

Family Agriculture for Bottom-up Rural Development

A case study of Indigenous Mayan population in Peninsular Mexico

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Abstract— The present research was conducted among the indigenous communities of Mayan origin in the state of Quintana Roo, Mexico, who widely practice home gardens as the principal form of family agriculture on a sustainable basis sine pre-colonial times; the objective of this study was to analyze the structural complexity, functional diversity, management strategy of these indigenous home gardens in order to propose recommendations for improved family farming for better adoption. The Mayan home gardens are structured into three or more vertical layers of multiple plant species of herbs, shrubs and trees and horizontally into well-defined zones for production of both domestic and wild animals; and provide multiple services apart from food and nutrition security. We recommend that promotion of multifunctional home gardens can serve as an effective strategy for sustainable bottom up rural development.

Keywords—Food security, home gardens, species diversity, sustainable development.

I. INTRODUCTION

HOME gardens embody an ancient and common practice of indigenous populations all over the world [16]. From their early conceptualizations, home gardens have come to be understood to serve several purposes through their crop diversity [7]. These purposes include more noticeably food and economic security, but also knowledge sharing and community building. They also help provide medicinal and ornamental plants in an altogether resilient practice. Although the definitional boundaries of home gardens continue to be debated, it is generally understood that home gardens allow for food production at a household level, where the female household head is usually the most involved [4].

Within this understanding, home gardens have been mainstreamed for their usefulness in ensuring food security for indigenous populations. This can be understood through the Millennium Development Goals and Sustainable Development Goals which have made it a priority to end food poverty and create successful access to nutrition. Indeed, recent estimates suggest that 850 million people suffer from undernourishment in terms of energy consumption and about

two billion people suffer one or more micronutrient deficiencies [13], [11].

Particularly striking in the context of global food insecurity is the case of Mexico. Firstly, Mexico has decreased its national average of underweight children under five years from 14.2% in 1998 to 5% in 2006 [6]. Perhaps more importantly, Mexico is interesting in that its Federal Government has acknowledged that 25% of its population live in food poverty [6] and has thus implemented the *Crusade Against Hunger*. In this policy, the government has delineated its goal of achieving national food security whilst maintaining environmental sustainability. It is in this that lies the importance of home gardens, as they are understood to allow for practices which create food security without jeopardizing environmental conditions.

In order to understand the mainstreaming of home gardens in the case of Mexico however, it is important to consider the role home gardens have played historically. Indeed, home gardens have played an important role for pre-colonial societies, such as the Mayans, Aztecs and Totonecs. Through these systems, the populations were able to develop settlements where food production happened year-round [1]. Moreover, the communities were able to form relations with nearby communities by means of buying and selling [4]. These practices continued even during and after the colonial invasions [4], so that home gardens are widely practiced in some of the poorest areas of Mexico [18]. In this sense, home gardens allowed for the creation of positive living circumstances through resilience, food, economic and social security. Today, the combination of these aspects by means of home gardens can be understood as a representation of bottom up development.

Within this international and national contexts, the research outlined below was carried out in order to study the structural complexity, functional diversity, and management strategy of Mayan home gardens. This was in order to suggest improvements through modern science and promote rural food security in similar biophysical conditions and socio-cultural settings around the world.

II. METHODOLOGY AND MATERIALS

A. Context

The research was carried out in the municipality of Felipe Carrillo Puerto in the south-eastern state of Quintana Roo,

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Mexico (Latitude N 19°03' y 20°25': Longitude W 87°25' y 88°43': altitude 0-100 m.a.s.l: annual rainfall 1250 mm: warm humid climate with Leptosol and Luvisolic soils). The entire area is populated by populations of Mayan heritage who engage in the practice of home gardens. The research area is shown in Figure 1 below.

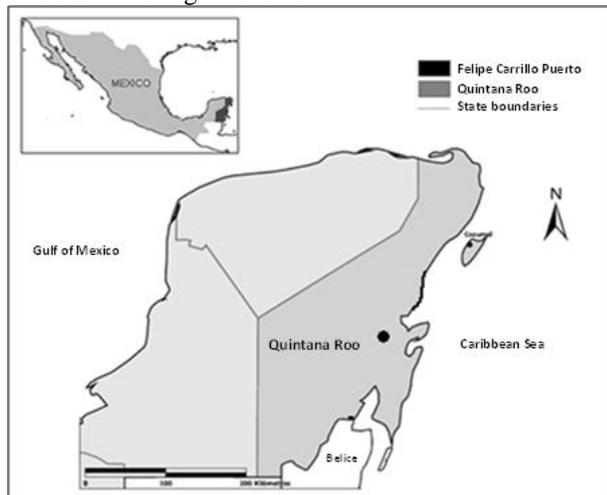


Fig. 1 Figure showing the study area of the municipality of Felipe Carrillo Puerto in Quintana Roo, Mexico.

B. Sampling

Home garden production components, both flora and fauna, structural complexity, functional diversity and management strategies data was collected from 20 households. These households were selected using random sampling so as to make the results fairer. The 20 households, lastly, were selected from traditional home gardens in the following five communities: X-Maben, X-Pichil, X-Yatil, San Jose II and Melchor Ocampo.

C. Methodologies

The collection of data involved a combination of qualitative and quantitative methods. These include field observations and focus group discussions. Field observations were gathered by the researchers and involved randomly chosen households with willing families. These field observations were mostly used for the purposes of collating quantitative data such as the home garden structural complexity and yield.

On the other hand, focus groups were used to discuss indigenous knowledge on the functional diversity and management strategies used for the maintenance of their own home gardens. Focus groups were also used to discuss notions of social welfare and community relations so as to understand the role of home gardens in creating positive social conditions for increased well-being and development. Focus groups consisted of 15 to 25 members of both genders, with the occasional participation of children. This was replicated in each of the five communities. Focus groups were chosen for two reasons. Firstly, taking the form of a group interview, it focuses on communication between participants for data creation [14]. This has thus allowed for focus groups to become increasingly recognized for data on sustainable management of natural resources [3], [5], and [19]. Secondly,

focus groups allow for a widespread understanding of common management strategies and knowledge which is consensual, so that individual biases are tackled by participants. This allows for a more representative understanding of social practices and knowledge, which in turn shed light on the social function of home gardens through community and network building. The participants were drawn from the randomly chosen households and they joined voluntarily. The community leader was also informed of the aims and purposes of the focus groups.

Lastly, the research also involved the participation of translators. Given that the entirety of the participants in the focus groups are of Mayan origin, their level of comfort with Spanish was very limited. Not only this, but certain notions discussed were complex, so the participants chose to answer in Mayan. Because of this, translators were used who helped translate information to Spanish. This information was then translated into English for data analysis. The translators consisted of a group of students from the Felipe Carrillo Puerto University, so that they were confident in both Spanish and Mayan.

III. RESULTS

A. Production Components and Structural Complexity

Data gathered on the production components, that is the various strata and plant diversity of the home gardens shows two key results. Firstly, there is a high number of architectural types and different life forms of plants. Secondly, more than 95% of the studied households consist of both domestic and wild animals. These constituents of production serve a variety of purposes, including the provision of food, fodder, medicines and many others outlined below in Table 1.

TABLE I
COMMON PLANT SPECIES FOUND IN HOME GARDENS IN THE STATE OF QUINTANA ROO, MEXICO OUTLINING THEIR USES

Local Name	Scientific Name	Family	Uses
Chincuya	<i>Annona purpurea</i>	Anonaceae	Food, aromatic, handcrafts, domestic construction, fuel wood and timber
Achiote	<i>Bixa orellana</i>	Bixaceae	Food, aromatic, ceremonial, dye, condiment, industrial use, fuel wood and medicinal
Chaka	<i>Bursera simarouba</i>	Burseraceae	Handcrafts, hedge, ceremonial, soil binding, instruments, fuel wood, timber, medicinal, tannin
Nance	<i>Byrsonima crassifolia</i>	Malpighiaceae	Food, crafts, ceremonial, dye, construction, fodder, soil binding, firewood, timber, medicinal, ornamental tannin
Papaya	<i>Carica papaya</i>	Caricaceae	Food, beverage, industrial, medicinal, ornamental
Cedro	<i>Cedrela odorata</i>	Meliaceae	Handcrafts, timber, soil binding, fuel wood, repellent, ornamental
Limón dulce	<i>Citrus limonia</i>	Rutaceae	Food, aromatic, beverage, seasoning, firewood, medicinal and ornamental.
Pajarito	<i>Cordia</i>	Boraginaceae	handcrafts, instrument,

	<i>alliodora</i>		firewood, timber , medicinal, ornamental
Jícara	<i>Crescentia cujete</i>	Bignoniaceae	Food, ceremonial , construction material, domestic appliances , instruments, medical, honey production
Cocoite	<i>Gliricidia sepium</i>	Fabaceae	Fodder, crafts, hedge, dye, nitrogen fixing, firewood, medicinal, repellent, shade, tannin, ornamental.
Aguacate	<i>Persea americana</i>	Lauraceae	Food, cosmetics , condiment, industrial use, medicinal, timber

It is also important to recognize the vertically stratified nature of the plant species, with each stratum containing plants that belong to a specific life form. This was recognized by previous researchers such as De Clerck and Negreros-Castillo in their 2000 paper [9].

In this sense, it can be said that the Mayan home garden is an integral production system which combines agricultural, forestry, pastoral, fisheries, honey-bee and aquaculture production managed within the household level as family labour. Needless to say, the households studied showed a diversity in foci of production, so that certain households specialized in animal production whilst others on traditional medicine. Therefore, the Mayan home gardens consist of highly complex, highly diversified species with flexible management strategies and minimal external input.

This data was collected by means of field observations.

B. Multiple products obtained from traditional home gardens

From the focus group discussions, it was possible to gather data on the types of products and services that households get from the home gardens. Perhaps one of the most important conclusions drawn from the focus groups discussions was the unanimous recognition of the role of women in managing the productive components of the home gardens. Men and other household members are in charge of other management tasks including tree pruning and construction by men and small scale selling by children for disposable income creation. This suggested once again that the management strategy of the home gardens is flexible and usually managed within the household with little external input. This also corroborated that home gardens are managed by family labour.

In terms of the products obtained from the home gardens themselves, it can be said that most of the food products are used for household consumption with the excess being occasionally shared with neighbours and other community members. This is a common Mayan tradition, so that household are expected to share their home garden produce for religious festivities. This serves to preserve culture, identity and tradition, whilst also serving the creation of social cohesion and social reproduction. Indeed, focus group discussions suggest that members consider the varied services and functions of home gardens to affect the communities in a positive way, so that it is possible to justify the practice of home gardens as much more than food necessity. This was yet

another important consideration discussed in the focus groups.

Indeed, the role of home gardens in creating social networks, cohesion and community building was considered an important discussion topic. This was most obvious in the focus group discussions where it was possible to extrapolate the importance of home gardens in day to day activities and discussions as well as a starting point in creating rapport for people within each community to relate to each other with. This is an important understanding for the mainstream agenda neglects the different ways in which social cohesion can be built from home gardens. Although there is a recognition of the exchange of ideas and traditional knowledge taking place, notions such as food sovereignty, identity, rapport and community building are often considered the result of positive accumulation of food and economic security, rather than a parallel consequence of the practice of home gardens.

Lastly, it is also possible to consider that certain households sell their home garden excess in local markets as an additional source of disposable income.

In this sense the functions of the home gardens can be considered under the spectrum of security, ranging from financial, to nutritious to social to health to well-being in the form of entertainment and personal mindfulness. The different uses and functions of home garden produce consist of: (1) food or groceries; (2) medicinal drugs (for human and domestic animals); (3) fodder; (4) aromatic (flavorings, perfumes, etc.); (5) sweeteners; (6) soft or alcoholic beverages; (7) spices; (8) stimulants; (9) ceremonial (amulets, magic, rituals); (10) drugs (hallucinogens, narcotics, tranquilizers); (11) resins; (12) honey; (13) oil (edible and industrial); (14) fences; (15) windbreaks; (16) tools for agriculture, hunting and fishing; (17) fibers (textiles, cordage and basketry); (18) construction (furniture or houses); (19) for handicrafts; (20) musical instruments; (21)waxes; (22) dyes; (23) biological control (insecticides, fungicides, herbicides); (24) Cosmetic; (25) domestic use (cooking, wrapping, drying adhesives, etc.); (26) bioenergy (coal, fuel wood, oil); (27) soil erosion control; (28) rubber and latex; (29) ornamental or aesthetic; (30) tannins; (31) toxic (poisonous to man and domestic animals); (32) honey bee stinging for medical purpose; and (33) green manure.

C. Functional services of home gardens

Different from the recognition of the various uses of the products grown in home gardens, the focus group discussions also considered a series of functions for the home gardens as units in themselves. These include: (1) services of provision: products obtained from the ecosystem, (2) services of regulation: the benefits of regulation the ecosystem include the improvement of air quality, climate regulation and the diminishing of proneness to natural hazards, (3) services of culture: non-material services gathered from spiritual enrichment, social status, recreation, entertainment, mindfulness, social rapport and social networks and (4) services of support: services deemed important for the other

ecosystem functions such as soil conservation, photosynthesis and the nutrient cycles. These randomly mentioned services were outlined using the fourfold classification of the Millennium Ecosystem Assessment (MEA) of 2001 [15].

IV. DISCUSSION

Home gardens are complex systems. They are resilient, that is “time-tested strategies” [7] and consist of flexible management strategies at household level. The home gardens practiced by Mayans in Quintana Roo conform a very specific type of home garden. This is because the indigenous communities grow home gardens that consist of a high number of wild and cultivated plant species which are structured into different vertical layers and managed so as to transmit knowledge in an inter-generational manner. Furthermore, the intricate combination of plants species are arranged horizontally which takes into consideration specific soil types and nutrient cycles for the best year-round production. What makes the combination of these factors so striking in the Mayan context is that the communities do not consider these aspects as separate units of analysis but instead as a whole where political, economic, cultural and social factors are interlinked and related to biological, agricultural and ecological factors. Leclerc and Thuillet noted similar patterns of family farming in different parts of the world in 2014 [2].

By considering the diversity of functions of home gardens it is possible to conclude three things. Firstly, home gardens play an important role in creating economic and food security. This is in facilitates livelihood security. Secondly, home gardens have a presence and influence on day to day relations and activities at household, fraternal and community levels. Thirdly, within the multiplicity of the functions of home gardens it is possible to see that they support the creation and recreation of both ecosystems for food production as well as social relations in a sustainable and interrelated manner.

When considering the ways in which home gardens help food and nutrition security it is important to note their definitions. Food and nutrition security can be understood as the condition where “all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life” [10] and as “adequate nutritional statues in terms of protein, energy, vitamins and minerals for all household members at all times” [17], respectively. This thus means, that the notion of food security encompasses food availability, accessibility, utilization and stability, addressing supply, household level design, income, expenditure, buying capacity and the amount and ways in which people consume food. These aspects thus cover important livelihood and well-being considerations such as sanitation, water, health care practices, purchasing power, economic freedom and resilience.

These definitions are important in understanding the role and purposes of home gardens because the research corroborates the mainstream discourse on home gardens. That

is, the main and most important reason for the practice and maintenance of home gardens is for the continuous production of varied food sources for household level consumption.

Aside from the recognition of home gardens as providers of food, it is important to consider their social functions too. In understanding the role of home gardens for the security and livelihood of indigenous populations, it is important to consider two things. Firstly, as a practice originated and kept within the communities who still practice them today, home gardens represent an instance of bottom up development. This implies that home gardens are a practice and approach that allows local communities and players to input their concerns and knowledge to define developmental pathways [8]. This is exemplified by the active involvement in the management of home gardens by the various family members. This can also be seen in the agreements drawn in focus group discussions about the different management methods as well as different utilities, for this sheds light on the principal developmental concerns of the communities involved. In this sense, it is possible to suggest that home gardens are key in allowing communities to become agents of their own change as they have control over their food, economic, livelihood and social security, who are flexible and adaptable to changing conditions.

Secondly, the role of home gardens can be understood in both a holistic approach as well as through an analysis of its diverse components and functions. This can be best illustrated by considering the home garden as a unit of analysis as well as its management, crops and yield purposes separate units of analysis. In this sense, for example, one can use the home garden as a unit of analysis to understand the social meaning and its symbolic use in creating conversations, relations and shared notions of identity. By considering the crops on the other hand, and its purposes it is possible to suggest that produce from the home garden alleviates social inequalities and poverty by providing food, medicine and ornaments. One can also consider the management methods, so that home gardens can be then be classified not only in terms of soil, produce, size and yield but also in terms of management methods used. This in turn allocates particular importance on the instances of identity and diversity of home gardens across different regions of the world.

The fact that home gardens and their purposes and roles can be understood in these ways suggests that home gardens play into indigenous realities and lives in various ways. This is a key consideration, for in studying the home gardens, a series of lifestyles and realities are also being considered. This thus facilitates the research into understanding bottom-up approaches to development. More importantly however, by considering the various functions of the home gardens, the discourses, literature and agendas will thus be able to consider indigenous communities as agents of their own well-being and security.

Having said this, however, it is important to consider the limitations in the practices of home gardens in the Mayan context. Firstly, for example, there is no body such as a

cooperative where communities could sell their excess produce in. For this, perhaps the establishment of an association or a communal body can improve access to markets and other public institutions where costs associated with the selling of produce can be reduced. This could also facilitate the finding of new demand sinks as well as to obtain training and technical knowledge and expertise from outside bodies such as government agencies, which could in turn help yield and production. The cooperatives could also improve the relationship and communication between the communities and the state helping to alleviate a series of problems in the communities which are not necessarily associated with the home gardens, such as infrastructure, information sharing and modernizing the area.

Lastly, although improvements and changes can be made to the practice of home gardens for their improvement, as well as the improvement of the communities engaged in managing them, it is important to remember that home gardens allow for flexibility, culture, identity and resilience. In this sense, it is important for any governmental bodies to consider the different types of family farming practices involved in managing home gardens so as to create policies that are aligned to the multidimensional realities of the indigenous experiences whilst helping macroeconomic, trade and public development.

V. EVALUATION

Although focus groups are becoming increasingly important in the study of social views and understandings of individual perceptions were left out. Indeed, focus groups are problematic in that certain voices and discourses can be ignored, as not all members would be comfortable talking in a group setting. Perhaps there might even be hierarchies in place that the researchers are unaware of. These can include hierarchies based on gender or social status. To avoid this, the research could have been carried out by means of semi-structured individual interviews. Another alternative could be the division of focus groups based on gender. This would have allowed for a better understanding of home gardens as a space for social well-being but also, more importantly, would have produced gendered data on management practices. This is important when considering the fact that home gardens, in the majority of cases are usually managed by the female head of the household. Because of this, it can be argued that women are more equipped and knowledgeable in the issues of management and functional diversity. They also spend a lot more time in the home gardens compared to men, and tend to be the ones in charge of deciding how to use the produce and yield for household consumption.

Not only this, but a gendered perspective would have also shed light on the ways in which subsections in society relate to one another. For example, female relations, knowledge sharing and well-being is more intrinsically related to home gardens than men, who would also have their work spaces to discuss.

Aside from the addition of a gendered understanding of home garden practices and social importance, a selective

sampling could have also helped the study. Given the random nature of the study, it can be argued that certain aspects of home gardens were ignored. These include proximity to other social spaces, roads, cities, etc. which could have an effect on the practices, views and relations to home gardens.

Lastly, it is important to recognize the limitations of using translators. Although in this case, there was little to no alternative, translators have biases embedded in their own understanding of the communities and participants involved. This in turn could have been applied on to the translations of the focus group discussions. Moreover, for the participants the involvement of these translators could have had implications overlooked by the researchers. These include issues such as wanting to appear a certain way to the translators and thus changing answers or perhaps biased towards their gender and age. In this case it is hard to find an alternative, but it is crucial to note when considering the results and conclusions drawn from them.

VI. CONCLUSION

All in all the results show that the Mayan home gardens are characterized by high species diversity, complex structure, minimum external input and influence and flexible management. This allows for the home garden to become an integral production system which combines agricultural, forestry and animal components. This in turn creates a year round production of a variety of nutritious food being the main purpose, but also serving the production of traditional medicinal plants. Not only this, but as an entity, that is as a holistic unit of analysis, the home garden also represents a space where communities can share and interchange knowledge and wisdom. This is important in the context that this allows for social cohesion and community building, which compounded with the food and economic security, suggests that home gardens have the capacity to create bottom up rural development.

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