Water & Agriculture in the San Joaquin Valley

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KEY POINTS

While the state's economic conditions and agricultural production statistics appear favorable, the same cannot be said for the state's water resource conditions:

- The state is three years removed from the worst drought on record.
- California's agriculture anticipates the potential need to fallow or retire from 500,000 to 2 million acres of productive farmland to accommodate state-mandated water reductions.
- Urban water agencies will be assigned mandatory water budgets to reduce indoor and outdoor water consumption for residential, commercial, industrial, and institutional users.
- The State Water Resources Control Board estimates that there are 200,000 to 300,000 Californians, most living in the San Joaquin Valley, who do not have access to clean, reliable, and affordable water for cooking, drinking, and basic hygiene.
- Several native species of Delta fish are on a trajectory toward extinction.
- Climate change and sea-level rise are upon us, and will require changes in water resources management.

California is the nation's largest agricultural producer and largest crop exporter, and in 2016-17 generated $46 billion in revenue (California Department of Agriculture). Of the $46 billion, $33 billion was grown in the eight-county San Joaquin Valley.

For the foreseeable future, the San Joaquin Valley will remain a global leader in crop production. A strong, resilient, and healthy agricultural economy will require a strong, resilient, and healthy water system that can support the demands of agriculture, urban areas, disadvantaged communities, and environmental interests. A key water resource management challenge for all water stakeholders in the valley will be compliance with the Sustainable Groundwater Management Act.

Sustainable Groundwater Management Act

On September 14, 2014, Gov. Jerry Brown signed into law three bills collectively referred to as the Sustainable Groundwater

Management Act (SGMA). SGMA was designed to address excessive groundwater extractions, which have resulted in groundwater overdraft, failed wells, deteriorated water quality, and irreversible land subsidence – none of which are sustainable, and all of which require corrective action.

SGMA's objective is to stop declining groundwater levels in the San Joaquin Valley and throughout California by reducing the amount of water extracted from aquifers to match the aquifer's "sustainable yield." SGMA defines "sustainable yield" as the maximum quantity of groundwater that can be withdrawn annually without causing an "undesirable result." Undesirable results include: (a) chronic lowering of groundwater levels, (b) significant and unreasonable reduction of groundwater storage, (c) significant and unreasonable land subsidence, and (d) significant and unreasonable degraded water quality, including the migration of contaminant plumes that adversely impact drinking water supplies.

Groundwater Overdraft

For valley farmers, the water available for crop irrigation can be groundwater, surface water, or both. The use of groundwater requires that groundwater surface elevations remain above the depth of a farmer's pump; when groundwater levels fall below pump level, a dry well condition occurs. Figure 1 presents the historical groundwater elevation changes observed in Fresno County.

Figure 1 uses the standard format of regulatory agencies to illustrate the changing depth of groundwater over time. The blue line, ground surface elevation, is the elevation of the ground itself above sea level. The red line, groundwater surface elevation, is the elevation at which groundwater may be found (also measured above sea level). In 1949, the depth of groundwater was 245 feet above sea level and 40 feet below ground level. By 2015, the depth of groundwater was 185 feet above sea level and 100 feet below the ground, a decline of 60 feet over a 66-year period, averaging just under 1 foot per year.

This decline is typical for the San Joaquin Valley and is referred to as groundwater overdraft. Overdraft occurs when groundwater extractions exceed nature's ability to replace the water extracted from the underlying aquifer. In 2014, the United States Geological Survey reported that within the eight-county San Joaquin Valley, average groundwater overdraft conditions were approximately 1.5 million acre feet per year.

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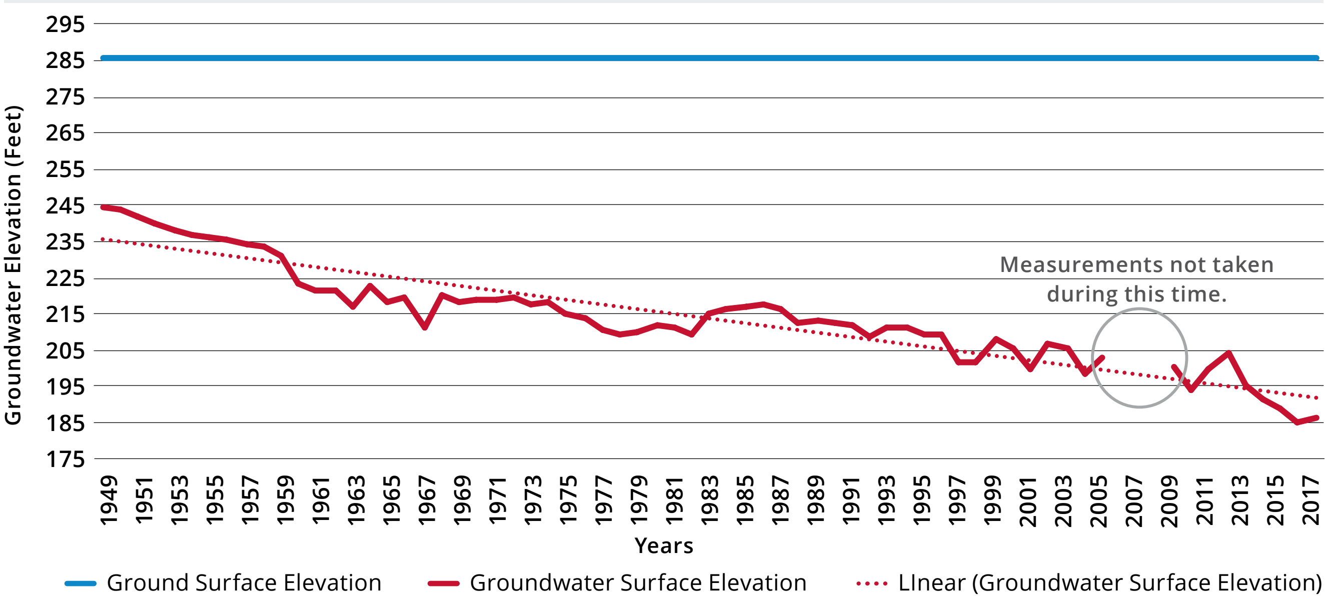
Figure 1
Typical Example of Groundwater Elevation Changes Over Time



Data Source: California Department of Water Resources, The Water Data Library

The depth of GROUNDWATER HAS DECLINED AN AVERAGE OF 1 FOOT PER YEAR for the past six decades.

During drought conditions, groundwater levels decline at an accelerated rate in response to increased groundwater extractions; and as more water is extracted, more dry well conditions are reported. Figure 2 presents the number of permit requests recorded from 1960 to 2016. As expected, requests for permits increase during drought conditions.

In reviewing well completion reports maintained by the state, it was observed that over time new wells are also being drilled at deeper elevations, as illustrated in Figure 3.

Figure 2
Total Annual Well Permits Issued in the San Joaquin Valley (8 counties)

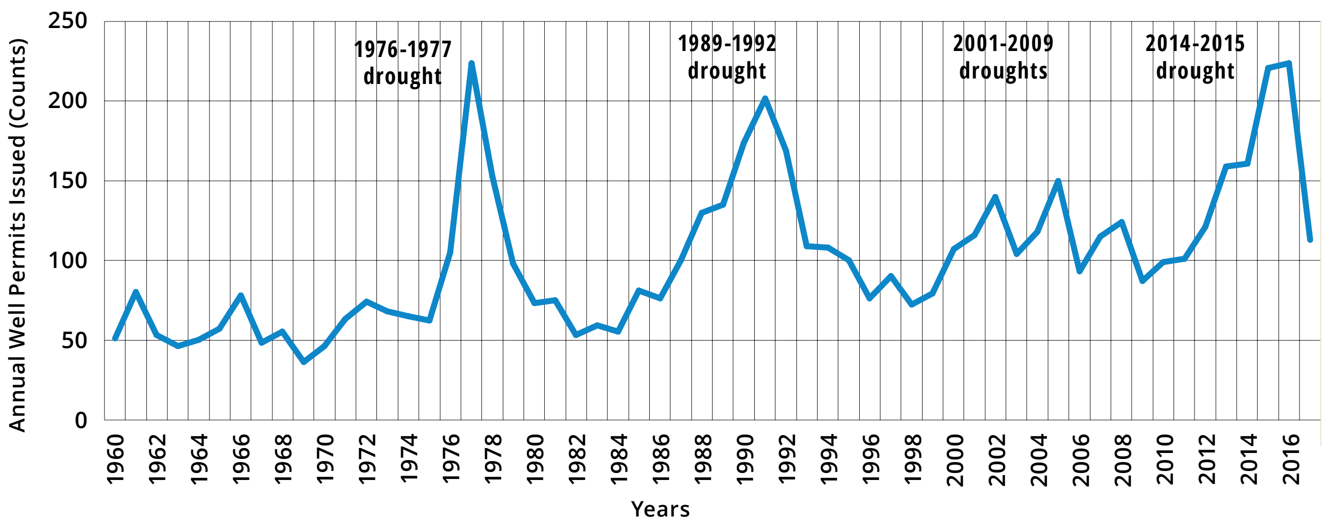
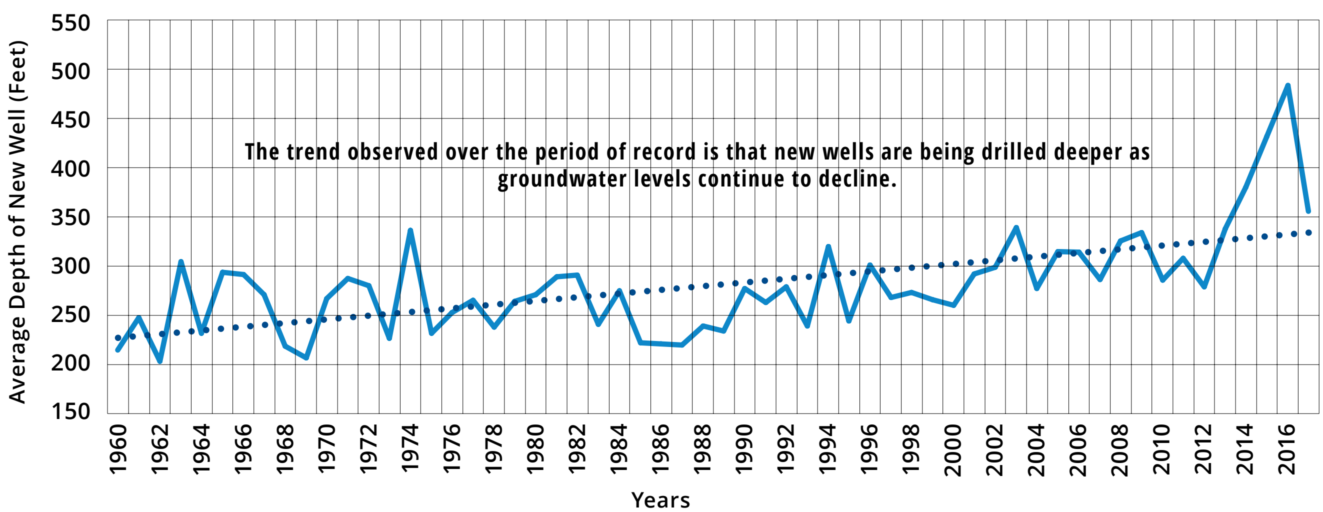


Figure 3
Average Depth of New Wells Drilled in the San Joaquin Valley (8 counties)



Figures 2 & 3 Data Source: California Department of Water Resources, Well Completion Reports

Land Subsidence

Subsidence occurs when groundwater pumping draws groundwater levels below certain types of soil materials present in the aquifers of the San Joaquin Valley. When groundwater levels decline below certain types of soil materials, they drain and the layers of soil compact and compress. The overlying soil subsides locally and at the ground surface. While the impacts of subsidence are irreversible, further subsidence can be arrested if groundwater pumping can be reduced to the point at which soil materials are not drained.

Some areas of the valley have observed subsidence of 9 inches per year. The most observable impact of subsidence is the Friant-Kern Canal, which has lost about 45 percent of its capacity to convey water along the east side of the valley due to structural issues caused by subsidence. In some locations, the water surface elevation encroaches on the canal's bridge crossings, requiring the water flow rate to be reduced to prevent water from flooding bridges.

Structural repairs to correct land subsidence conditions of the canal are estimated at $350 million to $500 million. Without corrective action, the reduced hydraulic capacity of the canal will adversely impact the ability of growers and water agencies on the east side of the southern San Joaquin Valley to address overdraft conditions that cause land subsidence.

For San Joaquin, Merced and Stanislaus counties, the combined economic impact of agricultural water reductions has been estimated at $3.2 billion and for Kern County, $4.2 billion.

Economic Impact Considerations

While the agricultural industry in the San Joaquin Valley has experienced periods of crop disruption from frost, drought, pest infestation, and other such temporary events, SGMA compliance requirements have the potential to create permanent crop disruptions resulting from permanent water supply reductions. As a result, it is anticipated that agricultural land may have to be removed from production. Current estimates of the productive land that may be fallowed range from 500,000 to 2 million acres. Based on the U.S. Department of Agriculture farm survey data of 2012, this reduction could result in annual farm receipt losses of $2.8 billion to $11.2 billion in the San Joaquin Valley. Given farm receipts for the eight-county region are $33 billion, the lower limit of losses is about 8%, while the upper limit represents a devastating 34% loss.

Because reductions in farm receipts will result in reductions in economic activity, tax revenues, employment, and thus portend a reduced standard of living for residents throughout the San Joaquin Valley, several counties have conducted economic analyses to define the impact of water supply reductions. For San Joaquin, Merced, and Stanislaus counties, the combined economic impact of agricultural water reductions has been estimated at $3.2 billion and 13,200 jobs; and in Kern County, the impact has been estimated at $4.2 billion and 24,300 jobs per year.

Opportunities for Innovative Water Resource Management Solutions

Given the San Joaquin Valley's long-standing position as a global food production region, the regional agricultural community has been moving rapidly to adopt and implement advanced technology solutions for water use efficiency that are currently used in other industries. At this time, San Joaquin Valley growers are working with Fresno State's Water Energy and Technology (WET) Center to foster innovators and entrepreneurs from all over the world to research, develop, and commercialize innovative technologies and management approaches that allow farmers to grow more food per unit input of water.

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The current model for water resources management is EXHIBITING SIGNS OF STRESS across all economic, social, and environmental sectors

Enhanced Agricultural Water Use Efficiency

On May 31, 2018, the state Legislature and the governor adopted Assembly Bill 1668 (Water Management Planning), which will require the California Department of Water Resources and State Water Resources Control Board to conduct investigations regarding the current state of agricultural water use efficiency.

To support implementation of this legislation, Fresno State's Center for Irrigation Technology and the WET Center will be working with growers, innovators and entrepreneurs from all over the world to research, develop, and commercialize smart-farming technology that optimizes irrigation scheduling and application efficiency. These two centers are working with innovators and entrepreneurs to advance the use of devices to monitor plant irrigation demands using advanced satellite imagery, drone imagery, soil moisture sensors, and directly embedded plant moisture sensors. For irrigation delivery system efficiency, the centers will rely on researchers from the Lyles College of Engineering and the Jordan College of Agricultural Sciences and Technology to develop irrigation efficiency diagnostics and metrics.

Water Commodity Market (Water Transfers and Exchanges)

To address the potential impacts associated with reduced water supplies for agricultural uses, growers, irrigation districts, and groundwater sustainability agencies are evaluating the creation of water exchange markets for surface water and groundwater entitlements assigned to individual properties in the valley. Conceptually, these markets would allow property owners within a defined geographic boundary to transfer and exchange surface water and groundwater with each other to ensure that all available water supply sources are beneficially used to the maximum extent practicable on an annual basis. There are several critically important issues that must be considered prior determining how such exchange markets could facilitate water supply management.

Development of New Water Supply Sources

Given the water resource management challenges, there is a growing desire to identify alternative water supply sources that could meet urban and agricultural water demands in the San Joaquin Valley. One option currently being utilized is recycled wastewater, treated to sufficiently high levels to allow for irrigation of food crops. Within the past 18 months, the City of Fresno and the City of Modesto have implemented recycled wastewater programs that will provide irrigation water for growers in the San Joaquin Valley.

Another option gaining favor in coastal communities, which could be adapted to the San Joaquin Valley, is the development of desalination facilities. A possible future scenario is to construct large-scale seawater desalination facilities along the Pacific Coast or San Francisco Bay, with the desalinated seawater discharged to the California Aqueduct or Delta-Mendota Canal for delivery to San Joaquin Valley urban users, agriculture users, and disadvantaged communities. The distance from San Pablo Bay to the south delta pumping facilities in Tracy is about 50 miles, and from Monterey Bay to San Luis Reservoir is about 50 miles, reasonable distances for desalination facilities and water supply transmission mains.

Conclusion

The evidence is clear that water resource management in California is difficult, complex, and controversial; and the current model for water resources management is exhibiting signs of stress across all economic, social, and environmental sectors. Opportunities to reduce the adverse economic impacts include improved water use efficiency, innovations in agricultural technology, enhanced water trading and sharing through water exchange markets, and development of new water supply sources.

References

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