

Reviews

Agroforestry in Mexico: Can the past be a guarantee for the future?

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Abstract. Some aspects of agroforestry systems in Mexico are reviewed, including the chinampas, a unique type of prehispanic home-garden, still in use today, mainly in the Mexico valley; the Huastec té'lom (in the north of Veracruz State) an agroforestry technique used by the farmers for sustainable exploitation of natural resources; and forest-farming among the Maya (Yucatan), a production strategy which has evolved over a long period. Some other, more recent agroforestry techniques are also reviewed. The discussion emphasizes the biological, ecological and social significance of agroforestry systems. Agroforestry, however, must be considered within its socio-economic context. Assessing the needs and potentialities of a region must be the first step towards integrating agroforestry systems into the socio-economic realities of today.

Key words. Agroforestry; chinampas; Huastec té'lom; Mayan agroforestry; rural development; traditional agriculture; humid tropics; land management; farmers; sustainability.

Agroforestry is widely studied today and is the subject of numerous articles, books and seminars. We do not intend to suggest a new definition, but merely to recall the one given by Combe and Budowski⁹: "Agroforestry includes farming systems in which trees appear – in time or space or both – as a supplementary element to yearly or perennial cultivations or to pastures and combine with cattle-breeding."

A long prehispanic tradition of agroforestry in Mexico offers examples anchored in past customs and history. On their arrival in the country, the Spanish found the gardens to be extremely diverse, and based on concepts widely different from theirs¹⁶. Each of these gardens was different from the others: all were partly home-gardens and partly orchards, but all were beautifully flowery. Newly developed techniques and present economic pressure in Mexico have led to a situation in which it is opportune to survey the agroforestry of the past, with a view to learning from it for the future. The examples that will be discussed here are: chinampas, the Huastec té'lom, Mayan agroforestry, and a few more recent agrosystems.

1. The chinampas

The chinampas are prehispanic gardens of a very particular kind: the tradition of cultivating them is still maintained, predominantly in the Mexico Valley. These chinampas were only one type of garden among others, but probably the most famous. Commonly referred to as 'floating gardens', they have been the subject of numerous archaeological, historical and ecological studies. Chinampas are a form of intensive horticulture, probably one of the most productive in prehispanic America. They are established in marshy areas (such as Xochim-

ilco, a suburb of Mexico City) which have been optimally exploited as a result of the combination of draining and irrigation. The swamps were drained by channels that could also be used as waterways. Between these channels, chinampas were built on rush-rafts – more or less floating – onto which mud, drawn from the bottoms of the channels, was heaped up in order to grow vegetables and flowers. The banks of the channels were planted with trees⁶.

Each chinampa consists of a roughly rectangular platform made by piling up dried plants, mainly *Typha*, *Juncus* and *Cyperus*, and covered with mud collected from the bottom of the channels. This platform – about 10 m wide by 100 m long – projects about 50 cm above the water level. The constantly renewed supply of mud and compost provides a cheap and efficient enrichment requiring neither supplementary inputs nor a means of transport.

In the prehispanic period, two main kinds of plants were grown in chinampas:

- Food-crops: amaranth (*Amaranthus leucocarpus*), beans (*Phaseolus spp.*), tomatoes (*Lycopersicum sp.*), chillies (*Capsicum annum*), maize (*Zea mäs*), gourds (*Cucurbita spp.*), sorrel (*Oxalis acutifolia*), etc.
- Ornamental plants: tagetes (*Tagetes erecta*), Aztec lily (*Tigridia pavonia*), dahlias (*Dahlia coccinea*, *D. excelsa*, *D. pinnata*), etc. This is indicative of the importance given to flowers in prehispanic times. (See e.g. the Badianus Codex, a treatise in Aztec medicine⁷; the Florentine Codex⁸).

Nowadays, Mexicans as well as tourists still enjoy relaxation on boat trips along the channels between the present-day 'floating gardens' of Xochimilco – the name meaning 'a place where flowers are grown'. Although

nutrition was the main objective of this prehispanic agrosystem, and in spite of the minor importance that trees had in it, it was related to forest farming. Cocoa trees, and other tropical species, were grown in the gardens surrounding Tenochtitlan (the name of ancient Mexico City).

The owner of the chinampa (the chinampero) lived in the middle of his compound. The gardens formed a dense, regular network with a settled population. To some extent this method of farming can be compared with cultivating a home-garden. Both types of garden consist of a small area surrounding the habitation (which saves work and time); permanent cultivation is improved thanks to soil fertilization from domestic refuse, and a wide range of plants is grown. Nevertheless, home-gardens and chinampas do differ in various aspects; in particular, thanks to irrigation and fertilizing mud, the production of a chinampa exceeds domestic needs, and may be commercialized. The channels enable farmers to transport their produce conveniently to local markets, so that economic activity is generated.

The chinampa technique was used earlier in the Mexico Valley and some other places such as the Veracruz area. It is still practised in those places, but it has also been imported into other regions. For example, new chinampas have been established near Balancán – Tenosique, in the far south-eastern part of the State of Tabasco¹². In the Mexico Valley, the future of the chinampas is in doubt owing to the increasing pressure of population growth, and to pollution.

II. The Huastec *té'lom*

The Huastec Indians of today live in the hills in the Tantoyuca area, in the north of Veracruz State, and in smaller valleys near Aquismón in the south east of the State of San Luis Potosí. Some anthropological characteristics, and their language, link them with the Mayas. It is known that they were practising agriculture at least as early as 3000 BC, and that they developed some original food-supplying systems adapted to humid tropical regions during that period²¹. The Huastec *té'lom* described in Alcorn's interesting study^{1,2} is the agroforestry system used by the Huastec farmer for sustainable exploitation of natural resources. The Huastec environment and vegetation have also been described by Puig¹⁷.

Alcorn¹ emphasises the fact that the Huastec peasant uses natural resources on two levels:

- the global management of the whole system at a site for his plot;
- the specific management of components selected from the ecosystem.

The *té'lom* is only one of the Huastec farmer's agrosystems. These also include maize fields, sugar cane fields, henequen fields (the henequen or sisal hemp contain an excellent fiber which forms one of the basis of Yucatecan

commerce. The species is *Agave fourcroydes*.) home-gardens etc. The *té'lom* (literally meaning 'a group of trees') includes various features, but generally trees are the basic components of the managed forest. The number of species, their arrangement in space and their insertion in the forest depend on several factors which vary according to history, socio-economic conditions, soils and topography, or which simply reflect an individual farmer's imagination or needs.

The *té'lom* is a kind of forest garden which can combine all sorts of species: either growing spontaneously, helped, saved or planted. Its exploitation is done on a family scale. The number of useful species may gradually increase, in relation to the farmer's priorities. Among the favoured protected species are *Chamaedorea elegans* (Arecaceae) and especially *Brosimum alicastrum* (Moraceae). The latter species – one of the dominant species in the forest – was certainly of major importance in Huastec nutrition in the past, as is confirmed by oral tradition.

Alcorn² has made a detailed record of the useful species of a *té'lom*. The main categories recorded include 33 timber trees species, 221 medicinal plants and 81 food plants. He also mentioned other kinds of uses: for ornamental and ritual purposes and for fuel, fodder etc. The Huastecs also succeeded in introducing into this traditional system some of the colonizer's imported plants (e.g. coffee, mango, sugar cane) and thus managed to diversify and improve the system. The Huastec *té'lom*, which has a remarkable flexibility both in its design and its use, offers the advantages of an agroforest in terms of ecological and biological efficiency and can be adapted to the socio-economic situation.

This type of agroforestry garden has been maintained for centuries, and still exists today. This is probably due partly to the flexibility it offers regarding design and use, and partly to its integration in a natural environment and in the living tradition of the Huastec people. The present decrease in such gardens as a result of severe demographic as well as political pressure is regrettable. People in power too often consider (perhaps unwisely) that this system is not sufficiently productive. Consequently, they encourage Huastec farmers to give it up and to replace it by pure stands of crops (maize, sugar cane, meadows, etc.) which may not ultimately prove to be the most appropriate ones.

III. The Mayan agroforestry garden

Forests of the Mayan area still show signs of use, both recent and from past times. Before commenting on some aspects of the use made of the forest by the Mayas, it seems necessary to emphasize the fact that the forest was not their only source of food or – in a broad sense – of natural resources. Mayan history and culture have, however, been linked with the forest ('quiche'), for a long time, and still are – particularly with the tropical rain forest, though the importance of the pine and oak forests in the

highlands of Chiapas (Mexico) and Guatemala should not be underestimated.

The Mayas are linked with the civilisation and the ecology of mesoamerica, which has been defined earlier¹⁸. The food of the mesoamerican peoples was based on maize (which in the Mayan language means food). Was maize ever grown in an extensive farming system (shifting-cultivation), or was the system of an intensive type? This question is of minor interest; the essential point to make is that maize was only one crop among others. In addition to maize, other food plants were obtained from home-gardens or from the forest, which yielded gathered plants and products of the forest-garden or 'ka'anche'. Further foodstuffs were produced by hunting, and even fishing activities in some areas.

A sizeable proportion of the Mayas' renewable resources was provided by home-gardens^{3,25} and/or by the cultivation of ka'anche, a Mayan technique for horticulture²⁴. Mayan agroforestry represented only one aspect of a complex combination of diverse agricultural, social and economic strategies. These had to be constantly re-evaluated and adapted not only to historical changes and changing socio-economic needs, but also to the ecological variation that resulted from human activity. Among others, Rico-Gray et al.²⁰ have analyzed the techniques used in the Mayan agroforestry garden. These forests, located in the area that was under Mayan influence, can be found today mainly in the states of Campeche, Chiapas, Quintana Roo, and Yucatan, and also in Guatemala. The Mayas' agroforestry system aimed at making the best of their natural resources and maintaining a balanced management of the forest.

'The use of plant resources requires a very efficient selective process in order to recognize, protect or reproduce the species that are most useful to men, and limit or attempt to eliminate those that can be harmful to them (toxic species) or to agriculture (weeds)'²⁰.

The fact that the Mayan agroforestry system developed over thousands of years is important for two reasons. Firstly, it took a long time to master the forest-farming techniques handed on by popular tradition. Secondly, the selection processes in the course of centuries undoubtedly had a lasting influence on the structure and floristic composition of the forest. Today, the useful species predominate in the forests of the Mayan area, even where the density of population is now very low, but where archaeology provides evidence of a greater population density in the past. This predominance is probably the result of traditional Mayan forest-farming¹³.

Taking the forest of Yohaltun, Campeche, as an example, Rico-Gray et al.²⁰ record that useful species predominate, with the five most frequent ones being: *Manilkara zapota* (Sapotaceae), *Brosimum alicastrum* (Moraceae), *Bursera simaruba* (Burseraceae), *Spondias mombin* (Anacardiaceae) and *Cedrela odorata* (Meli-

aceae). These multi-purpose species are still cultivated or protected today. Among them, *Brosimum alicastrum* was and still is definitely the most valued one because of its numerous uses. When necessary, its fruit can be used as a substitute for maize in the making of tortillas, and as a starchy vegetable providing proteins particularly during times of drought¹⁹. This may account for its abundance at archaeological and ceremonial sites.

The Mayan agroforestry strategy was based on a deep knowledge of forest species and their potentialities. Some species could be promoted in the agroforestry system, and others selected for other agricultural systems. Among these species, Barrera et al.⁴ refer to *Diospyros digyna* (Ebenaceae), *Jacaratia mexicana* (Caricaceae), *Parmentiera edulis* (Bignoniaceae), *Manilkara zapota*, *Pouteria campechiana* (Sapotaceae), *Talisia olivaeformis* (Sapindaceae) and *Spondias mombin* (Anacardiaceae). These authors also mention the pre- or post-Cortesian introduction of species from other neo-tropical regions: *Chrysophyllum oliviformis*, *Pouteria sapota* (Sapotaceae), *Persea americana* (Lauraceae), *Psidium guajava*, (Myrtaceae), *Annona cherimola* (Annonaceae) and some species brought in during or after the 16th century from the Old World: *Mangifera indica* (Anacardiaceae), *Tamarindus indica* (Caesalpiniaceae) and citrus fruits. Mayan agroforestry and agriculture were closely linked in systems that were both parallel and complementary⁴.

In the centre of the Yucatan peninsula, as well as in Peten and Belice, terraces still exist that bear witness to the fact that Mayan agriculture was adapted to different environments and in particular to various kinds of soils²³. The milpa – an original mesoamerican agricultural technique – is not a monoculture, but a complex gardening polyculture. Maize cultivation was dominant, but other species were combined with it: beans, gourds, chillies, yams, cassava, etc. It is most important to emphasize, as Barrera et al. do⁴, the very wide range of varieties of each cultivated species that were used. These varieties were adapted to very diverse mesoamerican environments (plain/mountain; dry/humid), and at the same time, met a diversity of social needs. Although the milpa involves a system of shifting cultivation it does not destroy the forest, when used moderately. On the contrary, the soil is not exploited intensively, and if the milpa is combined with agroforestry, forest regeneration can take place.

Today, Maya farmers still have a very sound and advanced knowledge of how to make rational use of forest resources, particularly of useful plant species, based on their long-lived traditions⁴. It is regrettable that such popular knowledge might be lost. The resources of Mayan society were not based on a unique farming system, but on a complex agroforestry system linking agriculture and forestry, and including various strategies always in complete harmony with the environment.

IV. Other recent forest-farming systems

Present farming systems – whether or not derived from ancient traditions like those mentioned above – have been analyzed or discussed in numerous surveys. We do not intend to give a full list, but merely to mention some, and to choose one example in support of our final discussion.

Such farming systems can be found in all parts of Mexico. There are recent studies of the western state of Colima by Fornage et al.¹⁰ and Leger et al.¹⁵ For Central Mexico, the studies by Toledo et al.²² and Caballero⁵, of the Purépecha people living around the Patzcuaro Lake, must be mentioned. For the east, there are reports by Gispert¹¹, and by Hoffmann and Rossignol¹⁴ on the state of Veracruz.

We will discuss in detail the example of coffee plantations and agrosystems in the state of Veracruz. Fornage¹⁰ lists the various kinds of coffee production most commonly used:

- The lowland system: a simple plantation in more or less thinned-out natural forest. Little care is provided and the yield is low.
- The traditional system, in which coffee trees are planted under the shade of small fruit trees (mainly banana and citrus), mixed with larger trees (such as *Inga* spp.) to provide shade. Yields are better due to more sophisticated management, but many of the plantations where this system is used are aged.
- The contemporary plantation system, which has specialized shade trees of one species, or sometimes no shade, according to the variety of coffee to be grown. The system is based on a highly skilled technique using fertilizers and phytosanitary treatments. (In some regions, shading is decreasing more and more or may even no longer be used).

The choice of a system will depend on the available land and on the technical, financial and human resources available to the farmer. Concerning the state of Veracruz, Hoffmann and Rossignol¹⁴ point out that since they must operate within a context dominated by local socio-economic factors, 'peasants have very little latitude to orientate or alter their farming-system'. It is often not possible for farmers to achieve a suitable balance between ecological considerations and a forest-farming system, traditional or not, even though peasant farmers are well aware of their environment.

The classification used above is theoretical, and various mixed or intermediate systems do exist. One can also find coffee plantations combined with the milpa farming system described above, with or without shade trees and including one or several strata, some of which may be productive and others not.

These coffee plantations are real agroforestry systems of a more or less complex type, and can be found in various forms in different parts of Mexico as well as in other tropical countries. They are therefore not unique, but

tradition has it that forest-farming techniques had their origin in the state of Veracruz. Although undoubtedly of post-Cortesian origin, they fitted in perfectly with customs and the global environment, because they followed an earlier forest-farming tradition, with coffee trees simply being substituted for, or added to other trees.

V. Discussion

The examples described provide us with a basis for discussion of forest-farming systems. We are convinced that they could play a valuable role in meeting the requirements of a changing society at the beginning of the 21st century.

The advantages of agroforests are three-fold:

- biological; diversification of production, evenly distributed over time.
- ecological; soil conservation and protection of the environment; sustainable use of the land.
- social; empirical and traditional systems yielding a variety of products which satisfy most basic needs (e.g. the Huastec *té'lom*).

In the worrying international context of excessive and uncontrolled deforestation, the ecological advantages of agroforests are of prime interest. It is clear that appropriate cultivation of the forest leads to more diversified and yet more ecologically balanced production. One may ask why agroforests should be necessary. The answer lies in the demographic problems that Mexico faces, as do many other countries. 'By the year 2000, there will be approximately 130 million Mexicans, for whom our country will have to supply food, medicaments, housing etc. . . .'¹³ The first function of the agroforest is specifically to supply food.

One should not have an exclusively scientific or historical view of agroforestry systems. Indeed, traditional knowledge – such as, for example, that of contemporary Mayas or Huastecs – is too valuable to be left unused even today. It would, in fact, be disastrous not to use it. The demographic situation cannot be ignored. Let us try to bridge the gaps and resolve the contradictions between scientific knowledge and popular tradition, economy and development. Or even better, let us integrate them. Is it realistic to support a subsistence farming system in a market economy? On the other hand, is it realistic to aim – at all costs – at intensive management, which often ends in ecological and economic disaster? If the answer is 'no' to both of these questions, it is clear that there is not one answer to the anxiety expressed in the above quotation¹³, but several different ones. In order to reconcile increasing population needs on the one side and a balance between ecological considerations and production on the other, activities on different scales (national, regional, or local) have to be considered as a whole, and should be linked together.

Intensification of traditional agriculture is certainly required when there is no other possible alternative to

land pressure problems. National requirements may render it necessary. Yet because of the risks taken, it must be limited. For instance, the risks linked to pesticides and other phytosanitary products are well known, as are those resulting from a too long-lasting dependence on a seed supply from outside. It seems appropriate to limit this type of intensive agriculture to ecologically suitable regions.

Parks should be provided for the people of highly populated regions. Furthermore, we should not forget that technical improvements generally lead to standardized cultivation methods and encourage monocultures, to the disadvantage of production diversity and traditional knowledge. However, intensive cultures need not be monospecific, but can combine two, three or even more perennial species or several annual herbaceous species. Such systems predominate in Colima, where systems can be found that are often more intensive and more productive than any monospecific system (Leger, pers. comm.).

When compared with intensive monoculture, agroforestry systems possess many biological, ecological, and socio-economic advantages. A prominent place should therefore be kept for agroforestry systems. But what sort of agroforestry? Here again, there cannot be one answer: Mexico is too diverse in its environment as well as in its traditions and popular knowledge. This is where its richness lies. One could suggest that each region should have its own type of agroforestry garden, adapted to its own environment and historical tradition and integrated into its present needs. Research into eco-development in Mexico should take traditional knowledge into account, preserving the diversity of existing systems and enriching them with new appropriate (yet not imported) technologies.

The agroforestry garden is not necessarily the only answer to regional development. It may – or sometimes must – be combined with other farming systems, as was done in the past, and still is today, for example among the Huastecs.

To sum up, agroforestry must always be considered within its socio-economic context. One cannot ignore the problems that exist: there are real contradictions that have to be resolved, for example between short-term or long-term development, minimized risks and maximized benefits, protection of the environment and production from it.

Our initial question about agroforestry systems was whether or not the past can be a guide for the future? Our answer is yes. Provided that its potentialities are recognized and integrated into today's socio-economic reality, agroforestry will provide a sound foundation for the future.

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