Sustaining Agriculture in an Uncertain Future: The Role of Water Efficiency

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What could agriculture in the western United States look like in the year 2050, given growing uncertainties over the reliability and availability of water? In a new report from the Pacific Institute, "Sustaining California Agriculture in an Uncertain Future," we offer a vision of a sustainable, healthy agricultural community—one far more efficient in its water use than today. While the focus is California, we believe that articulating this vision can help initiate discussion to develop a shared strategy for addressing increasingly contentious water challenges across the Southwest.

Agriculture in 2050: Our Vision

Today, in the year 2050, California agriculture is thriving, leading the world in sustainable production, efficient water use, fair and humane treatment of its workforce, and protection of ecological services.

Severe drought, financial constraints, and growing environmental problems that peaked around 2010 forced many farmers and irrigation districts to change the way they operated. In particular, sustainable water management practices already implemented in some areas became much more widespread, including efficient irrigation technologies, improved irrigation scheduling, integrated groundwater management, and measures that enhance soil-moisture retention. Few farmers attempt to grow water-intensive crops due to stiff competition from urban and ecological water users. But many crops now use less water anyway because of genetic improvements in crop cultivars and better irrigation technologies.

The water crisis also led to long-overdue changes in water-use monitoring and reporting. Farmers began to push for change as unconstrained groundwater pumping and contamination began to hurt more farmers than it benefited. All groundwater use and quality is now monitored and managed by local groundwater management groups, with guidance from statewide standards. Long-term over-pumping of groundwater—one of the clearest measures of unsustainable water policies in the past century—has finally ended. Integrated groundwater management has nearly doubled the amount of water stored in active groundwater basins for use during droughts.

The California agricultural community has also put in place several institutional innovations. Water management institutions ensure the "reasonable and beneficial" use of water resources. Federal and state water contractors have repaid the cost of building major water infrastructure projects, including the Central Valley Project and the State Water Project. Pricing is now used as a tool to encourage wise water use, and most urban and agricultural water suppliers have adopted tiered rates where those who use more water pay more per unit of water. The additional revenue gained from these rate structures finances on-farm and district improvements, including better measuring and monitoring of water use.

Farmers and environmentalists have worked together to define specific ecosystem goals, such as restoring and maintaining healthy fish populations, reducing salinity, and protecting waterfowl habitats. These partnerships ensure environmental protection and increase the certainty of water supply to farmers. As a result, fish populations that managed to survive to the turn of the century remain healthy, and tourists come to see the spectacle of millions of ducks, geese, and cranes in the refuges of central and northern California.

Achieving the Vision

We believe that achieving such a vision is possible, though clearly not inevitable. The challenge is finding the right path and policies to secure such a future. Many strategies will be needed to develop an agricultural sector that supplies food to the state and nation and supports rural livelihoods, while remaining consistent with long-term sustainable water use. One key approach is to improve the efficiency of water use. Water conservation and efficiency offers an inexpensive, flexible, and resilient means to adapt to pressures from competition over limited resources, drought, and climate change. In addition, today's conservation efforts are likely to produce a competitive advantage that ensures agriculture will continue to play an important role in the West.

The failure to accurately account for agricultural water use contributes directly to the failure to manage it sustainably.

Water Conservation and Efficiency Scenarios

Agriculture uses 80 percent of the groundwater pumped and surface water withdrawn in California. In 2000, California agriculture used 34 million acre-feet of water to produce food and fiber valued at $33 billion (in 2007 dollars). Many options are available for improving the efficiency of water use in California agriculture. For our analysis, we chose practices that numerous studies indicate reduce water use while improving crop yield and/or quality. Many in the agricultural community have already implemented these measures but more can, and should, be done.

This analysis was perfomed using the same model that the Department of Water Resources uses in its statewide planning efforts. As a starting point, we used irrigated crop area from 2005 and crop water-use estimates for the years 1998, 2000, and 2001 to construct baseline estimates of agricultural water use in California during wet, average, and dry years, respectively. A literature review was conducted to develop plausible water savings estimates for each practice. The practices evaluated include:

- ***Efficient Irrigation Technology:*** shifting a fraction of irrigated crops from flood irrigation to sprinkler and drip systems. Statewide, 60 percent of California's crops are still flood irrigated. For this study, we estimate water savings in a scenario where half of field crops continue to be flood irrigated and half are irrigated with sprinklers; additionally, 75 percent of orchard, vegetable, and vineyard acreage is irrigated using micro-sprinklers and drip, and the remaining 25 percent is irrigated using sprinklers.
- ***Improved Irrigation Scheduling:*** using local climate and soil information to help farmers irrigate more precisely to meet crop needs. We estimate that irrigation scheduling would reduce water use by 13 percent. The study assumed that 20 percent of farmers currently use these methods to schedule irrigation and projected the savings if all farmers used scientific irrigation scheduling.
- ***Regulated Deficit Irrigation:*** applying less water to certain crops (almonds, pistachios, raisins, and wine grapes) during drought-tolerant growth stages to save water and improve crop quality or yield. A literature review identified average water savings achieved in California under this approach; these were applied to crops showing greatest potential for response.

The combined potential savings from implementing these three practices range from 4.5 million acre-feet in a wet year to 6.0 million acre-feet in a dry year (see chart, below). This could reduce California agricultural water use by 17 percent without changing total irrigated acreage or the current mix of crops. Reducing acreage and changing crop types could lower total water use further, but we do not evaluate such options here because they are not "efficiency" improvements.

Our results indicate that water conservation and efficiency improvements are particularly effective in dry years, when agricultural water demand is greater and competition for scarce water resources is more severe and costly. By investing in "drought-proof" strategies, farmers can reduce their vulnerability to drought-imposed water-supply constraints. Because climate-change predictions for the Southwest call for increased frequency and intensity of droughts, these measures will be especially valuable.

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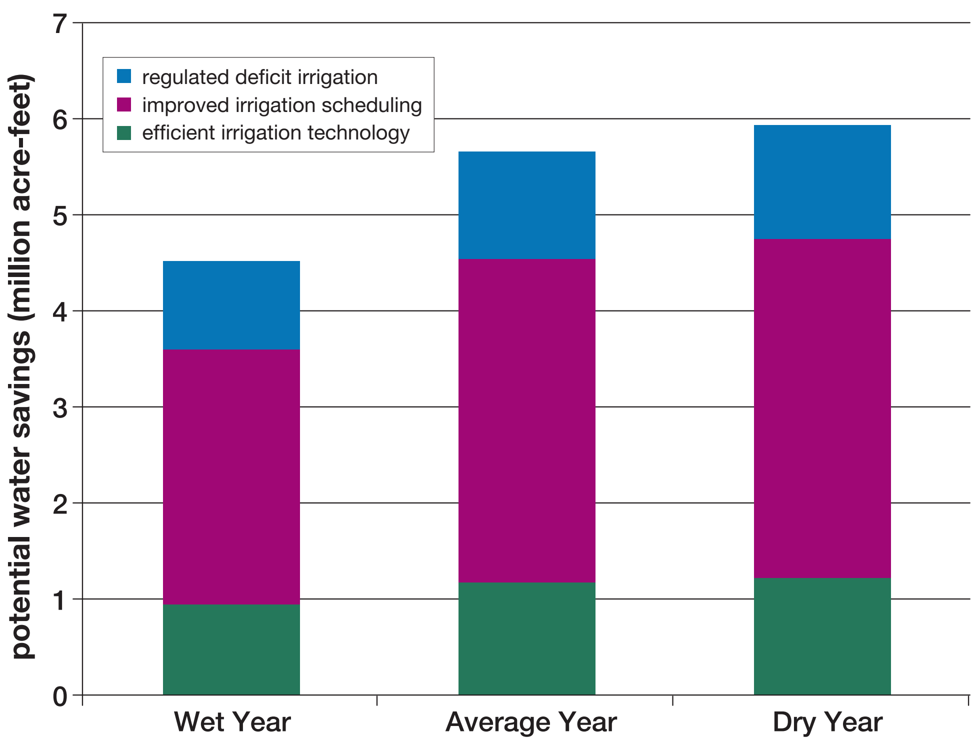

Potential water savings (in million acre-feet, maf) for wet, average, and dry years. Note that the baseline (before conservation) applied agricultural water use in this analysis was 26.6 maf for a wet year, 33.8 maf for an average year, and 35.4 maf for a dry year.

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The report also offers recommendations for capturing this conservation potential to build a stronger, more vibrant agricultural sector; these apply throughout the West. The most critical are:

- Local, state, and federal agencies should provide farmers with additional financial assistance and incentives to implement efficiency measures, such as rebates for efficient irrigation equipment and greater federal support through farm bill conservation programs.
- Water managers should implement water-rate structures that encourage efficient water use. Additional revenue generated from large water users could be used to finance on-farm and district-wide improvements.
- Local governments must create groundwater management authorities, particularly in areas with extreme overdraft.

Finally, one of the many challenges of studying water issues is the lack of consistent, comprehensive, and accurate estimates of actual water use. The failure to accurately account for water use contributes directly to the failure to manage it sustainably. Efforts are needed immediately to improve our understanding of agricultural water use, including surface-water diversions, groundwater use, crop-water consumption, and farm-gate deliveries. State-level coordination of water-use measurement, reporting, and data management and exchange are needed along with satellite-data analyses and local groundwater-monitoring and management programs.

Can a viable, sustainable agricultural future be achieved? Yes. But it will require the commitment of all parties to move from individually-focused interests to a deeper understanding of the interdependence between the agricultural and other sectors—including the environment—and recognition that cooperation benefits everyone. ■

Download the full report, "Sustaining California Agriculture in an Uncertain Future," at www.pacinst.org/reports/california_agriculture/. Contact Heather Cooley at hcooley@pacinst.org.