The Recovery of the Former Texcoco Lake Pro-Environment Engineering

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In 1971, Mexican scientist Nabor Carrillo proposed a project to rehabilitate the region of the former Texcoco Lake. It had three main aims: 1) to combat pollution and the diseases caused by the gigantic clouds of dust generated there; 2) to contribute to the water supply for the Mexico City metropolitan area through treatment and recycling of residual water, and 3) to restore the habitat of several plant and animal species. Thirty years later we can say that this has been one of the most momentous projects of environmental, hydrological and soil recovery programs ever carried out in Mexico.

Centuries of History

The lake region of the Valley of Mexico became the home of the powerful Mexica kingdom, the capital of New Spain and of independent Mexico,

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today considered the most populated city on the planet, mainly because of the natural wealth that its five lakes and its bountiful rivers offered. However, the passing of the centuries and the unstoppable advance of human activity turned a paradise into a desert where nothing more than dust, garbage and disease flowered.

The history of the desiccation of the lakes and the ecological deterioration of the Valley of Mexico basin has been intimately linked to the increasing urbanization and over-population of the country's capital and its metropolitan area.

When the Spaniards arrived, a large part of the Valley of Mexico was a lake region, fed by five lakes: the Zumpango, the Xaltocan, the Texcoco, the Xochimilco and the Chalco. The recipient was Texcoco Lake, located in the central, lowest part of the basin. This position made the waters salty because sediment poured into them from the higher areas. Since it had no outlet, the lake became a veritable internal sea. The size of the lakes and the lake region varied with the seasons and the cycles of abundance or drought. According to historical data, the lake region measured almost 2,000 square kilometers, with Texcoco Lake occupying about 50 percent of the total area.

The complex hydrological geography of the valley created a serious danger of floods for pre-Hispanic settlers in the rainy season. Before the conquest, the magnificent city of Tenochtitlan, founded on one of the basin's lake beds experienced several catastrophes of this kind. The most important was in 1449, during the reign of Moctezuma Ilhuicamina, who requested aid from Netzahualcóyotl, the lord of Texcoco, to solve the problem. Netzahualcóyotl suggested building a dike to separate the lagoon of sweet water from the salt water that came down from Texcoco Lake.

The priority, from that time on, would be to get rid of the valley's excess water. But the hydraulic works were never sufficient and flooding would persist until the twentieth century. Viceregal authorities repeatedly had to invest in repairing dikes, leveling causeways and clearing out rivers and canals. The idea of building a general drain was also considered. In that period, the basin was first artificially dredged, which also initiated the lakes' process of desiccation.

The Nabor Carrillo Flores Lake, where migratory birds land again.

The Former Lake Region of the Valley of Mexico

After independence, the works to control the area were constantly interrupted because of a lack of resources, civil wars and foreign intervention. The creation of a large drainage canal began under the restored republic of Benito Juárez but was not concluded until 1900 under the regime of Porfirio Díaz; simultaneously a sewage system was projected and studied. These works noticeably improved the situation in the first decades of the twentieth century, but around 1950, the problem would present itself again.

Renewed flooding was the manifestation of a growing unbalance in the Valley of Mexico's ecosystems, created by several related factors: the population explosion, the expansion of urban areas, the change in the use of the land, the growth in industrial activity, the destruction of green and forest areas, the expulsion of surplus rainwater and residual water through drainage systems and the over-exploitation of underground water resources to supply drinking water to the population.

The second half of the century saw the complete dehydration of the lake region. Recovering even a part of what had been lost became a hydrological challenge, but also one in the sphere of sanitation and ecology.

Dealing with the Problem

The Texcoco Project was divided into two large areas of work: the Texcoco lake bed, where hydraulic and ecological conservation works were carried out, and the main lake bed's eastern tributary basin, taking in several settlements, where integral management work was done, such as correcting the rivers' course, stopping erosion, recovering soil and wild animal species, as well as creating alternatives for raising domesticated animals. Also, a garbage dump for Mexico City was established.

Works to Stop Erosion

To reduce erosion and preserve soil and water, activities were carried out on 54,000 hectares of devastated land where *tepetate*, a porous, yellowish rock, was to be found. Different techniques were used:

Mechanical means: Tiered dams were built along the main causeways to lessen erosion due to the flow of the water and the formation of gullies by the uncontrolled running of surface water. Land with steep inclines were terraced.

Using plants: Land with little or no vegetation was planted with trees, particularly where mechanical means were also used, taking into account the *tepetate* content of the soil.

Agricultural and animal husbandry measures: The Agricultural, Animal Husbandry and Forestry Technical Aid Program was put into effect for local producers, since the devastation of the basin included problems of agricultural productivity.

Treatment Plants

The Texcoco Lake Project was one of the country's pioneers in establishing large-scale treatment systems with modern technology. Three plants process the discharge of the Churubusco and Compañía Rivers that arrive to the former lake with a mixture of residual rainwater. The resulting liquid has two uses: agricultural and industrial, on the one hand, and also potable water, which is injected into the lake strata. In addition, it is hoped that filtering the water through membranes will solve problems of water scarcity, the overexploitation of subterranean water deposits and sinking subsoil.

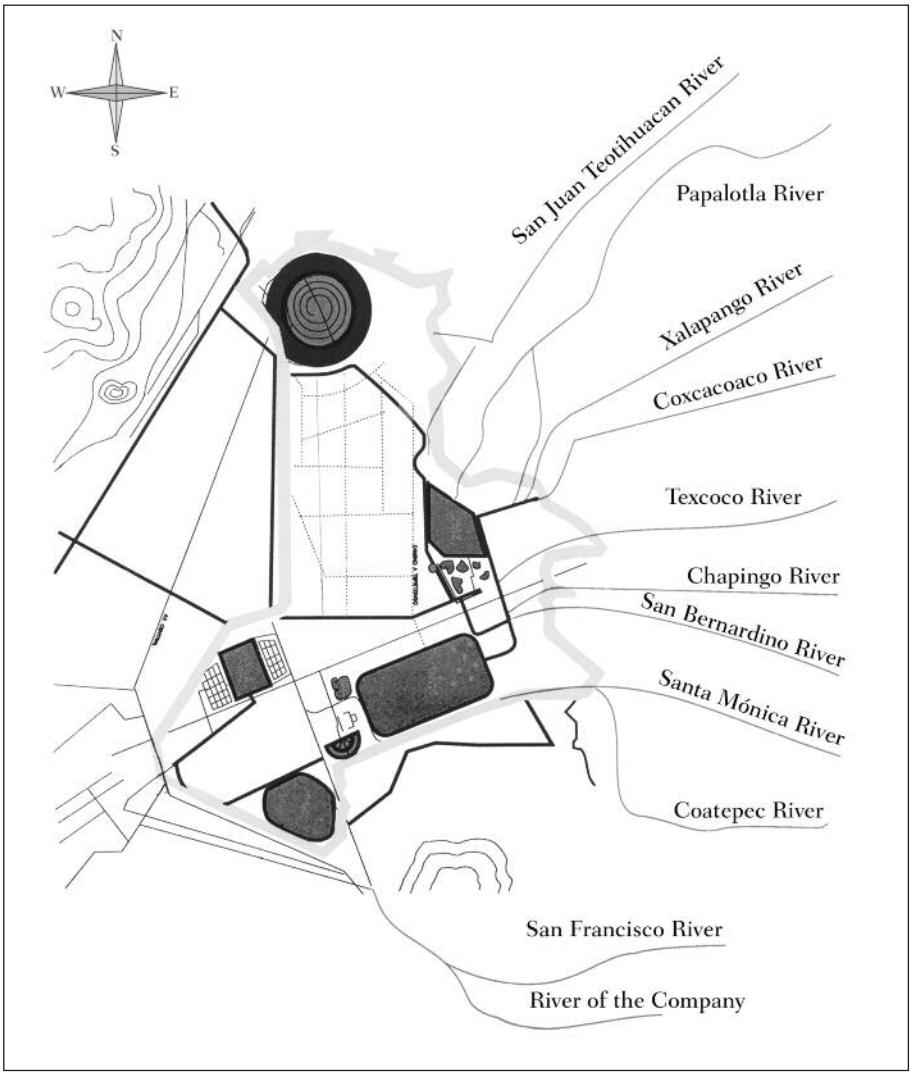
Building Lakes

To store treated water and the run-off from the rivers in the eastern part of the basin, five very deep, narrow artificial lakes were built to reduce loss by evaporation:

1. *Nabor Carrillo Flores Lake*. Surface area, 1,000 hectares; diameter, 12 kilometers; capacity, 36 million cubic meters. To create this lake, a process of natural sinking that took six years was used. It is the most important of the five lakes; migratory birds land here and several water and land species have been recovered.
2. *Schedule Regulation Lake*. Surface area, 150 hectares; capacity, 4.5 million cubic meters. The treatment uses aeration, where microorganisms are used to degrade organic material without any need to use chemicals.
3. *Churubusco Lake*. Surface area, 270 hectares; capacity 5-10 cubic hectometers. It only operates as a storage space for feeding works.
4. *Xalapango Lagoon*. Surface area, 240 hectares; capacity, 0.375 cubic hectometers. It stores the water that trickles down from higher areas during the rainy season.
5. *Recreational Lake*. Surface area, 25 hectares; capacity, 0.375 cubic hectometers. This is a model for environmental education.

Channeling

The integral management of the eastern tributary sub-basin includes channeling and correcting the rivers that cross the lake bed to avert overflowing, contamination and flooding.



Artificial lakes built to store treated water and the run-off from the rivers in the eastern part of the Basin.

Control of Dust Clouds

On 150 square kilometers of land with excessive saline, alkaline and sodium content and shallow subsoil water levels that impeded the growth of natural vegetation, a grass native to the region, *distchlis spicat*, was planted since it thrives in a salty environment, as well as a tree of the *Tamarix* genre. This program made it possible to control the dust clouds.

Waste Dump

About 11,400 tons of solid waste a day generated by Mexico City's Federal District are processed on the 233 hectares called the Western Edge. This is not an open-air dump; garbage is handled with a cover: the waste is encapsulated under a layer of soil compacted at the end of each day of operation to avoid flies, rodents and birds, to diminish bad smells and to protect it from water leakage, the possibility of fires and vents caused by bio-gas.

Fish Farming

A fish producing module has introduced species to recover the fauna of the zone and improve the community's diet.

Dust clouds were controled and dry lands were recovered thanks to the Texcoco Project.

Social Activities

Several sub-programs have fostered the development of local rural communities: environmental improvement, community organization, technical assistance, housing improvement, etc. Recreational and sports activities have also been fostered: athletics, model airplane making, sports fishing, rowing and canoeing, photography and bird-watchers' clubs.

The Benefits

Given the recovery project's integrated approach, the benefits have touched all aspects of the problem:

1) The danger of flooding in Mexico City and its metropolitan area has been reduced.
2) Health conditions for neighboring communities have improved because diseases and epidemics caused by dust clouds have diminished.
3) Conservation efforts and management of the basins has increased the filtration of rainwater, incorporating practices that save water in agricultural irrigation, fostering the exchange of treated water for potable water in industry and agriculture, favoring an important degree of replenishment of the valley's underground water supply.
4) By improving environmental conditions, biodiversity has been fostered, and different species of endangered fauna and flora recovered, with an increase in the number of migratory birds to total more than 300,000 of 134 species.
5) The project has contributed to the formation of the country's most important green area for the world's largest city thanks to the fact that the five lakes generated a microclimate that has favored the development of more than 4,000 hectares of meadows, tree breaks and forests where more than 25 million trees have been planted.
6) On the infrastructure that has been built, parks and centers for raising different species are being developed, including the development of products in great demand on the international market like "spirulina".[1]
7) On the 10,000 hectares of protected federal land, the practice of sports like athletics, rowing and canoeing, soccer, baseball, etc., has been encouraged.

We should remember that this successful project has been developed using technology adapted to the specific characteristics and problems of the area, by Mexican technicians and scientists. Its fame has spread beyond our borders and not a few governments from different parts of the world have come to study it and even to request assistance in solving their own problems. If we have not recovered the paradise of our Mesoamerican forebears, we can say that we have recovered the hope for a more promising future. VM

Note

[1] "Spirulina" is a blue-green algae sometimes added to food for its nutritional value.