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VII

Water Perspective in the Western U.S.-Mexican Border: Future Conflict?

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Abstract

The future of the California-Baja California region depends on finding alternative sources of potable water and new ways of distributing existing water sources. Insufficient water supply will limit regional capacity to sustain long-term development and growth. The Colorado River is the most important water source for seven western U.S. states (Wyoming, Colorado, Utah, New Mexico, Nevada, Arizona, California) and Baja California in Mexico. Due to global climate change, it is predicted that a reduction in the availability of water from the Colorado River will force all users to renegotiate existing compacts and international treaties (CDWR n.d.).

Given the availability of surface and groundwater from traditional sources, it is clear that the population of Baja California is near carrying capacity. This means that if the population continues to grow, water currently being used to support agricultural production will have to be shifted to urban use. Any reduction in flow from the Colorado River may have catastrophic consequences for Baja California's development. The state is more vulnerable to the effects of a reduction in the volume of water delivered by the Colorado River. Unlike the U.S. states, Baja California lacks alternative sources, such as rivers or aquifers not related to the Colorado River, from which it can draw in the event of an emergency shortage.

The dilemma of diminishing water supply has the potential to create international conflicts that will test the capacity of leaders on both sides of the border. The position of Baja California in the event of a reduction of flow from the Colorado River is desperate and actions born in desperation may lead to conflict. The 1944 Water Treaty should be revamped to deal with this potentially explosive scenario. Both the federal governments of the U.S. and of Mexico will have to deal with this problem within the framework of the 1944 Water Treaty at a diplomatic level, but local actions will be fundamental in finding new, creative ways to cooperate in solving the common problem for the future of the region.

Introduction

Cities in Baja California have been growing during the past 30 or 40 years and they are predicted to continue growing rapidly in the near future (CEA 2008; CDWR n.d.). Population centers along the Pacific Coast (Tijuana, Rosarito, Ensenada) are the fastest growing cities in the state. Although they use some water from local sources (Ensenada and parts of Tijuana), the bulk of the water consumed (87.3%) comes from the Colorado River, which is conveyed to the coastal region by an aqueduct that is at capacity. According to Mexico's National Water Commission (Comisión Nacional del Agua–CONAGUA), most local aquifers are overexploited or near capacity for extraction and these account for 35% of all water sources in the state (CEA 2008).

Global climate change has the potential to alter the current allocation of Colorado River water to Mexico and affect the flow of the river; thus, the U.S. is likely to make sure it can meet its own needs first in the event of a shortage. Due to the heavy dependence on this source by Baja California, there is the potential for binational conflict between the U.S. and Mexico that will have to be resolved under the framework of the 1944 Water Treaty (Mumme 2003). The U.S. Farm Bureau has also seized on the effects of climate change to argue for additional surface water storage. Climatologists predict that more rain than snow will fall in California and existing reservoirs that are designed to capture a gradual snow melt will not be able to accommodate the resulting flood-like conditions (Grenoble 2010).

Population Growth versus Carrying Capacity

The population of Baja California is mostly concentrated in the urban areas of the municipalities of Mexicali, Tecate, Tijuana, Rosarito, and Ensenada, accounting for nearly 82% of the state's population. The growth rate has been declining over the years, but it is still one of the highest in Mexico. During the 2000–2005 period, the average annual growth rate in the state was a historic low of 2.7%, with a population in 2005 of 2,844,469 inhabitants; yet, if this trend continues, the population will double by the year 2030 to more than 5.5 million inhabitants (INEGI 2007).

Most of the population of Baja California is located in the Pacific Coast region, far from the largest river of the state, the Colorado River. Baja California is a migratory magnet; only 47.8% of the population living in the state in 2005 was born in Baja California. Over 42% of the residents came from Sinaloa, Jalisco, Sonora, and other states. Approximately 11% of the population is from another country or origin not specified (INEGI 2007). The proximity of Baja California to California—as well as its level of economic development—has attracted large numbers of migrants in search of a better quality of life and economic opportunity. Most migratory flows from the state's municipalities are directed toward the city of Tijuana.

The annual growth rate in new home construction increased to 7.8% during the 1990–2000 decade, up from 4.4% in the 1980–1990 decade, and placing the state in second place at the national level. A larger number of homes meant a reduction of the average number of occupants per dwelling, in spite of an increase in population. This is an indication of a general improvement in the quality of life. In a similar manner, the total water demand for human consumption is also increasing. An individual living in informal periurban settlements without public services in Baja California uses about 50 liters of water per day, but if the individual relocates into the city, that person's water consumption typically increases to about 150 liters per day (Pombo 2003).

Based on data from CONAGUA, the volume of water available in Baja California per year is 3,622 million cubic meters (Mm^3). Sources include 672 Mm^3 from rain and snow runoff, 1,850 Mm^3 from the Colorado River, and 1,100 Mm^3 from aquifers. The annual demand for water in the state is 3,336 Mm^3, comprised of 1,869 Mm^3 from surface runoff and 1,467 Mm^3 from aquifers. The available volume of surface water is 653 Mm^3, and there is a deficit of 367 Mm^3 from aquifers. Therefore, the volume available in theory would be the difference between the supply and demand, which is 286 Mm^3 (CEA 2008).

About 84% of the water budget in Baja California is dedicated to agricultural uses, 8.2% to urban uses, and a similar percentage to industrial applications (CEA 2008). Baja California is located in the northwest of Mexico, within the barren and semiarid zone of the country. With the exception of the Colorado River Delta, most aquifers in Baja California are characterized by small storage capacity and discharge into the sea. In addition, most are overextended to meet agricultural irrigation demand and the water needs of local communities.

CONAGUA recognizes 48 aquifers in Baja California with a total annual recharge of 1,099.50 Mm^3 and an extraction of 1,149.80 Mm^3. This number includes the aquifer of Mesa Arenosa in San Luis Río Colorado (Sonora) that is shared with Baja California. Its recharge rate is 100 Mm^3 and extraction rate is 197.30 Mm^3. The balance results in a total deficit of 50.03 Mm^3, but without the Mesa Arenosa contribution, the deficit would be on the order of 247.33 Mm^3 for Baja California (CEA 2008).

Colorado River Water Policies

The Colorado River Delta and the flow of its water to Mexico are tightly controlled. The 1944 U.S.-Mexico Treaty on the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande (1944 Treaty) commits the U.S. to deliver 196,100 m^3 of Colorado River water to Mexico each year. Of this volume, at least 177,868 m^3 are to be delivered at the Northerly International Boundary (NIB) and the remainder may be delivered at the Southerly International Boundary (SIB) near the mainstem.[1] In years in which a water surplus exists in excess of U.S. demands, the Treaty commits the U.S. to deliver up to an additional 26,076 m^3 of water to Mexico (Hundley 1966).

A 1973 amendment to the 1944 Treaty—and the resultant federal implementing legislation of 1977—led to the discharge of brackish (>2900 ppm) groundwater (previously discharged into the mainstem) into an area in the southeastern edge of the Colorado Delta. This brackish water greatly expanded the extent of the Ciénega de Santa Clara from some 200 hectares to an estimated 20,000 hectares (Glenn et al. 1992; Zengel et al. 1995; Cohen et al. 2001).

From its headwaters high in the Wind River Mountains of Wyoming, the Colorado meanders 1,400 miles and is the sole dependable water supply for 244,000 square miles, an area embracing parts of seven western U.S. states (Wyoming, Colorado, Utah, New Mexico, Nevada, Arizona, and California) and Baja California in Mexico. Though the watershed is vast, the Colorado is not a heavy flowing stream, ranking about sixth among U.S. rivers and having an average annual volume of less than 15 million acre-feet. This is only about 3% of the flow of the Mississippi and about 8% of that of the Columbia, but during the 20th century, this modest flow became the most disputed body of water in the U.S. and probably in the world. The controversies extend far beyond the basin and involve hundreds of miles of aqueducts that were built, or are being built, to support population centers and to develop the farms, cities, and industries of eastern Colorado, western Utah, central New Mexico, and, especially, the vast megalopolis of Southern California, stretching from north of Los Angeles to the Mexican border. Over the years, heavy reliance on the Colorado River has resulted in significant alteration to the appearance and quality of the Colorado's flow. Such heavy competition led to the creation of domestic and international agreements that sometimes harmonized and just as often exacerbated tense relations among water users, creating a legacy of laws, court decisions, and water-use patterns that continue to influence the lives of millions of people in the United States and Mexico (Hundley 1996).

California and the Colorado River

Population growth is a major factor influencing current and future water uses. From 1990 to 2005, California's population increased from about 30 million to about 36.5 million. The California Department of Finance projects that this trend means a state population of roughly 60 million by 2050.

California is one of the most productive agricultural regions in the world. Agriculture is an important element of California's economy, with 88,000 farms and ranches generating $32 billion in gross income in 2006 and generating $100 billion in related economic activity, according to the California Department of Food and Agriculture. In 2000, California irrigated an estimated 9.6 million acres of cropland using roughly 34 million acre-feet of applied water.

Prior to 2003, California's annual use of Colorado River water ranged from 4.5 million to 5.2 million acre-feet. Since then, Arizona began full use of its basic apportionment, and Nevada approached full use of its entitlement and surplus allocation. Therefore, California has had to reduce its dependence on Colorado River water to 4.4 million acre-feet in normal years (CDWR n.d.). The Colorado River Basin is experiencing a record drought that began about 2000, which has reduced reservoir storage throughout the river system to just over 50% of total storage capacity (CDWR n.d).

In an average water year like 2005, California receives close to 200 million acre-feet of water from precipitation and imports the remainder from streams that flow from Colorado, Oregon, and Mexico. Of this total supply, about 50–60% is either used by native vegetation, evaporates into the atmosphere, is used by agricultural crops and managed wetlands (referred to as effective precipitation), or flows to Oregon, Nevada, the Pacific Ocean, and saline sinks such as aquifers and the Salton Sea. The remaining 40–50%, identified as dedicated or developed water supplies, is distributed among urban and agricultural uses, for protecting and restoring the environment, or as storage in surface and groundwater reservoirs for later use. In any year, some of the dedicated supply includes water that is used multiple times (reuse) and water stored during previous years. Ultimately, about one-third of the dedicated supply flows to the Pacific Ocean or to salt sinks, in part to meet environmental water requirements for designated Wild and Scenic Rivers and other environmental needs and objectives.

California is facing one of the most severe water crises in its history—one that is hitting hard because it has so many aspects. Growing population and reduced water supplies are worsening the effects of a multiyear drought. Climate variation is reducing the snowpack storage and increasing floods. Court decisions and new regulations have reduced Bay Delta water deliveries by 30%. Key fish species continue to decline. In some areas of the state, the ecosystems and quality of underground and surface waters are unhealthy. The current global financial crisis will make it even more difficult to invest in solutions.

The challenge to make sure that stored water is readily accessible is at its greatest during dry years because if there is an insufficient supply of water available for agriculture (due to drought conditions for that year), it will lead to a greater reliance on groundwater sources, which in most cases are already overextended and will increase the cost to consumers. In the meantime, those who have already pared down their water use may find it more challenging to achieve additional water-use reductions.

The quality of California water is of particular and growing concern. Various water management actions can potentially have a negative effect on water quality. These include transfers, water recycling methods, conjunctive use of aquifers, storage and conveyance, Bay Delta operations, crop idling, and hydroelectric power. Degraded water quality can limit, or make very expensive, some water supply uses or options because the water must be pretreated. Furthermore, water managers increasingly recognize that the quality of various water supplies needs to be matched with intended use of the particular supply.

Climate variations may worsen the state's flood risk by producing higher peak flows and a shift toward more intense winter precipitation. Rising snowlines caused by climate change will cause the Sierra Nevada watersheds to contribute more to peak storm runoff. High-frequency flood events (e.g., 10-year floods) in particular may increase with a changing climate. Along with changes in the amount of the snowpack and accelerated snowmelt, scientists predict greater storm intensity, resulting in more direct runoff and flooding, which is exacerbated in urban areas by impervious land surfaces such as asphalt and concrete. Changes in watershed vegetation and soil moisture conditions will likewise alter runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, modifying channel shapes and depths, possibly increasing sedimentation behind dams and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is, in turn, a potential for more floods following fires, which increases sediment loads and affects water quality.

Baja California and the Colorado River

There are indications that Baja California is already developing strategies to cope with a reduction of the volume of Colorado River water delivered from the U.S. (Minor 2009). The high dependency on flows from the Colorado River, combined with its relatively low position on the totem pole of the Colorado River users, puts Baja California in a vulnerable position. California may be able to substitute Colorado River water with other sources—although with potentially significant impact on the environment—but that is not the case for Baja California since all alternative water sources are at capacity or overexploited.

The difficulty of meeting increasing water demand for Baja California is in large part due to the lack of new infrastructure as well as the development of new water sources. However, the principal limitation, at least for the short term, is the inelastic supply. For years, all policies were directed toward expanding the supply with more infrastructure, but the state's residents are at a crossroads where they are using almost all available water. In the short term, it means that they can no longer follow the models of development they have been using thus far. In the long run, new ways must be found for allocating the resources to the different users. In the near future, the only way to solve the hydraulic deficit of Baja California is to make more efficient use of the water in the state's economic and domestic activities.

Urban water scarcity has a different meaning on each side of the border. While San Diego County residential users consume an average of 685.2 liters per capita per day (181 gallons) Tijuana residential users consume 150 liters per capita per day (39.6 gallons) (*San Diego Union-Tribune* 2009; CEA 2008; Pombo 2003). In other words, a family of four in Tijuana consumes about the same quantity of water as a single individual in San Diego. Therefore, the potential impact of water-saving measures is different on each side of the border, with a far smaller margin of return for Baja California.

Due to its high importance in the water budget, water savings in agriculture is the only option that will provide the volume that is required to meet the needs of the increasing urban population. Although the indicators of irrigation efficiency in Baja California are the highest in Mexico, these indicators must be improved. Steps are already being taken in this regard and include the rehabilitation of the irrigation district of the Valley of Mexicali as well as the use of water saving technologies and low-water demand crops.

Confronting the Challenge

Wastewater reuse will eventually become a new source of water for the region. Presently, in Tijuana, recycled water is substituted for potable water in landscape maintenance and industrial sector applications. Also, the large volume of wastewater not adequately treated by public utilities is creating a pollution problem in the region when it could be put to a good use if properly treated. As an example, in California, the Orange County Water District runs the Water Factory 21 that is currently injecting 56,780 m3 (15 million gallons) per day of a blend of reclaimed and deep-well water into the Santa Ana aquifer to maintain the hydrostatic pressure of seawater intrusion barriers (Mills et al. 1998). The recycled water from Water Factory 21 meets drinking water standards through treatment using advanced processes. Recycled water was chosen for many reasons. Cost was a definite consideration, but even more important were the environmental advantages:

- Reduction of 18,500,000 m^3 (15,000 acre-feet) of wastewater discharged to the ocean annually
- Reduction of dependency on the State Water Project and Colorado River supplies
- Constant availability of reclaimed water supply; seawater intrusion barriers are the last priority when imported supplies are diminished by drought or emergency interruption of importation systems (Mills et al. 1998; OCWD 2007; Pombo et al. 2008)

Unfortunately, on a larger scale, such technological and infrastructural advancements are still a long way from being implemented to meet regional demand. And so, in the short term, the growing competition for Colorado River water—due to a growing population on both sides of the border—is setting the stage for a conflict that will have to be resolved within the legal framework of the 1944 Water Treaty. When this time comes, the 1944 Treaty may fall short of what is needed to guide policymakers through the process of reevaluating and reallocating water rights among all the dependent states. In order to reduce the risk of conflict among interested parties, new policies and/or amendments may need to be drafted to prepare for the existing and predicted reality of supply versus demand of Colorado River water.

In the arid west, water is a limiting factor that affects the carrying capacity of the region. Cities can only grow to the extent that water is available. The carrying capacity of Baja California is almost entirely dependent on Colorado River water. Any reduction in the Colorado River water flow means a reduction in the carrying capacity of the state of Baja California. When carrying capacity decreases, human conflict is unavoidable (Read and LeBlanc 2003; Schwartz and Randall 2003) and then it becomes a matter of national security. Analyzing possible conflict scenarios for the Department of Defense, Schwartz and Randall (2003) point out that the most likely scenario will be that the U.S. will reduce the flows delivered to Mexico through the Colorado River, creating friction between the two governments. In the scenario of a catastrophic change in climate (as analyzed by Schwartz and Randall 2003), the United States turns inward, committing its resources to feeding its own population, shoring up its borders, and managing the increasing global tension.

The Earth's carrying capacity, which is the ability of the planet and its natural ecosystems to support life, is being challenged around the world. Technological progress has increased the carrying capacity for human populations over time. Over centuries, humans have learned how to produce more food and energy, and how to access more water. But will the potential of new technologies be sufficient when a crisis hits?

Historically, humans have conducted organized warfare for a variety of reasons, including conflict over resources and the environment. Humans fight when they outstrip the carrying capacity of their natural environment. Every time there is a choice between starving and raiding, humans raid. Peace occurs when carrying capacity goes up, as with the invention of agriculture, new management practices, and trade or technological breakthroughs. Population growth may be reduced below carrying capacity during peacetime, which can be the result of something as tragic as a large-scale dieback from disease. For example, in Europe after its major plagues, or in North America after European diseases decimated Native American populations, low population growth created peaceful periods between conflicts. But such peaceful periods are short-lived because population quickly rises to once again push against carrying capacity, and warfare resumes. Indeed, over the millennia most societies define themselves according to their ability to conduct war, and warrior culture becomes deeply ingrained. The most combative societies are the ones that survive (Read and LeBlanc 2003).

Conclusion

Diminishing water supply has the potential to generate international conflicts that will test the capacity of leaders on both sides of the border. Water allocations from the Colorado River will have to be renegotiated in the near future. The role of the International Boundary and Water Commission (IBWC) and its Mexican counterpart Comisión Internacional de Límites y Aguas (CILA) will be crucial in renegotiating water allocations for all of the Colorado River Basin. The stakes are different for both countries since it is likely that Baja California will be in a more desperate situation, due to near total dependence on water from the Colorado River and little or no availability of alternative sources.

Reductions in water use by the agricultural sector are already taking place on both sides of the border. Nonetheless, without an increase in availability, water for agriculture in Baja California will have to be reduced and the economic impact will be considerable. Moreover, Baja California has fewer options due, in part, to the fact that Mexican legislation places urban demand as the top priority for water allocation. Under Mexican legislation, only after the needs of urban users are met can the remaining water be allocated to agriculture. There is no system of redress for the revenue lost by farmers in the event of a shortage. Further, water delivery to farmers is contingent upon accessibility; if there is a failure in infrastructure such as the damage to irrigation channels in Mexicali caused by the 2010 earthquakes, water delivery to farmers can be interrupted and they do not receive compensation. California, however, has alternatives (although at a large ecological cost). In an extreme survival situation, border cities in California may use the water from the Sacramento River Delta. The position of Baja California in the event of a reduction of flow from the Colorado River is desperate and actions born in desperation may lead to conflict. The 1944 Treaty should be revamped to deal with this potentially explosive scenario.

It is important to remember that there are very strong ties between the societies of California and Baja California and that many positive actions take place at the local level, implemented by grassroots organizations from both sides of the border. For example, the Tijuana River Valley Recovery Team is a binational collaboration of more than thirty federal, state, and local agencies that was organized to implement recovery of the Tijuana River Valley (TRVRT n.d.). The U.S.-Mexico Border Environmental Program (Border 2012)—a collaboration between the U.S. Environmental Protection Agency (USEPA) and Mexico's Secretariat of Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales–SEMARNAT)—intended to be utilized to improve the environment and protect the health of the nearly 12 million people living along the border, is a program that takes a "bottom-up" approach to addressing environmental and public health needs of the border region (USEPA n.d.). The risk of conflict could be greatly reduced if the communities on both sides of the border take steps to reduce the impact of future water scarcities and cooperate with each other locally. As of now, both the central governments of the U.S. and of Mexico will have to deal with this problem within the framework of the 1944 Treaty at a diplomatic level, but local actions will be fundamental to finding new, creative ways to cooperate in solving the common problem for the future of the region.

Endnotes

[1] The mainstem is the principal channel within a river system.

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