

## **Water Perspective in the Western US-Mexican Border: Future Conflict?**

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The future of the California-Baja California region depends on finding alternative sources of potable water and new ways of distributing existing water sources. Water is a limiting factor in the capacity of the region for sustained development. The Colorado River is the most important water source for seven US western states (Wyoming, Colorado, Utah, New Mexico, Nevada, Arizona, California) and Mexico. Due to global climate change, an anticipated reduction in the availability of water from the Colorado River will force all users to renegotiate existing compacts and international treaties (California Department of Water Resources n.d.). Given the availability of surface and ground water from traditional sources it is clear that the population of Baja is near carrying capacity; therefore water from agriculture will have to be shifted to urban use in the near future. Any reduction of flows from the Colorado River may have catastrophic consequences for the development of Baja California. Baja California has a larger vulnerability to changes in the volumes delivered by the Colorado River due to a heavy dependence on this water source and lack of alternative water sources like rivers or aquifers not related to the Colorado River.

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 (Comisión Estatal del Agua de Baja California 2008), (California Department of Water Resources n.d.). Population centers in the Pacific Coast (Tijuana, Rosarito, Ensenada) are the fastest growing cities in the State, while they use water from local sources (Ensenada, and up to a certain point Tijuana) the bulk of the water consumed (87.3%) comes from the Colorado River that is conveyed to the coastal region by an aqueduct that is at capacity. According to the C.N.A. (Comisión Nacional del Agua). Most local aquifers are overexploited or near capacity, they account for 35% of all water sources in the state. (Comisión Estatal del Agua de Baja California 2008)

Global climate change has the potential to alter the present status quo with a reduction in the flow of the Colorado River. Due to the heavy dependence on this water by Baja California there is the potential for binational conflicts between the

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US and Mexico that will have to be solved under the framework of the 1944 treaty (Mumme 2003). The US Farm Bureau has also seized on effects of climate change to argue for additional surface storage, since predictions are that more rain than snow will fall in California, and existing reservoirs, which are designed to capture a gradual snow melt, won't be able to accommodate the resulting flood-like conditions.(Grenoble 2010)

The population of Baja California is mostly concentrated in the urban areas of the municipios of Mexicali, Tecate, Tijuana, Rosarito and Ensenada that account for nearly 82% of all 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 period 2000-2005 the average growth rate in the State was a historic low of 2.7 percent, with a population in 2005 of 2, 844 ,469 inhabitants, 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 is concentrated in the Pacific coast region, far from the largest river of the state, the Colorado River. Baja California is a strong migratory magnet ; only 47.8 percent of the population living in the State in 2005 was born in Baja California, over 42 percent of the residents came from Sinaloa, Jalisco, Sonora and other States and 11.0 percent is from another country or origin not specified (INEGI 2007). The proximity of Baja California to California (USA), as well as its level of economic development has attracted large numbers of migrants in search of better conditions of life. Most migratory flows from the state's municipalities are directed towards the city of Tijuana.

The rate of growth in the number of housing units has increased to a 7.8 percents in the decade 1990 -2000 from a 4,4 percent in the decade 1980-1990, placing the State in the second place at national level. A larger number of homes meant a reduction of the average number of occupants per dwelling in spite of the increase of the population, which is an indicator of a general improvement in the quality of life. In a similar manner, the total demand of water for human consumption is also increasing since all those newly relocated users from slum areas of the city increase their water consumption from about 50 liters per capita per day to 150 liters per capita per day (Pombo 2003).

Based on data from CONAGUA the volume of water available in Baja California per year is of 3,622 million cubic meters that are made up by 672 million from rain and snow runoff, 1,850 million from the Colorado River and 1,100 million from underground aquifers. The annual demand of water in the State is of 3,336 million cubic meters, comprised of 1,869 million from surface runoffs and 1,467 million from underground aquifers. The available volume of

surface water is 653 million cubic meters, and there is a deficit of 367 million annual cubic meters from underground aquifers. Therefore the volume available in theory would be the difference between the supply and demand which is 286 million cubic meters.

About 84 percent of the water budget in Baja is dedicated to agricultural uses, 8.2 percent to urban uses and a similar percentage to industrial applications. (Comisión Estatal del Agua de Baja California 2008)

Baja California, located in the northwest of Mexico, within the barren and semi-arid zone of the country. With the exception of the Colorado River delta, most aquifers are characterized by small storage capacity with most of them discharging in the sea and dedicated to agriculture and for the water supply of local communities.

Conagua recognizes 48 aquifers in Baja California with a total annual recharge of 1,099.50 million cubic meters ( $\text{Mm}^3$ ) and an extraction of 1,149.80  $\text{Mm}^3$ . This number includes the recharge of the aquifer of Mesa Arenosa of San Luis Rio Colorado (Sonora) that is shared between both states of 100.00  $\text{Mm}^3$  and the extraction of 197.30  $\text{Mm}^3$ . The balance results in a total deficit of 50,03  $\text{Mm}^3$ . But without the Mesa Arenosa contribution, the deficit in would be in the order of 247,33  $\text{Mm}^3$  (Comisión Estatal del Agua de Baja California 2008).

The flow of Colorado River water to Mexico and the delta is 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  $\text{m}^3$  of Colorado River water to Mexico each year, of which at least 177,868  $\text{m}^3$  is to be delivered at the NIB and the remainder may be delivered at the SIB near the mainstem. In years in which a surplus of water exists in excess of U.S. demands, the Treaty commits the U.S. to deliver up to an additional 26,076  $\text{m}^3$  of water to Mexico (Hundley, 1966).

A 1973 amendment to the 1944 Treaty, and resultant federal implementing legislation, led in 1977 to the discharge of brackish (>2900 ppm) groundwater (previously discharged into the mainstem) into an area in the southeastern edge of the delta, greatly expanding the extent of the Cienega 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 states (Wyoming, Colorado, Utah, New Mexico, Nevada, Arizona, California) and Mexico. Though

the watershed is vast, the Colorado is not a heavy flowing stream, ranking about sixth among the nation's rivers and having an average annual volume of less than fifteen million acre-feet. This is only about three percent of that of the Mississippi and about eight percent that of the Columbia, but this modest flow became in the twentieth century the most disputed body of water in the country and probably in the world. The controversies extend far beyond the basin and involve population centers that have built or are seeking to build aqueducts hundreds of miles long 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 the drive for water significantly altered the appearance and quality of the Colorado's flow, forced domestic and international agreements that sometimes harmonized and just as often exacerbated relations among water users, and created 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)

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, according to the California Department of Food and Agriculture and generating \$100 billion in related economic activity. 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. (California Department of Water Resources n.d.). The Colorado River Basin has just experienced a record eight-year drought resulting in current reservoir storage throughout the river system reduced to just over 50 percent of total storage capacity.

California in an average water year like 2005 receives close to 200 million acre-feet of water from precipitation and imports from Colorado, Oregon, and Mexico. Of this total supply, about 50 to 60 percent is either used by native vegetation, evaporates to 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 like groundwater aquifers and the

Salton Sea. The remaining 40 to 50 percent, 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 water and groundwater reservoirs for later use. In any year, some of the dedicated supply includes water that is used multiple times (reuse) and water held in storage from previous years. Ultimately, about a third of the dedicated supply flows to the Pacific Ocean or to other salt sinks, in part to meet environmental water requirements for designated Wild and Scenic rivers and other environmental requirements and objectives. California is facing of the most significant 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 multi-year drought. Climate variations is reducing the snowpack storage and increasing floods. Court decisions and new regulations have reduced Delta water deliveries by 30 percent. 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 water is in the right place at the right time is at its greatest during dry years – when water for the environment is curtailed sharply, less water is available from rainfall for agriculture and greater reliance on groundwater results in higher costs for many users. In the meantime, those who have already increased water use efficiency 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 potentially have water quality impacts. These include transfers, water use efficiency, water recycling, conjunctive use of aquifers, storage and conveyance, 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 water quality of various water supplies needs to be matched with its eventual use and potential treatment.

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 allow more of the Sierra Nevada watersheds to contribute to peak storm runoff. High-frequency flood events (e.g., 10-year floods) in particular may increase with changing climate. Along with changes in the amount of the snowpack and accelerated snowmelt, scientists project 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 change runoff and recharge patterns. As streamflows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildland fires due to climate change, there is in turn a potential for more floods following fire, which increases sediment loads and water quality.

There are indications that Baja California is already developing strategies to cope with a reduction of the volume of US delivered Colorado River water. (Minor 2009). The high dependency of flows from the Colorado River as well as its relatively low position in the totem pole of the Colorado River users puts Baja California in a vulnerable position. Although with a large impact to the environment, California may be able to substitute Colorado River water with other sources; that is not the case with Baja California since all alternative water sources are at capacity or overexploited.

The difficulties of meeting the increasing water demands is related largely 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. In the near future the only way to solve the hydraulic deficit of Baja California is to make a more efficient use of the water in the state's economic and domestic activities. Urban water scarcity has different meaning in both sides 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 capita per day (San Diego Union Tribune n.d.; Comisión Estatal del Agua de Baja California 2008; Pombo 2003) in other words, a family of four in Tijuana consume about the same water as a single individual in San Diego therefore the potential impact of water saving measures differ in both sides of the border with a far smaller margin of return in the Mexican side.

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 efficiency in the water use of irrigation of Baja California are the highest of Mexico, these indicators must be increased. Steps are already being taken in this regard such as the rehabilitation of the irrigation district of the Valley of Mexicali and the use of saving water technologies and low water demand crops, among others.

Wastewater reuse will eventually become a new source of water for the region, presently is being used in Tijuana for substituting recycled water for potable water in landscape maintenance and industrial sector applications. Also, the large volume of wastewater treated in public utilities that are creating a pollution

problem in the area could be put to a good use if properly treated. In California (U.S.A.), the Orange County Water District runs the Water Factory 21 that is currently injecting into the Santa Ana aquifer 56,780 m<sup>3</sup> (15 Million Gallons per Day) of a blend of reclaimed and deep well water to maintain the hydrostatic pressure of seawater intrusion barriers (Mills et al 1998). The recycled product 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<sup>3</sup> (15,000 acre-feet) of wastewater discharged to the ocean annually.
- Reduction of dependency on State Water Project and Colorado River supplies.
- Constant availability of reclaimed water supply; seawater intrusion barriers are last priority when imported supplies are diminished by drought or emergency interruption of importation systems ( Mills et al. 1998, Orange County Water District, 2007, Pombo et al. 2008).

The growing competition for a limited and scarce resource due to a growing population in 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 treaty, although it is highly likely that new, more advanced negotiations will have to be made to secure the flows of the Colorado River. In the arid west, water is the 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 is almost entirely dependent on Colorado River water. Any reduction in Colorado River water flows means a reduction in the carrying capacity of the state of Baja. When carrying capacity decreases, human conflict is unavoidable (Read & LeBlanc 2003; Schwartz & Randall 2003) and then it becomes a matter of national security. Analyzing possible conflict scenarios for the Department of Defense, Swartz and Randall point out that the most likely scenario will be that the US will reduce the flows delivered to Mexico through the Colorado River creating frictions between the two governments. In the scenario of a catastrophic climate change analyzed by Schwartz and Randall, 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 for the planet and its natural ecosystems including social, economic, and cultural systems to support the finite number of people on the planet, is being challenged around the world. It has been technological progress that has increased carrying capacity over time. Over centuries we have learned how to produce more food, energy and access more water. But will the potential of new technologies be sufficient when a crisis hits?

Historically humans 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, trade or technological breakthroughs. Population growth may be reduced below carrying capacity during peacetime due to large scale die-back such as from plague can make for peaceful times---Europe after its major plagues, North American natives after European diseases decimated their populations and thus create 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 & LeBlanc 2003)

Diminishing water supplies has the potential of generating international conflicts that will test the capacity of leaders on both sides of the border. The allocation of water from the Colorado River will have to be renegotiated in the near future. The negotiator role of the IBWC and its Mexican counterpart CILA will be crucial to renegotiate water allocation in all the Colorado River basin. The stakes of are different for both countries since Baja will be in a more desperate situation due to an almost total dependence on water from the Colorado River and little or no availability of alternative sources. Reductions in water use by the agricultural sector is already taking place in both sides of the border, but Baja California face harder options in part due to the Mexican legislation that place cities on top of the priorities of water uses. Water for agriculture will have to be reduced and therefore the economic impact will be considerable. California on the other hand has alternatives (although at a large ecological cost). In an extreme survival decision, California may use the water from the Delta. The position of Baja in the event of a reduction of flows from the Colorado River is desperate and actions born in desperation may lead to strong conflict. The 1944 treaty will have to 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 actions at a local level are being performed by grass roots movements and organizations on both sides of the border. Just to name a couple of them, the Tijuana River Valley Recovery Team, a collaboration of more than 30 federal, state, and local agencies organized to implement recovery of the Tijuana River Valley (TRVRT n.d.). Or the U.S.-Mexico Environmental Program (Border 2012) that is a collaboration between

the United States and Mexico to improve the environment and protect the health of the nearly 12 million people living along the border by cleaning the air, providing safe drinking water, reducing the risk of exposure to hazardous waste, and ensuring emergency preparedness along the U.S.-Mexico border; a program that takes a “bottom-up” approach to addressing the environmental and public health needs of the border region (US EPA n.d.). 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. Both the central government of USA and 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 in finding new, creative ways to cooperate in solving the common problem for the future of the region.

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