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Xochimilco Ecological Park: a replicateable model

Appendix

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Appendix I

XOCHIMILCO ECOLOGICAL PARK'S SOILS

The area ocuppied by the park is a flat space in a lacustrine zone surrounde by volcanic mountains, the Chichinahuitzin sierra. Different factors such as weather, volcanic activity, and human action have altered the processes of soil formation. This fact has contributed through the years to create a wide variety of soil formation types.

The natural origin of these soils is basically is lacustrine and marshy, although there are also of antropic origin, in the artificial organic soils in chinampas.

Their parental constituent is a mixture of a number of materials that have been deposited during several geological and historical periods, amongst which products of volcanic, alluvial, and, most of all, organic origin are found.

Being a lacustrine plain located in a depression or accumulation zone, all area's soils are deep, well developed and mature, and are limited by the phreatic level of ancient Xochimilco lake. However, they are exposed to two very important problems: floods and saltpetering. These two phenomena represent very serious impediments for the use and exploitation of the soil.

Most of them are organic soils, rich in nutrients and influenced by the phreatic level whose variations depend on the rain and low water seasons; they are dark brown, gray or very black. Because of their high content of organic matter and humus, they have proved to be, since the prehispanic period, very fertile, though they can easily become saltpetrous and sodify if not employed properly.

The vital importance of the soil-water-plant relation has become, in the Xochimilco Ecological Park, a triad of fundamental factors for the development, maintenance and adequate evolution of the restored landscape, which must be fully preserved.

Accordingly, a detailed edaphological study was carried out during the construction of the park in 1992. 30 wells were constructed and 30 profiles were analyzed; 206 layers [horizontes] were registered and each was evaluated according to 36 characteristics or attributes, yielding more than 5,000 diagnoses.

The profiles were subject to physico-chemical testes in the park's own soil and water laboratory. 16 analysis were carried out for each soil sample. All this laboratory work contributed to the knowledge of the physical, chemical, and biological properties of the park's soils and for their classification, according to FAO-UNESCO-DETENAL, in four taxonimic units, with 12 sub-units and soil associations. The four main units are:

HISTOSOL (O).- A black organic soil, which can be very fertile if it does not become nitrous. These are the typical soils of chinampas.

FEOZEM (H).- Dark soils, soft and abundantly supplied with organic matter and nutrients. They are deep, well structured, fertile, and employed in agriculture. They are widely distributed in Mexico.

GLEYSOL (G).- Soils sateenated by water. They are literally flood soils and can be either gray, blue or greenish; they exhibit oxidation reduction, their fertility is moderate and are used for growing pastures.

SOLONCHAK (Z).- Nitrous soils of low fertility; they can sustain halophile vegetation as well as salt-tolerating crops.

There are also [antroposoles], that is, soils created by man, brought from different places and artificially deposited in the park.

Soil management

Soil management is often difficult because of the serious problem of high salt presence during the low water season and the flooded soils by the rise of the phreatic level during the rain season.

Saltpetered soils have been treated with washing metal plates, with treated water and organic fertilizers (composta) produced in the park. When the salt leves are high, halophile plants and pastures are planted.

It must be pointed out that the management of soils has been done following ancient agricultural techniques, derived from the knowledge of the traditional chinampa agriculture, orally transmitted from geneartion to generation through centuries.

The combination of both ancient and modern techniques yields better results; thus, this can be considered one of the great contributions of the park's management.

Appendix II

XOCHIMILCO ECOLOGICAL PARK'S METEOROLOGICAL STATION

The fast development of computer systems has made possible to study more varied relations and to make more complete analyses of the different ecosystems. One of ecology's fundamental contributions today is the interdisciplinary analysis of phenomena.

The average weather conditions of a zone were traditionally understood as the outcome of exogen variables (sun radiation, winds, clouds, etc.) which were sometimes reinforced or reverted by local conditions (flora, fauna, and water layers, among others).

These analyses overlooked the effects that local flora and fauna could produce in the general weather conditions. The general opinion was that the climate had modified the mores of the different communities; it has been only recently that the opposite influence has been under consideration.

A meteorological station has been installed in the park in order to gather data, [series de tiempo], and studies on the local average weather conditions. Such studies are incorporated in other research projects and are employed for the optimum use of the park's resources as well as of those of the community.

Research has shown well defined patterns (for instance, "maximum local winds analysis" and "maximum-minimum temperature analysis") and rainfall registers show a few abnormalities in relation to Mexico City's average. Objective and subjective evidence point to the fact that the rainfall average is higer in the southern area of the city (where the park is located) and is on the rise. It seems that the presence of greater lake and vegetation areas induces more rain, though the specific mechanisms that account for this fact are not well known.

However, it is important to mention that the variations of the deterioration tendencies in a restricted area does not immediatly contribute to the betterment of those areas

surrounding it. Rain has obviously very different effects in the zones near the park; a storm in the city causing the streets to flood is quite different from the same phenomena ocurring in the chinampa area. Hysterisis is very likely to be ocurring in nature; that is to say, that once that the environmental phenomena have changed in relation to their normal (statistic) state, the will hardly return to it and, more importantly, the reversal of these processes is not necessarily an ideal state of affairs.

In recent years Mexico City has exhibited a higher rainfall average. It is possible that this is being caused by the increase of pollutant elements (which act as condensation nuclei). However, the presence of condensation nuclei is not a sufficient condition for rainfall; humidity is also needed. The rainfall increase has been accompained by a decrease of the phenomenom in other regions of the country (it is a large scale phenomenom), but what matters here is the lack of any useful exploitation of such increase and, what is more important, the lack of control of the harmful effects of rainfall in cities such as Mexico City. It would be worthwhile to ask ourselves about the relevance of the preservation of restricted areas and its consequences for the rest of the region where they are located.

Several research projects are conducted in the park such as studies on maximum winds (and their effects on evaporation and soil saltpetering); on maximum and minimum temperatures (and the effects of freezing on vegetation). Also, a semi-empiric formula is being investigated in order to calculate evapotranspiration (volume of water loss) as a function of relative humidity, temperature, and a seasonal factor.

Each project has as its main purpose the benefit of the communities surrounding the park. Their implementation is carried out by incorporating conclusions to other projects and by following requiremnts set for other research areas. Problems are being tackled, as far as our resources permit it, in an interdisciplinary way.

Appendix III
RESULTS IN FIGURES

Attention to Visitors

Due to its operation system —a public space concessioned by the government to a civil association which has, among other commitments, to make of the park a self-financing entity— the Foundation of established, since the opening of the park, a recuperation admission fee. This fee has not changed since 1993. The entrance is free for children under fourteen, adults pay 10 pesos and senior citizens five pesos. The fact that children do not pay makes it impossible to have an exact record of the number of visitors. Ticket sales permits a projection over 2,500,000 people. 5,000 visited the park from june to december, 1993; 800,000 in 1994; 1,000,000 in 1995, and approximately 1,100,000 in 1996.

The foundation, according to its own commitment to supporting small, medium, and micro enterprises, has granted the functioning of a number of services to several firms. Today, these concessions are: the parking lot —with a capacity for 1,000 cars—, the ecological vehicles (bicycles, four-wheeled cycles, and pedal boats) and the scenic train.

In the Information Center, visitors can find out about the origins of the project by watching a brief video program. They can also enjoy an exhibition, be it of an artistic,

scientific, or environmental character. Aquariums exhibiting such species as the "ajolote and different kinds of fish, as well as a [serpentarium], have been added. There is also an exhibition showing archaeological pieces obtained during the excavations in the zone. In addition, there is a curios shop, where craftsmanship products elaborated with natural materials and bought to their original producers are sold. In lake Huetzalín visitors can enjoy colorful trajineras administered by their own propiertors: the former ejidatarios of San Gregorio. The park has three fast food stands with restrooms. There is a playground, with a section for handicapped children, and three "palapas" (sheds built with palm trees). The park has a 24 hour vigilance system, including closed-circuit TV.

Vegetation Covering And Park Infrastructure Improvement

On June 5, 1993, the Foundation recieved the park's installations completed in a 59% (115 hectares, from which 60 are occupied by water bodies). Today, 159 hectares ae in use.

The vegetal covering occupied in 1993 less than 14 hectares, there were planted 156,730 plants and trees (31,346 trees belonging to 15 different species —with a density 4 m^2 per tree— and 125, 384 flower plants belonging to 26 different species) and 24 hectares covered by grass. In 1996 there were 26.14 hectares of vegetal covering, 377,184 plants (39,686 trees from 23 species and 337,498 floral plants from 45 species, 40 hectares of grass and 1.58 hectares of "tule" (bulrush tree) in the water bodies.

In the remaining 41% (67 hectares) the Foundation has accomplished different recuperation tasks: 4,020 meters of canals (1 meter wide and 1.5 meters deep) were built in order to carry water to the reforestation areas that did not have pressurized irrigation yet; 6 hectares for chinampas were arranged for didactic and productive purposes; 1.6 hectares of small lakes were built in order to induce the development of wild fauna and to control flood problems caused by unleveled terrain; 9 valves were installed to increase the irrigation capacity; 2,500 loads of soil ($6m^3$ per load) were used in leveling 4.5 hectares and to form some mounds in other zones in the park.

The pressurized irrigation system was enlarged with 350 meters of tubing of 2" and 32 sprinklers. With this investment, the distribution network grew to reach 4,326 meters of tubing (from 12" to 1.5") and 99 sprinklers. The irrigation system installed in 1993 consisted of 2 50 hp pumps and 67 sprinklers. However, this system had not enough capacity; it could only cover a 30% of the vegetation covering and was afflicted by leaks.

In those areas which still do not have pressurized irrigation, a 840 meter system of drop irrigation was installed, with 168 drop valves; 9 5 HP pumping engines are employed, 5 of them with 100 meter hoses. 20 hoses of 30 and 40 meters are temporariliy connected to the nearest pressurized irrigation ditch; 2,000 meters of [poliagua] of different diameters connected to the valve system are employed.

During the period between 1993-1995 the park produced 86,557 plants belonging to 27 different species (12,717 in 1993, 40, 240 in 1994, and 33,600 in 1995).

With the support of students and different social organizations, the team of gardeners in the park planted 255,753 flower plants from 48 species.

In order to produce plants continually throughout the year, 4 greenhouses were built, with different dimensions and for different purposes: 8 x 5 and 21 x 5 meters, both with a height of 3.6 meters, for root planting; 16 x 6 meters, with a height of 2.8 meters, for seed propagation; and 18 x 18 meters, with a height of 4 meters, for mushroom production.

The variability of water levels in some swamps made it necessary to build 4 communication ways between water bodies, using cesspool tubes of 20 cm of diameter and 146 meters long, and 4 dampers in order to make their maintenance easier. With the same purpose, 65 meters of fences were built.

Since the maintenance building and the three vigilance modules did not have a potable water installation, a proper connection was made with a total of 720 meters of 1" and 5" ducts.

An acces to the main building's rear was built that communicates it with the vehicle's and pedestrian's paths, using 60 meters of "tezontle" (volcanic stone) and 48 meters of hydraulic concrete.

In order to make things easier for handicapped people 8 ramps were built: 4 to enter the main building and another 4 outside the park, in the entrance and exit of the parking lot.

It was necessary to remodel in the main building the restrooms and to increase their number. Urinals for children were installed.

3,800 meters of cable were installed for the electrification of the three vigilance modules.

A small pier (a wooden platform of of 8 x 15 meters and a tube structure with a roof) was constructed in Lago Acitlaín for pedal boats.

A 8 x 15 m cement platform was built at the bicycle rental station. Awnings were erected for the boat, bicycle and train stations.

A 110 m duct was installed for telephone lines, from the street to the main building's basement, where distribution ducts were laid. A 670 m telephone line duct was laid from there to the maintenance building. In addition, another line was installed for public telephones inside and outside the main building and on the sidewalk.

In order to reinforce the vigilance of the park, the Foundation expanded 480 m the wire mesh that surrounds 2,814 m of the 5,392 m perimeter of the park.

Educational Services

Soon after the park's opening, an agreement with the Secretaría de Educación Pública was reached to organize guided tours for scholar groups. This service has become a major success. The park has recieved up to 2,000 in one single day.

In June, 1993, the first two school arrived, a total of 57 children. During the rest of the year the number reached 5,846 children and 77 public and private schools.

From January to December, 1994, the children added up to 39,532, and the schools were 506 (325 public; 157 private).

In 1995, the figures were: 51,734 children from 511 schools (323 public; 188 private).

The service was later requested by business, institutional, and touristic groups, both national and foreign.

Considering its success, the service is being improved day by day. Audio and video material, as well as graphic specifications, have been added.
It is worth mentioning that in spite of the low fee, the income deriving from this service was in 1995 of $165,412.00 pesos.

The summer courses began a few weeks after the park's opening with an 80 children group. The course has continued during 1994, 1995, and 1996, developing an exceptional program that makes good use of the park's magnitude and characteristics. This year, the course recieved 300 students from the Universidad Autónoma Metropolitana, Xochimilco Campus.

A new service is the Club de Corredores (Runner's Club), intended to offer runners a wide, beautiful, and safe space for the practice of their sport, as well as the basics for those who start to run and, very soon, a specialized instructor.

Finally, the park offers a unique opportunity for those young university students who do their social service with us, for they not only get a chance for putting into practice their professional knowledge, but also to practice different activities and acquire new information.

Soil and Water Analysis Laboratory

This laboratory was a product of a research project financed by CONACYT, and has become an important support for the park's activities. It's constant analyses of the park's water and soils helps to program the vegetation covering and its preservation.

In addition, the laboratory is able to offer external services and produces its own income. It has assisted several public institutions such as CORENA, the Tláhuac District, and INAH.

The laboratory, opened during the first anniversary of the park, has conducted the following analyses (both for internal and external uses): in 1994, water analyses (with 8 determinations) 85 [monitoreos]; 1,700 analyzed samples, 11,040 physico-chemical analyses. Soil analyses (with 6 determinations) 308 analyzed samples; a total of 16,233 in six months. In 1995, water analyses (with 14 determinations) 28 [monitoreos]; 420 analyzed samples; 7,327 physico-chemical analyses. Soil analyses (with 11 determinations) 381 analyzed samples; 9,352 physico-chemical analyses; a total of 14,679 analyses for that year. Sum total: 30,912 analyses in 18 months.

A pamphlet was published in order to promote and commercialize the laboratory's services.

Research Projects

Since its formation, the Foundation is commited to the development of research projects and to support the activities of external researchers. Many studies have been conducted in several fields, such as biology, geography, antropology, and etnohistory, among others. Moreover, some of the future members of the park conducted research programs that were later very valuable for the park's tasks.

Among the main projects are those financed by CONACYT, including the laboratory, an ecogeographic study on the environmental conditions of the area surrounding the park, and an antropological study on the children morbidity in a specific area of Xochimilco.

While the plans for the construction of the Xochimilco Ecological Park project were being finished, a project was developed in the affected area, the Archaeological Xochimilco Project. The goal of the project was the recuperation of information about the human settlements of the area during the Postclasic period (1150-1521 A.C.). Once the archaeological field investigations were concluded, excavations were finished and the construction of the park began. The first published book of the series *Xochimilco Arqueológico* belongs to this project.

Appendix IV

AGREEMENTS FOR ADVISEMENT AND COOPERATION WITH OTHER PUBLIC AND PRIVATE INSTITUTIONS

Advisement

Sharing knowledge and expierences is among the foundation's goals. The park has had the opportunity for supporting both private and public institutions, such as the Tláhuac Forest, the Dolores Olmedo Patiño Museum, the Huayamilpas Park, the San Juan de Aragón Park, Poliforum Cultural Siqueiros, the Deportivo Ecológico Cuemanco, the Los Coyotes Park, the León Trotsky Museum, the John Langdon Down Foundation, the Ecociudadanía del Futuro Association, the International Association of Researchers of Xochimilco A.C., the Veracruzana University, and the Ecological Park of Zacatecas.

Agreements

The foundation has established several cooperation agreements with different firms, institutions and independent producers.

The most important agreements are those reached in 1995 and 1996 with the Secretaría de la Educación Pública; the former made posssible the implementation of the *Programa de visitas guiadas* (Guided Visits Program), while the latter led to the implementation and renovation the *Programa de educación ambiental para niños* (Environmental educational program for children), financially supported by the own Secretaría; and the agreement with the Departamento del Distrito Federal for the control of climate, water, and soil, as well as for the reception of distinguished visitors, both national and foreign.

There are also other agreements between the park and several dependencies of the UNAM, such as the Geology Institute, the Atmosphere Sciences Institute, the Social and Political Sciences Faculty, and the Institute of Antropological Investigations. There are also agreements with the National School of Biological Sciences of the IPN, the National Institute of Nutrition, the Natural Resources Comission of the DDF (CORENA), the Deportivo Ecológico Cuemanco, the Plant, Vegetable, and Flower Market, and the milk producers of the region.

The Foundation considers social service as a very valuable support. Agreements have been reached for this purpose with the UNAM, the UIA, the La Salle del Pedregal, the UACh, and the ITESM. The Foundation has recieved 59 future professionals from 19 different fields.

In order to present events that contribute to the preservation of culture and traditions, there are agreements with theater, music, pantomime, and oral narration producers. Thus, the park has held academical and cultural events, such as the International Xochimilco Researchers Seminar held twice, in 1993 and 1995. The third seminar is programmed to take place in 1997, with the collaboration of many universities, research centers, and government dependencies related to the southern area of the Mexico basin.

Appendix V

PROJECT: "TWENTY LUNGS FOR MEXICO CITY"

Considering the figures summarized in this document, together with a study on the deterioration of many green areas in Mexico City, a project called "Twenty lungs for Mexico City, ecological rescue of the largest city of the world" was designed and submitted to the government of Mexico City. The following is a brief description of the project.

The Project's Motives

The growing deterioration of the urban environment, together with its disproportionate population growth, are two of the most important problems for the city's authorities and inhabitants. This situation is worsen by the vandalism derived from a defficient environmental education and the lack of employment opportunities for unprepared young people.

Main Goal

To rescue part of the natural ecosystem that once existed in the Mexico basin, by the creation of a self-financing system of green areas under a cultural concept.

Specific Goals

1. To promote a civic awareness with the aid of educational programs designed for such purpose.

2. To create an ecological recuperation network constituted by autonomous and interdependent spaces in order to fight against the city's pollution.

3. To develop a Master Ecological Rehabilitation Program of selected green areas.

4. To implement new techniques for the integral rehabilitation of green areas.

5. To improve the recreational environment of the different social groups of the city, creating natural recreational spaces for families.

6. To involve citizens in the preservation and betterment of green areas in their neighbourhoods and working centers.

7. To create employments both for professionals and underqualyfied workers, with or without formal training.

8. To stimulate the development of small, legally constituted enterprises, which are the most important source of employments.