

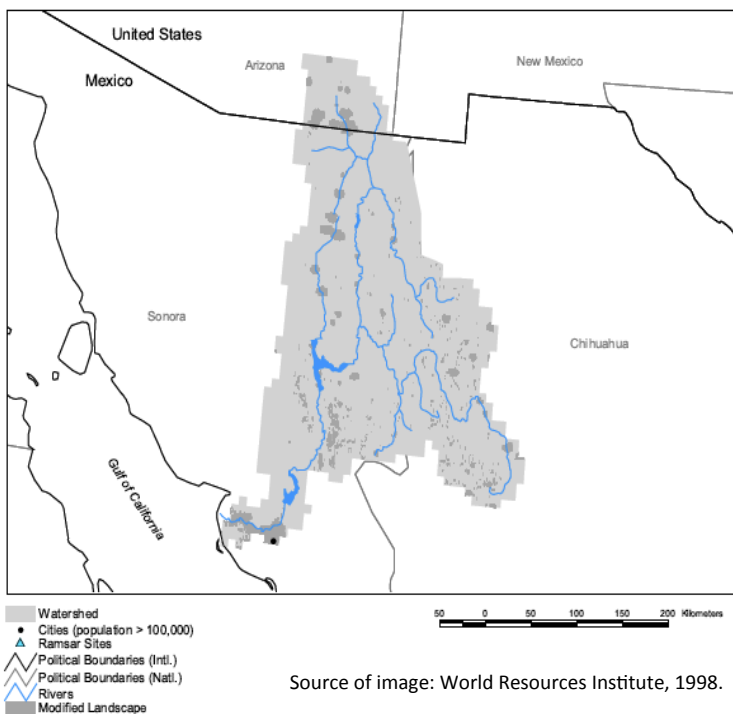
Río Yaqui river basin at a glance

Overview.- The Río Yaqui river basin (RYRB) is the largest in northwest Mexico, both in terms of area and volume of flow. Water resources in the region are under increasing stress due to intensive use for agriculture and urban growth, compounded by climate change and variability. More complete knowledge of the basin and its socio-ecological characteristics is necessary. This factsheet provides an overview of the RYRB and constitutes a point of departure for further research.

Geographic and physical features.- The Río Yaqui river basin, which lies principally in the eastern-central portion of the Mexican state of Sonora, originates in Chihuahua state to the east and in Arizona in the United States to the north. The basin is generally bounded by 27 and 32 N and 107 and 111 W. The Río Yaqui is the largest river system in Sonora State (397 km in length) and also the largest west of Continental Divide in northern Mexico (azheritagewaters.nau.edu). The mean annual temperature in the region is 20.8°C (69.4°F), while the mean annual precipitation is 475mm (18.7in). These conditions are related to the great biodiversity of the region, including various endemic species of birds and fish (World Resources Institute, 1998).

Hydrologic features.- There are different estimates of the total basin area, most vary from ~72,000 km² (Munoz-Hernandez & Meyer; Hendrickson et al, 1980; McCullough, 2005; and Addams, 2005) to 79,172 km² (World Resources Institute, 1998). The tributaries of the Río Yaqui in Sonora are the Río Bavispe and Moctezuma-Nacozari; in Chihuahua the Papigochic, Sirupa, and Aros; and in the U.S. the Leslie Creek and Whitewater Draw. The annual average discharge of the Yaqui is almost 2,800 Million Cubic Meters (MCM) (Hendrickson et al, 1980). The infrastructure of the system includes three large dams: **La Angostura (Lázaro Cárdenas)** located on the Río Bavispe in the upper basin (880 MCM of storage capacity); **El Novillo (Elías Calles)** located at the confluence of the Yaqui and Moctezuma rivers midway between Oviachic and Angostura dams in the mid basin (2,799 MCM), and originally constructed mainly for electricity generation for the Yaqui and Mayo irrigation districts; and **El Oviachic (Alvaro Obregón)** located 35 km north of Ciudad Obregón in the lower basin (2,782 MCM). The RYRB system also includes two large irrigation districts: Valle del Yaqui and Colonias Yaquis.

Yaqui Watershed

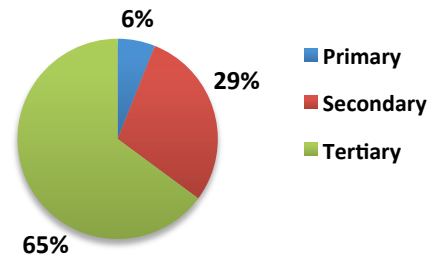


Source of image: World Resources Institute, 1998.

Social features.- The Sonora State Water Commission (CEA, 2008) has delimited the Río Yaqui planning subregion to account for its main natural and social characteristics. Accordingly, the Sonoran subregion includes 33 municipalities, which accounted for a total population >800,000 people in 2010. Considering also the 13 municipalities in Chihuahua's portion of the basin and the U.S. portion, the population totals approx. 1.2 million people. In the watershed there are five big cities and towns: Ciudad Obregón (>400,000 population), Guaymas (~150,000), and Agua Prieta in Sonora; Cuauhtemoc in Chihuahua (>150,000) (INEGI, 2010), and Douglas in Arizona. The region's social complexity is increased because of the presence of the Yaqui indigenous population which represents 2.3% of the Sonora state population of the basin in 2008 (CEA, 2008).

Economic features.- Development in the Río Yaqui river basin, both in the Mexican and U.S. portions, is highly dependent on agriculture and livestock. However, up to 2008, in the Sonoran sub-region, which accounts for the major area of the basin, most GDP came from tertiary activities (services) (CEA, 2008). This means that even though primary (agriculture, livestock), and secondary (mining, industry) activities use large amounts of land, water, and other resources, earnings do not correspond to the magnitude of use of natural resources. The most intensive water and land use corresponds to agricultural activities, which totaled almost 650,000 hectares (ha) planted in 2009, comprising both Sonora and Chihuahua states (INEGI, 2012). Water rights in the watershed are also mainly concessioned to agricultural uses, comprising approximately 90% of the water volume titled (CEA, 2008). In terms of human development, in 2000 the Human Development Index mean for the 33 Sonoran municipalities and 13 Chihuahuan municipalities was 0.77 (min. 0.65, max. 0.84) (scale 0-1) (CONAPO, 2001).

Value of Economic Activities Production in the Yaqui river basin (Sonoran sub- region's GDP)



Source of data: CEA 2008.

Current challenges.- The government of Sonora has undertaken a large-scale, state-wide water **infrastructure improvement plan** called Sonora SI (*Sonora Sistema Integral* or Sonora Integrated System). The largest piece of this project is the Independence Aqueduct (*Acueducto Independencia*), which will transport 75 MCM of water 152 km from the **El Novillo** dam in the RYRB to Sonora's capital city of Hermosillo to the west outside the basin. It is projected to cost \$3.86 MEX billion (\$294 US million) (CEA, 2011), or a third of the total Sonora SI cost (\$856.3 US million) and will almost double the city's current water supply of 80 MCM per year. The transfer is controversial, however, especially in the Yaqui Valley where more than 225,000 ha under irrigation rely on Río Yaqui water. The main critiques of the plan have to do with the lack of transparency in the planning of the aqueduct, as well as confusing and often contradictory legal and administrative provisions used by the government. Several lower court judges have ordered a halt to construction of the aqueduct until outstanding issues, such as the Yaqui tribe's claim to the Río Yaqui's water, are settled but the government has ignored the orders in each case.

The Yaqui tribe, located in the Yaqui Valley in the far south of the basin, **has serious problems with water access for agriculture and domestic use**. Water infrastructure is old and falling into disrepair, and the Yaqui communities lack the funds to repair infrastructure themselves. Water quality has recently emerged as a serious issue as reports of arsenic, agro-chemical, and fecal contamination are released. A recent recommendation by the Human Rights Commission of Mexico recognizes this as a human rights issue and recommends, among other things, that the governor of Sonora follow the orders of the courts.

Climate change has serious implications for the RYRB because of the river's importance for the large and economically important Yaqui Valley agricultural region which produces around 30% of the nation's wheat. The water yield of the basin has also already been fully allocated through water rights so any decline from the current average runoff and groundwater availability will have negative impacts on crop production. An extended drought between 1992 and 2004 led to only about one-fifth of the land in the productive region of the Yaqui Irrigation District being cultivated in 2004 due to low reservoir levels. The water withdrawal for Hermosillo could place further pressure on the system, although the government is pushing for the purchase of an equivalent amount of water rights from other water users in the basin.

Synthesis.- Science and policy in the Río Yaqui river basin must emphasize resilient water management in a social-ecological systems context. The basin is shared among sectoral uses, across ethnic, state and international boundaries, and poses critical human-ecosystem tradeoffs. These conditions stress the need for adaptive management strategies in the face of global change processes including climate change and growing human and ecosystem needs for water.

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