California's Sustainable Groundwater Management Act: What Are Its Early Impacts?

Ellen M. Bruno and Nick Hagerty

In this article we discuss the early effects of the Sustainable Groundwater Management Act (SGMA) on water-related investments in agriculture. We consider the role of the regulation in driving observable trends in new well construction and permanent crop acreage. Contrary to expectations, we find that future regulation does not yet appear to be affecting the rates of well drilling nor new perennial planting.

Fall 2024 marked ten years since the passing of the Sustainable Groundwater Management Act (SGMA). Since 2014, hundreds of groundwater sustainability agencies (GSAs) have formed and developed plans to achieve sustainability in their jurisdictions by 2040, all of which have been reviewed by the Department of Water Resources. Meaningful changes are underway to correct groundwater overpumping and the other consequences of groundwater overdraft, representing a major shift in California's groundwater management relative to the past. The timeline for achieving sustainability is shown in Figure 1.

Savvy, forward-thinking farmers are likely taking SGMA into account when making long-term investments that depend on future water availability, such as the decision to drill a new well or to plant an orchard. However, the 2040 deadline to achieve sustainability is still a long way away. Is SGMA playing a role in planting and drilling decisions yet?

Since the passage of SGMA, California has seen remarkable increases in permanent crop acreage and new agricultural wells. In 2020, pistachio, almond, and walnut production increased from the year prior by 41%, 22%, and 20%, respectively, according to the California Department of Food and Agriculture (CDFA). In fact, since SGMA passed in 2014, perennial crop acreage has increased by nearly 50%.

Similarly, new well construction has shown no evidence of slowing down. Right after SGMA passed, there was a large spike in new well construction. But, that also coincided with a major drought, when new groundwater supplies were in high demand. California's major expansion of perennial fruit and nut tree crops also began long before SGMA, thanks to favorable market conditions.

It's hard to predict which way SGMA should influence trends in water-related agricultural investment. On the one hand, it could be that future groundwater regulation under SGMA makes these investments less attractive since less water might be available to pump in the future. Perhaps SGMA is leading farmers to gradually adjust and reach a new, sustainable level of pumping. On the other hand, farmers might feel a perverse incentive to race to make investments and extract groundwater now, before the regulations kick in. This could lead well drilling and orchard planting to accelerate.

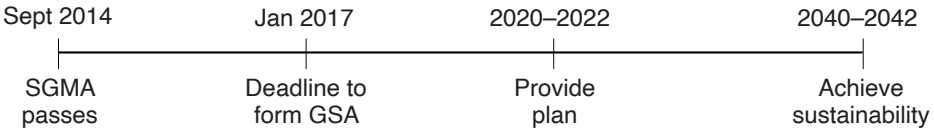
While a long transition period is helpful for farmers and managers adjusting to the new law, it can also mean that the groundwater overdraft problem gets worse before it gets better. Maybe 2040 is simply too far in the future to meaningfully influence decisions today, and business-as-usual irrigation practices will continue to deplete groundwater resources for the time being.

To empirically evaluate the early and ongoing effects of SGMA on water-related capital investments, we conduct a data analysis designed to isolate the impact of SGMA. It is important to control for other factors that might influence planting decisions, like changing crop prices and drought. Our study takes advantage of the decentralized nature of SGMA and the fact that there is a large amount of variation across GSAs. Areas with greater overdraft at baseline will likely face more stringent regulation within their basins in order to achieve sustainability.

It is this variation that we use to evaluate the early effects of SGMA on new well drilling and new perennial plantings. We compare changes over time for cropland near the boundaries of neighboring groundwater subbasins, holding constant all the other factors that influence these decisions.

The intuition for how we do it is simple. Consider a pair of neighboring

Figure 1. Timeline of the Sustainable Groundwater Management Act



Source: Adapted from the Legislative Analyst's Office timeline. Available at: https://lao.ca.gov/sections/resources/water/sgma-requirements.pdf.

GSAs. One is subject to greater overdraft (and thus more stringent regulation under SGMA) than the other. If we think about parcels of farmland immediately along either side of the subbasin boundary, they likely face very similar groundwater, agronomic, climatic, and economic conditions, but the fact that they reside in different GSAs means they will face a different magnitude of regulation under SGMA. Looking at the difference in outcomes between these neighboring parcels, before and after SGMA was announced and GSA plans were developed, reveals early responses to SGMA. We do this kind of comparison for all subbasin pairs within the Central Valley. Our results are the average effects across all these parcel-level comparisons.

Regulation Under SGMA

How do we characterize the degree of regulation that subbasins are facing under SGMA? Importantly, we want to proxy for farmers' expectations of their future groundwater regulations. We start by assembling measures of overdraft volume and planned future reductions as stated in the Groundwater Sustainability Plans (GSPs) submitted by each local groundwater agency to the state. These plans were the product of lengthy public participation processes with local stakeholders, so they are likely the best information farmers have about their own future restrictions. Still, it is possible that the numbers in GSPs are strategically reported and that farmers are aware of this.

We, therefore, obtain a third estimate by running one of the main hydrological models commonly used for water resource planning in California: the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM). This statewide model represents an unbiased, third-party representation of overdraft, but may lack detailed knowledge of local hydrological systems. The GSPs may incorporate this local information; plus, they represent the officially stated intentions of the relevant regulatory agencies. No single measure is clearly superior to the others, so we average across all three measures. This estimate of regulatory stringency is shown in Figure 2.

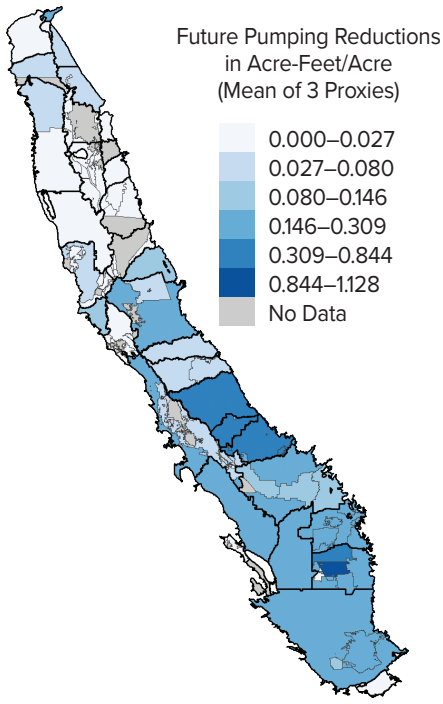
What Do We Find?

Figures 3 and 4 (on page 4) show trends in new well construction and the change in the share of fields planted in new permanent crops over time. In each figure, one line plots the trends in those parcels facing fewer future pumping reductions under SGMA and the other represents those parcels facing greater future pumping reductions. The gray shading marks the period between when SGMA passed and when local sustainability plans were published (and, we believe, before expectations about future groundwater availability were widely formed).

The average annual count of new irrigation wells per square mile has gone up and down over time, with a huge spike in well drilling occurring in 2014. But this increase was not different between regions facing greater or lesser future groundwater regulation under SGMA, suggesting that this spike was more likely driven by drought or other economic factors, rather than by SGMA. Similarly, trends in new perennial plantings do not differ based on whether or not a parcel will face more or less regulation in the future under SGMA.

We focus specifically on 2020 and 2021, two years when expectations about future groundwater regulation under SGMA were likely clear to farmers. We compare differences between the two groups from these two years relative to 2014—before SGMA passed—and see no detectable difference. Parcels on the side of the boundary with greater future reductions are just as likely to plant new permanent crops and drill new wells in 2020 and 2021 as their immediate neighbors in different GSAs facing less regulation under SGMA. There's no evidence that SGMA is causing farmers to drill wells or plant new perennials at a slower rate than before SGMA.

Figure 2. Spatial Variation in Regulatory Stringency in the Central Valley



Source: Authors' calculations.
Note: The map shows the average expected reduction in groundwater pumping required under SGMA in acre-feet per acre (AF/acre) for basins in the Central Valley. This average reduction is estimated by averaging across three variables: GSP reported overdraft, GSP projected reduction, and C2VSIM-modeled overdraft.

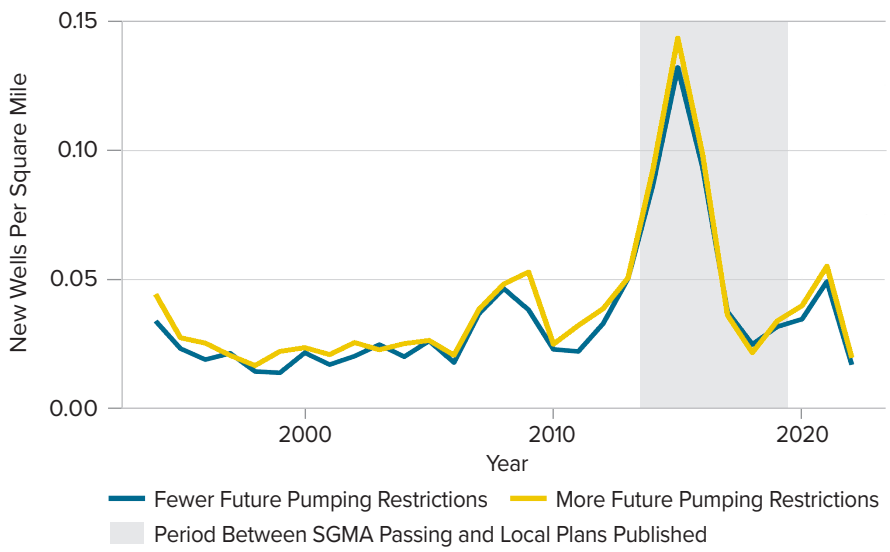
Discussion

Why could this be? Measuring future extraction restrictions is not straightforward, due to high scientific uncertainty and a lack of agreement over the volume of reductions that will be necessary in the future to halt further depletion in each subbasin. For anticipatory responses, what matters is farmers' own beliefs about their future regulation, but these are not directly observable. It could be that our three

measures of future regulation are noisy proxies for farmers' true beliefs, and this noise is preventing us from seeing a signal in the data.

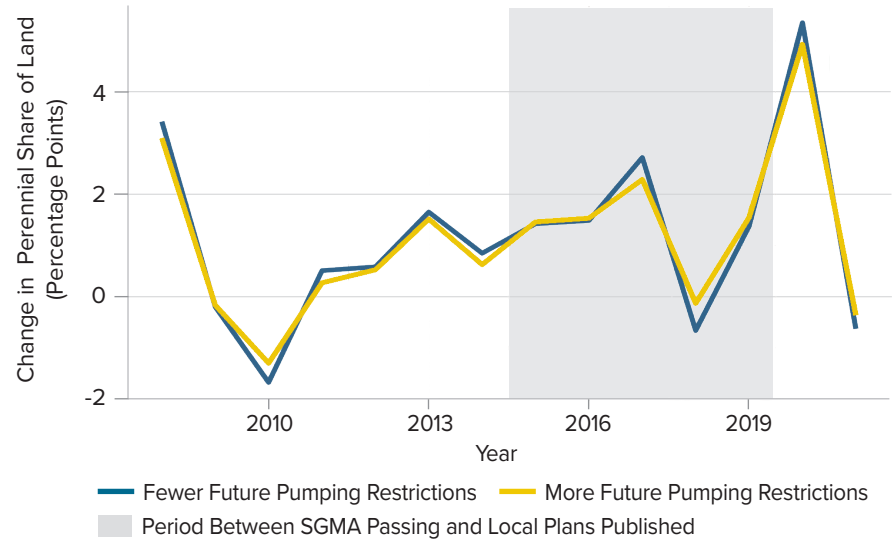
Alternatively, it could be that not much movement is happening yet, but it will later. Adjustments are needed to achieve sustainability goals by 2040. However, 2040 is still well into the future, and perhaps farmers are making a rational choice to delay these changes. This lack of response in these early years of SGMA implementation suggests that adjustments will likely come closer to 2040. Delaying adjustments means that for now, more wells will be drilled and more perennial crops will be planted, exacerbating the groundwater overdraft problem that SGMA seeks to address.

Figure 3. New Well Construction by Treatment Status, Paired Sample



Source: Authors' calculations.
Note: This figure plots the mean annual count of new wells constructed per unit area in the paired sample, which stacks all neighboring subbasins and includes only observations within 15 kilometers of their boundary. "More" and "fewer" are within these pairs, relative to neighbors in the same year.

Figure 4. New Perennial Plantings by Treatment Status, Paired Sample



Source: Authors' calculations.
Note: This figure plots the annual change in the share of fields planted in perennial crops in the paired sample, which stacks all neighboring subbasins and includes only observations within 15 kilometer of their boundary. "More" and "fewer" are within these pairs, relative to neighbors in the same year.

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For additional information, the authors recommend:

Friberg, Astrid Borup, Arthur Wardle, and Ellen M. Bruno. 2023. "How Is Demand Management Developing in SGMA Groundwater Sustainability Plans." *ARE Update* 26(5): 5–8. University of California Giannini Foundation of Agricultural Economics. Available at: https://tinyurl.com/2kx9bnca.

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