Identifying Policies to Mitigate the Costs of Drought

Ellen M. Bruno

In this article, I discuss past and current strategies to mitigate the costs of drought. Adapting to future droughts will require policy changes that increase the flexibility in use of both surface water and groundwater, particularly from year to year.

Crises often lead to policy change, and drought is no exception. The last drought spurred the Sustainable Groundwater Management Act (SGMA) of 2014, which is revolutionizing the way groundwater is managed throughout California and providing incentives to store water underground during wet years for use during dry years.

Previous droughts have resulted in similar policy changes. For example, the 1991–1992 drought begot the passage of the Central Valley Project Improvement Act (CVPIA) and the development of the Kern County water banks, both major water policy advances. Each policy advance has provided an opportunity for market-based instruments to emerge or advance. The CVPIA increased the ability to transfer water between users across space and the water banks enabled water transfers within users over time.

Although large variability in precipitation from year to year is normal for California, we face a future where climate change may exacerbate droughts. As we grapple with drought this year and in the years to come, it will be important to continue to reevaluate the strategies at our disposal for mitigating the costs of drought.

What policies are needed so that we can better adapt to periods of water scarcity? In this article, I discuss past strategies for mitigating the costs of drought and their potential, the current challenges in groundwater management, and potential future policies to improve water allocation in the state and reduce the costs of drought in years to come.

Groundwater Supplies

Historically, groundwater has served as an adaptation strategy during times of drought to buffer costs associated with reduced surface water supplies. But under open-access conditions, where groundwater pumpers face little to no constraints on well drilling or pumping, groundwater levels get drawn down increasingly over time, increasing the costs for everyone to access that groundwater. Groundwater in California is largely unmetered and property rights to groundwater are not well defined.

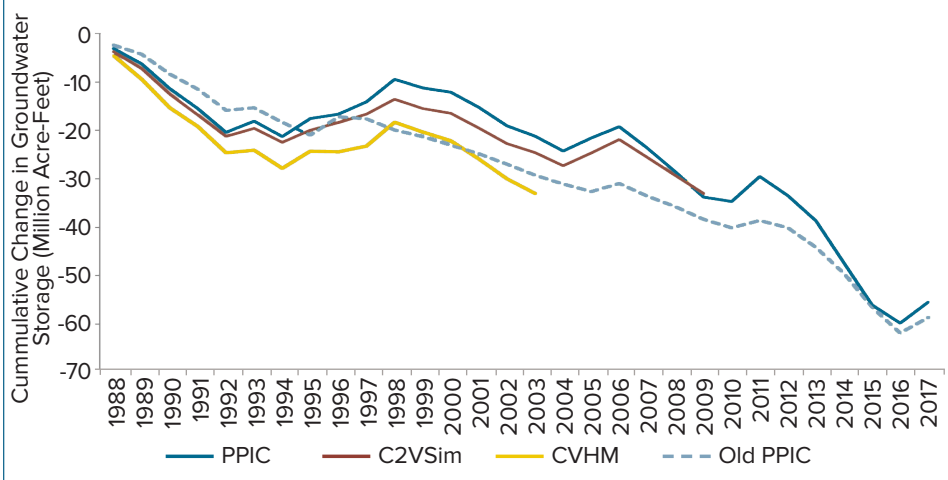
Since groundwater pumping is largely unmetered, hydrologic models have difficulty estimating groundwater balances without much ground-truth data. Figure 1 shows that while there are differences across models, there is general agreement on the decline in San Joaquin Valley water storage over time. The lowering of groundwater levels implies higher costs to pump, decreasing the buffer value of groundwater during droughts. If left unaddressed, the buffer value of groundwater will decrease over time as this resource becomes increasingly inaccessible and expensive.

California's Surface Water Market

The surface water market has also been seen as a strategy to mitigate the costs of drought. Farmers in California can voluntarily reallocate scarce water supplies amongst each other using a vast network of infrastructure, subject to regulatory constraints. If scarce water can be reallocated to its highest-valued uses, then the largest costs of drought can be avoided.

However, California's surface water market is characterized by low transaction volume and that volume has remained low since the early 2000s. On average, California uses about 43

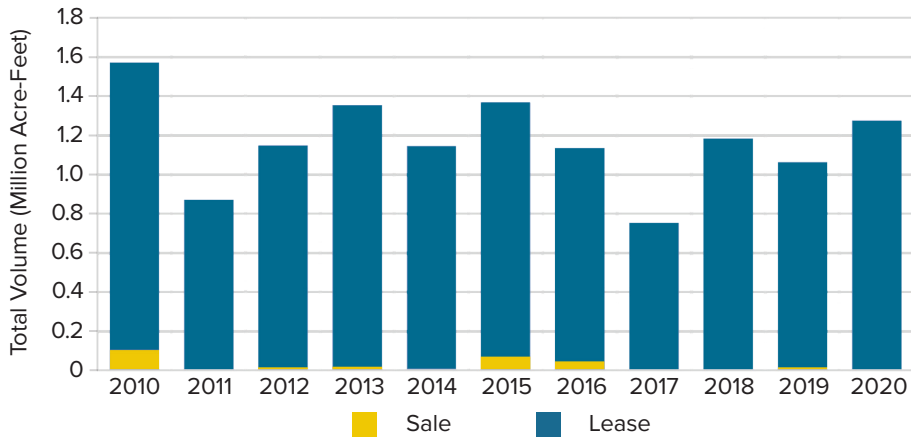
Figure 1. Cumulative Change in Groundwater Storage in the San Joaquin Valley



Note: Lines represent estimates of the cumulative change in groundwater storage from different models.

Source: Adapted from the Public Policy Institute of California's (PPIC) report "Water and the Future of the San Joaquin Valley. Technical Appendix A: Updated Assessment of the San Joaquin Valley's Water Balance." Available at: https://bit.ly/3Bcye9N.

Figure 2. Total Volume of Water Transacted in California's Surface Water Market



Source: "The Future of Water Markets: Obstacles and Opportunities." Clay Laundry presentation, July 20, 2021.

million acre-feet (AF) of water each year for agricultural and urban uses, with 80% of that (34 million AF) going to irrigate crops and the remaining 20% (8.6 million AF) going towards residential, commercial, and industrial uses. Meanwhile, total volumes traded in the surface water market haven't exceeded 1.6 million AF in the last 10 years, and these include transfers to and from urban areas.

Figure 2 plots the volume of water traded in California since 2010. Volumes in any one year range from 700,000 AF to 1.6 million AF and look small compared to the total water use in the state, averaging just 4% of statewide use.

Perhaps a better comparison point than statewide water use is the quantity of surface water deliveries in an average year, since groundwater is known to constitute 40% of the water supply, on average. California Department of Water Resources data from 1998–2015 shows that during drought years in that period (2007–2009 and 2012–2015), water supplied from state, federal, and local projects, plus the Colorado river, averaged 19.7 million AF. By contrast, it averaged 24.9 million AF during the remaining non-drought years (1998–2007 and 2009–2012). Comparing deliveries in drought years to non-drought years throughout this period of 17 years, we see that the average drought-induced deficit in surface water deliveries is around 5.2 million AF.

This implies that quantities traded in the surface water market make up for a non-trivial amount of the average drought-year deficit in surface water deliveries. However, the volume of water traded in the surface water market has remained constant since the early 2000s. If water scarcity increases and the market size remains unchanged, then its capacity to mitigate the costs of drought in the future may be limited.

The Sustainable Groundwater Management Act (SGMA)

Presently, the state is grappling with new groundwater legislation. SGMA requires newly formed groundwater management agencies to develop and implement plans to achieve groundwater sustainability over the next 20 years.

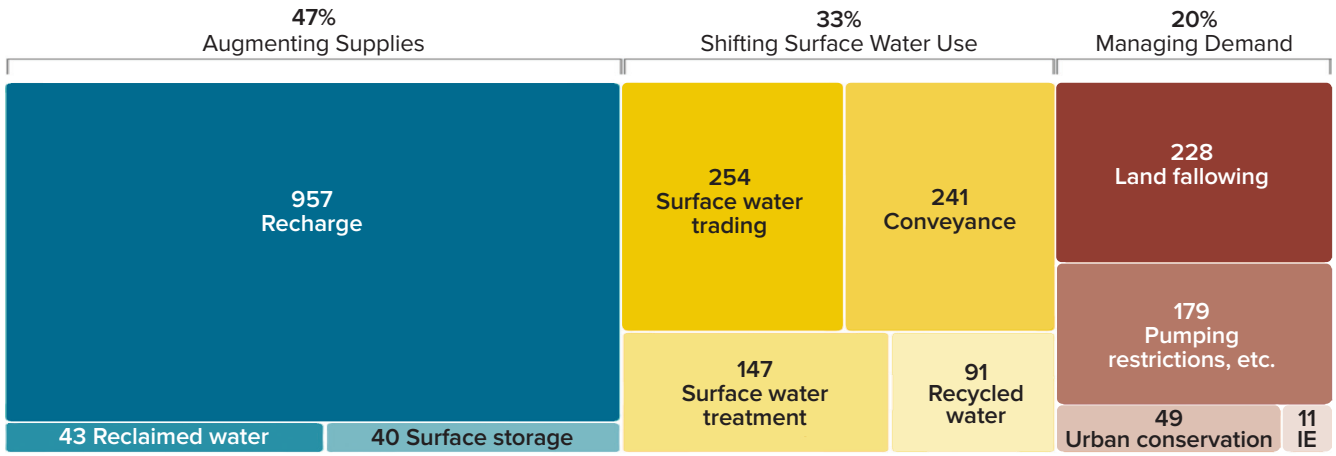
Maintaining groundwater storage seems broadly good for long-run adaptation to droughts and climate change. However, agricultural users may be concerned that measures taken to maintain groundwater levels in the short run could hinder their ability to make up for shortages in surface water during times of need. For example, if agencies restrict groundwater pumping in order to let groundwater levels recover, this may further exacerbate the costs of drought for growers.

In reality, it looks like SGMA is acting primarily as an incentive for agencies and users to recharge the groundwater through increasing supply, as opposed to reducing demand. Figure 3 summarizes how groundwater agencies plan to bring their basins into balance, with almost 80% of the overdraft deficits being met with either supply augmentation strategies, like artificial groundwater recharge using winter flood flows, or with shifting surface water use, like recycled water. If climate change condenses the winter period in which the bulk of precipitation falls and reduces the snowpack storage capacity by shifting the form of precipitation from snow to rain, then it is good that local water managers and state regulators are taking action to use our groundwater aquifers as underground storage.

Most groundwater plans reveal that agencies are using groundwater cutbacks as a last resort to achieve sustainability. Although they will likely be necessary for some of the most overdrafted basins, groundwater agencies are largely incentivized to find other solutions. Many of the agencies that are considering groundwater restrictions or allocation, are also considering the development of a groundwater market to trade those allocations.

Of the proposed groundwater management plans that have been submitted so far, 60% suggest the possibility of setting allocations, and two-thirds of those say they will consider facilitating the trade of those allocations. Allowing trade of allocations is an important part of reducing the economic cost of pumping restrictions.

Figure 3. Summary of Groundwater Management Plans Under SGMA



Total Amount: 2,241 Thousand Acre-Feet per Year

Note: The amounts are shown in thousand acre-feet per year. IE is irrigation efficiency. The pumping restrictions category also includes groundwater allocations, water metering, pricing incentives, and groundwater trading. Reclaimed water includes desalinated brackish groundwater and water produced by oil extraction.

Source: PPIC Report: "A Review of Groundwater Sustainability Plans in the San Joaquin Valley." Available at: https://bit.ly/3mdmL3A.

Coping with Future Droughts

Mitigating the costs of future droughts will require a suite of policy instruments. There is no silver bullet for fixing California's water problems, but there is potential for improvement in many areas.

Efforts to allocate water more efficiently, both across space and over time, will enhance the value derived from scarce water. Water is unlike other commodities in the way we can and cannot move it around and in the way moving it around can harm the environment and communities. Market-based policy instruments need to be designed with these issues in mind.

Spatial arbitrage of surface water is limited because of physical transport constraints and regulations that are designed to protect third parties from harm. Reducing the transaction costs of surface water trades, while ensuring protections—e.g., by streamlining the approval process or centralizing information—could increase the adaptive capacity of the surface water market. Estimates by Nick Hagerty suggest that eliminating transaction costs in the wholesale market for surface water could lead to benefits ranging from $86 to $278 million per year. Simultaneously enabling trade of either surface or groundwater at the local level—within irrigation districts and between agricultural and urban users—would lead to further gains.

Policies to improve arbitrage across time could also greatly enhance the ability of users to adapt to water scarcity. The Sierra snowpack, combined with our system of surface water reservoirs, enables us to capture and store water during the winter for use during the summer. This system does a remarkable job of reallocating use over time within a year. However, we could do more to store water from year to year and enable water users to arbitrage across longer time horizons.

While SGMA is encouraging agencies to bank excess water during wet years, efforts to set up more official groundwater banks—where formal accounting systems enable individual water users to draw from their reserves when needed—will enhance the flexibility of water users. The Kern County water banks remain the most active groundwater banks in the state by far; other regions could take advantage of a similar scheme.

It's largely accepted that there isn't much capacity left for additional surface water storage. All the most promising areas for dam construction have already been built. However, we have vast storage potential underground. We need to take advantage of this, while creating mechanisms for water users to flexibly arbitrage across both space and time. This can all be done with protections to reduce harm to third parties.

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For additional information, the author recommends:

PPIC. 2021. "Improving California's Water Market." *PPIC Report*. Available at: https://bit.ly/3uH6JTB.