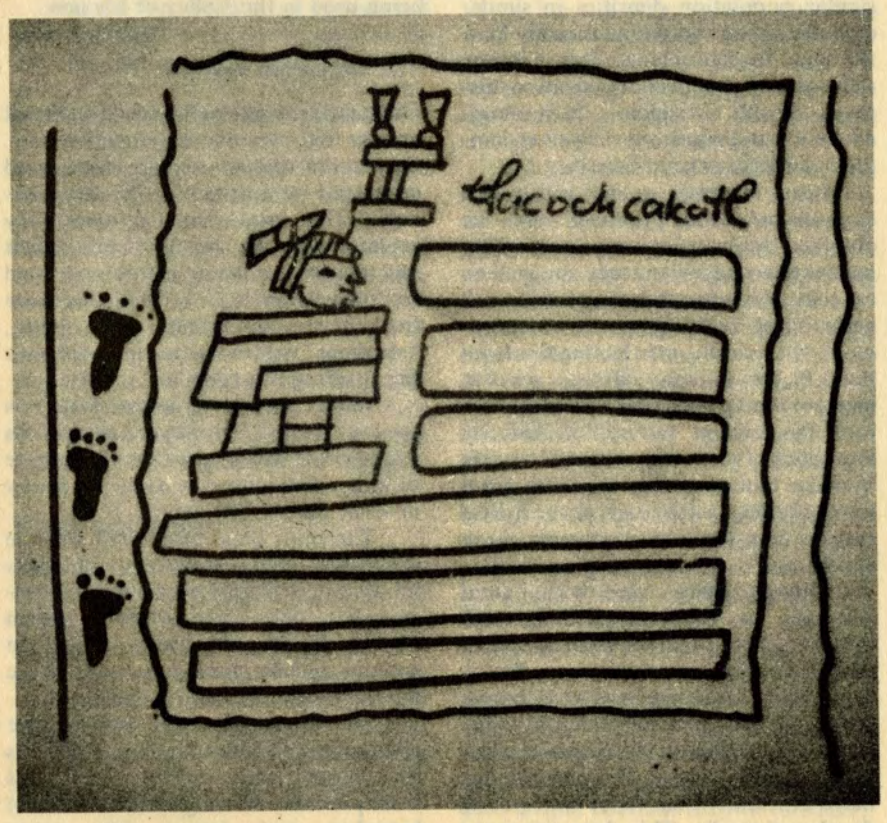
# An old answer to the future

by Arturo Gómez-Pompa*



# Mexico's chinampa agriculture—an ancient ecotechnique—has been revived and is helping to resolve the food problem

Food production is without doubt the world's major problem. Since population growth is the primary cause of this problem, any solution to the food problem must include measures to control population growth. However, similar population densities in similar climatic regions do not necessarily have the same food problems. This is due to differences in political organization, history, health, religion, technology, education and many other diverse, complex and inter-related factors.

Some increases in the quality and quantity of food produced may be obtained by changing water availability, nutrients in the substratum, the genetic capacity of food organisms, pest control, agricultural techniques and management. Historically, man has manipulated these factors in many different ways to improve food production. For example it took the ancient cultures of America thousands of years to produce the strains of maize that are still in use today yet it took only decades to produce the hybrid maizes that are now becoming more widely used.

Though there have been great advances in food production since ancient times, they have often spread slowly. This has become more evident as communications have improved, especially in the scientific and technical areas. Those countries with better communications systems spread their knowledge more efficiently than those with poorly developed media. This does not mean that their achievements in food production were better, only that they had the capacity to capture their own experience and knowledge and let other regions know about it with great efficiency.

There are no under-developed techniques of food production. Any improvement is a step forward. In my opinion, such a step forward is the "chinampa agriculture system." It is an excellent example of an outstanding improvement in food production made by ancient cultures which has been overlooked for centuries by agronomists and biologists. Fortunately, the system is still being used in the Valley of Mexico.

## The chinampa system

Chinampa is a self-sufficient agricultural system that uses intensive hand labour. Small plots of land are constructed and separated by a network of water channels. The plot soil is constantly replenished with organic debris (plant and animal), aquatic plants and mud from the channels. In addition, seeds are first sown in small mud cubes, "chapines", which are transplanted once the seedling is established.

We do not know where or when this system started. However, during its evolution, it has adopted many separate techniques which evolved independently in other parts of the world.

The most important event was the discovery that irrigation channels increase agricultural production. Consequently, this agricultural system developed close to water bodies; in swamps, on lake shores or in areas where the water table was near the soil surface.

The main difference between the chinampa and other similar systems is that initially some of the raised fields were probably floating on dense mats of branches and leaves (the name chinampa in náhuatl means: chinamitl=net of branches). On these floating mats the farmers, "chinamperos", built their own soil using plant material and mud from the bottom of the water channels or lake. Using this enriched 'mud soil', the chinamperos were able to grow many kinds of crops with good yields. In my opinion, this type of agriculture may have evolved rapidly during the period when the central portion of lakes were filled creating islands on which cities, for example the great Tenochtitlan in the Valley of Mexico, were constructed.

As the total number of agricultural plots increased a transport system for the soil components and agricultural products was needed. The existing network of interconnected channels proved ideal for the purpose. In the Valley of Mexico, at the time of the conquest, there was a complex city in the middle of the lake, with a complicated system of roads into the centre. This environment was ideal for the evolution of the chinampa. Large amounts of food could be produced in the nearby area and the water could be used for transport. And until very recently the products of the chinampas of Xochimilco in Mexico City were transported several kilometres by water channels to the big market of Jamaica.

## Water and fertility

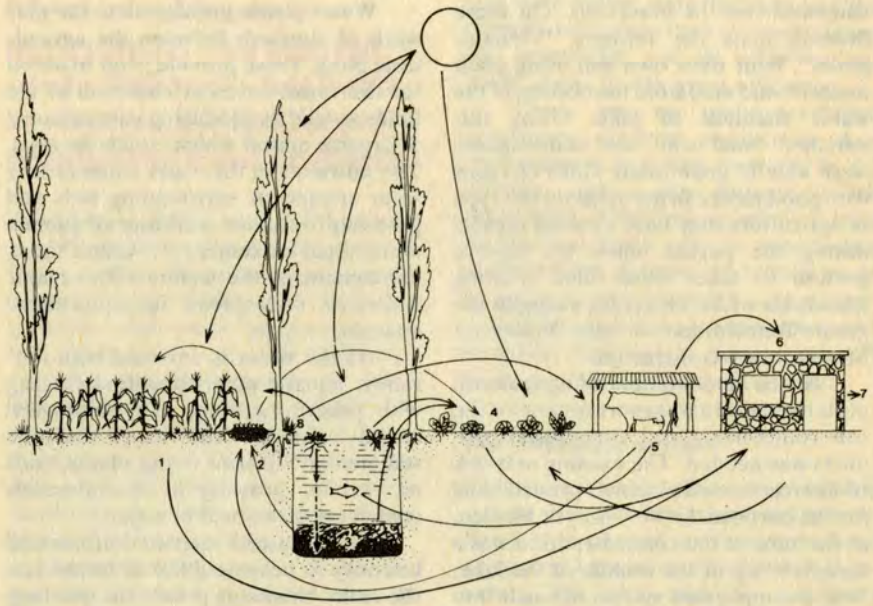
The channels used for transport also provided a ready source of water for irrigation. By hand-carrying water from the channels to the fields, the chinamperios were able to maintain high levels of production even during the dry season. Thus they were able to overcome a major limiting factor to increased food production in many parts of the world: water availability.

Water plants proliferate in the network of channels between the agricultural plots. These provide plant material for the construction or elevation of the fields as well as producing vast amounts of organic matter which enrich the mud. The nutrients in the water come mainly from erosion of surrounding hills and probably from the addition of human and animal excrement. In China today enrichment of the waters with organic wastes is widespread in aquaculture systems.

As the water is enriched with nutrients, aquatic plants proliferate along with other organisms. This biological activity enriches the water and the sediments. Nitrogen fixing plants, such as *Azolla*, growing in the channels contribute additional nitrogen.

As the system increased in size and intensity it became difficult to fertilize the entire chinampa prior to its planting. There then evolved the crucial technique of the specially constructed seed beds, the "almácigos". These beds are constructed with mud from the channels and organic fertilizer. They are small in size, 2 x 4m, and are cut into small cubes which allows the seedlings to be easily separated. One or more seeds are planted in each cube. The almácigos is then covered with grass to prevent excessive drying. Once the seedling has grown, the mud cube or chapin is transplanted to a pre-determined place in the chinampa. Production of the chapines is very active throughout the year and today some are even sold commercially.

The use of the almácigos allows the selection of only the most hardy seedlings. Also, since the chapin contains an entire living plant, no damage occurs to the roots when transplanted. In addition, each chapin contains its own fertilizer.




*Continuous recycling of energy and materials in a Mixquick chinampa. 1. organic soils 2. seed bed 3. organic mud 4. vegetables 5. manure from stable 6. human food 7. cash income 8. weeds*

Use of interconnected canals, almácigos, crop rotation and natural fertilization results in a very simple and yet highly productive system. This system thus represents a combination of many elements that are not new and have been employed in other areas for centuries. But the chinampa system is unique in the way it combines these elements to provide a highly productive and self-sufficient agro-ecosystem.

The products of today's chinampas in the Mixquic-Xochimilco area are diverse: vegatables, maize, beans, young trees and flowers. Crop yields are very high.

There are several other places in Mexico where this system is still practised but they are scattered and not as extensive as those in the Mixquic-Xochimilco area of the Valley of Mexico.

It is very difficult to imagine that a system like this could not have evolved elsewhere. This appears to have happened since relicts of chinampas or chinampa-like agriculture have been found in several places.

## Chinampas in the hills

Terracing has been used in agriculture for centuries. The most impressive and well-known ancient terraces are those of Peru, while the most recent are those of China.

Hills had some advantages over plains for living. They were easier to defend and when terraced provided more land surface for cultivation. The main problems of trying to cultivate hillsides were water availability and soil protection. Terracing partially solved both problems and has since become a highly recommended and widespread agricultural practice.

In the Valley of Mexico, which is surrounded by mountains, a unique event occurred in the fifteenth century. In the south-eastern portion of the Valley, in the area of Texcoco, the poet king Netzahualcoyotl, probably with the advice of chinamperos from Xocimilco, designed a system of terraces using chinampa techniques. However, to construct these terraces, he had to bring water from the higher mountains nearby. He therefore designed an incredible (for those times) hydraulic system that brought water from several miles. It included solid aqueducts which extended from mountain to mountain, finally reaching the top of the terraced mountains. A system of channels was constructed in the inner portion of the terraces, thus proving a source of water for irrigation within the terraces. Water plants were also introduced from the low-land chinampas and used as mud builders.

This development stimulated the area to become a great agricultural production centre, and the population it supported has been estimated to be higher than that of the present day.

It is unfortunate that scientists have not recognized this as one of the most significant agricultural systems ever developed. It is comparable only to the work done by the Tachai Brigade in China within the past twenty years. There, by utilizing a large labour force, a poor and eroded mountain area was changed into a rich, agricultural zone through the construction of terraces and a water transport system.

## Chinampas in the humid tropics

Most hot tropical regions encounter difficulties in producing enough food. Although several factors are involved, the most important one is the poor agricultural soil.

These soils supported or support eco-systems of many types which have evolved through millions of years and which are well adapted to the poor soils on which they exist. Since there has been a significant amount of research done in this area, I wish to mention only the fact that in these regions shifting agriculture has evolved as an adaptation to the poor soil conditions. The reasons for shifting agriculture are ecologically based, since it allows the soil time to regain fertility through ecological succession. On the other hand, population pressure in most of these areas has not been great. But problems arise when populations expand and there is no longer enough land to support this type of agriculture. According to recent research, a family of five needs a minimum of 4 to 6 hectares to maintain itself using shifting cultivation and a fallow period of five years. However, as population increases so too do the chances of soil deterioration and agricultural food production decreases unless shifting cultivation methods are continuously employed. To date, the main use of depleted soils has been cattle-grazing which cannot alone meet internal food demands.

Shifting cultivation does not require as much human effort during the year as the chinampa. Furthermore, fire is used for weeding and clearing during the initial period and liberates the nutrients. In tropical Mexico, this type of agriculture is still used in the remaining evergreen rain forests. However, because these areas are rapidly dinimishing, a different type of agriculture has to be designed for the tropical rain forests and related eco-systems.

With this idea in mind, and knowing the success and simplicity of the chinampa agriculture, an attempt was made to establish some chinampa techniques in rain forest regions of Mexico. Two sites were chosen, one in the state of Tabasco (San Pedro Balancán), the other in the rain forest of Chiapas (Lacandone Forest). In the region of Tabasco, swamps and semi-evergreen rain forests are the most important eco-systems. The climate of the area is seasonal, with a dry period of six months. We selected the swamps in an attempt to build a tropical chinampa. The field project was directed by an expert chinampero of Xochimilco. In less than two months the fields were constructed with mud and plant material from the swamps, and channels were made including simple banks for flood protection. This attempt was successful and in the following months many different crops were obtained. The experimental area is still in operation and proves that there is no reason why we cannot use this system in the tropical swamps. The transfer of the technology was a complete success because the area was abandoned by us in 1976 and left to the care of the local people who have preserved and enlarged it since then with their own resources.

The second eco-system chosen was a tropical rain forest site in Chiapas (the Lacandone forest) where shifting agriculture is widely used. At this site the water was diverted from a nearby creek and chapines were made with river mud and enriched with litter from the adjacent rain forest. The fields were also fertilized with litter. This attempt was also successful, and as many crops were obtained as from the site in Tabasco.

## Chinampas as a solution

At both sites the work was done using hand labour with no external mechanical or chemical aides. The systems were designed to be simple, practical and require little capital investment. Our modern attempts to use the chinampas in the tropical lowland areas of Mexico have led me to explore the literature on labour-intensive agricultural developments in the tropical regions of the past and present. I was fascinated to learn that ancient raised fields have been discovered in lowland tropical regions of the world. However, I have found no evidence that chinampa agriculture is used outside Mexico today. In southern China they do use an agricultural technique employing mud, water channels and organic fertilizers which is similar to the chinampa system but is not such an integrated method.

There is now a great need to find and apply efficient and self-sustaining methods of agriculture. Agricultural techniques throughout the world should be carefully evaluated as to their practicality and applicability. The system of chinampa agriculture clearly demonstrates that ancient agricultural systems do exist which are capable of increasing world food production. □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