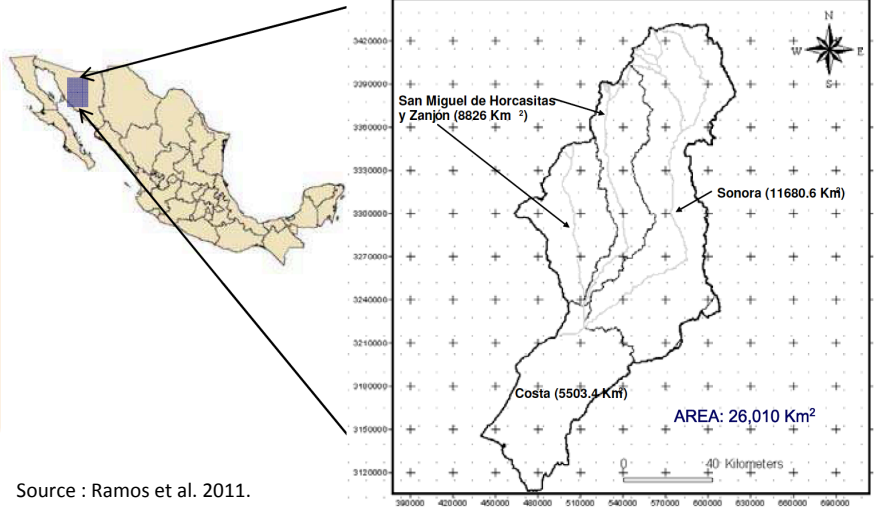


Sonora River Basin at a glance

Overview.- The Sonora River Basin (SRB) is an arid watershed located in central Sonora State, in arid Northwest Mexico. It has multiple socio-ecological subsystems and great diversity of uses and actors. Global climate change, demographic dynamics, economic factors and management challenges threaten the ability of the SRB's population to keep sustainable livelihoods and ecosystems in the long term. This document briefly identifies some of the features and challenges of the SRB.



Geographic and physical features.- The Rio Sonora has a length of 294 kilometers and flows south into the largest reservoir in the system, the Abelardo L. Rodríguez dam (CEA Sonora, 2008). The river has no continuous surface flow and the dam has been not active since 1998, although a wells system in the area supplies Hermosillo, the State's capital city. The mean annual precipitation in the basin ranges between 100 and 300 millimeters (3.94 to 11.81 inches) and follows a bimodal summer-winter pattern, with most of the rainfall occurring between July and August. Mean annual temperature ranges between 18 and 22° C (64 to 72° F) but in winter it can be below 0° C (32° F), and above 45° C (113°F) during summer (Romo-León et al., 2014). Dominant ecosystem types are open, closed and wooded shrublands (72% of the basin area), woodlands (12%), and grasslands and croplands (14%) (Robles-Morua et al., 2014).

Hydrologic features.- The SRB has four distinguishable sub-basins related to its tributaries (see figure above): 1) the Sonora river's main channel at the easternmost portion, with headwaters in Cananea and Bacoachi flowing south to Hermosillo; 2) the San Miguel river that runs north-south from Cucurpe into the main channel north of Hermosillo city; 3) the Zanjón stream, which runs parallel to the San Miguel and joins the river in Hermosillo; and 4) the lower part of the basin, the Costa de Hermosillo, which borders the Gulf of California. The Sonora River mean runoff for 1960-1997 is estimated at 16.74 Km³ (Rangel-Medina & Lopez-Ibarra, 2013). In 2007 The National Water Agency (CONAGUA) stated that all the sections of the SRB had a deficit in the volumes of surface water available with respect to the concessioned. Historic lack of water has promoted intensive use of groundwater. Currently 59% of the total volume allocated corresponds to surface water with the remaining 41% to groundwater. However in the lower SRB almost all concessions are to groundwater (Pineda et al. 2014).

Socioeconomic features.- The river basin includes totally or partially the territories of 15 municipalities that cover an extension of approx. 26,010 Km² (Ramos et al., 2011). These municipalities sum up around 860,000 people (INEGI, 2010) or 32% of the total State's population. In terms of officially registered water concessions, CONAGUA's REPDA (Public Registry of Water Rights) indicates that the SRB has 4,975 water titles in total, equivalent to 1,026 millions of cubic meters (MCM). Of these, 76% are concessioned in the lower part of the SRB, where the capital city and the Costa de Hermosillo irrigation district are located (Pineda et al., 2014). The upper section features the most productive copper mining complex in Mexico (*Buenavista del Cobre is the main company of the conglomerate*) in the municipality of Cananea. Through the mid-basin the main activities are small scale ranching and farming, while the lower basin's economic basis is tourism, commerce, and services; but also important agriculture for exporting is developed in the Costa de Hermosillo and San Miguel de Horcasitas- Carbó valleys. The SRB contributes 34% to the State's total GDP (Rangel-Medina & Lopez-Ibarra, 2013).



Shoreline change, Sonora, Mexico. Left: August 7, 1993. Right: July 8, 2011. These images show changes to the western coastline of Sonora, Mexico due to the construction of shrimp farms over the past two decades. Images taken by the Landsat TM 5. The area mapped corresponds to the lower SRB. Source: <http://coastalcare.org/2012/04/earths-changing-face-a-nasa-image-gallery/> (Accessed December, 2014).

Institutional features.- According to Mexican law, water is owned by the nation. Management is a federal government task developed through a centralized hierarchical bureaucracy headed by CONAGUA. Between the early and mid-90's several institutional reforms began a decentralization process that is still evolving today (Scott and Banister, 2008). Reforms set a frame to regularize water concessions, foster an incipient water market, promote management at the river basin level, and give opportunity to users' participation in decision-making. So far these objectives have been only partially accomplished. CONAGUA remains the central actor in management of big projects and most of large infrastructure, with local issues being addressed by the State Water Commission (CEA-Sonora) and several regional and local bodies for surface and groundwater. For administrative purposes the SRB is included within the Hydrologic-Administrative Region no. 9 "Sonora Sur" managed by the Northwest Basin Organization (OCNO).

Current challenges.- A) Water impacts of climate change.- People in the SRB have been historically struggling with water scarcity and extreme weather conditions. The southwest U.S.- northwest Mexico region is expected to face more variable precipitation patterns and higher temperatures by the end of this century (Overpeck et al. 2013), however specific global change scenarios for Sonora indicate that more rainfall could be expected with altered seasonality (Robles-Morua et al. 2014) particularly in winter (Magaña and Conde, 2000). Uncertainty in water resources availability is maybe one of the most important management challenges in the region. **B) Water management sustainability.-** Agriculture has been the main consumer of water with more than 90% of the total allocated volume. The second largest user is the domestic sector, which heavily relies on groundwater sources. Agricultural over-pumping of in the lower SRB has led to the salinization of the coastal aquifer of the Costa de Hermosillo, with consequent loss of agricultural areas (Moreno, 2006; Romo-León et al., 2014). In the coastal lower SRB there is also an increase in fish and shrimp farming, whose environmental impacts remain unknown. In the rural communities aging infrastructure will require innovative approaches to finance and manage drinking and waste water systems deeply connected to health issues (Robles-Morua et al., 2011). Recently also the upper and middle SRB were affected by a mine spill from Buenavista del Cobre in Cananea's municipality due to above average rainfall and technical failures in the tail pond system. Water wells in the river bed were closed and ranchers and farmers' livelihoods have been seriously affected and still remain dependent on governmental support. **C) Urban-rural competition and conflicts.-** Water scarcity can have implications not only for agricultural productivity but also for the evolution of the urban landscape. Hermosillo city in particular has faced the burdens to supply water for domestic use during the last 15 years. The municipality authorities have envisioned different type of solutions (new wells, water restrictions locally known as "tandeos", wastewater treatment, among others) but most of them have been short-lived or politically conflicting. The latest of these actions was the building of an aqueduct between Hermosillo and the Novillo Dam in the neighbor Yaqui River Basin to transport approx. 50 MCM of water per year. This action has been surrounded by a series of legal conflicts and institutional discussions between the population in Hermosillo, Ciudad Obregón, the Yaqui Native People, the producers of the Yaqui Valley and the State's Government, requiring at some point also the intervention of international agencies of human indigenous rights.

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