

Drought in Northern Mexico

by

Andrea Munoz-Hernandez



Objective and Tasks

The objective of this presentation is to perform a brief overview of the impacts of drought during the late twentieth century and early twenty first century in northwest Mexico, specifically in the Yaqui Basin of Sonora.

Additionally, the implementation of some adaptive strategies, and future challenges faced within the basin are discussed.

Mexico



Mean annual precipitation from 1945-2005 (INEGI, 2010)

The most important irrigation zones and the majority of industrial plants within the country are located in the northern states of Mexico.

However, the states located in the southeast and along the Gulf of Mexico hold approximately 70% of the available water in Mexico (Magana and Conde, 2000).

The Yaqui Basin, Sonora



The Yaqui basin is characterized by semi arid conditions with an average precipitation of 526 mm/year and a mean annual temperature above 22 °C.

The Yaqui Basin



The basin consists of roughly 72,000 square kilometers.

Water users include farmers, rural and urban municipalities, industries, and mines.

The water to satisfy user needs comes from reservoirs constructed in series.

The Yaqui River Basin includes one of the most important agricultural regions in Mexico, known as the Yaqui Valley.

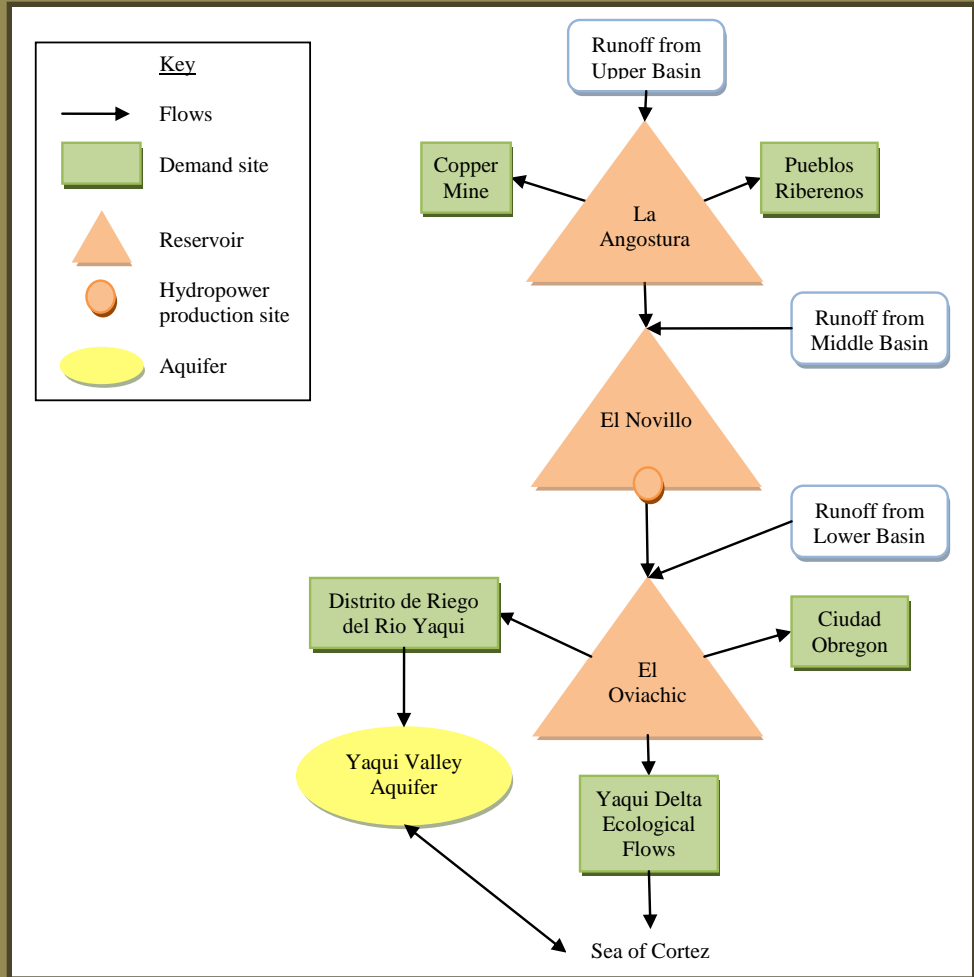
The Yaqui Basin

Reservoir	Capacity* (MCM)	Extractive Water Rights (MCM/yr)	Primary Purpose of Extractions
La Angostura	880	88	Small towns, mine
El Novillo	2,799	NA	Hydroelectric power production
El Oviachic	2,782	60	Ciudad Obregon
		255	Yaqui tribe
		2500	Yaqui Valley irrigation

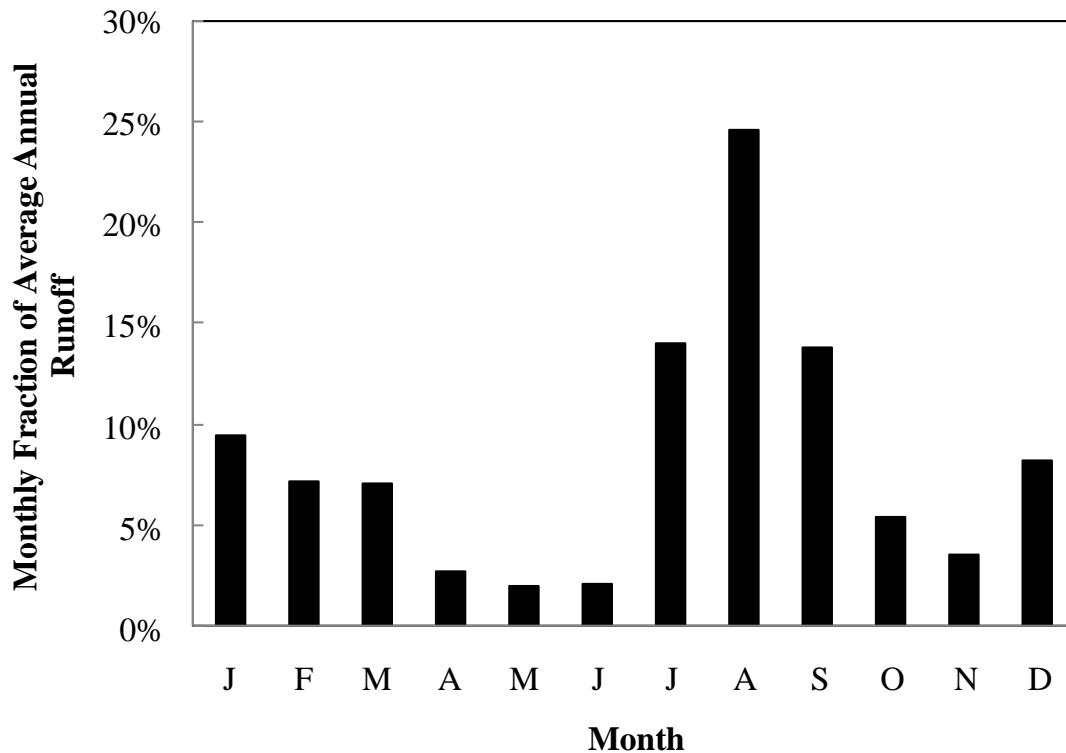
*less dead storage

Additionally, irrigated agriculture in the Yaqui Valley holds water rights of 600 MCM/yr of groundwater.

The Yaqui Basin



Runoff Distribution

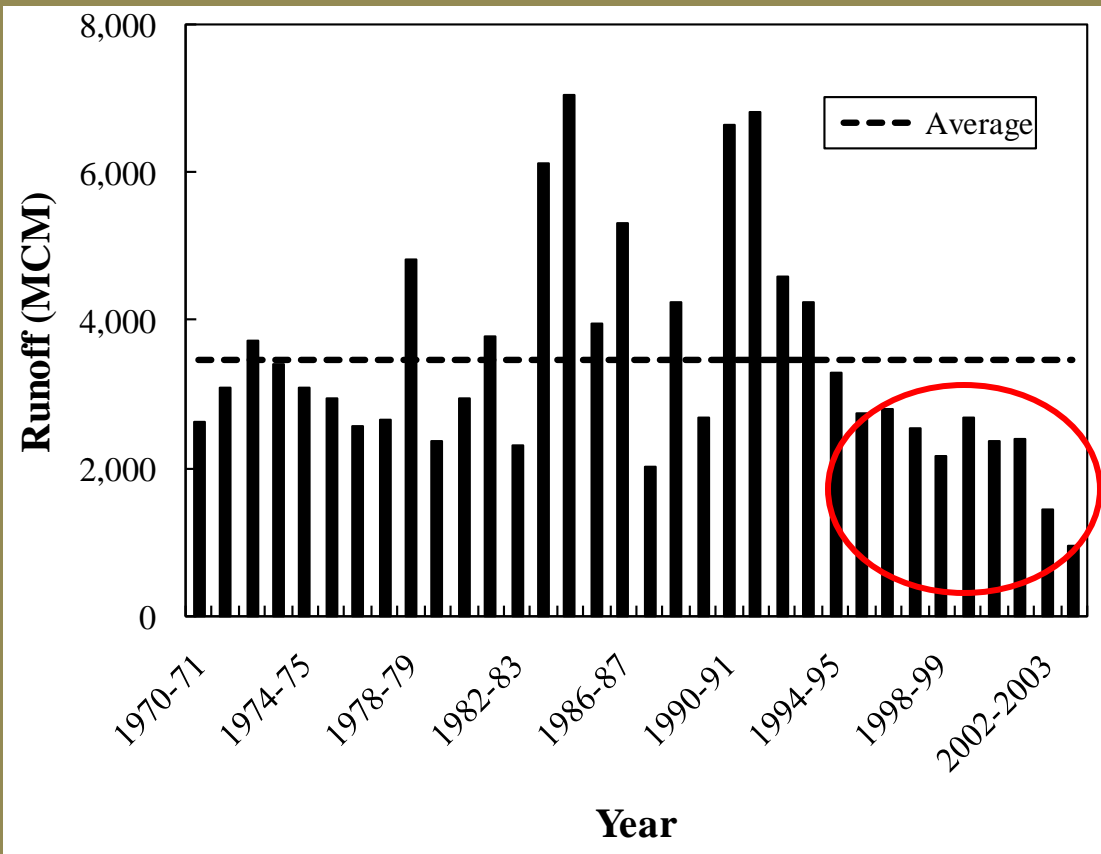


Munoz-Hernandez et al., 2010

The monthly distribution of runoff within the basin shows three distinct runoff seasons:

- a **wet summer** season, when the majority of the runoff is generated,
- a **wet winter** season;
- a **dry spring** season.

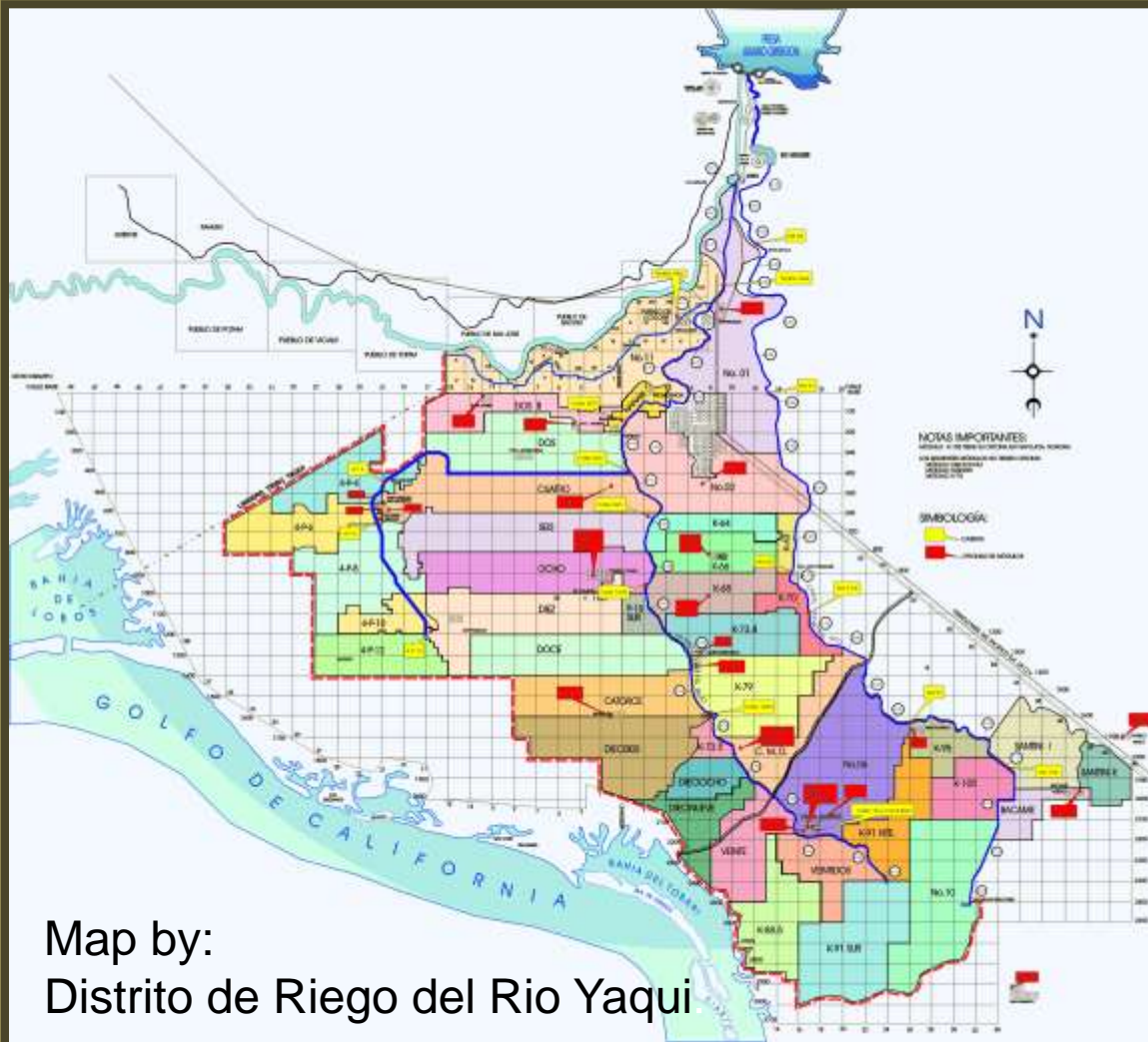
The Rio Yaqui Basin



The annual runoff of the basin is highly variable with an average of approximately 3000 MCM/year.

The severe drought (1994-2003) is clearly indicated in this record.

The Yaqui Valley

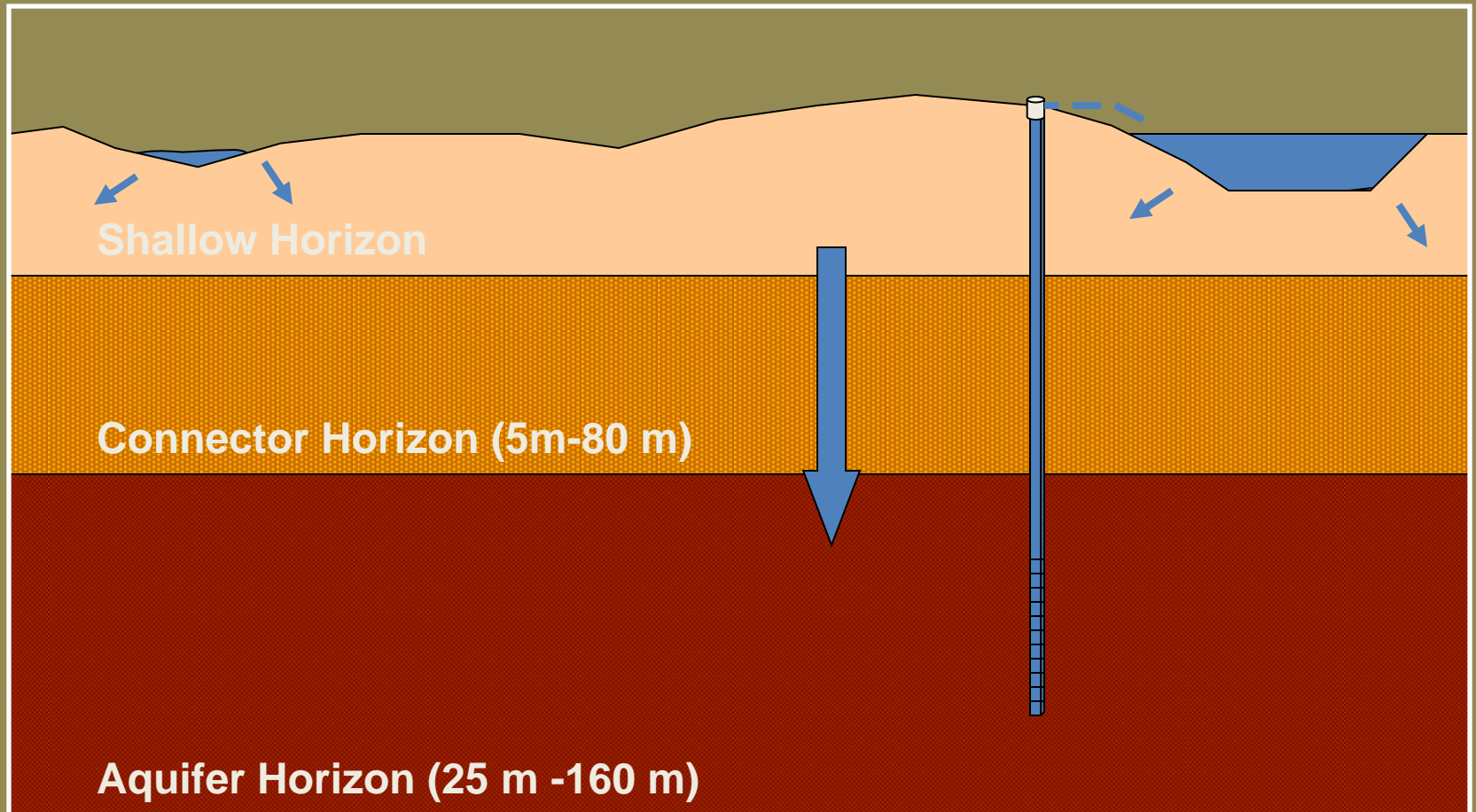


Map by:
Distrito de Riego del Rio Yaqui

The Yaqui Valley contains roughly of 227,000 hectares of irrigated land.

The rainfall in the Yaqui Valley is significantly lower than the rest of the basin with an average of 317 mm/year.

Groundwater in the Yaqui Valley



after Addams (2004)

Policies Reforms in the 1990s.

A series of reforms produced new policies aimed to increase the efficiency of the agricultural sector (Naylor et al., 2001).

Some of these policies included:

- Elimination of direct price supports for grains,
- Privatization of the Mexican Fertilizer Company (FERTIMEX),
- The operation and maintenance of irrigation districts was transferred from the government to local groups of farmers.

Drought

- The policy reforms, in combination with the severe drought that affected the area, severely impacted the farmers.
- In the 2003 agricultural cycle, the farmers were able to irrigate only 1/5 of the total area, using mainly groundwater.
- This situation affected not only agriculture, but also a variety of businesses that depend indirectly on this activity.

Farmers Response

- Traditionally, the farmers had two agricultural cycles (one in the winter and one in the summer) reaching a maximum irrigated area of 360,000 hectares. Nowadays, they only irrigate one cycle.
- The Yaqui Valley increased the number of pumping wells to increase their water extractions. Water rights increased from 450 MCM/year to 600 MCM/year.
- Several infrastructure upgrades went into effect, trying to improve the water distribution system.

Farmers Response

- Several proposals were petitioned to organizations like the World Bank, with the objective of obtaining funding to line the distribution canals.
- A set of “sustainable rules” were created to achieve sustainable water use within the basin (Minjares, 2004).
- Partial conversion of the Yaqui Valley to less intensive water use crops.

Modeling Tool

An Integrated Water Resources Model was created to support decision makers in managing the water resources in a more efficient way (Munoz-Hernandez, 2009). The model integrates hydrologic model with economic models.

This IWRM model has the capability of evaluating:

- a) Alternative Water Management strategies
- b) Climate Change (using GCMs and RCMs)
- c) Climate Variability (ARMA Models)
- d) Environmental Flow Strategies

Future Challenges

- Based on the annual growth rate, the population in Ciudad Obregon is projected to double in the next 30 years.
- There is a desire to further develop the area. However all the water resources are completely allocated.
- Water is allocated without consideration to the environment causing degradation of the local system.

Future Challenges

The basin is located close to the ocean. If groundwater extractions exceeds the recharge, salt-water intrusion may occur damaging the water quality.

- Currently, there is a heated debate regarding water transfers from El Novillo to Hermosillo, which is the capital of the State.
- Climate model experiments indicate that Northwest Mexico will experience a progressive drying during the 21st century (Seager et al., 2007).

Thanks!