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MEXICO CITY-XOCHIMILCO NORTH PROJECT
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Xochimilco Ecological Park: a replicateable model

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I. INTRODUCTION

Xochimilco's ecological rescue is an unprecedented historic event in Mexico City as well as in the whole nation. Many reasons took us to embark in this rescue project, all of them of vital importance. Xochimilco is a special place; it is the only living testimony of a way of life which combined a series of elements which make it unique for, in the first place, *Xochimilco was not there*, as one can say that a mountain or a jungle are there. The entire place was made by man, it was invented and created by an indian group which brought together various characteristics of engineering and art, reflected most of all in that agricultural masterpiece known as *chinampa* (Chinampas are floating orchards used by ancient xochimilcas in the southeast of Mexico City). We must acknowledge our indian ancestors their enormous capacity to live in harmony with nature, modifying the environment only as it was necessary and aided by remarkable hydraulic works.

Due to the increasing deterioration of the planet's environment, a process of civic awareness of the situation has emerged in recent years. This growing awareness has encouraged governments and institutions to implement shared political resolutions in order to prevent and diminish the negative consequences of a phenomenon that reaches and therefore matters to all social classes.

Today the word "ecology" is part of every person's vocabulary. Etymologically, the word means "the study of home", the study of everyone's home and of how we live in it. In

the present time, everything called "ecological" is deemed as valuable and welcomed as a contribution to the salvation of the planet from human destruction.

Although this anxiety has given place to all kinds of misuses of the concept, it is also true that there are certain actions which truly deserve their classification as ecological because of their tangible benefits, if by "ecology" one understands the relation of living creatures with their natural environment. International agreements for the preservation of natural resources and conditions are conspicuous among these actions. Xochimilco's ecological rescue is one of these efforts. It has restored a zone declared by UNESCO *Patrimony of Humanity* in 1987 and intends to preserve it with its own singular characteristics as far as possible.

II. BACKGROUND

Xochimilco and water culture

Xochimilco is the center of a very deep communitarian way of life; moreover, it is a surviving evidence of the ancient indian world in the south of Mexico's basin. The meaning of its name captures its essential attribute: "the place of flowers".

Historic documents point to the fact that this place was the settlement of one of the first nahuatlaca tribes to arrive to the lake zone. Soon they met those who already lived in the zone, establishing a unique interchange with their new neighbours. Since then, the ecosystem had already suffered severe transformations, some of them caused by natural phenomena and others by the action of human groups, although these groups always made an effort in order to maintain a harmonic relation with the natural environment.

Xochimilcas succeeded in transforming the banks of lakes Xochimilco and Chalco into good places to live and to produce their most elemental satisfactors. They acquired a deep knowledge of the established order and about how to preserve a balance between rational

exploitation and natural resources. This wisdom was applied not only on the mainland, but also on the lake's small islands, where symbolic and material commerce between the different groups from the lake basin and its environs took place.

The chinampa, a highly productive ancestral agricultural system, unique in the world.

Lakes became an essential element for the cultural development in the area. The beneficial properties of water provided a wide variety of crops as well as an efficient transit system, thus reducing the distance separating the different points in the area. The chinampa was created, a non seasonal system of agricultural production, conceptually advanced due to its high productivity. It consists, until today, in floating orchards built weaving together vegetal material and mud with ahuejote roots (a tall and thin willow tree, typical and exclusive of Xochimilco); this technique prevents the orchard from crumbling and at the same time it forms a vegetal barrier which protects crops against excessive sun and wind. The chinampa is the center of a whole culture of water, a culture flourishing in the humidity and fertility of a soil that is a product of a wise and noble labor that makes use of the natural environment without disturbing its balance.

The multiplication of sowing fields in this artificial manner transformed the lake into wide and narrow canals, the latter ones called *apantles*, in nahuatl language. Water flows through them as an omnipresent fountain of life. Through these canals xochimilcas traveled in order to establish commerce and exchange their products, as well as to establish communitarian relations and to share beliefs, knowledge, habits and customs, creating a regional identity which still survives in our days.

Thus, Xochimilco is not a mere place; it is not something that already existed and that was simply occupied by a group of people. Xochimilco was conceived, invented and built by its inhabitants, peasants who were half engineers and half artists. That is why

Xochimilco has not been modified as other places that also belong to Mexico's basin; tradition lives in all its inhabitants, enterprising men and women who wish to preserve all that has kept them together as a community in order to live as they have always done, with their modest peasant work, feeding the neighboring city and embellishing it with flowers.

Rediscovery and deterioration of Xochimilco

At the end of the nineteenth century, Xochimilco's potential is noticed and the place is officially rediscovered, not only as a symbol of national identity but also as a solution to one of the main problems of the capital city. Xochimilco's proximity to the center of political and economic power that was Tenochtitlan 600 years ago, and its absorption to what today is Mexico City --the largest and most populated metropolis in the world-- brought to the zone the very same growing necessities of the big city, and Xochimilco was forced to bestow its natural wealth, agricultural production and water springs in order to satiate the metropolis' thirst.

This was the beginning of a series of problems that affected the Xochimilco zone, leading it almost to collapse: Rain water, filled with pollutants originated in the middle mountain, poisoned the soil and affected its productivity; and once the soil becomes useless as a means to earn a living, the peasant is obliged to abandon his parcel or chinampa. This situation also involved and affected tourism, which has suffered a drastic diminishment in recent years. Tourists feel disappointed with the manifest deterioration of the lake filled with drainage waters, the water lily plague, and the bad odour of neglected chinampas. There is another factor: the often severe floods, which have caused human and material losses. All this reinforced an ominous possibility: the chinampa's urbanization, which would have put an end to the culture of Xochimilco, the water culture.

Some twenty years ago, prestigious scholars claimed that, in spite of the sombre prospect created by the deterioration of the environment, the planet's capacity to purify itself

actually surpasses the capacity of the negative impact generated by the human race. Mankind could only alter the parameters of humidity, the local or biophysical cycle of water, but, as they argued, the quantity of radiation from the sun remains stable. Today we might think, given the results of more recent research, that the effects of chemical substances damage the atmospheric shield, and that the sun must be considered as a potentially dangerous agent. This view seems to be supported by the implementation in Mexico City of periodical measurements of the ultraviolet rays from the sun. The data obtained from this routine procedure is transmitted to the citizens through the media in order to prevent sunlight overexposure.

Human action transforms a geographical landscape into a cultural landscape, that is to say, a landscape modified or created by man upon a natural basis. This is what one finds in the southern area of Mexico's basin, wrongly known as a "valley". In the central-west portion of the outskirts known as Sistema Volcánico Transversal there is a clearly spatially limited morphological structure, which forms what is known as an closed basin. It is the basin of Mexico, an extense high plateau with a minimum of 7347 feet above the sea level, surrounded by chains of mountains of different ages and geological constitution. Small groups of mountains can be seen in this plateau, like the Sierra de Santa Catarina and the Sierra de Guadalupe, among others. The limits of the southern area of the basin constitute a group of mountains: the Sierra de las Cruces, in the southwest; the Sierra Chichinautzin, in the south; and the Sierra Nevada, in the southeast, stretching to the Sierra de Río Frío.

In the basin, between the mountain slopes and the extended plain of lacustrine origin, one finds a series of water layers formed by volcanic and detritus accumulation shaping a mountain foot, irregular in extension and composition. Due to the evolution and growth of its geographical landscapes, lacustrine mirrors are a constant element in the southern area of the basin. The natural and cultural history of the territory is the history of the lakes. Paleonthological evidence testifies the former existence of a great lake in the basin two million years ago, which suffered several changes owing to natural causes. Highly

satisfactory conditions presumably prevailed around 7,000 years B.C. There is also evidence of a consecutive human occupation with an estimated age of 5,500 years. It is precisely in the southern area of the basin where sedentary life acquires a special meaning, stressing the role of the freshwater lakes during the first period of settlement.

From the beginning, the agricultural way of life in the basin (or at least in some parts of it) depended on lakes. Water is closely related to Xochimilco's historic evolution and its economic growth. Together with the Texcoco lake, this zone represents the last bastion of the legendary basin lacustrine system. Since the xochimilca's arrival, one of the seven nahuatlaca tribes established in the basin, Xochimilco's economic activity was vinculated to the use and protection of the existing water sources. There was a wide variety of plants and animals, mixed forests with oaks and pines. Vegetation consisted mainly of ahuejotes, which are a sort of trees presumably exclusive of Xochimilco, and that are used to fasten strongly the chinampas to the bottom of the lake and also to protect crops from excessive sunlight and strong winds. Fauna was constituted by an important group of terrestrial animals as well as fish and birds. There were coyotes, tlacuaches, squirrels, armadillos, rabbits and mice; in the lake, there were trouts, turtles, clams, mojaras, frogs and acociles. Migratory birds such as the water hen, the agachona and wild ducks used to gather there.

For two centuries, Xochimilco provided food and plants to the great Tenochtitlan, the center of the aztec empire. Xochimilco became, after the Spanish conquest, the most important "encomienda", but the severe epidemics that devastated Nueva España also reached Xochimilco and reduced its population to nearly 80,000 inhabitants.

During the colony, the production forms become diverse. They are organized in different craftsmanship activities for each neighbourhood, and people are forced to combine agricultural work with that new activity. Chinampas have always represented a relevant element as a valuable productive unit in the region. They also served as an element for the urban development which maintained a close bond between production and dwelling. This relation continues to exist nowadays, and this is the reason why that zone registered the

highest population growth. After Mexico's Independence, Xochimilco continued to furnish, efficiently and discreetly, the great city. At the beginning of our century, Xochimilco is rediscovered and its deterioration process, which grew to reach an unquestionable seriousness, begins.

Towards the environmental collapse

Xochimilco's ecological balance suffered an accelerated alteration during the present century. In 1913 the construction of an aqueduct deviated two original river beds. As a consequence, the water levels in canals and apantles (the smaller canals that irrigate chinampas internally) diminished. The enormous water demand of the city increased from three cubic meters per second in 1930 to more than 50 cubic meters in 1980. The crystal water springs were exhausted by the fifties, so crops had to be irrigated with treated waters, insufficient in quality and quantity. In order to satisfy the drinking water demand of Mexico City it was necessary to resort to Xochimilco's entrails, extracting water from deep wells. Today, water is obtained at more than 1,300 feet of depth, and this well system is one of the main water sources of Mexico City.

The break of Xochimilco's ecological balance brought about several problems. The weather in the area changed and rain precipitation diminished almost 30% causing higher temperatures and environmental dryness. Water level decreased considerably and the introduction of drainage waters [de tratamiento secundario] provoked the annihilation of most of the lake's fauna. Phosphates in the water created a very favourable environment for the water lily, which became a plague and paralyzed the water flow, thus contributing to its evaporation. This originated a drastical decrease in the flower and vegetable production, both in quality and quantity. At the beginning of the century, Xochimilco represented a 70% of Mexico City's production; by 1989 it represented only a 15%.

Another problem caused by the extraction of water from the subsoil was irregular sinking, which lead to the construction of floodgates in order to control the different water

levels in the canals. And finally, all this deteriorating process also affected tourism. Xochimilco became a dirty and foul-smelling place, not much attractive to visitors.

Simultaneously, the Xochimilco district (occupying the third place in size in Mexico City), increased three times its population between 1960 and 1980, with a much greater growth rate than the rest of the country. This was a consequence of the introduction of public services such as trolleys, electricity, tubed water, means of communication as well as the establishment of textile, pharmaceutical and graphic arts industries, among others. By 1990 this growth increased enormously due to high immigration rates. The population density today is of 225 inhabitants per hectare (112.5 per acre). This population growth considerably reduced the non-urban surface. Lacustrine zones were the most affected by the new uses of land (basically for livestock and construction), which in turn provoked serious sanitation problems, worsened by irregular settlements lacking urban services, especially drainage. Sewage had to be directly poured into the canals, worsening the water's quality. In addition, since there are no natural outlets for the water in the region, there were serious floods in various zones.

The problem became even worse because the permeability of soil made it easier for sewage to get in contact with the water layer, especially in those zones lacking even the most basic sanitary works. The drainage of Xochimilco's chief city, where the 17 traditional neighborhoods are located, had been losing its original capacity due to the saturation of the underground. This situation could not be worse.

IV. XOCHIMILCO'S ECOLOGICAL RESCUE PLAN

In spite of all these inconveniences, Xochimilco's attributes still make it an exceptional place. Its peculiar way of life in the middle of a lacustrine zone, its identity as a different social group, and the chinampas themselves, promote the emergence of special cultural values which influence life in the zone. Xochimilco never surrendered to its deterioration and continued to produce as much as its capacity allowed. The community of Xochimilco evolved and became a different kind of society, and adopted foreign values. But it always managed to preserve its own identity.

The increase of the economically active population forced Xochimilco's community to explore new ways of life. Youngsters soon found new occupations which were more income-producing, required less effort and produced immediate satisfactions. However, the chinampa's production has grown and improved its quality thanks to the incorporation of modern techniques and equipment to the old, but still efficient, forms of production. In 1989, the new federal government made a historic decision: the problem should be thoroughly faced. The situation no longer admitted any delay. Water was defined as the nation's main problem: its supply, quality, and optimum exploitation, as well as its preservation for the generations to come became central issues in the agenda. Xochimilco was undergoing a series of conflicts derived most of all from the water problem and its misuse. The project started basically as a government plan, but different social groups in Xochimilco started to show an interest in participating, a fact that gave the project a new orientation. The participation of the community involved professionals from different specialties: biologists, historians, agronomists, anthropologists, sociologists, archaeologists, chemists, etc., who contributed with their skills in the detection of all aspects of the conflict, as well as in the definition and possible solutions to the problem. Accordingly, the project was divided in three great headings: hydraulic and integral sanitary rescue, archaeological rescue, and historical legacy rescue.

A first measure adopted by the rescue project was the expropriation of 1,038 hectares (2560 acres) from ejidos. This carried several social conflicts, for most of the people ignored the project's purposes. Considering the magnitude of the work to be done, and the diversity of the agents involved, it was necessary to create an Advising Council. This organism managed to reach an agreement by means of which government agencies, regional associations and academic institutions worked together in the project, taking into account all points of view and all possible solutions.

Hydraulic Rescue

The goals of the hydraulic rescue were the following: to achieve an efficient use of drinking water in the metropolitan area of Mexico City; to gradually reconstitute the hydrological balance of the southeast area; to reduce the extraction from the water layer of the zone; to rationalize the consumption and water recycling; to increase the utilization of third level residual treated waters for the city's industrial, agricultural and recreational areas; to attend to the cleanliness and maintenance of Xochimilco's waters; to protect and induce the natural recharge of the water layer and to enlarge the hydraulic works of the zone by the construction of primary and secondary drinking water and drainage networks, regulation lagoons, pump systems, and the preventive and corrective maintenance of the networks.

The following steps were taken in order to fulfill the purposes mentioned above: a hydraulic diagnosis of the region updated each year; the reduction, from 18 to 6 liters, of the water flush of all public and private toilets; the incrementation in four years of the supply of purified residual waters to the canal system by the enlargement of the Cerro de la Estrella water plant and the construction of a new plant in San Luis Tlaxiátemalco; the construction of 2,000 blocked-up pipes [tinas ciegas], 20 dams and 5,000 square meters of terraces and subsoilers [subsoleos] in dales, river beds and brooks located in the mountainous zone of Xochimilco; experiments involving the injection of purified residual waters in the water stratum; the reforestation of the ejido, chinampa and mountainous zones; the construction of 12 kilometers of water collectors [de red primaria] in the district's chief city and other towns in the mountains; the construction of 120 kilometers of secondary drainage networks in the towns of Xochimilco and 55 kilometers of drinking water secondary networks; 31 kilometers of pluvial drainage collectors; the improvement of the drinking water supply pressure; the cancelation of 20,000 residual water discharges from houses and farms; the construction of two regulation lagoons [lagunas de regulación] in order to store 3 million cubic meters of residual waters during the rain season; to put into tubes the San Buenaventura river and the construction of a pumping plant for it; the construction of a semideep tunnel to dislodge the waters from Xochimilco's hydrological basin; the construction of 48 sections

[seccionamientos] and 6 floodgates to stabilize the water levels of the lacustrine zone; and the attempt to control biologically the water lily. All these measures were fully implemented.

Agricultural Rescue

Xochimilco's vocation is agriculture. In order to restore its productive capacity, a series of projects were envisaged, such as: the utilization, purification and recycling of residual waters from towns and neighbourhoods; the use of pluvial waters recollected in neighbour towns in order to increase the water level of the canals; the re-establishment of the water flow and the transit of production and touristic boats; the complete use of floodgates and [seccionamientos] and the oxigenation and cleaning of the waters in the lacustrine system.

Vegetal species with a higher resistance to salinity and sodium were also employed; the quality of the soil was improved by using organic matter extracted from fertilized and purified canal muds. Farmers were supported with credits, incentives and technical advisement on agricultural and trading methods. 1,271 hectares of chinampas were incorporated to cultivation; 180 hectares of ejidos recieved irrigation systems for intensive production; 177 flooded hectares were rescued and equipped with irrigation systems and 150 hectares which were also flooded were concessioned for the development of aquiculture.

In order to guarantee the quality of the water recieved in the canals, the water lily plague was removed. This also facilitated the boat transit through the canals. In addition, ownership of land was legalized as an incentive for the production in the chinampa zone as well as in the ejido and mountain zones. Strict measures were implemented in order to protect the lacustrine area, the chinampas and the recharge area of the water layer from the urban growth. Agreements were established with land owners in order to promote the agricultural use of the soil. The Plant, Vegetable and Flower market, the Cuemanco Ecological Sports Park and the Xochimilco Ecological Park were built as shields against the excessive growth of the great city.

Archaeological and Historical Rescue

The rescue of Xochimilco's historical heritage was prompted basically by the destruction of archaeological ruins from the mexica postclasic period and the ancient settlements of the people who created the chinampa agricultural system, as well as by the eradication of historical characteristics that belonged to the first settlements in the lake some 3,500 years ago and by the gradual deterioration of several constructions from the sixteenth to the twentieth century that belong to the historical patrimony of Xochimilco.

The first and most important goal was to protect and defend archaeological vestiges from being destroyed by the new hydraulic works and the construction of new road systems. An agreement was established between the Dirección General de Construcción y Operación Hidráulica, the Dirección General de Obras Públicas and the Xochimilco District (all dependencies of the Departamento del Distrito Federal, Mexico City's government), the Instituto Nacional de Antropología e Historia and the Instituto de Investigaciones Antropológicas of the Universidad Nacional Autónoma de México in order to accomplish the task coordinately. It was also agreed to take into account the community's proposals and to involve the people of Xochimilco in the archaeological rescue tasks.

Once the team work had begun, the following tasks were designed and fulfilled: to define working sectors in San Gregorio Atlapulco and the ejidos of Xochimilco in order to carry out archaeological expeditions and surface explorations; to elaborate detailed topographical maps in the areas under investigation; to locate and mark the limits of the archaeological sites, indicating their extension and complexity. 40 sites were located, formed by 117 mounds not higher than 1.5 meters and an average ratio of 20 meters. Photogrametric studies were carried out in the archaeological sites utilizing a captive balloon. As a result, 15 tons of archaeological material were recuperated, including the discovery of ceremonial burials.

V. XOCHIMILCO ECOLOGICAL PARK

In addition to the agriculture problems mentioned above, the community of Xochimilco occupies itself in other economical activities such as commerce and touristic services.

A cleaning and beautification program was implemented with the object to offering tourists a pleasant image. Many of the trajineras, Xochimilco's colorful boats, were restored.

The Natural Park

In order to prevent the advance of urban settlements into the renewed chinampera zone, the construction of what was then called a "Natural park" was included as one of seven supplementary actions in the agreement mentioned above. The park occupies 300 hectares distributed in three great zones, each with a different function. In the first zone there is a market of flowers, plants, and vegetables, as well as of all kinds of products related to that activity. It occupies 13 hectares and is constituted by 1,850 establishments which makes it the largest in Latin America and the third largest market in the world. The commercial spots were donated to former ejidatarios as part of the compensation for the expropriation of their lands. The market commercializes the regional products, thus satisfying one of the community's demands. The market is managed by the owners of the establishments themselves.

The second zone corresponds to the Deportivo Ecológico Cuemanco. It occupies 67 hectares and offers facilities for the practice of soccer, basketball, volleyball, skating, cycling, and jogging. There is also a little lake in the park. The zone is managed by the Delegación del Departamento del Distrito Federal in Xochimilco.

Owing to its extension, functions, and the benefits it offers to the community, the Xochimilco Ecological Park is the largest and most important of all three zones.

The Xochimilco Ecological Park

This park was created with different purposes which can be resumed in one main goal: the preservation of the diversity and the natural and cultural balance of the ecosystems. Therefore, it is the finest expression of the integral rescue intended for Xochimilco. It seeks to combine the restoration of the natural environment with recreational activities for its visitors. It also offers an approachment to the cultural aspects of the ecological rescue, especially to those aspects related to traditions, customs, ceremonies, economical activities and all kinds of elements that give a sense and cohesion to the xochimilca community: in one word, to the water culture.

Many rehabilitation works had to be carried out in the park's 235 hectares, in former agricultural fields and abandoned barren lands. Both kinds of terrain lacked a natural development, that is to say, that they needed human intervention in order to recover from their devastation. Therefore, it was decided to use them in a different way, involving the citizens as direct participants, and not only as spectators. The park is an artificial recovery zone of barren agricultural lands; a condition shown as possible by the edaphological studies of the zone. It is a sheltering barrier for the chinampas against the urban growth in the zone. It also satisfies another demand of the Xochimilco community: the necessity of green areas for amusement purposes and the contact with nature. The ecological values the park intends to promote are, basically, cultural values.

The Concept

The area occupied by the park is visually surrounded by the four sierras, or mountain chains, of the southern limits of Mexico's basin, at 2,300 meters above the sea level. In the middle of the mountains one can see the Popocatépetl and Iztaccíhuatl volcanoes. This landscape allows a better view of the park's dimensions and makes more intense the impression of magnificence produced in the visitor. The weather is mild and humid, with a lot of rain in summer --the rainfall annual rate is of 620 mm-- and an average temperature of 15 centigrades.

The Mexican government originally conceived the park as a mere touristic attraction, a recreational area, a wide open space to enjoy a rehabilitated portion of nature, replicating, as far as possible, the landscape enjoyed by Xochimilco's first settlers. During its four years since its opening, it has also been conceived as an environmental education center, especially for the many organized groups of students and tourists that visit the park year by year. In order to divulge the regional culture, there is an area of chinampas, so the visitor can have an opportunity to know directly this ancient agricultural system. Today's productive chinampas cannot be visited, for they are private property and are not in the traditional touristic tours in Xochimilco's trajineras.

Among the services for the visitors to the park are trajineras belonging to the former ejidatarios, who received them as a part of a compensation for the expropriation of their lands in order to make the ecological rescue possible. The lakes and swamps were filled and are still filled with treated water [de calidad terciaria] so that no drinking water of the city's supply is employed. The water flows towards the canals of the productive chinampera zone.

The Architectonic Project

The park is located on a flat surface which contrasts with a curtain of mountains in the background. It is a place where the relation between still waters, trees, chinampas, and mountains emerges with great force. The basic design of the park follows an ancient indian architectonic principle. The axis are oriented towards the great mountains that usually configure these kinds of landscapes, so that the main axis are the hills and mountains that surround the area. For instance, one of the canals points directly to Cerro de la Estrella; the Information Center, the access platform and the botanical garden are directly related to the position of the Popocatepetl, Iztaccíhuatl and Teuhtli volcanoes.

A Brief Description of the Park

The area of the park covers almost 235 hectares. 57 hectares correspond to water surfaces: three lakes, swamps and the interconnecting canals. There are only two buildings: the Maintenance Unit and the Information Center, which lodges the administrative offices, an auditorium, an exhibition area, a live museum, restrooms, and a craftsmanship shop. In the upper level of the building there is a balcony with a 360 degrees perspective of the park.

In front of this building is Lago Acitlaín, a middle sized lake where the visitor can enjoy a boat ride. The pedal propelling system of the boats waves the water and stimulates its oxygenation, thus creating a propitious condition for the development of aquatic flora and fauna.

The winding Paseo de las Flores --about 435 meters long, with 88 pergolas that reiterate the dominant form found in the park: the arch-- leads to the small pier in Lago Huetzalín, where trajineras are available for the visitors. At both sides of the Paseo one can admire the colorful element that identifies Xochimilco, namely, the flowers. There is a wide variety of species of flowers, many of them introduced since the arrival of the first settlers in Mesoamerica and other introduced after the Spanish conquest.

The park offers roads for vehicles and corridors for pedestrians. The latter facilitate the tour around the park. These paths lead to a forum in the open air, separated by a swamp from the Explanada del Sol, a natural tier of seats with a capacity for 20,000 people. At the farthest point from the the main entrance is the Isla de los Mitos, with gardens dedicated to the deities of the wind, water, and flowers, very important figures in the xochimilca pantheon. The island is used for agricultural research and for the production of the grana cochinilla, a very ancient, natural, and non-pollutant dyeing color. This pigment has become a real means for earning a living for many people in the region. Flying butresses with solar cells are utilized for outdoor illumination.

The park is divided in four main zones: The Botanical Garden, the Bird Natural Reservoir, the Xochitla Garden, and the recreative zone. The first zone is located in the

surroundings of lake Acitlaín and is divided in six sections: Xochimilco's lacustrine vegetation, senecio bushes, terraces, forests, ethnobotany, and taxonomy. The second zone was designed in order to offer a proper environment for birds which had abandoned the zone because of the pollution. Visitors are not allowed in this zone so that the birds that arrive are not disturbed. The Xochitla garden is a reminder of Xochimilco's past. It is located near the chinampas and all the park's vegetal cover is cultivated there. The recreational zone includes the access platform, the Acitlaín lake, the Paseo de las Flores walk, the Huetzalín lake, the Open Forum, the playground area, and the Isla de los Mitos.

Since its opening four years ago, the park has incorporated thousands of trees and bushes from different species in harmony with the landscape. This flora represents an unconditional support to the battle against pollution. Many of those trees were planted by visitors, most of all students. Today there are 280,000 trees in the park and 450,000 bushes and ornamental plants.

The Foundation

When the construction of what was then called Natural Park was conceived, an effort was made to avoid adding more expenses to the city's public treasury. Therefore, the management of the new Flower Market was handed over the merchants and producers themselves as a payment for their expropriated lands, and the Deportivo was put under the administration of the Xochimilco District, but it was necessary to charge "recuperation" fees for the use of its facilities.

The Ecological park was something different. The government decided to give a permission for the administration and preservation of the park to a Foundation formed by 28 people: 12 associate founders, amongst who were distinguished scholars (like José Sarukhán Kermez, former rector of the Universidad Nacional Autónoma de México, Mexico's most important university; Dr. Gustavo Chapela Castañares, former rector of the Universidad Autónoma Metropolitana, another important University of Mexico; and Dra. Mari Carmen Serra Puche, a well-known archaeologist), as well as important officials of the city's government, 13 associate neighbours, and 3 honorary associates.

The Xochimilco Ecological Park Foundation is committed, since its creation in 1991, to the preservation and the betterment of all aspects of the park. It is a non-profit organization which generates its own financial means in order to accomplish its tasks. In addition to the conditions for the park's grant, the Foundation has added an educational function to the park, focusing on environmental issues.

The Foundation also supports scientific research in different fields. Several books have been published as a result from this activity, such as *El Ahuejote* (a study on Xochimilco's typical tree), *Xochimilco arqueológico* (a report of recent archaeological work), and *Pasado, presente y futuro de las chinampas*. The first book of a series called *Ceremonias de Xochimilco* will appear this year. It is a document about the many festivities that have shaped the identity of the people of Xochimilco for five centuries. In addition to all this, the Foundation has organized and published the proceedings of two international seminars with researchers from Xochimilco.

Financial Means for the Park

The Foundation has chosen four basic procedures in order to receive funds: 1) "Recuperation" fees paid by visitors. Senior citizens pay half the fee and the entrance is free for children under fourteen years. The fee has not incremented its price since the opening of the park in 1993 (ten Mexican pesos, about a dollar and 20 cents, a much lower price than a ticket for the cinema, to mention one). 2) The concession of a number of services, taking a percentage from the revenues of the concessionaires. 3) Incidental --tax deductible-- economical support or in kind by different firms, institutions or individuals. This strategy reduces expenses and also involves the community in the project, since the petitions for economical support need to include information on the park and its purposes. 4) The continuous implementation of new financial means that fulfill two conditions: they must be a public service and generate funds. Among these financial means are the educational services of the park such as guided tours, summer courses and workshops. The coproduction of a number of events and the rent of locations for special events such as the shooting of films for TV or the cinema should be mentioned. The Laboratory of Soil and Water Analysis is still

another service. Originally created for the park only, today its capacity surpasses the park's needs. The Runner's Club, the three food stands, the craftsmanship shop, and the chinampa's production represent a small income. There will soon be restaurant, a camping zone, and a movie theater, among other facilities.

All the money collected by the Foundation is deposited in a trusteeship agreed with Nacional Financiera, S.N.C. The trusteeship is managed by a technical committee formed by seven members: two of them appointed by the Foundation, two more by Nacional Financiera, and the rest by the government of Mexico City.

Operating Scheme

The Foundation designated as the first director of the Xochimilco Ecological Park its secretary, who participated in the project ever since the rescue plan was being conceived. He would formally assume his responsibilities once the park was opened and officially given by the government to the civil association. Meanwhile, the Foundation worked on the system that would operate in the park and even started to take care of the maintenance of the vegetal covering seven months before the opening day.

The direction of the park focuses on four basic tasks: management, maintenance, administration, and research support for the other three tasks. The first task takes into account the new organization concepts and the social-natural relation; the second task is devoted to the necessary works for the maintenance of installations and improvements. The third task is in charge of organization aspects, the attention to visitors, the implementation of human, material, and financial resources, and the generation of funds for the park's operation. The fourth task takes into consideration the development of the project and supports it by introducing new ideas for the solution of problems and the continuous improvement of the park's conditions.

The structure of the staff was reduced only to the necessary people to satisfy the daily needs. The director himself is in charge of its functioning. It is composed of a private secretary, an employee to serve visitors, another employee in charge of the guided tours, one more for communication and divulgation services, a bookkeeper and an assistant for

external bookkeeping, a receptionist, a ticket seller, a clerk for the craftsmanship shop, three people for the cafeterias, and, finally, a messenger and a technician for general repairs. The personnel is asked to help each other when necessary. When special problems come up, external specialists are required. Two very important services are operated by specialized firms: the vigilance of the entire park and the cleaning of buildings and kiosks.

Young people who do social service in the park have provided an excellent support, especially in guided tours. They all come from various public and private universities. Their aid helps to avoid considerable expenses.

Two people are in charge of maintenance. They have experience and knowledge in their tasks and a disposition to adopt the new ideas required by the basic demand in all the tasks carried out in the park: to respect the rhythm of nature, to avoid forcing it with efficient solutions that turn out to be, in the long run, very harmful. Instead of chemical pesticides and fertilizers, natural predators and organic fertilizers are employed. The vegetal covering program is supported by data obtained from the meteorological station brought by the Foundation. The cleaning of water bodies is always a special work, and the quality of water is continually checked by the Foundation's own laboratory.

All the park's gardeners --about 80 people-- come from different zones in Xochimilco. They are organized in zone teams, each team under the lead of a gardener designated by the chief of gardening.

Due to its extension --6.5 hectares-- and its characteristics, including cultural ones, the chinampa sample-productive area has its own employee in charge, as well as its group of farmers from Xochimilco. It works independently, trading the various merchandises at xochimilca markets.

During the Park's four years of operation, the foundation has developed other independent areas which have reduced their costs in a short period of time by avoiding expenses for things they produce themselves. Those areas will represent complementary incomes to the Park by trading their own products and services, like the Demonstrative Production Units, whose goal is to produce all the necessary plants in order to increase and satisfy the vegetal covering of the park and commercialize its surplus.

The park is an exceptional place where visitors will find, above all, tranquility, a quiet and relaxing environment; rejoining nature is an incomparable experience. One can go through the park by foot or riding a bicycle.

The Foundation is always concerned to increase the recreational and educational services and to preserve the park in an excelency level. The preservation of traditional craftsmanship is supported by acquiring products directly from the producers and selling their art in the shop located in the Information Center. A small revenue is obtained by this means. There is always at least one exhibition related to environmental issues or artistic expressions of Xochimilco's culture. In addition, small enterprises are supported by granting complementary services. This generates employment, and today the park supports, directly or indirectly, the economies of 220 families.

Environmental Educational Programs

To promote the preservation of environment is a main concern for the Foundation. In order to implement an ambitious *Environmental Educational Program*, an agreement was reached with the Secretaría de Educación Pública and another similar one with the Departamento del Distrito Federal. These two programs will be oriented to children and families.

In order to eradicate prejudice towards nature in all visitors, the Foundation devotes its best efforts to the many school groups that visit the park. About 9,000 children visit the park each month. The park is intended to be an agent for a social change in favor of nature.

Research Collaboration Agreements Between Institutions

In addition to the original obligations acquired by the concession's terms, the Foundation added more obligations aimed to the development and support of many research programs in various fields in order to improve the quality of life in Xochimilco by promoting the knowledge and preservation of its traditions. Collaboration agreements have been reached to fulfill this purpose with institutions such as the Universidad Nacional Autónoma de México, the Universidad Autónoma Metropolitana, and the Instituto Nacional de Nutrición, only to mention three. Several research programs of the Foundation have been financed by the Consejo Nacional de Ciencia y Tecnología.

Results

Visitors themselves regard the park as the most beautiful and clean place in the city. The spectacular landscape produces in the visitors a moving experience, a feeling that we are in possession of a treasure that must be preserved. This favorable effect is reflected in the fact that very little litter is collected and the park has never suffered a deterioration caused by human agency.

Benefits for the Community

As a consequence of the park's management, many benefits, both particular and general, have resulted. Considering in the first place the mere recreational aspect of the park, it is a wide space that offers a direct contact with nature to local residents and national and foreign tourists. This is very important given the lack of green areas with such dimensions and characteristics for the urban population.

Turning to the ecological aspect --defined as the relation of living beings with their environment--, the social group of Xochimilco, especially farmers, floriculturists, horticulturists, chinamperos, cattlemen, and tourism workers (such as trajineros), have been especially benefited by the park, the largest controlled green zone of the southeast area of

the city. Some of these benefits are: the restoration of ecosystems, the return of animal species, many of them endemic, and the restoration of the food chain; the utilization and control of treated waters from the Cerro de la Estrella plant; the protection of water layers for their optimal recharge; the reduction of dust storms and, finally, the shelter against the city growth.

Regarding the educational aspects, the benefits are many. The park is conceived to become an agent of social change in order to modify harmful behaviours for the environment. This has been pursued almost since the opening of the park in 1993, when guided tours were implemented for school groups.

Xochimilco's ecological rescue and its excellent results have been awarded by several international organizations. Among others, the park was awarded with the *Waterfront Center Annual Award*, and the *Merit Award* by the American Society of Landscape Architects for its architectonic concept. In 1997 the park was awarded with the *Long Haul Special Award*, by British Airways, for its management and touristic potential capacity for the future. The park also received a honorable mention in the *Premio al Mérito Ecológico Award*, by the Secretaría de Medio Ambiente, Recursos Naturales y Pesca de México.

VI. REPLICABILITY OF THE XOCHIMILCO ECOLOGICAL PARK

Achievements

The aims determined by the government of Mexico City as obligations for the Foundation were all accomplished and have even been surpassed.

- The park has been considered by local, national, and foreign visitors as the most beautiful place in Mexico City. This satisfies the requirement of "keeping, preserving, and managing" the park, which has been subject to many aesthetic and functional improvements.

- All the operation and improvement expenses of the Xochimilco Ecological Park have been paid with its own income generated by ticket sales, educational services, participation in concessioned services, and the reception of --tax deductible-- donations.
- The trusteeship constituted in Nacional Financiera has been the instrument for the control of the Foundation's funds.
- The park has never admitted sidewalk vendors in its interior or access platform, parking lot or surroundings.
- The relation with the DGCOH has not only been in order to supervise the Hydraulic system and to inform the DDF, but it has also been a close collaboration. Similarly, what the Foundation itself proposed as its social goal was surpassed by the work done:
 - To contribute with the recuperation of different areas in the lacustrine system has been a priority.
 - More than 300 demonstrative flower boxes [jardineras] have been built, each with an average surface of 30 square meters. A collection of didactical guides on different aspects of the park is being edited; the *Guía del visitante*, the *Guía botánico-turística*, and the *Guía de las aves del parque* are now available. The forthcoming titles deal with such aspects as chinampas, wild vegetation, guided tours, demonstrative production units, and the Runner's Club, among other topics.
 - Many formal and verbal collaboration agreements have been established with public and private institutions, cattlemen, and entertainment firms, among others, in order to promote the divulgation of interdisciplinary scientific knowledge and the preservation of culture and traditions, especially those from the Xochimilco area.
 - Free attention and special facilities to senior citizens and handicapped throughout the park.

Long-run aspirations

As its most basic objective --supported in the recognition by the Instituto Nacional de Ecología (INE) of the government's incapacity to administrate the protected green areas-- the Foundation hopes that the park can function as a tested model of sustainable development for natural areas rehabilitated in urban zones.

To constitute a permanent and safe habitat for the flora an fauna, both resident and migratory.

To incorporate continually to the park ecological technology and avoiding as far as possible pollutant elements.

To conclude the botanical rescue of 329 representative vegetal species —including curative plants— of the southern area of Mexico's basin.

To restructure the botanical garden according to the Master Plan.

To offer visitors a wider variety of ecological recreational services.

To promote the elimination of harmful habits for the environment in the regional and national population.

To promote familiar and communitarian integration by means of didactic and recreative activities involving environmental issues.

To function as a meteorological center for farmers and the environmental monitoring system.

To offer reliable advising to similar projects in other parts of the country or even abroad.

To constantly offer a decent employment for the residents in the area and a development opportunity for small enterprises.

To advance proposed laws to the effect that urban parks be considered as protected natural areas, with all the benefits for their operation carried by such recognition. ●