WATER SCARCITY AND THE CALIFORNIA ECONOMY

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SUMMARY

This policy brief summarizes trends on water use and economic performance and highlights recent management innovations that have helped Californians adapt to growing water scarcity. It then discusses key vulnerabilities that require policy attention to cope with future droughts, the frequency and duration of which may increase with climate change.

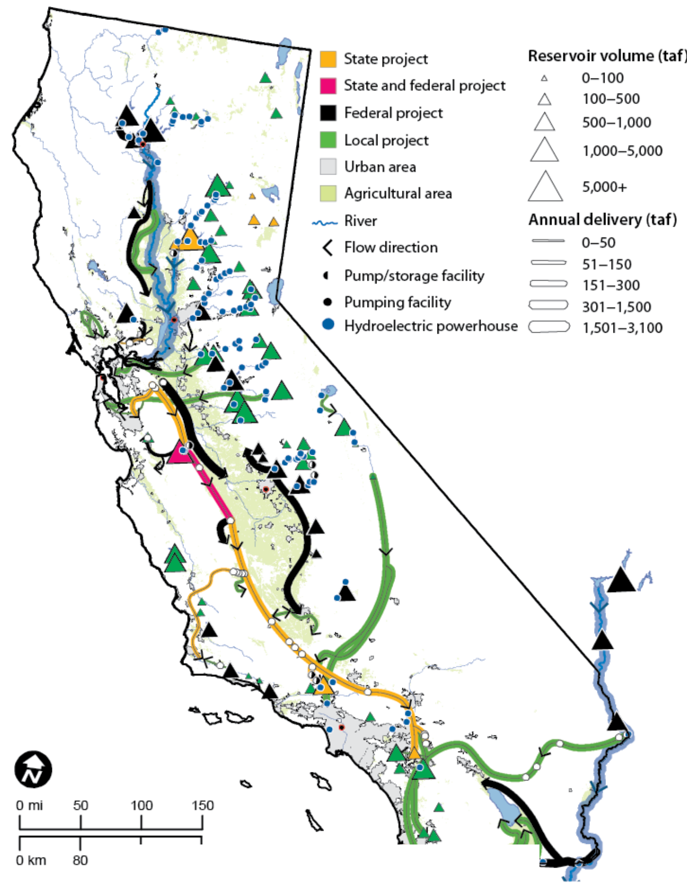

Figure 1. California's network of water storage and conveyance facilities.

INTRODUCTION

California – the state with the nation's largest population, economy, and farm sector – is in the midst of a major drought. 2013 was the driest year since recordkeeping began in 1895, and the Governor's January 2014 drought emergency declaration came in the midst of another sparse rainy season. The drought has become a regular feature in the news, and a major preoccupation of state and federal policymakers. The sound bites often simplify the tradeoffs (e.g., water for farms versus fish) and potential solutions (e.g., calls for new reservoirs to drought-proof the state). But droughts, like floods, are an inevitable feature of California's Mediterranean climate, marked by long, dry summers and significant interannual variability in precipitation. The state's economy has long coped with this variability, and crises such as this one provide opportunities to reassess vulnerabilities and consider policy and management reforms.

RISING ECONOMIC PRODUCTIVITY OF WATER USE

California's variable climate, coupled with stark regional differences in water availability and demand, spurred the construction in the early to mid-20th century of a vast network of storage and conveyance facilities. This infrastructure delivers water from the state's northern and eastern mountain ranges and the Colorado River basin to population and farming centers in the San Francisco Bay Area, the southern Central Valley, and Southern California (Figure 1). California also benefits from free seasonal storage in the mountain snowpack, an asset that is expected to diminish as temperatures warm (Hanak et al., 2011). There has been little expansion of major water infrastructure since the early 1970s, reflecting both rising real costs of new facilities and growing concerns about the environmental impacts of this infrastructure.

Yet the state's economy has continued to prosper. From 1967 to 2005, per capita water use declined by half, real per capita state GDP doubled, and the economic value of each unit of water increased four-fold (Figure 2). These trends – temporarily slowed by the recent recession – reflect increased efficiency of water use in all sectors. Although agricultural water use likely peaked in the early 1980s, productivity growth and shifts toward higher-value activities have spurred continued increases in the economic value of crop and livestock production, which now generate over $20 billion in GDP and over $40 billion in revenues (2010 $), roughly double the size in the late 1960s (Hanak et al., 2012). Urban use (including all residential, commercial, and industrial water) plateaued later, once utilities began to significantly promote water use efficiency in the 1990s. Daily per capita urban use fell from a peak of 247 gallons in 1995 to 199 gallons in 2010, enabling California to accommodate continued population growth without expanding total urban supply.

These trends in the economic productivity of water use also reflect a long-term decline in the relative importance of agriculture (Hanak et al., 2012). Agriculture still accounts for roughly 80 percent of human water use, but only 1 to 2 percent of state GDP, roughly half its share in the late 1960s. (In 2010, crop and livestock production made up 1.2 percent of GDP, and 2.3 percent including all food and beverage-related manufacturing, some of which would likely occur even if the state had no farming.)

PORTFOLIO APPROACHES TO COPE WITH SCARCITY

The striking contrast between agriculture's share of water use and its share of GDP is one reason why California's economy is expected to weather the current drought relatively unscathed. But the state has also made significant progress in reducing economic vulnerability to water shortages, particularly since a major drought from 1987 to 1992 (Hanak et al., 2011). In addition to increasing water use efficiency through better price incentives and the promotion of technologies like low-flow plumbing, urban utilities have invested in "portfolio approaches" to water management that include use of nontraditional sources like recycled wastewater, development of local surface and groundwater storage, new interties for emergency water sharing among local agencies, and long-term water purchase agreements from some farmers.

Farming is inherently more vulnerable to droughts because it requires large volumes of water for irrigation, and some portfolio tools are less effective in the farm sector. Improving irrigation efficiency stretches on-farm supplies and enhances crop productivity, but it generally does not create basin-wide water savings because it does not lower net crop water use. (Indeed, more efficient irrigation technology often increases net water use per acre by facilitating productivity gains [Scheierling et al., 2006].) New storage is also a more limited option for farmers. Although some have invested in relatively economical groundwater storage, agriculture cannot generally support the cost of new surface storage. However, the growth of a statewide water market since the early 1990s has significantly improved agriculture's adaptation capacity (Hanak and Stryjewski, 2012). The market enables farmers growing higher revenue crops to purchase water from those with more reliable supplies and lower revenue cropping opportunities. In 2014, water trading is making it possible to keep orchards alive in areas that would otherwise have received little or no water deliveries.

REMAINING VULNERABILITIES

The drought has also underscored several major weaknesses in California's approach to coping with growing water scarcity:

- **Declining aquatic ecosystems.** Populations of native fish species – an important indicator of overall ecosystem health – are declining across the state, despite several decades of well-intentioned efforts and expense (Figure 3). These declines heighten conflicts with other water management goals – including supply for human uses – and conditions are expected to get worse with a changing climate (Moyle et al., 2013). This drought has shown that regulators are unprepared for critically dry years and the difficult tradeoffs they bring.
- **Declining groundwater basins.** In most agricultural areas, groundwater is only loosely managed, and excessive pumping in normal years has led to long-term overdraft, limiting the availability of groundwater as a source of dry-year supply (Hanak et al., 2011). The lack of formal management also limits the ability to realize the significant potential of underground storage, or groundwater "banking" – which will become increasingly important as the snowpack shrinks.

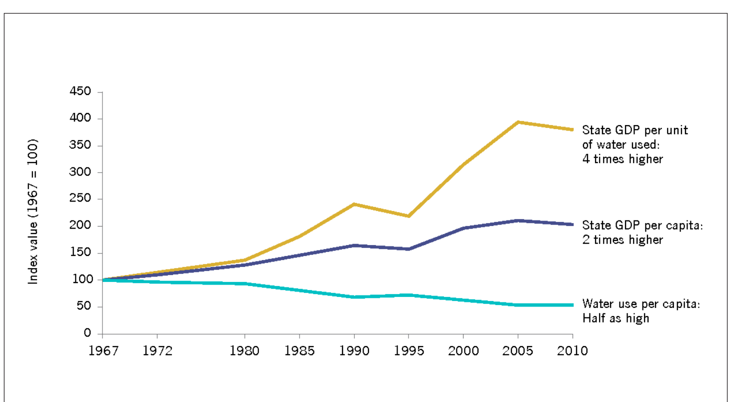

Figure 2. California's per capita water use, real per capita GDP, and economic value of water units, 1967-2005.

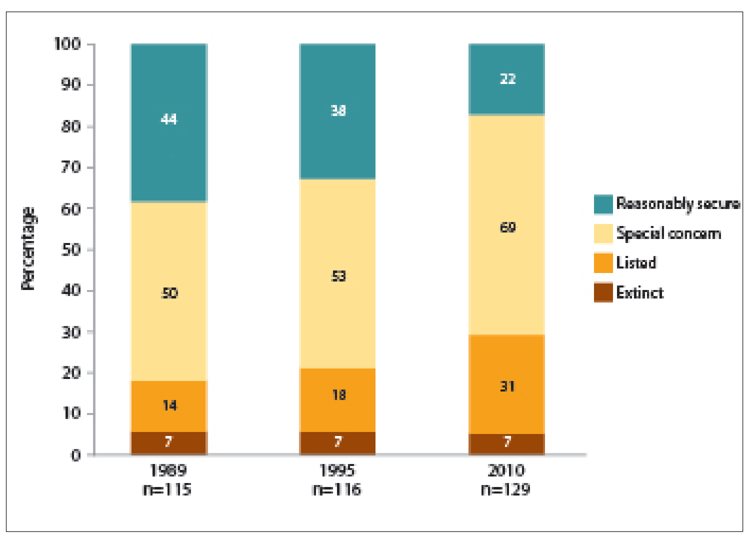

Figure 3. Rapid decline of California's native inland fishes: a status assessment.

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- **Weaknesses in the grid.** California's statewide infrastructure network has one major weak spot: the transit point in the Sacramento and San Joaquin River Delta, a network of manmade channels and low-lying islands located east of San Francisco (Lund et al., 2010). Large pumps pull water through the Delta toward aqueducts that deliver water to several regions, harming endangered fish along the way. New pumping restrictions to limit environmental damage increase water scarcity and reduce the ability to market water during dry years.
- **Rising vulnerability of the crop mix.** To tap favorable world market conditions, farmers have been shifting towards higher-value orchard crops (e.g., almonds, pistachios, wine grapes). From 2000 to 2010, orchard acreage rose by nearly 20 percent in the southern Central Valley, reaching 40 percent of irrigated crop acreage. This expansion, while generating more "cash per drop," also reduces flexibility to cope with droughts in regions that are particularly susceptible to supply cutbacks. It also increases pressure on overtaxed groundwater basins.

POLICY IMPLICATIONS

The most promising area for near-term change is groundwater management. Fueled by the drought and concerns over increased pumping for orchards, local water managers – until recently opposed to state intervention – are now calling for reform (Mount et al., 2014). The basic proposal, shared in broad strokes by the Governor's office and grassroots efforts, is to empower local agencies to adopt sustainable groundwater plans (e.g., authority to measure, monitor, and charge fees for pumping), with the state providing a backstop if locals fail to act. This approach will likely require controversial reductions in crop acreage, but it can reduce agriculture's vulnerability to drought. In addition, orchard crop growers would benefit from developing dry-year water purchase agreements with annual crop growers (who can more readily fallow).

The Delta presents greater challenges. State, federal, and local agencies have proposed a large-scale habitat restoration program and new tunnels beneath the Delta to improve water supply reliability while reducing environmental harm. But the conveyance investments would be costly – especially for agricultural water customers – and there is still great uncertainty about the program's ecological benefits and the willingness of the general public to pay for habitat, as now envisaged.

Beyond the Delta, improving the performance of California's aquatic ecosystems will require regulators to move away from piecemeal, project-based interventions to approaches that seek to improve outcomes for entire watersheds. Everyone can likely agree on the goal of spending environmental water and dollars more wisely, but identifying practical solutions may be the greatest water management challenge facing the state. Protecting ecosystems during droughts is essential, because it can take years to recover from mistakes, heightening the tradeoffs with other water uses (Mount et al., 2014).

REFERENCES

Hanak, E. et al. (2011). Managing California's Water: From Conflict to Reconciliation. Public Policy Institute of California.

Hanak, E. et al. (2012). Water and the California Economy. Public Policy Institute of California.

Hanak, E. and E. Stryjewski. (2012). California's Water Market, By the Numbers: Update 2012. Public Policy Institute of California.

Lund, J. et al. (2010). Comparing Futures for the Sacramento-San Joaquin Delta. University of California Press and Public Policy Institute of California.

Mount, J. et al. (2014). Drought's Number 1 Lesson: Modernize Water Management. University of California, Davis, Center for Watershed Sciences. CaliforniaWaterBlog.com. April 9.

Moyle, P. et al. (2013). Climate Change Vulnerability of Native and Alien Freshwater Fishes of California: A Systematic Assessment Approach. PLOS ONE. DOI: 10.1371/journal.pone.0063883.

Scheierling, S. M., R. A. Young, and G. E. Cardon (2006). "Public Subsidies for Water-Conserving Irrigation Investments; Hydrologic, Agronomic, and Economic Assessment," Water Resources Research, Vol. 42, W03428, DOI: 10.1029/2004WR003809.

Figure 1: Hanak, E. et al. (2011). Managing California's Water: From Conflict to Reconciliation. Public Policy Institute of California.

Figure 2: Updated from Hanak, E. et al. (2012). Water and the California Economy. Public Policy Institute of California. State GDP is adjusted for inflation. Water use estimates are for applied use in the agricultural and urban sectors. The figure shows "normalized" and "normal" water years.

Figure 3: Adapted from Moyle, P. et al. (2011). Rapid Decline of California's Native Inland Fishes: A Status Assessment. Biological Conservation 144:2414-23. "Extinct" = extirpated from California; "listed" = threatened or endangered under state or federal Endangered Species Acts; "special concern" = in decline and could qualify for listing in the future; "reasonably secure" = widespread and abundant according to current knowledge. N = number of known species.

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