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The Future of Agriculture in the San Joaquin Valley

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Highlights

- Agriculture in the San Joaquin Valley is a key driver of the regional economy and an important contributor to the nation's food supply—but it faces a future with less water for irrigation.
- By 2040, average annual water supplies could decline by 20 percent, constrained chiefly by the transition to groundwater sustainability under the Sustainable Groundwater Management Act, but exacerbated by climate change and increased environmental regulations.
- In the worst-case scenario, nearly 900,000 acres of farmland would be fallowed, almost 50,000 jobs would be lost, and regional economic activity would decline by 2.3 percent. But adaptations such as water trading and investments in new supplies—along with continued growth in agricultural productivity—could soften the economic blow; new supplies could also significantly reduce the need to fallow lands.
- Improving trading rules, water infrastructure, and groundwater recharge could lower the cost of adapting to the coming changes. Incentivizing alternative uses for irrigated lands could bring additional income to farmers and local communities, while improving public health and environmental outcomes on fallowed lands.

Water challenges loom over California's most important farming region

The San Joaquin Valley produces more than half of the state's agricultural output, and it is an important contributor to the nation's food supply. In terms of revenues, Fresno, Kern, and Tulare Counties are the nation's top three agricultural counties. In 2018, about 4.5 million acres of cropland were irrigated in the region, using 16.1 million acre-feet (maf) of water. The valley is also home to significant dairy and beef industries.

Farming and related industries play an outsized role in the San Joaquin Valley's economy, accounting for 14 percent of GDP, 17 percent of employment, and 19 percent of revenues. Valley agriculture employs around 340,000 people; its crops produce more than $24 billion in revenues, led by orchards and vines (almost $20 billion) and vegetables ($2.8 billion). Dairies and beef produce about $6.4 billion and $3.2 billion in revenues, respectively. A $34 billion food and beverage processing industry also relies directly on the valley's crops.

Ensuring the economic and environmental sustainability of San Joaquin Valley agriculture is key for the region's wellbeing, but this sector faces a future with less water for irrigation—an essential input. In 2019, we assessed the socioeconomic consequences of the transition to groundwater sustainability and other potential water supply constraints. Now, new data have enabled us to provide a more up-to-date analysis, and while our results are broadly consistent with the 2019 study, we assess water availability, overdraft, and the impact of the transition to groundwater sustainability at a much more granular scale than in any previous study. Fallowing will likely be greater than we initially estimated, unless growers are able to develop considerably more additional supplies.

The transition to sustainability will constrain farm water availability, leading to significant land fallowing

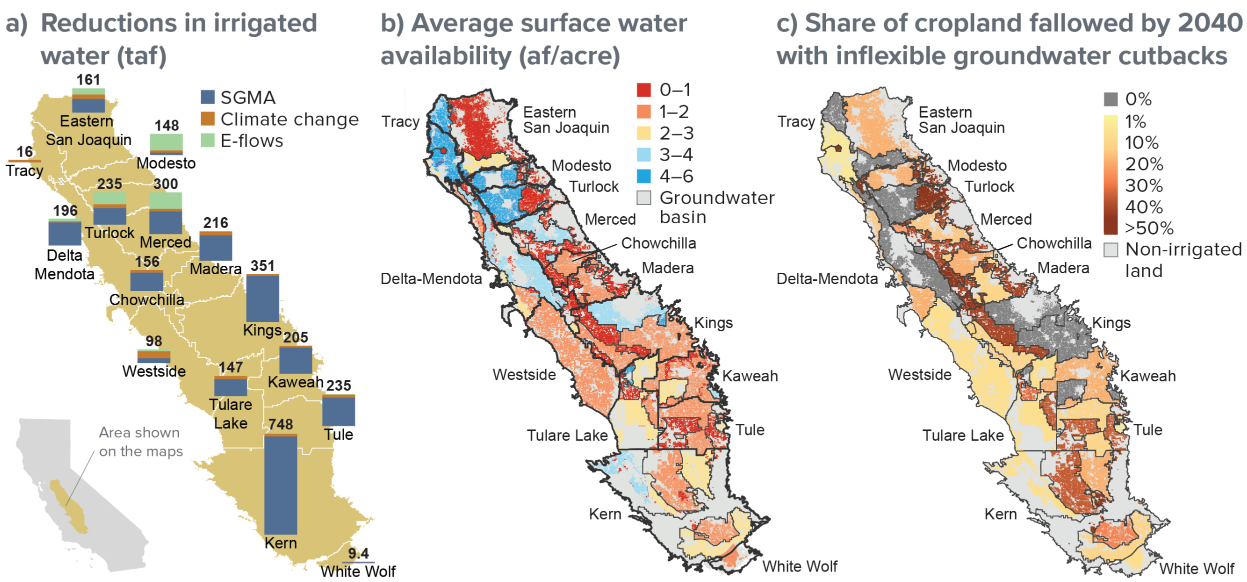
The Sustainable Groundwater Management Act (SGMA), enacted in 2014, is key to ensuring the San Joaquin Valley's future as an agricultural region. The law requires local water users to form groundwater sustainability agencies and develop and implement groundwater sustainability plans to bring use to sustainable levels by the 2040s—basically by reducing water use and/or developing new water supplies. Local water users must also avoid significant undesirable effects of groundwater use along the way.

SGMA was prompted by the chronic overpumping of groundwater, which has reduced groundwater reserves, dried up wells, and damaged infrastructure. These issues will worsen, and become increasingly costly for farmers and valley communities, if the region fails to achieve sustainability.

Achieving groundwater sustainability will be the single biggest driver reducing water supply in the valley. But climate change—which will affect precipitation patterns and increase crop water demands—will further constrain water supplies. So will additional water dedicated to the environment, especially in a few specific basins.

We estimate that by 2040, the combined impacts of SGMA, climate change, and environmental regulations could cause a 20 percent reduction in water availability for valley agriculture, or around 3.2 maf (panel a in the first figure). Water constraints will lead to a reduction in irrigated lands, and in overdrafted basins, areas with less access to surface supplies will face a much higher risk of fallowing (panel b). In the worst-case scenario, without developing new supplies or engaging in water trading activities, the transition to sustainability under climate change and increased environmental flows will require the fallowing of nearly 900,000 acres with respect to current conditions. In some areas, more than 50 percent of lands may need to be fallowed (panel c).

Supply reductions will affect the entire San Joaquin Valley, and lands with less surface water face the highest risks of fallowing



Source: PPIC estimates. For details see the technical appendix to this policy brief.
Notes: Af is acre-feet, and taf is thousands of acre-feet. E-flows are environmental flows. Panel a shows applied water reductions from different supply constraints for each of the San Joaquin Valley's 15 groundwater basins. Panel b shows the average annual availability of surface water for irrigated lands in 49 local areas that have similar access to surface water within these basins; lands with less than 3 acre-feet/acre generally require at least some groundwater for irrigation. Panel c shows the share of cropland that is at risk of long-term fallowing to end overdraft, after accounting for climate change and environmental effects, with proportional cuts in water use. The geographic distribution of fallowing could shift with more flexible water use, including trading within and across basins.

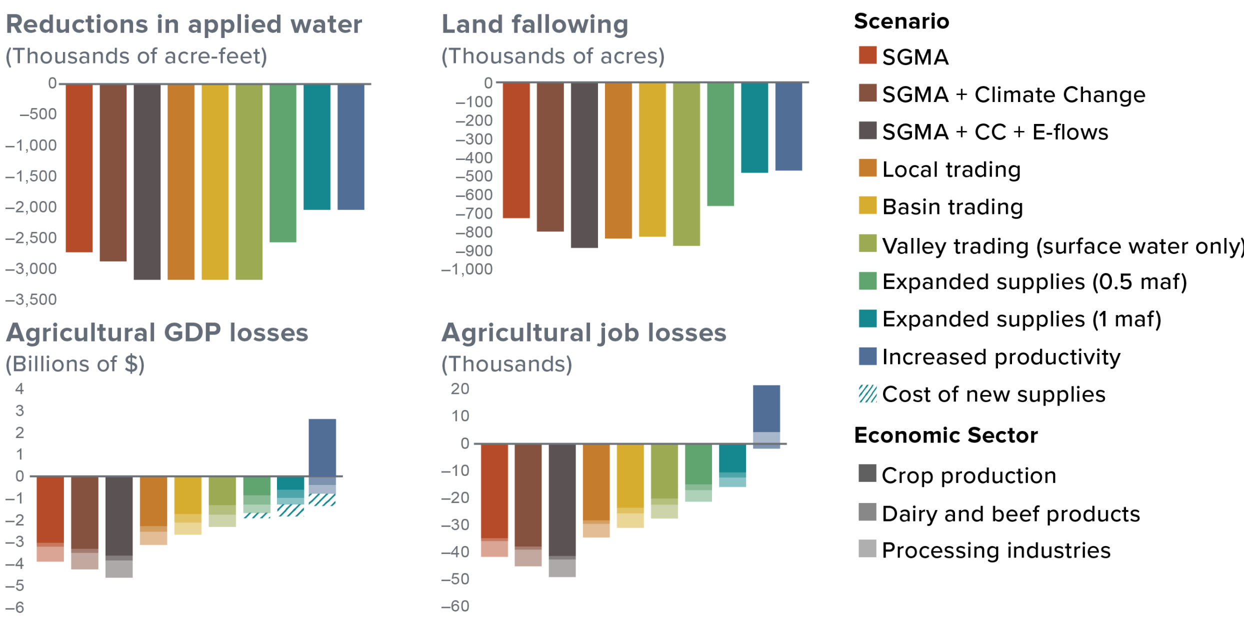
These estimates are average annual values for scenarios in 2040—but it is important to note that there is no "average" in California. The San Joaquin Valley will continue to face droughts, in addition to the water reductions we describe above, and additional seasonal fallowing will be needed in some years to cope with the intrinsic variability of the state's Mediterranean climate.

Demand and supply strategies can soften the impacts of water stress

Growing water scarcity will cause substantial land fallowing and losses of agricultural GDP and jobs by 2040. In past work, we found that two approaches could significantly mitigate the socioeconomic losses: increasing flexibility through water trading and expanding water supplies. Trading does not substantially reduce fallowing because it does not increase water availability, but it does reduce economic impacts by moving water to crops and locations where cutbacks would be most costly for growers and the regional economy. New cost-effective supply investments can also provide economic benefits, while reducing the need to fallow land.

Here we revisit our earlier analysis, exploring a range of scenarios with more recent, granular data (see box). Below we present the main conclusions based on the water, land, and socioeconomic results shown in the second figure.

By 2040, water trading, new supplies, and increased productivity can temper the impacts of farm water reductions



Source: Authors' estimates. For details see the technical appendix to this policy brief.
Notes: Maf is millions of acre-feet, CC is climate change, and E-flows is environmental flows. These scenarios report average annual impacts for 2040 relative to current conditions. Each scenario builds on the water availability and management assumptions of the previous scenario. See the box for a description of the scenarios. New water in the last three scenarios is assumed to cost $500/acre-foot.

Inflexible water management is a costly way to cope with growing water scarcity. In the most constrained scenario—when cuts from SGMA, climate change, and increased environmental regulations are all included and no trading is allowed—GDP would decline by more than $4.5 billion, employment by nearly 50,000 jobs, and regional economic activity by 2.3 percent.

Water trading would significantly reduce regional economic losses. Localized trading of both surface and groundwater can reduce the regional costs of adjustment roughly by a third (33% for GDP and 30% for jobs). More flexibility further reduces costs: with basin-wide trading and valley-wide surface trading, GDP losses are 42–50 percent lower, and job losses 37–44 percent lower, than with inflexible water management. Small reductions in total land fallowing would occur as farmers switch away from some thirstier feed crops towards perennial nuts and fruits.

New supplies would further mitigate losses. Even with relatively high costs for new water, expansion of supplies would further reduce GDP losses, while also saving jobs. At $500/af, GDP losses would decline by 58–61 percent relative to the baseline for the +0.5 and +1 maf scenarios respectively (shown in the second figure), and job losses would decline by 57–69 percent. At the heftier price of $1,000/af, the GDP benefits of a +0.5 maf expansion would still be greater than a future with flexible trading and no new supplies, and roughly equal for a +1 maf expansion. But perhaps the most noteworthy effect of new supplies is on farmed acreage: expanding supplies would reduce fallowing by 225,000 and 395,000 acres (26 and 45%) for the two scenarios considered.

Productivity growth could raise farm output above today's levels. Continued advances in productivity will significantly soften the impacts of water supply cuts facing the valley: with just half the yield growth of the past 40 years, roughly half of the transition cost could be offset by 2040 even without new supplies or water trading. In the scenario shown in the second figure—which combines productivity growth, flexible trading, and 1 maf of new supplies—regional GDP and jobs actually increase (+1%) relative to current levels despite 1.25 maf less irrigation water.

Considering potential tradeoffs of different management strategies

Although water trading and new supplies can generate broad regional benefits, it is also important to consider the tradeoffs they may entail.

Trading and new water supply projects should avoid significant harm to water users and ecosystems. Trading needs to be done in ways that avoid significant impacts to other water users and the environment. Such safeguards are already in place for surface water trading—and it will be crucial to incorporate them as new groundwater markets develop. For instance, trading should not adversely affect small community drinking water wells. Providing small communities with adequate groundwater allocations—caps on what each user may pump—is another way to ensure their supplies. It also will be important to develop new supplies in ways that mitigate or avoid significant adverse impacts on others.

Trading may adversely affect some agricultural industries. Trading would shift water away from some feed crops (especially alfalfa and irrigated pasture) toward specialty crops—accelerating a process that has been underway for some time. This will raise costs for dairy, beef, and their related processing industries, which will have to buy these inputs from elsewhere or find suitable substitutes. Although these adverse impacts are overshadowed by the larger benefits of water trading, transitional support for affected communities may be warranted.

The valley will still need to manage large increases in fallowed land. Trading reduces the socioeconomic costs of having less water, but barely changes fallowed acreage. Even with an optimistic scenario for new supplies, the valley is looking at close to half a million acres coming out of irrigated production. Haphazard land fallowing could increase dust and air quality problems, exacerbate the spread of weeds and pests, and degrade soils. It will be essential to put these lands to alternative uses that avoid these problems and generate economic and environmental benefits.

Future scenarios for San Joaquin Valley agriculture

Using our models, we estimate average annual conditions in 2040 under nine scenarios with different water supply and management strategies, and we compare them to current conditions. Results are summarized in Figure 2 and explored more fully in the technical appendix. Each scenario builds on the prior one:

- **SGMA:** This scenario examines a reduction of 2.7 maf in groundwater pumping to achieve groundwater sustainability under SGMA. It assumes inflexible water use, in which every farm has to cut its use in proportion to local overdraft conditions, without the option to trade water.
- **SGMA + climate change:** This scenario includes further constraints on irrigation water from climate change, including a 243 taf decline in surface deliveries and a 70 taf increase in crop water demands. It also assumes inflexible water use.
- **SGMA + climate change + environmental flows:** This scenario adds new environmental flow requirements that cut back farm water deliveries (293 taf in the northeastern part of the valley and 44 taf in Delta imports). This is the most constrained scenario for farm water availability—with combined cutbacks totaling 3.15 maf annually—and we use it as the future baseline. It assumes inflexible water use.
- **Local trading:** This scenario begins our exploration of water trading as a loss mitigation strategy. It allows both surface water and groundwater to be shared flexibly within each of 49 local areas that have similar water availability. Current practice lies somewhere between the inflexible use approach and this one; many irrigation districts allow local surface water trading, but groundwater trading is still rare.
- **Basin trading:** This scenario expands trading options by allowing water to be shared flexibly across local areas within each of the valley's 15 groundwater basins. For some basins with large internal differences in water availability—such as Turlock, Kings, Kaweah, and Kern (as shown in panels b and c in the first figure)—achieving this level of trading would require substantial changes in practice.
- **Valley trading:** Here we also allow valley-wide trading of surface water to cope with increasing water scarcity. This is an optimistic scenario; although surface water trading is already a common way to secure regular supplies in some areas, additional water movement might be constrained by regulations or lack of infrastructure. We assume groundwater will not be allowed to move across basins, consistent with greater legal restrictions on this resource.
- **Expanded supplies:** We include two scenarios, adding 0.5 maf and 1 maf in water supplies that are shared flexibly in areas with strong demand. The first option is close to what we estimated to be cost effective in our previous analysis, and the second provides an optimistic scenario for augmenting water supplies. Sources for new supplies might include local recharge, changes in operations to capture more flood flows under new climate conditions, and imports from other regions.
- **Increased productivity:** California farmers have been increasing productivity over time. Although acreage has remained relatively constant, yields and quality of many crops have been growing, and farmers have been shifting to crops that generate more economic value. As a result, real farm GDP has grown by an average rate of more than 1.5 percent annually since 1980. We use a simple measure of productivity increases, based on the historical evolution of crop yields, with comparable increases in the productivity of applied water and farm labor. If trends since 1980 continue, yields would increase by an average of 17 percent by 2040, and almost 30 percent for some important crops like almonds and pistachios. Given potential constraints, we assume half the historical yield growth. We present this in a scenario that also includes water trading and new supplies, which increases growers' incentives to expand crops experiencing faster productivity growth. But productivity increases would likely occur under any scenario.

Valley farms and communities can thrive with less water

The footprint of the San Joaquin Valley's irrigated agriculture will shrink in the next two decades as SGMA comes into force. While we focus here on possible trajectories as water availability diminishes, we recognize that changing markets, access to labor, product markets, and technology will bring further shifts. But valley agriculture can remain a major global supplier of food, and a vibrant force in the regional economy. The following actions can support positive transitions.

Facilitate flexible demand management. Transparent, well-run water markets will be essential to lessen the cost of growing water scarcity. It's urgent to get the basics in place for local groundwater trading—including groundwater allocations, strong oversight, and protections for small communities. Improvements in local, state, and federal surface water trading rules can also help.

Improve procedures and infrastructure to boost supplies. Capturing and storing more water during wet periods can reduce water scarcity and the need to fallow farmland. Taking advantage of these opportunities will require smoother permitting processes and strategic investments in water conveyance and storage infrastructure.

Plan for and incentivize smart choices on transitioning lands. It is also essential to avoid the downsides of haphazard land fallowing by putting formerly irrigated lands to beneficial uses such as solar development, water-limited agriculture, and habitat restoration. This will require both careful planning and financial and regulatory incentives. Progress will be hindered if these lands become a liability to growers.

Take coordinated action. There are no farm-by-farm solutions when it comes to improving water trading, enhancing water infrastructure and supplies, or managing large-scale farmland transitions. Achieving successful outcomes will require unprecedented coordination and cooperation among local and regional parties—with strong partnership and support from state and federal agencies.

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