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MEXICO WATER REPORT

Lga Consulting

Agriculture and Water in Mexico

This article will review, as an introduction of sorts, the characteristics of the Mexican regions, by water and agricultural characteristics, to give the reader a perspective on Mexican water use and related national and regional goals and objectives to make the Mexican agriculture system more productive, efficient, and sustainable by means of better water management. Future editions will deal with each of these issues and other related issues in greater detail.

This article will specifically address the following agricultural-related water issues:

- Water Use in Mexican Agriculture
- Mexican Hydro-Agricultural Infrastructure
- Mexican Agricultural Water Systems, Distribution and Productivity
- Mexican Federal Budget for Agricultural Water Projects

General Overview

The agricultural sector is by far the largest user of water in Mexico with 77% of its water resources destine for agriculture, representing the fourth largest percentage in the world and almost twice the US figure of 40%. At the same time, the Mexican agricultural sector provides Conagua, the Mexican federal water commission, with less than 2% of its total revenue while contributing significantly to the degradation of land, deforestation, and the overexploitation of aquifers. For these reasons, we feel the need to increase our analysis of this sector and we see the need for Conagua and other Mexican water entities to increase their analysis of these issues and government funding of related hydro-agricultural programs, projects, and solutions.

The geographical area dedicated to agriculture in Mexico is about 21 million hectares, which represents 10.5% of the total Mexican land surface. On average, Mexico harvests about 19.6 millions of hectares per year with 6.5 million under irrigation and 14.5 million dependent almost exclusively on seasonal rains. The crops grown in irrigated areas receive water from surface and/or groundwater supplies.

When comparing national land mass dedicated to agricultural activities, Mexico (10.5%) is not dramatically different from its trade partners nor those Latin American countries with similar or significant agricultural focuses:

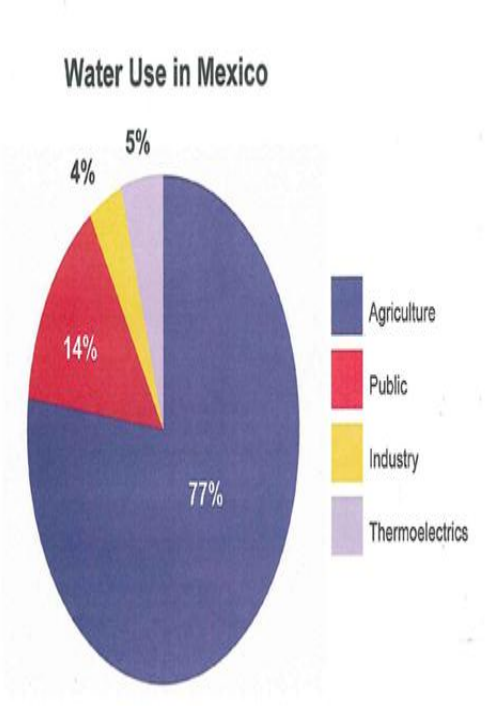
a. US 16% (164 million hectares)
b. Brazil 8% (66 million hectares)

c. Argentina 10.5% (29 million hectares)
d. Canada 7% (69 million hectares)

However, none of these countries provides anywhere close to Mexico's 80% of total water supply for the agricultural sector:

a. US 40%
b. Brazil 61%
c. Argentina 74%
d. Canada 12%

There are several factors that contribute to the extensive use and excessive waste of water by Mexican agriculture. The most obvious causes are the low price of water for Mexican farmers and the lack of accurate measurement of water consumption. Without adequate metering technology and despite the lack of water in different regions of the country, farmers only pay a very small part of their water cost, paying a base rate that serves as a poor, low estimation of their consumption.



There is another somewhat unique Mexican factor that leads to this misuse. The low volume assignations due to low levels of water in dams creates an interesting phenomena. Under this circumstance, when Mexican farmers irrigate their crops, they extend the irrigation time to ensure that their fields get an exaggerated amount of humidity in case water is not available at the later, programmed time.

A final factor is the need for modern irrigation methods and the training of Mexican farmers in irrigation processes which could and should be an important part of the solution for these problems. It is estimated that these efforts could impact the total amount of agricultural water loss by as much as 60-70%.

Analysis of Mexican Water Basins and Regions

For our analysis, we divided the country into 5 regions that group states with similar characteristics like weather, population, and aquifer resources with each region including two or more basins:

1. **Northwest Region (formed by the following states): Sonora, Sinaloa, Baja California and Baja California Sur**
   Water Basins (inside of the region): Baja California Peninsula, Northwest and North Pacific
   Despite being one of the driest regions in the country, this region is where the greatest national agricultural production is located, especially in the North Pacific water basin. This

region is characterized by its extensive irrigation, its adoption of technologically intensive modern inputs, and its high percentage of land ownership concentration which has lead to a very homogeneous level of development in the agricultural sector.

At the turn of the last century, this region of Mexico had more sophisticated irrigation systems than the US. While during the last 100 years, the US has caught up and passed the region in this area, it nonetheless is still the most developed region in Mexico in this regard. The State of Sinaloa is the most important agricultural producer in the country, being the leading producer of corn, beans, chili and tomatos. The land dedicated to agriculture in the region is the largest in the country with 850,000 hectares and the highest in crop value representing more than $2.33 billion USD. The third largest water basin in Mexico in terms of volume is the North Pacific where the El Fuerte River is located, which is 540 Km. in length.

2. **North Region: Nuevo Leon, Coahuila, Chihuahua, Durango, Zacatecas, San Luis Potosí and Tamaulipas**
   Water Basins: Rio Bravo, Central Northern Basin and North Gulf
   In this region the weather is moderate warm with little rain throughout the region with a regular spike during the summer months. During both the summer and winter months, the region is known for its dryness and its extreme temperatures. The fourth most important water basin in Mexico, the Rio Bravo (or Rio Grande in the US), is located in this region.

   While agriculture is not the economic driver in this region, in light of the business culture and dry nature of the region, it has to rely on water saving measures, irrigation systems, and more modern technologies to remain competitive.

3. **Center Region: Jalisco, Colima, Aguascalientes, Guanajuato, Queretaro, Hidalgo, Tlaxcala, State of México, Federal District**
   Water Basins: Lerma-Santiago-Pacific, North Gulf and Valley of Mexico
   This region is surrounded by mountain ranges which are isolated from the humid winds from the sea and negatively affects the level of rainfall that fall each year ensuring that there is always a shortfall in the water levels required for agriculture and dam replenishment. The weather is moderate to very warm with sub-tropical highlands. This is a mixed region being the most important region in terms of economic development and population but still a very important area for agriculture especially in the less developed states in the region. . The Lerma-Santiago-Pacific water basin, located in this region, has the largest volume of water in the country via its two principal rivers, the Santiago River and the Lerma River. Despite this abundance of water and reasonably fertile lands, this all important river basin area was only half has productive in terms of hectares dedicated to agriculture and value of agriculture production.

4. **Southwest Region: Michoacán, Puebla, Guerrero, Morelos, and Oaxaca**
   Water Basins: Balsas and South Pacific

In this region, the temperatures are high but generally uniform with regular rainfall although lower than rainfall in the Southeast Region. Agriculture is less corporate and more dominated by communal farming with low technology operations. The region has the second most important basin in terms of volume, the Balsas water basin where the Balsas River, with a length of 770 km., is located. Most of the agriculture in this region, like that of the Southwest Region, is small than larger with some communal farming focus. This fact together with the abundance of rain makes this region's agriculture one of the least sophisticated and the least reliant on irrigation.

5. **Southeast Region: Veracruz, Chiapas, Tabasco, Yucatán, Quintana Roo and Campeche**
   Water Basins: Center Gulf, Southern Border and Yucatan Peninsula
   In general this region has high temperatures and well distributed rains making this region the one with the highest water availability in the country. The Grijalva River, with an extension of more than 1500 km. which runs from Guatemala to the Gulf of Mexico, is the main river and usually is the major cause of the regular floods of the region. Most of the agriculture in this region, like that of the Southwest Region, is by smaller farms rather than larger ones with a definite communal farming focus. This fact together with the abundance of rain makes this region less sophisticated and much less reliant on irrigation.

Hydro-Agriculture Infrastructure

The Mexican hydro-agricultural infrastructure has the following characteristics. There are over 4000 dams in Mexico from which 667 are classified as large dams according to the International Commission on Large Dams (ICOLD). The storage capacity of dams in Mexico is 150 billion m3 with the 100 most important dams having a total capacity of 118 billion m3, representing 79% of the total storage capacity in the country. Of these top 100 dams, 36 are used exclusively for agricultural purposes while 44 are used for agricultural and other purposes.

During 2008, the irrigated land represented 25% of the total national agricultural land surface, while the other 75% was fed from seasonal water sources. Nonetheless, the production value of irrigated land represented over 60% of total production. Regarding the total amount of water extracted from aquifers, 69% is used for agricultural irrigation.

In Mexico, the infrastructure areas of irrigation represent 6.5 million hectares making it the 6th most irrigated country in the world. Of the surface with irrigation infrastructure, 54% corresponds to 85 Irrigation Districts (IDs) and 46% to the more than 39 thousand Irrigation Units (IUs). The IDs and IUs - defined below - use almost the same volume of water, with the Districts using 48.5% of the total volume of water assigned for the agricultural sector, and the Units use the 51.5%.

Water Irrigation Systems, Distribution and Productivity in Mexico

Irrigation Districts (IDs) - Of the 6.5 million hectares with irrigation infrastructure, 3.5 million (54%) correspond to 85 IDs. Those IDs are located in almost every state except for Campeche, Tabasco, and

the Federal District. Almost 75% of the ID areas is concentrated in 6 states: Sinaloa, Sonora, Tamaulipas, Michoacan, Baja California y Guanajuato – four northern states and two central states.

The IDs are established under Presidential Decree and they are formed by one or more surfaces whose perimeters enclose an irrigation area. Said area or ID has hydraulic infrastructure works, superficial and underground water sources and storage which can but do not have to include more than one or several IUs. Each ID must have a concession title that is provided to users (farmers) organized as a User Civil Association (ACU) by Conagua. This concession gives these ACUs the possibility to use a certain amount of water during the year and establishes the source of said water. The main crops in IDs are grains (corn, wheat and sorghum), sugar cane, beans, and to a lesser extent, horticulture products generally fed with underground water from private wells.

Most of the IDs are supplied by superficial water which from storage dams and water channels. Each water basin has a Basin Council which determines the volume of water that will be assigned to users depending of the current dam storage realities. On the other hand, IU main water sources are subterranean (aquifers) generally obtained from wells as well as small dams and other small water storage bodies. And only 1/3 of the water utilized for agriculture which includes agriculture, aquaculture, livestock, and other related areas, comes from subterranean sources.

Irrigation Units (IUs) – Of the 6.5 million hectares with irrigation infrastructure, 3 million hectares (46%) correspond to the more than 39,000 IUs. These IUs are agricultural areas with water infrastructure although different from an ID in that they are commonly operated by small land owners and communal farmers and that they obviously have smaller land surfaces and both less and lower technology than the IDs. IUs can be integrated by ACUs or other entities organized to provide irrigation services and operate hydraulic infrastructure works for the reception, conduction, regulation, distribution and dispersion of national water assigned to agricultural irrigation.

Water productivity in IDs and IUs is a key indicator to evaluate the efficiency in the use of water for agriculture. Said productivity includes the efficiency in driving the water from the source to the field and its use directly in the fields which is where the majority of the way, as much as 70%, is lost. In general, the productivity of irrigated areas is 3.7 times higher than those fed with seasonal water sources. Despite the fact that irrigated areas are substantially less than those fed by seasonal sources, irrigated land generates more than half of the national agricultural production. Conagua reports that the average productivity in irrigated areas is about 27.3 ton/hectare, significantly higher than in the seasonal surface of 7.8 tons/hectare. However, according to contacts in the industry, while they confirm this 4 to 1 difference in the productivity, they indicate that said productivity per ton is probably closer to half of the figures provided by Conagua.

IUs as well as IDs were established and designed according to technology for the distribution of water by gravity systems. In many cases, they only built channel networks and principal drainage systems leaving the rest of the infrastructure works in the fields to the users. This situation together with accumulated deterioration from several decades of insufficient spending on preservation and maintenance programs generated a backlong of essential rehabilitation requirements that led to a

dramatic drop in the efficiency of agricultural and general Mexican water management.

Irrigation methods are rudimentary or traditional in more than 80% of Mexican surface (superficial) irrigation and their efficiency in terms of water use is very low, somewhere between 33 to 55%. With the use of better techniques and irrigation infrastructure modernization, the water use efficiency could increase to 50 to 65%, which would notably lower the extraction of water from Mexican aquifers and allow these water savings to be used in other applications like the better preservation of rivers, lakes and aquifers.

The intensity in the use of land for agriculture is an important characteristic to review when analyzing IDs and IUs. A great part of the IDs are cultivated twice a year in the crop cycles autumn-winter and spring-summer. Nonetheless, some districts are only harvested once a year. In 92% of IUs, with their water source being superficial waters often based on season water sources, only one harvest is programmed due to the lack of water, further exacerbated by the increase non-agricultural water demand, the regular uncertainty of availability, and the drop in the pumping levels. Conagua officials insist that this very high percentage can be reduced through technical irrigation assistance programs for producers as well as the substitution of crops with much lower water demands such as barley and chickpea.

Conagua Budget for Hydro-Agricultural Infrastructure
In the last five years (2006-2010), the general Conagua budget was increased almost 210%. Meanwhile, the budget for hydro-agricultural infrastructure during this period was increased almost 237% with double figure annual inceases demonstrating how Conagua recognizes the importance and severe problems of water in the agricultural sector. Below is the breakdown of the Conagua budget during the last five years and the budget information for 2011:

YEAR	TOTAL BUDGET (Billions of Pesos)	ANNUAL INCREASE	BUDGET FOR AGRICULTURE (Billions of Pesos)	ANNUAL INCREASE
2006	16.6		3.8	
2007	19.5	18%	4.8	26%
2008	29	48%	5.7	18%
2009	32	10%	8	40%
2010	35	9%	9	12%
2011	36.4	4%	N/A	N/A

The Mexican federal government has increased Conagua resources in recognition of the importance of water issues at all levels and in light of the increasing need for potable water treatment, wastewater treatment and water infrastructure. Regarding hydro-agricultural spending, said funding is designated to create and maintain water and wastewater infrastructure, to introduce new water technology and irrigation infrastructure improvements, and to better train users on the benefits of

these technologies and improvements. In the next few years, the need for a more efficient agricultural system will be an even greater priority due to the increase of the population that requires both more food and more water, both of which they can obtain from a more efficient Mexican agricultural system.

In our next edition, we will expand one some of the above issues and discuss some other important hydro-agricultural issues in Mexico.