Water Supply and Demand

AIC White Papers on California Agricultural Issues

California faces serious water supply issues, in which agricultural uses must compete with environmental uses and the demands of a growing population. Several options are open to policymakers regarding the state’s supply, demand and transport of water.

California’s primary source for water is California precipitation—rain and snowfall, not water imported from other regions or from desalinization (UC AIC 2009). Much of the precipitation is stored as surface water in reservoirs or as groundwater. In a normal precipitation year, the state will receive a total of about 200 million-acre-feet of water (maf), including 5 to 10 million maf of imports from Colorado, Oregon and Mexico (DWR 2005). Of the total surface supply, about 60 percent is used directly by native vegetation or cropland, evaporates, or flows to salt sinks like the Pacific Ocean, saline aquifers and the Salton Sea. The remaining 40 percent, or about 80 maf, is referred to as “developed” or “dedicated” and is distributed among agricultural, urban and environmental uses or is stored in surface or groundwater reservoirs (DWR 2005). About 34.2 maf is used for agricultural irrigation and about 8.9 maf is devoted to urban and industrial uses in a normal year (DWR 2005).

Most of the precipitation occurs in the mountains north and east of the Sacramento-San Joaquin Delta. However, irrigation water demand is highest in the state’s valleys and coastal plains south of the Delta so storage and transport systems were developed to capture this runoff and deliver it during the dry months. California has more than 1,200 surface water reservoirs, in addition to an extensive conveyance network dependent on rivers, levees, canals and pumping stations (see Figure 1). Since most of the urban demand lies in the South and along the coast, a series of pumps must transport water at great expense over mountain ranges. The irrigation provided by this system, together with the Mediterranean climate through much of the state, allows the cultivation of a great variety of crops. However, precipitation varies significantly from year to year and water supplies are therefore unpredictable. Moreover, current climate change models suggest that the Sierra Nevada snow pack, which serves as a natural reservoir with gradual release, is likely to decrease in the future (Kapnick and Hall 2009).

Recently, increased efficiency in usage has contributed to the state’s ability to meet water needs. However, urban and industrial water demand has risen as the population has continued to grow. Urban water usage, including residential, commercial and industrial uses, is about 8.9 maf annually and growing (DWR 2005). Environmental and agricultural water usage varies significantly from year to year, depending on drought conditions. In a normal precipitation year, agriculture will irrigate about 9.6 million acres of cropland with 34.2 maf of water, equivalent to 41 percent of total applied surface and groundwater usage (DWR 2005). In particularly dry years, agricultural usage has exceeded 50 percent of total usage (including stream flows for environmental benefits).

As more water has been allocated to urban and environmental uses, agricultural producers have adjusted by using less water. In many cases, water application is already relatively efficient so further reductions will be difficult. Moreover, decreases in water applications may lead to
decreased yields. Yet field efficiency in agriculture can undoubtedly be improved, perhaps at substantial cost, through the widespread adoption of micro-irrigation techniques. In some cases, water savings and the value of crops produced will not justify the added capital or variable costs and land fallowing or a shift in land use will follow.

The “Delta”—the confluence of the Sacramento and San Joaquin rivers at the eastern edge of the San Francisco Bay—is central to the current delivery of water from Northern California to the San Joaquin Valley and beyond. However, the water supply through the Delta is not reliable because of fragile levees, variable precipitation, and saline tidal flows. Poor quality means that Delta water has to be treated before being used for urban and industrial purposes. The Delta’s flow is controlled to enable exports. Flows below the minimum needed to sustain the local ecosystem cause severe environmental consequences. As a result, to protect fish species federal court action has restricted water exports from the Delta. The federal Central Valley Project, authorized in 1937 with first deliveries to the San Joaquin Valley in 1951, and the State Water Project, constructed during the 1960s, each export water from the southern end of the Delta (see Figure 1). The Central Valley Project (CVP) typically delivered 7 maf, but 2008 deliveries amounted to 5.7 maf (DWR 2009). The State Water Project originally delivered 2.2 maf (Howitt and Sunding 2004). Although 2009 deliveries initially amounted to only 15 percent of this amount, after May snow and rains the final allocation was raised to 40 percent (DWR 2009b). Uncertainty about water supply is an important factor in farm decisions.

Figure 1: California Water Projects. Source: California Department of Water Resources 2003.
The state has sufficient surface and groundwater storage capacity to withstand one or two dry years. However, long droughts – projected to become increasingly common due to climate change – will have even larger consequences. Droughts cause economic harm and the loss of crops. They lead to lower water quality, and raise the risk of fires and species loss. As noted above, groundwater becomes the primary water source during droughts. However, many aquifers are contaminated with metals, nutrients, or salinity due to poor land use practices (See white paper on Water Quality and Agriculture) (SWRCB 2002). Some regions withdraw too much groundwater and do not allocate water such that aquifers recharge fully during wet years. Such overdraft has not been assessed since 1980, but DWR believes that the statewide deficit averages 2 million acre feet each year (DWR 2009a). When properly managed, conjunctive use of ground and surface water enables aquifers to recharge in wet years for withdrawal in dry years.

The 2007-9 drought is causing significant economic harm in agriculture and the rest of the economy. Water shortages are projected to lead to the loss of crop value of about one billion dollars in 2009 (Howitt et al. 2009). The drought also exacerbated conditions during the worst fire season in the state’s history. In addition the risk of levee failure and catastrophic flooding from earthquakes, rising sea levels and predicted higher flood flows makes the state’s North-South water transfer process vulnerable to failure.

In November 2009, the legislature and Governor agreed on a comprehensive water package consisting of four policy bills and an $11.14 billion general obligation bond proposal, which must be approved by the voters in 2010. The bills establish a Delta Stewardship Council, require local monitoring of groundwater elevations, require statewide water conservation and increase State Water Resources Control Board enforcement of illegal water diversions. Together with local cost sharing, funds from the $11.14 billion bond measure will be used for drought relief, water supply reliability, statewide operational improvement including development of additional storage, groundwater quality protection, water recycling, conservation and watershed restoration projects (DWR 2009c). It is not clear if the state is in a financial position or the voters will agree to make these investments.

Desalination has been suggested as another possibility to address part of California’s water shortage. However, the reverse osmosis process is expensive because of high energy requirements and yields relatively little water. California’s 24 desalting plants now in operation have a combined capacity of only 79,000 acre-feet (ACWA 2009). With current technology, desalination costs are more than $1,000 per acre-foot of water plus the costs of brine disposal.

Public-works projects of the scale that made large-scale irrigated agriculture feasible in California have largely fallen out of favor. Therefore, conservation must play an even more significant role in addressing California’s water crisis. Furthermore, restricted water supplies mean that California’s future urban development will likely become denser, with less water demand for landscaping – upwards of 80% of total residential demand. Nonetheless additional water is likely to be transferred from agriculture.

Sources:


