PACIFIC INSTITUTE

Sustaining California Agriculture in an Uncertain Future

Executive Summary

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About the Pacific Institute

The Pacific Institute is one of the world's leading independent nonprofits conducting research and advocacy to create a healthier planet and sustainable communities. Based in Oakland, California, we conduct interdisciplinary research and partner with stakeholders to produce solutions that advance environmental protection, economic development, and social equity—in California, nationally, and internationally. We work to change policy and find real-world solutions to problems like water shortages, habitat destruction, global warming, and environmental injustice. Since our founding in 1987, the Pacific Institute has become a locus for independent, innovative thinking that cuts across traditional areas of study, helping us make connections and bring opposing groups together. The result is effective, actionable solutions addressing issues in the fields of freshwater resources, climate change, environmental justice, and globalization. More information about the Institute and our staff, directors, funders, and programs can be found at www.pacinst.org.

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Acronyms and Abbreviations

ABARE – Australian Bureau of Agricultural and Resource Economics
AF – acre-feet
AWMC – Agricultural Water Management Council
CCID – Central California Irrigation District
CDFA – California Department of Food and Agriculture
CEC – California Energy Commission
CIMIS – California Irrigation Management Information System
CVP – Central Valley Project
CVPIA – Central Valley Project Improvement Act
DWR – California Department of Water Resources
ET – evapotranspiration
EWG – Environmental Working Group
EQIP – Environmental Quality Incentives Protocol
FAO – Food and Agriculture Organization
LEPA – low-energy precision application
LESA – low-elevation spray application
MAF – million acre-feet
NRCS – Natural Resources Conservation Service
PIER – Public Interest Energy Research
RDI – regulated deficit irrigation
SEBAL– Surface Energy Balance Algorithm for Land
SWP – State Water Project
USBR – United States Bureau of Reclamation
USDA – United States Department of Agriculture
USGS – United States Geological Survey

Conversions

1 cubic meter (m^3) = 264 gallons = 0.0008 AF
1,000 gallons (kgal) = 3.79 cubic meters (m^3) = 0.003 acre-feet (AF)
1 million gallons = 3,785 cubic meters (m^3) = 3.1 acre-feet (AF)
1 acre-foot (AF) = 325,853 gallons = 1,233 cubic meters (m^3)

Executive Summary

What could California agriculture look like in the year 2050 – still many years in the future? The answer, of course, is almost anything: from a smaller, weaker sector to a healthier, stronger global producer and exporter of food and fiber. What the future holds depends on decisions made today and tomorrow. This report offers a positive vision for California agriculture and water – a vision of a sustainable, healthy agricultural community.

Agriculture in 2050: Our Vision

It is now the year 2050 and California agriculture is thriving, leading the world in sustainable production, the efficient use of water, the fair and humane treatment of its workforce, and the protection of ecological services. Over the past several decades, innovative thinking, smart policies, and careful actions transformed disputes over water into efficient use and cooperative management.

Some California farmers have always been innovative and flexible, but the pressure to transform the sector built to a crescendo around 2010 when severe drought coupled with financial constraints and growing environmental problems forced many farmers and irrigation districts to change the way they operated. In particular, more farmers began to treat water as a scarce resource, exploring ways to boost yields while reducing water use. Sustainable water management practices already implemented in some areas of California became much more widespread, including efficient irrigation technologies, improved irrigation scheduling, rainwater collection, integrated groundwater management, and measures that enhance soil moisture retention.

The water crisis also led to long-overdue changes in water use monitoring and reporting. As hard as it is to believe today, groundwater use and quality were not consistently monitored and managed in California, nor did the state have an accurate estimate of agriculture's actual water use. Things began to change as unconstrained groundwater pumping and contamination began to hurt more farmers than it helped. All groundwater use and quality is now monitored and managed by local groundwater management groups, with the guidance of statewide standards. Long term over-pumping of groundwater – one of the clearest measures of the unsustainable water policies of the past century – has finally ended. A comprehensive system of integrated management has nearly doubled the amount of water stored in active groundwater basins for use during drought periods.

Several significant changes in the U.S. Farm Bill now encourage farmers to conserve water and use their working landscapes to provide multiple benefits, e.g., food and fiber production, wildlife habitat, and groundwater recharge. Growing competition for water by urban and ecological water users has made water-intensive crops increasingly unpopular and difficult to sustain. Direct commodity payments have been retooled to support payment for environmental services and irrigation efficiency improvements. Rice, cotton, alfalfa, and other field crops are still grown in California, but they no longer dominate the landscape due to a variety of factors including market changes and water availability. Furthermore, many crops use far less water than they used to because of genetic improvements in crop cultivars and more sophisticated irrigation technologies. New federal and state programs provide financial incentives for farmers

and irrigation districts to modernize their water management practices. Overall irrigation efficiency has risen significantly measured as both farm revenue and crop production per unit of water.

The California agricultural community has also put in place several institutional innovations. Water management institutions ensure the "reasonable and beneficial" use of the state's water resources. Federal and state water contractors have repaid the cost of building major water infrastructure projects initiated in the 1950s, 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. Now that all water use is carefully monitored and reported, flexible market mechanisms permit growers to retain water rights while transferring the use of that water to other users. Thus, farmers regularly buy and sell water within a state-regulated market that also provides water for the restoration of aquatic ecosystems. While urban agencies sometimes apply for temporary use of water from these markets, most transfers are limited to farmer-farmer trades.

Farmers and environmentalists have worked together to define specific ecosystem goals, such as restoring and maintaining healthy populations of freshwater and anadromous fish, keeping salinity below certain levels, and protecting habitat for waterfowl in coastal and inland wetlands. These partnerships have helped to ensure environmental protection and increase the certainty of water supply to farmers. Fish populations in California's rivers that managed to survive to the turn of the century remain healthy. Every year tourists come to see the spectacle of millions of ducks, geese, and cranes wintering in the refuges of central and northern California.

Achieving the Vision

Farmers are already adapting to a changing world, but this can be expensive and risky. How can we, as Californians, help ensure that California continues to be a state of vast natural beauty and agricultural bounty for future generations? This question is a central focus of this report. We describe some of the tools that can help maintain a thriving agricultural sector, report on recent trends in the California agriculture, and address emerging challenges such as climate change that will impose new difficulties for growers. We then quantify the water conservation and efficiency potential of three water management scenarios. We describe some of the challenges that farmers and agricultural water suppliers face in capturing this potential and provide recommendations for overcoming these challenges. Throughout, we profile farmers and irrigation districts who are already moving in innovative directions and whose experiences will help overcome barriers to a healthy agricultural sector in the future.

Water Conservation & Efficiency – Future Scenarios

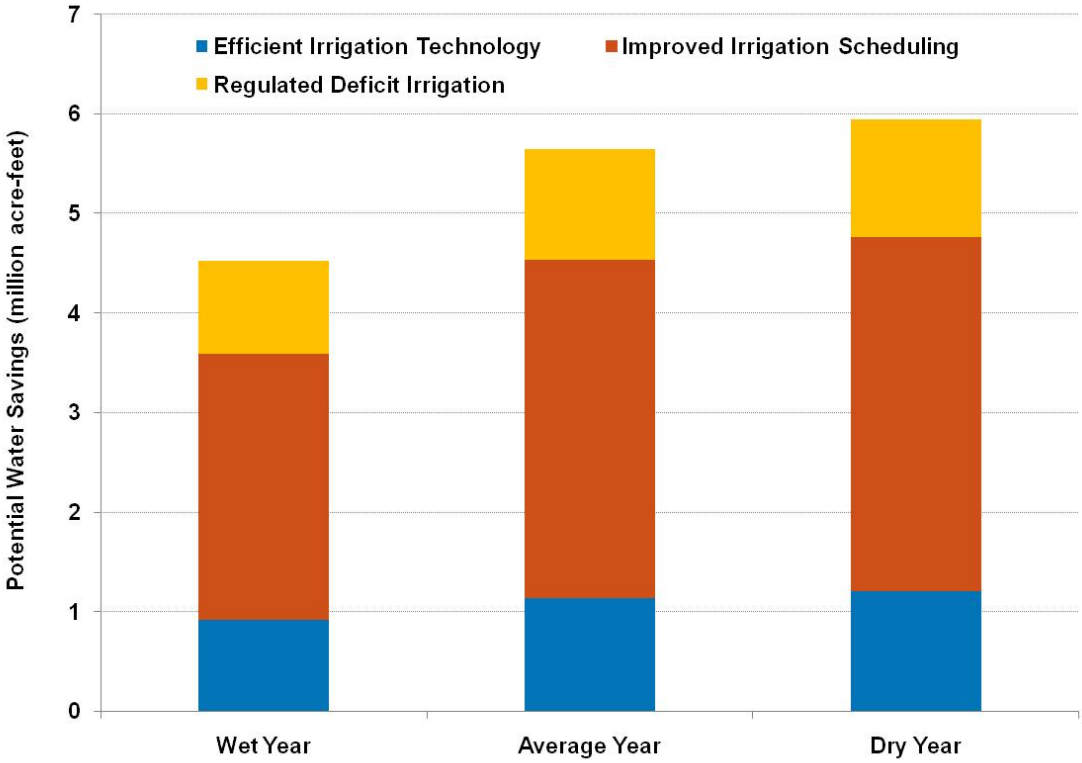
Many options are available for improving the efficiency of water use in California agriculture – this report quantitatively and qualitatively explores the following three technology and management scenarios:

- **Efficient Irrigation Technology –** shifting a fraction of the crops irrigated using flood irrigation to sprinkler and drip systems;

- **Improved Irrigation Scheduling –** using local climate and soil information to help farmers more precisely irrigate to meet crop water needs; and
- **Regulated Deficit Irrigation –** applying less water to crops during drought-tolerant growth stages to save water and improve crop quality or yield.

The three scenarios we evaluated here all conservatively show the potential for significant water savings. The combined potential savings from the technology and management scenarios are between 4.5 million acre-feet in a wet year and 6.0 million acre-feet in a dry year (Figure ES-1). In total, these scenarios would reduce agricultural water use by 17 percent. Water savings were substantial for all scenarios but were greatest in the Improved Irrigation Scheduling scenario.

Figure ES-1. Potential water savings (in million acre-feet) in a wet, average, and dry year



Our results also indicate that water conservation and efficiency improvements are particularly effective in dry years, when agricultural water demand is greater and conflict over scarce water resources is more severe and costly. By investing in "drought-proof" strategies, California farmers can reduce their vulnerability to the kinds of water-supply constraints experienced in the past three years due to drought. Because climate change is expected to increase the frequency and intensity of droughts, these measures can also help California farmers improve their resilience to a changing climate. We must learn from the example of the Murray-Darling basin in Australia, which concentrated primarily on building bigger storage for rains that, in the end, never came. This resulted in the widespread collapse and restructuring of agriculture in the region. Water conservation and efficiency are increasingly important tools that can help California adapt to a drier future and continue to be a world leader in agricultural production.

Conclusions & Recommendations

California's future is increasingly uncertain. Competition over limited water resources continues and climate change is increasing climate variability. With existing technologies, management practices, and educational and institutional resources, we can reduce agriculture's vulnerability to water supply constraints and improve its long-term sustainability. We conclude with a series of key political, legal, and economic initiatives that would promote more productive and, ultimately, more sustainable water management in California.

One of the many challenges to studying water issues in California is the lack of a consistent, comprehensive, and accurate estimate of actual water use. The failure to accurately account for water use contributes directly to the failure to manage it sustainably. Efforts should be implemented immediately to improve our understanding of actual water use in the agricultural sector.

- Implement California Assembly Bill 1404 in a timely manner, which would ensure coordinated water use measurement and reporting.
- Use satellite and other technology to improve data collection and analysis, particularly for annual assessments of crop area and evapotranspiration.
- Ensure that the Landsat-7 follow-on mission is equipped with a thermal band to allow for the continued use of satellite imagery for data collection and analysis.
- Design and implement comprehensive local groundwater monitoring and management programs statewide.
- Require the state to evaluate the measurement needs for accurately monitoring return flows.
- Implement a statewide system of data monitoring and data exchange, especially for water use and quality, available to all users.

While agriculture has social and cultural importance, it is also an economic endeavor and farmers must make choices about investments based on expected costs and returns. While investments in on-farm efficiency improvements can be offset by a reduction in operation costs and/or increased crop revenue, the initial investment required can be a significant barrier – policies are needed to overcome this economic barrier.

- Federal funding for conservation programs, especially the Environmental Quality Incentives Program, should be increased.
- State and county governments should provide property tax exemptions for farmers that upgrade to more efficient irrigation systems. Exemptions could apply to the value added to a property by the irrigation system and would be valid for 5-10 years.
- The State should develop new legal mechanisms by which municipal water or state or local wildlife agencies could invest in farmers' irrigation systems in exchange for some portion of the water conserved.

In California, irrigation water is predominantly delivered through canals designed and constructed in the early and middle of the 20th century. Nearly 80% of these water systems fail to provide water on-demand, which is a necessary precondition for many on-farm water efficiency improvements.

- State and federal governments should expand efforts to finance district-wide improvements that provide water to farmers when needed, such as lining and automating canals and distribution systems.
- Irrigation districts should implement new water rate structures that encourage efficient use of water. This additional revenue generated from large water users can be used to finance on-farm and district-wide improvements.

More aggressive efforts are needed to apply the constitutionally mandated concepts of reasonable and beneficial use in ways that encourage improvements in water-use efficiency. Implementation of the State Water Resources Control Board's mandate will be stymied by political forces until the appointment and confirmation processes, and funding of the board are significantly altered.

- As a regulatory agency, the State Water Resources Control Board should be an independent body with a secure funding source, e.g., fees or regular funding increases consistent with the consumer price index, outside of the political budget process.
- Establish a panel of independent judges to review and recommend candidates for the State Water Resources Control Board.
- Change Water Code Section 275 to eliminate the "and" between the State Water Resources Control Board and the California Department of Water Resources. The State Water Resources Control Board should have independent authority to prohibit waste.

A more sound and integrated water management system is needed given changing social, economic, hydrologic, and environmental conditions. In particular, California's water rights system should be expanded to include groundwater and the potential impacts of climate change.

- Legislative, regulatory, and administrative support should be given to update the water rights system given future hydrologic uncertainties.
- Current state law allows local government to create local groundwater management authorities. The law should be changed to require local government to create these authorities.
- The state and local agencies should immediately establish groundwater management authorities in regions where overdraft is most severe.

Many agricultural water users in California receive water from the State Water Project (managed by the California Department of Water Resources) and the Central Valley Project (managed by the United States Bureau of Reclamation). These water projects, however, have over-allocated and under-priced water.

- The United States Bureau of Reclamation should re-visit its water rate structures, ensuring that all water use does not fall within the first tier and that there are large increases between tiers.
- The United States Bureau of Reclamation should re-negotiate all Central Valley Project contracts in light of the new biological opinions issued by the National Marine Fisheries Service and Fish and Wildlife Service.

- The United States Bureau of Reclamation should require all project contractors to provide a valid "Needs Assessment" that conforms to state law by demonstrating reasonable and beneficial use of water and prohibiting the waste of water.
- The State should require that all water deliveries, including the settlement contractors, be measured at the turnout with sufficient accuracy (generally ± 6%) and be subject to tiered pricing.
- The California Department of Water Resources should make the water contract amendment process reliant on an evaluation of the efficiency of current water use in the contractor's service area.

Education and outreach programs are critical for disseminating new research, information, and technical assistance directly to farmers. Programs are available but underfunded. These on-the-ground efforts are central to achieving a sustainable agricultural future.

- Expand water-efficiency information, evaluation programs, and on-site technical assistance provided through Agricultural Extension Services and other agricultural outreach efforts.
- Ensure a stable source of funding for education and outreach programs.
- Expand development and deployment of efficient irrigation technologies and new crop types.
- Fund the Agricultural Water Management Council to update and expand its Efficient Water Management Practices.