

California’s farms face growing water management challenges

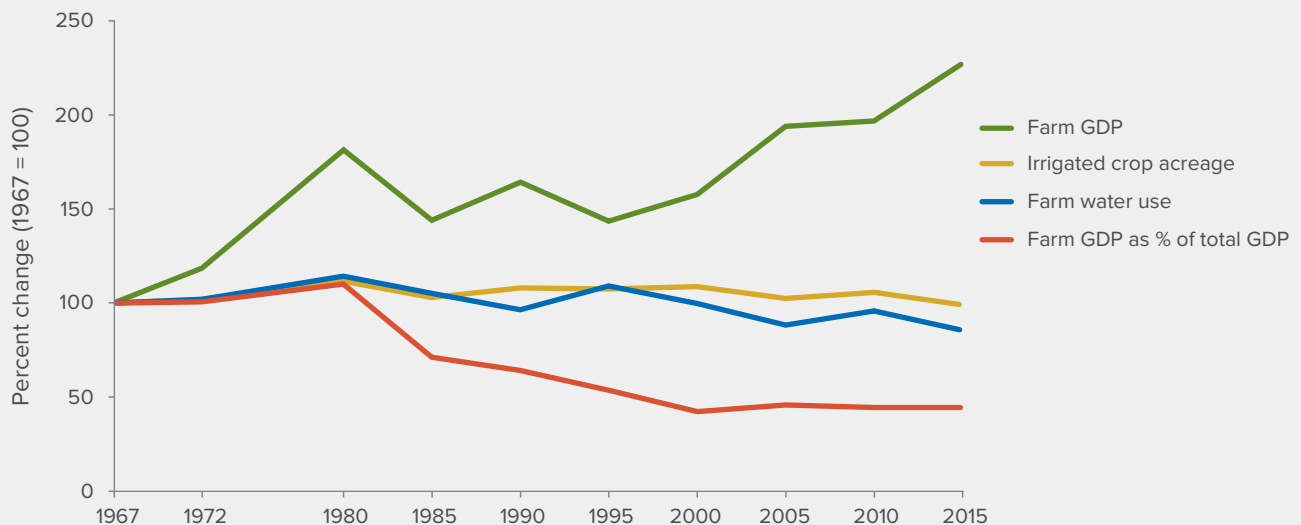
California is an agricultural powerhouse—the nation’s largest farm state and a world market leader, with 2017 sales of \$50 billion. Its dry summers make irrigation essential. Farmers use about 40 percent of available water to irrigate some 9 million acres of crops. Cities use 10 percent, and the remaining half is categorized as environmental water.

Farmers have steadily improved productivity and shifted to crops like fruits, nuts, and vegetables. These 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 water used. But California’s nonfarm sectors have grown faster, and agriculture is now around 2 percent of the state economy.

Water is an enduring 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—surface water supplies, thereby prompting more groundwater use. Pumping increased dramatically during the 2012–16 drought, causing dry wells and infrastructure damage from sinking lands. This prompted the landmark Sustainable Groundwater Management Act (SGMA), which requires water users to develop and implement plans to bring their basins into long-term balance.

SGMA could build agriculture’s resilience to droughts, which are expected to become more severe as the climate changes. Farmers also need to improve water quality management. Local and regional efforts—with state and federal support—present opportunities to make progress in addressing these challenges.

THE VALUE FROM 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 E. 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 estimates are adjusted to levels for 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's agriculture is diverse, with more than 400 commodities produced in several major farming regions. Irrigated farmland is concentrated in the Central Coast, the Sacramento and San Joaquin Valleys, and parts of Southern California. Farmers respond continually to changing market and technological opportunities. These adaptations have boosted earnings and raised the value of scarce water supplies. But they have also brought new challenges.

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

California farmers have shifted markedly to fruits, nuts, vegetables, and nursery crops. In 2012, these made up 47 percent of irrigated acreage, 38 percent of farm water use, and 86 percent of crop revenue. Forage crops such as alfalfa and corn silage—inputs for the large dairy and cattle industries—generate less direct revenue per unit of water. The water-limited San Joaquin Valley is home to roughly half of all irrigated acreage. Between 2000 and 2016, its orchards increased from 34 to 46 percent of irrigated cropland. This rise in nut and fruit orchards—which must be watered every year—has reduced farmers' ability to withstand intermittent water shortages. The region is also home to more than 80 percent of California's dairy cows. And because silage for dairies is costly to transport, corn and other silage is also fairly inflexible here, at more than 20 percent of total acreage.

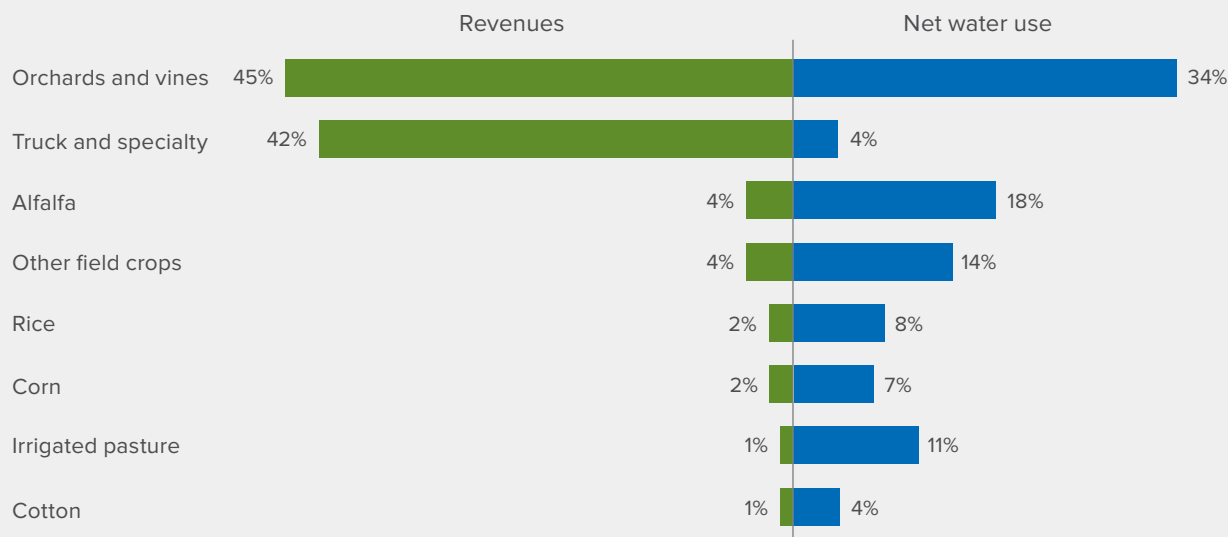
- **Water delivery and field irrigation efficiencies are rising, bringing trade-offs.**

Many irrigation districts have been upgrading delivery systems to provide more flexible service and to minimize canal spills and seepage. Federal and state grants have helped farmers switch from flood- to drip- and micro-irrigation. These 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 habitat. 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, which further aggravates depletion. In some areas, groundwater quality is also declining—nitrate from farm runoff seeps into aquifers and harms drinking water, and salt buildup in groundwater and soils lowers crop yields.

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.

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

Groundwater is a major asset for California agriculture, especially during droughts. But farmers could traditionally pump without quantity restrictions—a practice that has lowered reserves and caused other problems. SGMA now requires water users to manage their basins for the long term. By mid-2017, more than 250 groundwater sustainability agencies (GSAs) were formed in 140 basins. The first plans are due in early 2020, and GSAs will have 20 years to achieve sustainability. If they fail to prepare or implement plans, the State Water Board can take over. Bringing basins into balance will require increasing recharge. And in the most stressed basins—particularly in the San Joaquin Valley and Central Coast—it will likely require pumping less and reducing irrigated cropland.

- **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. In addition to recharging in dedicated basins and unlined canals, spreading excess winter flows on farmland is promising but requires careful consideration of water quality. Shifting the timing of reservoir releases could increase the availability of surface water for underground storage. To facilitate recharge, some areas will need infrastructure upgrades—especially of conveyance.

- **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, and it helped keep orchards alive during the latest drought. Markets also make water available for the environment and growing urban areas and provide revenue to farmers who sell it. Trading partnerships between Southern California farmers and cities are helping that region adapt to growing scarcity of Colorado River 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 and other high-revenue crops to compensate other farmers for reducing use.

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

Further improvements in irrigation practices will reduce harmful discharges, as will better management of agricultural chemicals and drainage. Soil management on rangelands and idled cropland can improve air quality and sequester carbon. Beneficial on-farm practices that provide habitat for California's fish and wildlife also merit expansion, with programs to compensate farmers for these services. Federal Farm Bill programs offer assistance for a range of stewardship activities, and some state programs can also help.

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. Groundwater sustainability agencies can monitor, manage, and charge for groundwater pumping and the cost of recharge programs. And 2015 legislation makes it easier for them to allocate pumping rights. But achieving sustainable groundwater use will be difficult and controversial—especially in areas where pumping must decline. State bonds provide resources for local planning, and the state can contribute valuable technical support and guidance.

Improve water information. Successful groundwater management requires developing good accounts to track water use, pumping, and recharge. Data remain fragmented and often rudimentary regarding groundwater use, water use by crops, and other key information. California also needs to employ more advanced technology such as remote sensing, which can enhance or replace sometimes costly, less reliable data collection on the ground.

Facilitate recharge and water trading. One urgent state priority is to clarify water available for groundwater recharge. Trading water is an important way for farmers to decrease the costs of drought and reductions in groundwater pumping. Federal, state, and local agencies should do more to simplify and expedite the approval process for trading.

Improve water infrastructure. California’s water infrastructure—including reservoirs and aqueducts—is aging and needs an upgrade. Regional and local conveyance investments are critical to support groundwater recharge and trading and to maintain water supplies drawn through the Delta, which could be disrupted by rising seas, seasonal flooding, and earthquakes. Some state and federal funding is available to support these efforts, but agricultural and urban water users will need to shoulder much of the cost.

Support farmworker communities. Continued progress is needed to provide safe drinking water in rural communities where groundwater is contaminated, and where shallow domestic wells are at risk from falling levels. Farmworkers are also vulnerable to losing jobs, commuting longer distances, or having their hours reduced when cropland is fallowed due to water scarcity. Emergency financial and food assistance helped during the latest drought. Beyond that, the state and federal governments should support workforce development to help rural communities adapt to the changing farm economy.

Encourage regional collaboration. Much of the initial planning for groundwater sustainability is occurring at the very local scale. But many promising approaches for meeting sustainability goals—including groundwater recharge and water trading—will require broader collaboration. Regional approaches can also help address other challenges—such as safe drinking water and environmental stewardship. The state should incentivize collaboration through its allocation of bond funds.

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