

## California's farms face growing water management challenges

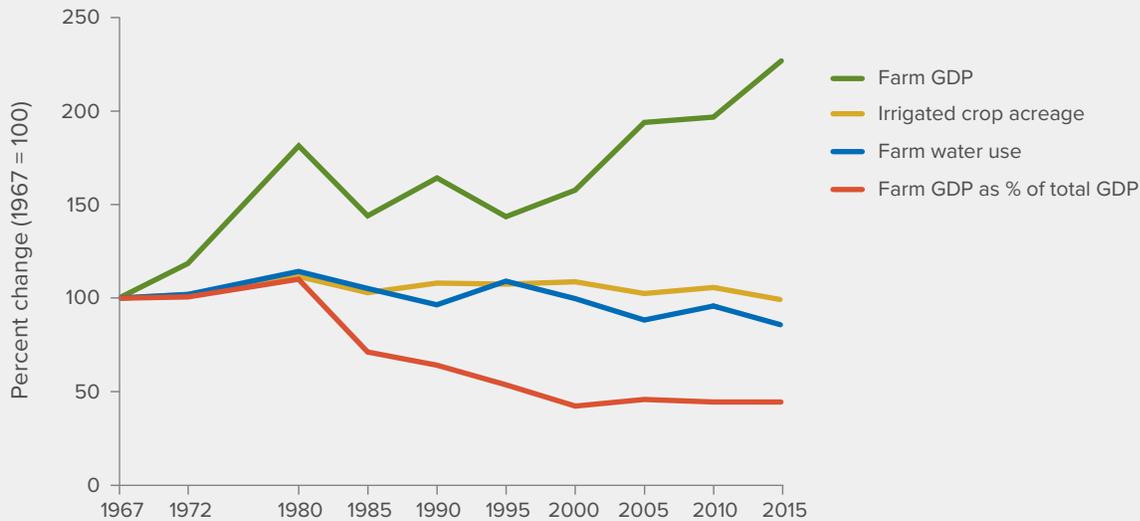
California is an agricultural powerhouse—the nation's largest farm state and a world market leader, with 2015 sales of \$47 billion. California's dry summers make irrigation essential. To irrigate some 9 million acres of crops, farmers use about 40 percent of California's available water, compared with 10 percent used in cities. The remaining half is categorized as environmental water.

Farmers have steadily improved productivity and shifted to crops like fruits, nuts, and vegetables that generate more revenue and profit per unit of water, as well as more farm jobs. Adjusted for inflation, the value of farm output and related food processing has more than doubled since the late 1960s despite little change in acreage or irrigation water used. But California's nonfarm sectors have grown faster, and agriculture is now around 2 percent of the state economy.

Water is a perennial concern. Many farmers get surface water from federal, state, and local projects. Many also pump groundwater. In some regions, groundwater reserves have been shrinking for decades. Since the 1980s, environmental regulations have limited—and sometimes cut—the surface water supplies, thereby encouraging more groundwater pumping. Pumping increased dramatically during the latest drought.

The drought has exposed farming's growing vulnerability to water shortages. Climate change is expected to make severe droughts more likely. New groundwater legislation, local efforts, and Proposition 1—the state water bond approved in 2014—provide opportunities to strengthen water management.

### THE VALUE OF FARM WATER IS RISING, BUT FARMING IS DECLINING AS A SHARE OF THE ECONOMY



SOURCE: Author calculations using data from the US Bureau of Economic Analysis (total GDP), the US Department of Agriculture (farm GDP), the California Department of Water Resources (water and land use through 2010), and UC Davis (water and land use data for 2015, as summarized in Table A5 of Ellen Hanak et al., *What If California's Drought Continues?* [PPIC, 2015]).

NOTES: GDP is California's gross domestic product, adjusted for inflation. Farm GDP is for primary crop and animal production and other farm-related income. Irrigated crop acreage includes land used for multiple crops within a year. Farm water use is the amount applied to fields. Net water use—the volume consumed by plants, evaporated, or discharged to saline waters—is lower, but reliable long-term estimates are unavailable. Pre-2000 water use estimates are adjusted to levels that would have been used in a year of normal rainfall. Estimates from 2000 onward are for actual use in years with near normal precipitation, except 2015, a critically dry year. Estimates omit conveyance losses and active groundwater recharge.

## Farm water use is changing

California farmers respond continually to changing market and technological opportunities. These adaptations have boosted earnings and raised the value of scarce farm water supplies. But they have also brought new challenges.

- **Acreage is shifting toward higher revenue—but less flexible—crops.**

California farmers have shifted markedly to fruits, nuts, vegetables, and nursery crops, which made up roughly 47 percent of irrigated crop acreage, 38 percent of farm water use, and 86 percent of crop revenue in 2012. By comparison, forage crops, such as alfalfa and corn silage—inputs for the important dairy and cattle industries—generate less revenue per unit of water. In the water-limited San Joaquin Valley, orchards grew from 34 percent to 40 percent of irrigated cropland between 2000 and 2010. The rise in fruit and especially nut orchards—which must be watered every year—has reduced farmers’ ability to withstand intermittent water shortages. Because silage for dairies is costly to transport, corn is also fairly inflexible in that region, at 12 percent of total acreage.

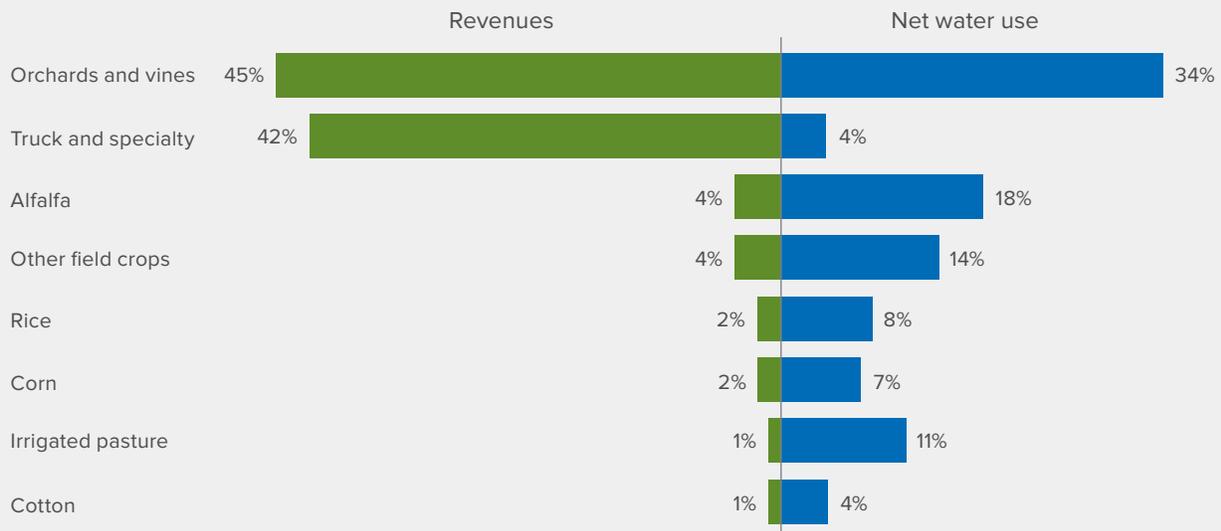
- **Water delivery and field irrigation efficiencies are rising.**

Many irrigation districts have been upgrading delivery systems to provide more flexible service and minimize canal spills and seepage. Farmers have been switching from flood irrigation to drip- and micro-irrigation systems, which improve crop yields and quality, reduce the application of water and chemicals, and help prevent chemicals from seeping into aquifers. However, in some regions—especially the San Joaquin Valley—these upgrades have the unintended consequence of lowering groundwater levels. That is because irrigation water not consumed by crops is a major source of groundwater recharge.

- **Groundwater is becoming more important—and more threatened.**

Even before the latest drought, San Joaquin Valley farmers were pumping more groundwater to replace surface water previously shipped through the Sacramento–San Joaquin Delta or diverted from the San Joaquin River, as both those sources have been decreased to support endangered fish habitats. Groundwater is also being used to establish new orchards in previously unirrigated areas that lack surface water. High returns on orchard crops have made it profitable for farmers to invest in deeper wells, aggravating groundwater depletion. Groundwater quality is also declining in many areas, threatening crop yields and drinking water.

### CALIFORNIA HAS A DIVERSE CROP MIX, WITH WIDE VARIATIONS IN REVENUE AND WATER USE



SOURCE: Author calculations using data from the California Department of Water Resources (2010 water use) and the National Agricultural Statistics Service (2012 crop prices). Revenues are estimated using the Statewide Agricultural Production (SWAP) model.

NOTES: Total 2010 net water use for crops was 20.2 million acre-feet (maf), versus 29 maf applied to fields. Total 2012 crop revenues were \$36.4 billion; dairy cattle and milk brought in \$6.9 billion and other animal production brought in \$2 billion. Alfalfa, corn, and irrigated pasture are key inputs for animal production. Crop revenues do not sum to 100 percent because of rounding. Truck and specialty includes non-tree fruits, vegetables, flowers, and garden plants.

## California needs to manage farm water for the long term

California will continue to be an agricultural leader, but it must keep adapting and focus on sustainably managing both water quantity and quality. To achieve this goal, farmers will likely farm less acreage but more intensively.

- **The latest drought has exposed strengths and vulnerabilities.**

During 2014, surface water deliveries to Central Valley farmers fell by over a third, and in 2015, by nearly half, with reductions varying hugely depending on location. The drought caused hardship in some farm communities. In each year, about half a million acres were fallowed, costing the farm economy nearly \$2 billion, along with as many as 10,000 full- and part-time jobs. But the losses would have been far greater if farmers had been unable to pump much more groundwater than usual or buy water from other farmers. Groundwater pumping replaced roughly 70 percent of the lost surface water.

- **Better groundwater management is a top priority.**

Groundwater is California agriculture's largest water reserve in dry years. But long-term declines in groundwater levels will limit its availability in many farming areas. The Sustainable Groundwater Management Act of 2014 requires local water users to create basin-level agencies with the ability to monitor, manage, and charge for groundwater pumping and the cost of recharge programs. The state can step in if local water users fail to put in place sustainable management plans. Implementation—which can include increasing recharge and/or reducing pumping—will likely require better measurement of pumping and the allocation of pumping rights to groundwater users. Today, landowners can generally pump without quantity restrictions.

- **Better integration of surface water and groundwater management is key.**

Many irrigation districts already manage surface and groundwater resources jointly to encourage groundwater basin replenishment in wet years. These local efforts need to increase. For instance, basins can be recharged with recycled wastewater from neighboring urban areas. Pilot programs are also exploring opportunities for spreading winter and spring floodwaters on fields, including those normally watered by drip irrigation. By shifting the timing of reservoir releases, federal, state, and local agencies can increase the availability of surface water for underground storage. Investments in new storage and conveyance can increase system flexibility and boost water supplies.

- **Water markets provide essential flexibility.**

California farmers have been active participants in the state's water market for more than two decades. This market has supported productive farming areas that lack reliable supplies of their own, and it has helped to keep orchards alive during the latest drought. Markets also make water available for the environment and growing urban areas, while providing revenue to farmers who sell water. Localized trading of groundwater pumping rights within basins can help implement the new groundwater law by allowing farmers who need more water for their orchards to compensate other farmers for reducing use.

- **Agricultural stewardship can do more to support the environment.**

Further improvements in irrigation practices, and in the management of agricultural chemicals and drainage, will reduce harmful discharges. Beneficial on-farm practices that provide habitat for California's fish and wildlife also merit expansion. Programs may be warranted to compensate farmers for providing habitat services on their lands.

## Looking ahead

Farmers and irrigation districts are the frontline stewards of agriculture's future, but the state and federal governments can provide technical, regulatory, and financial support to help California agriculture adapt to changing conditions.

**Support local groundwater management efforts.** Proposition 1 provides \$100 million to help implement the new groundwater law. Legislation enacted in 2015 will make it easier to allocate pumping rights. These rights should be tied to recharge sources. All landowners should share the recharge from natural precipitation, while irrigation districts should retain rights to water they bring into the basin. Local plans will also need to adjust pumping rights when farmers make efficiency upgrades to keep these investments from reducing long-term supplies.

**Improve information flows.** Data on groundwater use, water use by crops, and other key information about agricultural water management are still fragmented—and in some areas rudimentary. California also lags behind some other western states in using advanced technology, such as remote sensing, that can enhance or replace sometimes costly data collection

on the ground. Developing good accounts to track rights, pumping, and recharge will be essential for successful ground-water management. Informing growers about efficient management options can also yield dividends.

**Strengthen and streamline water markets.** State and federal agencies have expedited water transfers during the latest drought. However, California would benefit greatly from clarifying the conditions under which water transfers can be carried out without causing harm to the environment or other water users, and from simplifying the approval process.

**Develop funding sources to improve water reliability.** Proposition 1 will provide up to \$2.7 billion to fund the public benefits of new surface and groundwater storage, including ecosystem, recreation, and flood protection improvements. Water tunnels beneath the Delta are another key infrastructure project under consideration. Tunnels would be expensive, but the resulting improvements in the reliability and quality of water supplies may make it worth the investment for some farmers and urban residents.

**Support farmworker communities.** Proposition 1 and some federal programs can help fund safe drinking water for rural communities where groundwater is contaminated by nitrate from farming and other contaminants, or where shallow domestic wells have gone dry from falling groundwater levels. Farmworkers are also vulnerable to losing jobs, commuting longer distances, or having their hours reduced when cropland is fallowed due to water scarcity. The state has provided emergency financial and food assistance to farmworker communities during the latest drought. Beyond that, the state should support workforce development programs in farm communities.

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