California’s New Groundwater Law and the Implications for Groundwater Markets

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The rules regarding the formation of groundwater sustainability agencies under California’s new groundwater law will influence the development of groundwater markets. Multiple groundwater agencies are forming over single basins; there is potential for strategic interaction and welfare loss when trading occurs.

Groundwater is an important component of California’s water supply that has historically been unmeasured and unmanaged at the state level. Groundwater accounts for about 38% of total water use in California on average, and many communities and agricultural areas depend primarily on it. In fact, as of 2013, about 20% of agricultural water users relied exclusively on groundwater for irrigation, and another 52% relied on both surface water and groundwater. Users with access to both sources apply more groundwater during drought years to compensate for reductions in surface water supplies.

Groundwater plays an important role in reducing water risk; it acts as a critical buffer to the climate variability that drives uncertainty in surface water supplies. Central Valley farmers use surface water, delivered through state infrastructure projects, that originates from Sierra Nevada snowpack. In the absence of snowfall, groundwater becomes the primary source of irrigation water. Estimates show that groundwater storage has been declining significantly in parts of California over the past several decades; groundwater is often pumped faster than the rate of replenishment. This overdraft, the result of extracting more than the maximum sustainable yield, has created concerns about maintaining a long-run groundwater supply.

Groundwater in California, with its lack of well-established property rights, exhibits the classic problems of an unmanaged, commonly held resource. Access to groundwater is largely unregulated, yet one user’s consumption negatively affects others by increasing pumping costs and reducing future availability of the resource. Groundwater over-pumping can also cause land subsidence, poor water quality, and other undesirable outcomes. This is a classic “tragedy of the commons” scenario where, in the absence of well-defined property rights, the result from each individual acting in his own self-interest is an outcome that is preferred by none. Prompted by years of drought, the California state legislature passed a groundwater law in 2014 that provides a statewide framework for local management of groundwater.

California Passed Groundwater Law in 2014

The Sustainable Groundwater Management Act of 2014 (SGMA) imposes timelines for basins in California to reach a long-term sustainable groundwater level. The law provides a statewide framework for local agencies, established within individual basins, to coordinate data management and organize basin management plans to eliminate overdraft. The more severely over-drafted basins are required to meet sustainability goals more rapidly.

The Department of Water Resources (DWR) assessed the degree of overdraft in all 515 California basins and designated them by priority level. The legislation applies to high- and medium-priority basins, of which there are 127 throughout the state that account for 96% of the total groundwater pumped. See Figure 1 for DWR’s basin prioritization map. From this, we can see that SGMA applies to the Central Valley aquifer system, the Salinas...
Valley, several Southern California basins, and others. New, self-organized groundwater agencies are required to form and adopt management plans. Following the adoption of groundwater management plans between 2020 and 2022, local agencies are given 20 years to achieve sustainability.

Groundwater sustainability is defined in terms of the maximum amount of water that can be withdrawn from a basin without causing “undesirable results”; these include seawater intrusion, land subsidence, degraded water quality, and depletion of the water supply to a “significant and unreasonable” degree. The maximum sustainable groundwater yield will be defined at the basin scale on a case-by-case basis.

SGMA mandates the establishment of new governance structures called Groundwater Sustainability Agencies (GSAs) on each basin to determine sustainable yields and to implement management plans of their own making. These public GSAs can take many forms; they can emerge from pre-existing water agencies (e.g., city or county agencies, water or irrigation districts) or as brand-new coalitions of groundwater stakeholders. One entity may govern an entire groundwater basin or several can share the responsibility. In many cases, multiple GSAs are being established over a single basin because, among other reasons, it is difficult for all groundwater stakeholders to organize at the basin-scale. Often, the basin is a larger area than the jurisdiction of any one pre-existing agency, nor does it align with city or county boundaries.

If there are multiple GSAs within a basin, they must choose the degree with which they will cooperate through the development and implementation of basin management plans. When there are multiple agencies over one basin, the law allows them to either write a single joint Groundwater Sustainability Plan (GSP) or to have multiple GSPs that coordinate data collection methods. That is, the stakeholders on each DWR-defined basin must decide by June 2017 to: (1) form a unifying GSA with a single basin management plan, (2) form multiple GSAs but write a unifying management plan, or (3) form multiple GSAs with multiple management plans.

Although not mandatory, GSAs are given authority to require registration of wells, measure extractions, and charge fees for pumping. For basins with multiple groundwater agencies, all governing agencies must adhere to the same definition of sustainable yield and coordinate the collection of certain variables. The law does not specify, however, how each groundwater agency should achieve its sustainability goal.

Coordinated groundwater management plans overlying a common basin are only required to sync the measurement of key variables. They must use the same data or methods in estimating a) groundwater elevation, extraction, and storage data; b) total water use and surface water supply; and c) the sustainable yield and water budget. After coordinating these metrics, GSAs are free to design management plans within their respective boundaries as they see fit.

SGMA was intentionally designed to be a decentralized form of regulation, allowing flexibility among local agencies. Lawmakers acknowledged the heterogeneity in hydrogeology and stakeholder needs across California,
and are therefore relying on local decision-makers to make locally informed decisions.

This flexibility leads to several unresolved issues when it comes to management, particularly if economic instruments will be used. With multiple agencies governing a shared basin, reaching sustainability goals will likely involve a considerable amount of coordination beyond that required for syncing data collection. Effectively addressing the “tragedy of the commons” problem associated with a common property resource like groundwater is challenging, and it becomes more difficult as the governance over an aquifer is subdivided by the emergence of multiple GSAs.

Groundwater sustainability agencies are currently being formed. By reviewing notices submitted to the Department of Water Resources, we can see how many agencies have already filed to be a GSA and how many basins already have multiple GSAs governing them. A recent report by Stanford University’s Water in the West analyzes this unfolding process, concluding that most basins will have multiple GSAs, many of which will not write a unifying GSP. This lack of consolidation will influence which management tools are used. See Figure 2 for a map of the number of agencies submitting notices to serve as a GSA by basin as of October 2016. Note that most basins already have more than one GSA, and there are still several months for additional agencies to file.

**Possible Management Strategies**

Prior to SGMA, about a third of the local water agencies throughout California voluntarily wrote non-binding basin management plans. We can draw on previously written basin management plans to get a flavor for what may unfold in the coming years. For example, a basin management plan from Coachella Valley Water District cites pumping restrictions, demand management (e.g., increasing irrigation efficiency), groundwater recharge, and source substitution (using additional delivered surface water in-lieu of groundwater) as possible management alternatives for fighting declines in groundwater levels. However, there may be limits to many of these strategies. For example, additional water for direct or in-lieu recharge may be costly or impossible for some agencies to obtain.

Groundwater overdraft can be reduced by decreasing extraction and/or increasing replenishment or recharge. Natural recharge in California is small relative to pumping and artificial recharge is not widely practiced. Thus, in terms of correcting overdraft, the most substantial gains can be made by reducing pumping. Increasing recharge alone is unlikely to eliminate the deficit in severely overdrafted areas. Although measuring groundwater extraction is not explicitly required of GSAs, it is within the GSAs’ authority to do so. For groundwater sustainability goals to be met in certain basins, groundwater use will likely need to be measured and restricted.

Aside from in-lieu recharge, there are several ways to reduce groundwater use. To enforce basin-wide reductions in pumping, agencies can either: (1) impose prescriptive standards that put mandatory limits on individual use, or (2) apply market-based policy instruments that use price as an incentive to change behavior. Economic or market-based instruments like taxes, subsidies, or transferable permits allow users greater flexibility in dealing with restrictions than prescriptive standards. Some of these economic tools also generate revenue that can be used to fund...
Groundwater projects like a recharge program.

Groundwater markets are an appealing mechanism for reaching sustainability goals for several reasons. Unlike quantity restrictions that put limits on individual pumping, groundwater markets can be designed to reach the same aggregate sustainability goal in a cost-effective manner. And unlike taxes for pumping or subsidies for recharge, groundwater markets eliminate the uncertainty in reaching a particular management goal. However, the efficiency property of markets, where trading enables the maximization of net benefits for society, breaks down in certain circumstances. These circumstances, such as when there are only a few buyers or sellers, may arise in this California groundwater setting.

Potential Impacts of Groundwater Trading

Groundwater markets are one possible management solution to emerge from SGMA. By examining GSA formation notices submitted to and approved by DWR, we can forecast the emerging regulatory landscape and interpret what it might mean for future groundwater markets in California. In many cases, DWR has already approved multiple GSAs to jointly govern common basins. This implies potential for both groundwater trading among farmers under one groundwater authority and trading of groundwater permits between GSAs.

Potential for trade will of course be influenced by local, pre-existing laws governing groundwater. SGMA does not change pre-existing groundwater rights, but rather provides an overlying framework to structure groundwater regulation. For example, some counties have ordinances restricting the delivery of groundwater outside the county. Thus, groundwater trading will likely look different in each basin within which it occurs.

Let us suppose that property rights for groundwater become more clearly defined in the future and permits for groundwater pumping are allocated within a basin. How will the permits be traded and what will the welfare impacts be? If GSAs compete with each other on behalf of the constituents in their service area, groundwater markets may be characterized by only a few buyers or sellers.

When markets are characterized by either small numbers of buyers or small numbers of sellers, there is potential for welfare loss. Depending on the number and size of emerging GSAs, there is potential for seller or buyer market power in the trading of groundwater. Market power here refers to the ability of a GSA to manipulate price and make it something different than it would be in the presence of healthy competition. A bargaining framework may also emerge where strategic interaction on both sides of the market determines outcomes. Under these trading scenarios, groundwater markets may not achieve a sustainability goal in the most cost-effective manner.

Conclusion

Several groundwater basins throughout the state have seen significant reductions in the water table over time. California recently passed legislation to sustainably manage groundwater, which will result in short-term cutbacks for long-term gains to irrigated agriculture and others that depend on groundwater. However, implementation of the new groundwater law is clouded by uncertainty. How will agencies reach their sustainable groundwater goals? Which management strategies are best for different stakeholders?

The guidelines regarding the formation of GSAs across California’s groundwater basins will influence the development of groundwater markets. While the law specifically requires groundwater agencies to sync data collection and estimation methods, it does not specify how these agencies should achieve reductions in groundwater use. Groundwater markets are one appealing strategy for managing this resource. However, where multiple groundwater agencies are forming over a single basin, there is potential for strategic interaction and efficiency loss when groundwater trading occurs.

When designing local groundwater rules, groundwater agencies should be aware of the potential shortcomings of different management tools. Furthermore, it will be important for policy-makers to continue monitoring the formation of GSAs and GSPs, and introduce corrective policies as necessary.

Suggested Citation:


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