

Emilio Slavik Susunaga Vega  
Colegio Williams  
Mexico City  
Mexico, factor 2: Water Scarcity

### **Piping system as solution to water scarcity in Santa Maria de Los Angeles, Jalisco**

Agriculture and livestock are key factors in the economic growth of a country; it takes more importance if we are talking about a developing country like Mexico, where a great part of the national economy depends on these two activities. It is known that the country has a variety of environments optimal for planting and harvesting diverse products, from vegetables to grains. Large farmer states such as Sinaloa and Jalisco had focused their infrastructure and resources on the production of corn, but they are having problem with the water distribution in specific areas of this territory.

The objective of this research is to identify the main problems referring to water scarcity in the State of Jalisco, specifically regarding to the city of Santa Maria de los Angeles, that has suffered from this situation in a serious way, and to determine and propose an available solution that can be easily installed, using minimal resources such as plastic, PVC and Recycled PET to give an optimal water supply for farms in the area. By applying this proposal, the corn crops are expected to improve on the farms on Santa Maria de los Angeles, also it is expected that the use of the proposal will increase the economic activity of the city.

#### **Jalisco's current Situation**

The State of Jalisco is located in Western Mexico, having part of the Pacific Ocean as border. It plays an important role in Mexico's economy due to its geographic diversity, making it the first place in agricultural production in the country. In collaboration with secondary activities, Jalisco produces around \$418.172.157 usd per year, making it one of the four most important States in Mexico's GDP (Gross domestic product).

Actually, Jalisco takes the national second place in corn production. It produces a third part of the total national white corn in collaboration with the State of Sinaloa, according to SAGARPA (Secretaria de Agricultura, Ganaderia, Desarrollo Rural, Pesca y Alimentación, Livestock and Rural Development Ministry for its acronym in Spanish) Jalisco produced 2.753 million tons of white corn back in 2013, having an average of 5,62 tons per hectare.

Jalisco produces also yellow corn which has different purposes from the white corn (white corn is used for the elaboration of tortillas and oils for soap, paints and artificial rubber while yellow corn is used for human consumption). The corn harvested in Jalisco is helped by the water precipitation that passes through the country from the Pacific Ocean, covering the Western part of it. (Castañeda, 2014)

Unfortunately, Jalisco continuously suffers from extended drought periods, specifically in the Northeast of the State, 14% percent of the State territory presents semiarid and arid climates, making it hard for the farms to collect water from rain and beneath the surface. This problem can be solved with the use of water transport trucks, but this method can't satisfy the needs. On the other hand this technique creates a lot of air pollution and wastes a great amount of the liquid.

There are cities within the State of Jalisco that are not greatly affected by the lack of water supply because of their environmental condition, mostly Southern and Western cities; Northern cities constantly suffer from water scarcity which also creates an agricultural delay in a specific area of

the State. There is an actual national need of having a stable economic growth on each State. It is necessary for every city to have an optimal supply of basic resources for the main economic activities, such as agriculture and livestock.

By 2010, a total of 55.984 people from the State of Jalisco was living in the United States, 39.366 of them were men and 16.618 were women. According to CONAPO (Consejo Nacional de Población, National Population Council for its acronym in Spanish) the City of Santa Maria de los Angeles has a high migration level, 27,92% out of total household get economic support from outside the country.

### **Santa Maria de los Ángeles's current situación**

The city of Santa Maria de los Angeles is located in the North of the State of Jalisco. It has an extension of 284.94 square kilometers and most of the land used has agricultural purposes. The main products of the farms are chili, beans, corn, and barley. Most of them are used for self-consumption, making them part of the basic basket. The city had a population of 3.726 inhabitants by 2010 (Jalisco, 2010), divided into 1.758 men and 1.968 women. On the same year 91,28% of its population could read and write and 25,25% of them were economically active.

One of the most important situations within the city is the lack of an educational structure. There were only 117 bachelor students, 196 high school students and 488 elementary school students in 2010 (Jalisco, 2010) with only 11 bachelor teachers, 21 high school teachers and 35 elementary school teachers. This happens because of the familiar priorities through the farms and agricultural purposes. People prefer to work on their farms for a living than attend school. This situation delays the city educational process and also the preparation that current generations had for future opportunities.

The city has access to the Jerez River and the streams of Tenasco, the stream of Las huertas and the stream of La Cantera. These are part of the hydrologic region of Lerma-Chapala-Santiago. 86,59% out of the total housing counts with sewer systems and 98,06% counts with electrical systems. The average maximum temperature of the city in 2010 was 27.8 Celsius degrees, while the average minimum temperature by the same year was 9.1 Celsius degrees; the average water precipitation by 2010 was 26.70 inches, but there were only 73 days of rain through the year. This means that a great part of the year the city lacks from water precipitation, but at the same time they suffer from excess of pluvial activity at specific times of the year (especially in July, August and September).

The city has priority on a few occupations: 34,99% out of the total population were dedicated to agricultural purposes in the year 2010, while other 31,64% of the remaining population were dedicated to local commerce; 16,95% out of the remaining population were dedicated to industries and just 15,98% were technicians and administrators. The city counts with 4 health clinics and one hospital from the IMSS (Instituto Mexicano del Seguro Social, Social Health Mexican Ministry for its acronym in Spanish) a Mexican institute responsible of the city healthcare.

Santa Maria de los Angeles is also one of the cities with most damaged soil, caused by the lack of rain and the continual production change. This praxis generates continuous pH perturbations, taking away vital soil sources. The misuse of soil, the extended water scarcity, the lack of agricultural infrastructure make Santa Maria de los Angeles one of the poorest cities of Jalisco. This situation delays the economic State growth and restrict Jalisco from focusing all it resources to national exportation. Santa Maria de los Angeles represents a problem for Jalisco's agricultural development so it needs to be addressed immediately, improving the city's hydrologic structure for farms and corn crops.

The city population is distributed in rural areas, with 34,9% dedicated to agricultural production, most of the farms focus their crops on self-consumption. The lack of water infrastructure for transportation and access to the liquid creates a lot of difficulties for farmers. A possible solution to these problems has to be practical, of low cost and accessible to local materials. This proposal also needs to be able to adapt to a specific environment with a specific hydrology due to the approach the project had to the problematic.

## Proposal

My proposal to improve the water infrastructure of the city of Santa Maria de los Angeles is the use of an artificial waterway that can be adapted to the population needs using the local hydrography. The main purpose of this project is to create an optimal water sustain for cornfields, due to the Mexican legislations that restrict farms to use superficial water for vegetables.

It is expected for this proposal to satisfy the local water needs; corn crops need 0,19 inches of water constantly for an optimal development, this means that corn crops need a constantly water supply for its development. And advantage of corn production is the easy adaptation of the crop to different altitudes, this makes corn so easy to be planted across the country.

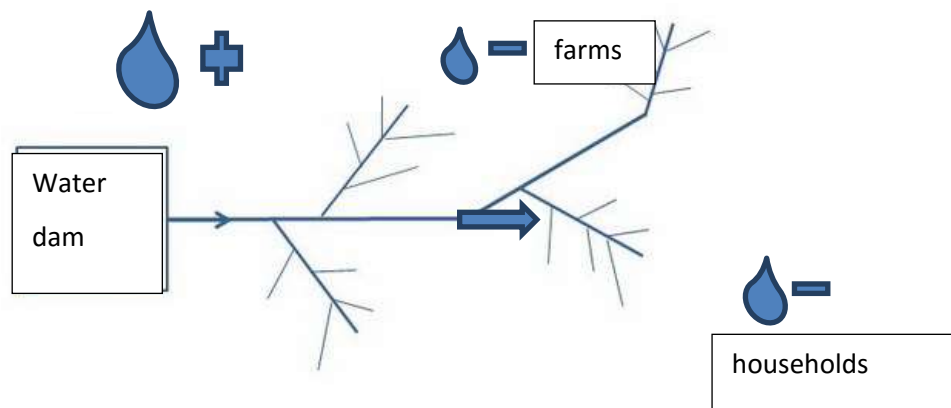


Fig.1: scheme of the pipeline system; water will be guided from the Tenazco water dam to farms, the river will split at key locations allowing a specific volume of water to enter through it and provide the liquid to farms, the remaining water will keep its way to water treatment centers for human consumption

This pipeline system will guide the water from rivers, lakes or streams from the local area such as the Jerez River and the Tenazco Water Dam, which are two of the most relevant water sources of the city. The project will split at key areas of its extension into smaller pipelines, from a pipe of two meters diameter to a pipe of 50 centimeters diameter. This system fragmentation will carry smaller water volumes each time, this will provide an efficient sustain of water for farms and houses, depending on how much water they need (the pipeline system that guides to a house will carry a smaller water volume than the pipelines that guides to a farm).

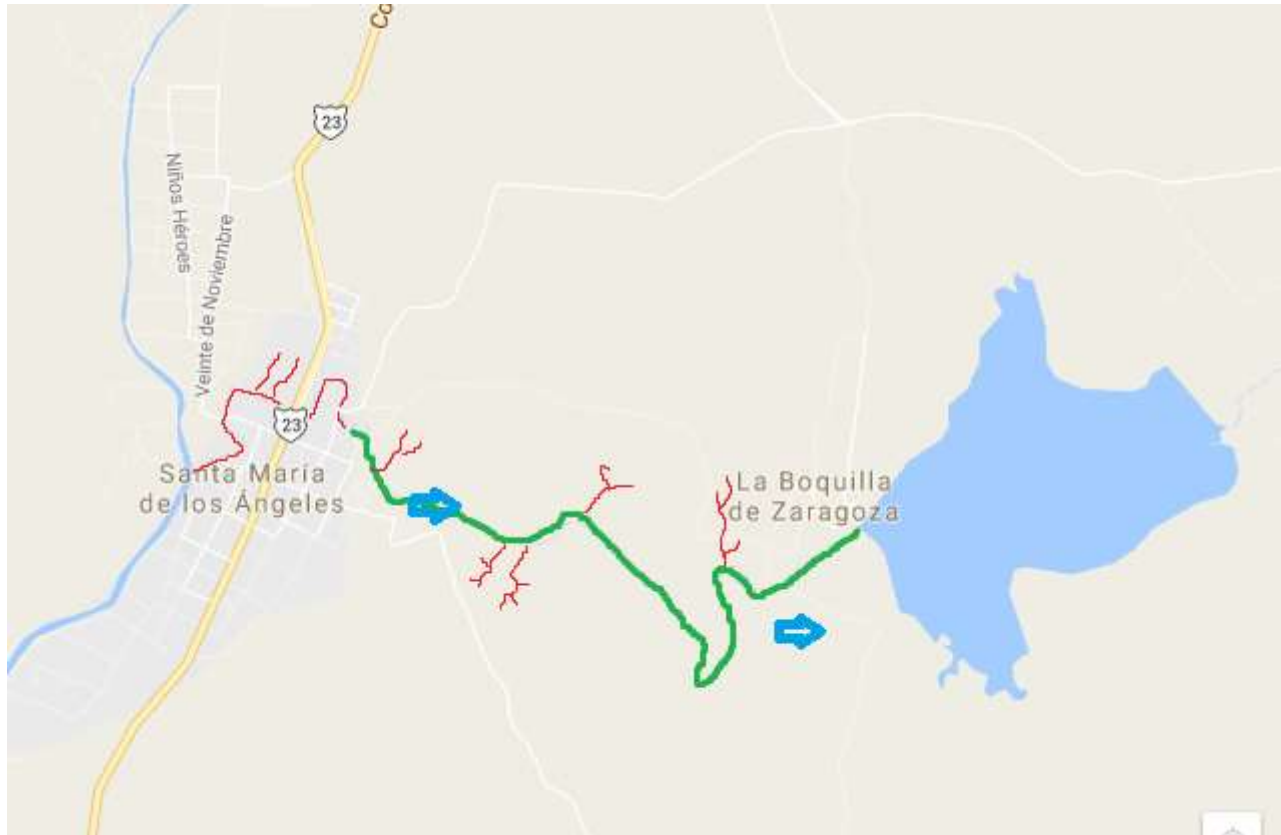


Fig.2: map from Santa Maria de Los Angeles (left) and the Tenazco Water Dam (right). The water will be guided from the river (blue, left) to the city using the main pipeline system (green), having the water dam as destination (blue, right). The main pipe will split into smaller pipelines of 50cm diameter (red) that will carry a smaller water volume to farms. Water will run from left to right following the course of the stream.

Water will be transported using the force of gravity, so it will move downhill. The main pipeline will guide to a water treatment center so it can be cleaned and useful for urban centers. This proposal will not only benefit big mass corn producers or big enterprises, but also familiar farms and self-consumption crops, which are most of the agricultural community from Santa Maria de los Angeles.

The material for the pipelines will be mostly recycled Pet and PVC, collected from houses and public places as a campaign for the piping system. This campaign will not only be in *Santa Maria de los Angeles*, but also in close places to the city such as *Huejucar* and *Colotlan*. By using recycled materials, we are countering the excessive production of trash that could be used for social and agricultural purposes. The recycled PET will, shaped into pipelines for water transportation. It is expected for this proposal to be low cost due to the use of waste materials.

One problem about using recycled PET is how much time does the material will support the constant water pressure until it is completely useless. PET (Polyethylene terephthalate) is a polymer with incredible resistance to weather conditions, making it a non-biodegradable material, but this does not make PET completely weatherproof. A constant water pressure would waste it and break it. A solution to this could be the production of spare parts for this artificial river, so when a segment of it starts to lose strength it will be immediately replaced for a new one, these parts will be produced with recycled PET

from the local area as the original PET for the proposal. The use of pipes made of PET as spare parts for the piping system will also help the city to minimize the excess plastic waste. According to Eduardo Martinez Hernandez, President of the National Plastic Industries Association (ANIPAC) Mexico generates 3,8 million tons of plastic trash per year, 38% of total garbage are PET. Jalisco has the 3<sup>rd</sup> national place in garbage collection, with 7 thousand tons of garbage. The use of recycled PET collected from local garbage can reduce the amount of total plastic waste from the city.

## Conclusion

It is expected that the analysis of this proposal could help a developing population to determine the main problems related to the extraction, transport, and exploitation of water for crops. Agriculture and livestock are the basis of the social development of any country, this praxis had been improved through time with the objective of giving an optimal food supply for this area. These needs increase as time goes by, so farmers and governments improve their techniques to get better results from their crops. This agricultural development could only be given if natural resources allow it, so if it exists a shortage in one of the basic natural resources of a city, what can the city do?

Jalisco has been involved in Mexico's economic development as one of the main States involved on it. This State has also suffered from agricultural delays (one example of this is the city of Santa Maria de los Angeles) but at the same time Jalisco has been looking for different techniques to solve these scarcities. At this moment what the city needs is the support of governmental programs for water treatment, but also the support of people from the city for making various projects proposed by the community real.

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