lower yields... The irrigation management demonstrations produced dramatic results. Plant and soil water status measurements resulted in delayed irrigation initiation compared to standard practices in both demonstration vineyards. Then, irrigation frequency and duration were optimized to minimize irrigation water

movement beyond the active root zone. The total irrigation water supplied in the two years was 8% to 32% of crop ET at the Red Fan vineyard and 11% to 24% of crop ET at the Landslide vineyard. Those percentages are below typical deficit irrigation targets of 60% or more using crop ET models to manage irrigation."

## Impacts

Thomas maintains that Sonoma County growers have increased adoption of frost protection

BMPs and use of weather station data to improve accurate decision making about frost protection.

Three frost/drought workshops were held and one Water Conservation Field Day event. These events were attended by 477 producers and partners. A survey following the Water Field Day indicated a number of producers will change practices or investigate wind machines as an alternative frost protection method. All respondents indicated they would change practices based upon the irrigation management presentation.



## Post-projects Activities and Impacts

By sticking with good science and best practices, the Sonoma County Winegrape Commission is assisting producers meet the challenges provided by both Mother Nature and the politics surrounding an endangered species in a region with increasing urban-ag interface. According to

Thomas, the area's wine grape growers continue to adopt the project's recommended practices. Because of the on-going drought in California and the need to minimize impacts to an endangered species, producers affirm the importance of changing practices in favor of greater water efficiency. To that end, the Sonoma County Winegrape Commission continues to

sponsor frost protection and irrigation workshops that remind them of the recommended practices and keep them motivated toward making changes. Importantly, they have been able to demonstrate to producers that saving water saves money.

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## Where to Learn More

### Annual and Final Reports in SARE Database:

[mysare.sare.org/  
mySARE/ProjectReport.  
aspx?do=viewProj&pn=OW12-008](http://mysare.sare.org/mySARE/ProjectReport.aspx?do=viewProj&pn=OW12-008)

### Sonoma County Winegrape Commission Sustainability website:

[sonomawinegrape.org/  
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## WATER: THE FOUNDATION OF AGRICULTURAL SUSTAINABILITY CONFERENCE

Because water scarcity is one of the most urgent challenges confronting farmers and ranchers in the southwestern United States today, the Western SARE Professional Development Program and New Mexico State University held the Water: The Foundation of Agricultural Sustainability Conference on August 7, 2012 in Santa Fe, N.M. Drawing together 113 farmers and ranchers, extension educators and researchers, and other stakeholders from across the Southwest, this conference addressed agriculture's water challenges - those related to both severe drought and a growing demand by non-agricultural uses - by sharing some of the latest, most promising technologies and techniques in water-use efficiency.

The conference focused on proven, proactive technologies and approaches aimed at making a difference both now and particularly in the years ahead. This one-day conference was developed in response to seven listening sessions held by Western SARE, during which farmers, ranchers, and other agricultural professionals ranked water-use efficiency among the top ten priorities for sustainable agriculture research and education.

PowerPoint presentations from each session can be downloaded from [aces.nmsu.edu/programs/sare/workshop-2011.html](http://aces.nmsu.edu/programs/sare/workshop-2011.html).



# ABOUT WESTERN SARE

SARE is a USDA competitive grants program that supports agricultural systems that are economically viable, environmentally sound, and good for communities and families.

The Western SARE region has a diversity of agriculture and a broad geographic range that encompasses 13 states and four pacific island protectorates. Western SARE manages five grants programs: Research and Education; Farmer/Rancher; Ag Professional + Producer; Professional Development; and Graduate Student. All grants programs address the same goals:

- Promote good stewardship of the nation's natural resources using site-specific, regional, and profitable sustainable methods.
- Enhance the quality of life of farmers and ranchers and improve the viability of rural communities.
- Protect the health and safety of those involved in food and farm systems.
- Promote crop, livestock, and enterprise diversification.
- Examine the regional, economic, social, and environmental implications of adopting sustainable practices.

In 26 years, Western SARE has awarded over \$50 million toward ground-breaking projects cooperatively conducted by producers, ag professionals, and researchers, and created an extensive learning center to ensure that research results are easily and rapidly accessible.

## ADDITIONAL PROJECTS

More information about Western SARE's extensive project portfolio addressing livestock, grazing management, and other agricultural issues can be found at [westernsare.org/projects](http://westernsare.org/projects).

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