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Family agriculture for bottom-up rural development: a case study of the indigenous Mayan population in the Mexican Peninsula

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Abstract

Since pre-colonial times the indigenous communities of Mayan origin in the state of Quintana Roo, Mexico, widely practice home gardens on a sustainable basis as the principal form of family agriculture. This study analyzes the structural complexity, functional diversity and management strategy of these indigenous home gardens in order to attempt to propose recommendations for improved family farming. 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. The home gardens provide multiple services apart from food and nutrition security. For sustainable bottom-up rural development, we recommend the continuation of multifunctional home gardens.

Introduction

Home gardens embody an ancient and common practice of indigenous populations all over the world (Eyzaguirre & Linares, 2004). Home gardens, which generally consist of multiple crops, serve several purposes (Galhena et al., 2013). These purposes include food and economic security, but also knowledge sharing and community building. Home gardens also provide medicinal and ornamental plants. Although several definitions of 'home gardens' exist (cf. Torquebiau, 1992; Mendez et al., 2011), for the purposes of this paper, home gardens are considered to be farming systems which combine different physical, social and economic functions in the area of land around the family household. The home garden system produces food for consumption at the household level, and is generally managed by the female head of the household (Caballero, 1992).

Home gardens fulfil a crucial role in ensuring household food security among indigenous populations. Globally, therefore, home gardens have a strategic relevance: both the Millennium Development Goals and subsequent Sustainable Development Goals have made it a priority to end food poverty and create successful access to nutritious food. Despite significant economic development at the global level, addressing food insecurity remains a key challenge. 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 (FAO, IFAD & WFP, 2012; FAO, 2013).

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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 (CONEVAL, 2013). However, Mexico's Federal Government has acknowledged that 25% of its population live in food poverty (CONEVAL, 2013) and has thus launched the Crusade Against Hunger that aims to achieve national food security whilst maintaining environmental sustainability. It is in this context that home gardens can play a significant role as they can facilitate food security outcomes 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 played an important role for pre-colonial societies, such as the Mayans, Aztecs and Totonecs (Caballero, 1992). Through these systems, the populations were able to develop settlements with assured annual food production (del Angel-Pérez, 2013). Moreover, the communities were able to form relationships with nearby communities by means of trade and these practices continued during and after the colonial invasions (Caballero, 1992), such that home gardens are widely practiced in some of the poorest areas of Mexico (Rebollar-Dominguez et al., 2008). 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 represents a form of bottom up development.

This paper examines the role of home gardens for bottom-up rural development, with a specific focus on the contribution to food security in the context of indigenous Mayan populations in the Mexican peninsular. It examines the structural complexity, functional diversity, and management strategy of Mayan home gardens. Based on the research carried out, the paper suggests improvements to promote rural food security. This paper is structured in the following manner: section II considers the theoretical framework of home gardens through a literature review; section III presents an explanation of the context, justification of sampling and overview of methodologies; section IV includes the key research findings; section V provides an interpretation of the results. The final sections (VI and VII) draw insights into potential improvements as well as implications for home garden theory and policy.

Theoretical Framework

The practice of home gardens is considered to be one of the oldest land use activities; they have evolved through generations of gradual land use intensification (Nair and Kumar, 2006). The concept of the operational foundation of home gardens is that they are based on close multistory combinations of various trees and crops, sometimes in association with domestic animals around the homestead (Wiersum, 1982; Brownrigg, 1985; Fernandes and Nair, 1986; Soemarwoto, 1987; Kumar and Nair, 2004). Home gardens, though practiced across different socioeconomic sectors, are predominantly adopted by subsistence farmers and are widespread mainly in tropical climates in rural settings. One distinguishing characteristic of home gardens is the presence of high species diversity of different functional groups such as food crops, vegetables, fruit trees, medicinal plants, spices and condiments, beverage, ornamental plants as well as domestic and wild animals.

Several studies on home gardens have focused on structural complexity (Mariaca, 2012; Soemarwoto, 1987; Flores Guido, 2012; Arias Reyes, 2012), structure and function (Fernandes & Nair, 1986), biodiversity, food security and nutrient management (Montagnini, 2006; Cahuich-Campos, 2012), economic gains (Mohan et al., 2006; Cámara-Cordova, 2012), and sustainability issues (Torquebiau, 1992; Torquebiau & Penot, 2006). In spite of receiving high ratings on productive and service functions, home gardens have not been given importance as a bottom-up development strategy. Indeed, home gardens have come to the fore as mere practices to ensure food security in marginal areas and communities.

The mainstreaming of food security in the international development agenda has had a transformative effect on the home garden literature, with an ever increasing number of peer-reviewed publications focusing on the topic (102,000 papers in the period 1980-1990 compared to 205,000 in 1990-2000 and 937,000 in 2000-2010; Google Scholar search term="home garden*"). The increasing focus

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on the topic, especially since 2000 when the Millennium Development Goals were agreed upon indicates that home gardens research has geared itself towards the inclusion of issues of sustainability and resilience. For example, while the traditional literature understood home gardens as agricultural systems which provided biodiversity conservation (e.g. Caballero, 1992) the literature has recently focused on how traditional indigenous agricultural methods allow for resilience, both economic and food-wise in a sustainable manner (e.g. Galhena et al., 2013). In this stream of the literature, resilience is interlinked with sustainability, with home gardens playing a significant role in promoting both. Resilience, the capacity of a system to withstand social, political and environmental change (FAO, 1996), is achieved by the availability of additional food and income sources outside of traditional employment. Sustainability, the quality of a practice that is not harmful to the environment, both socially and ecologically (UNO, 2000; FAO, 2013), is also a key component of home garden practices as their ecological footprint is traditionally very low (cf. Galhena et al., 2013).

Furthermore, it is also important to consider the way in which the literature pairs food security with economic security. For example, the Food and Agriculture Organisation argues, firstly, that home gardens are grown to "generate income from the sale of garden produce… [which] can contribute to a family's income" (FAO, 2015:2). 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" (FAO, 1996:2) and as "adequate nutritional status in terms of protein, energy, vitamins and minerals for all household members at all times" (Quisumbing, 1995:11) respectively. Thus 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 cover important livelihood and well-being considerations such as sanitation, water, health care practices, purchasing power, economic freedom and resilience.

This understanding is corroborated by the World Bank's assessment on the economic effects of malnutrition and food poverty which suggests that due to "high food prices, many poor families cope by pulling their children out of school and eating cheaper, less nutritious food…[thus causing] infant, child and maternal illness; decreased learning capacity, lower productivity, and higher mortality" (World Bank, 2015:56). This interchangeability between economic and food security generates confusion around two very important issues. First, in the field, economic opportunities are relatively low, especially as home gardens use the same growing system to produce the same types of crops across a community. This in turn, decreases the demand openings. Second, it implies that the literature considers the home garden as a unit of economic empowerment where food operates as a commodity, rather than a necessity. This is problematic, as the understanding of home gardens is limited to simple monetary utility, rather than having intrinsic, traditional or cultural value. We argue in the present paper that home gardens can serve as viable strategy for bottom up development, especially in marginal areas left out of the benefits of advanced production technologies promoted during the past few decades.

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, 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 people of Mayan heritage, engaged in the practice of home gardens. The research area is shown in Figure 1.

B. Sampling

Data about home garden production components, including both vegetation and animal components, structural complexity, functional diversity and management strategies were collected from 100 households. These households were selected using random sampling to obtain representative data. Twenty households were selected from each of the following five communities: X-Maben, X-Pichil, X-Yatil, San Jose II and Melchor Ocampo.

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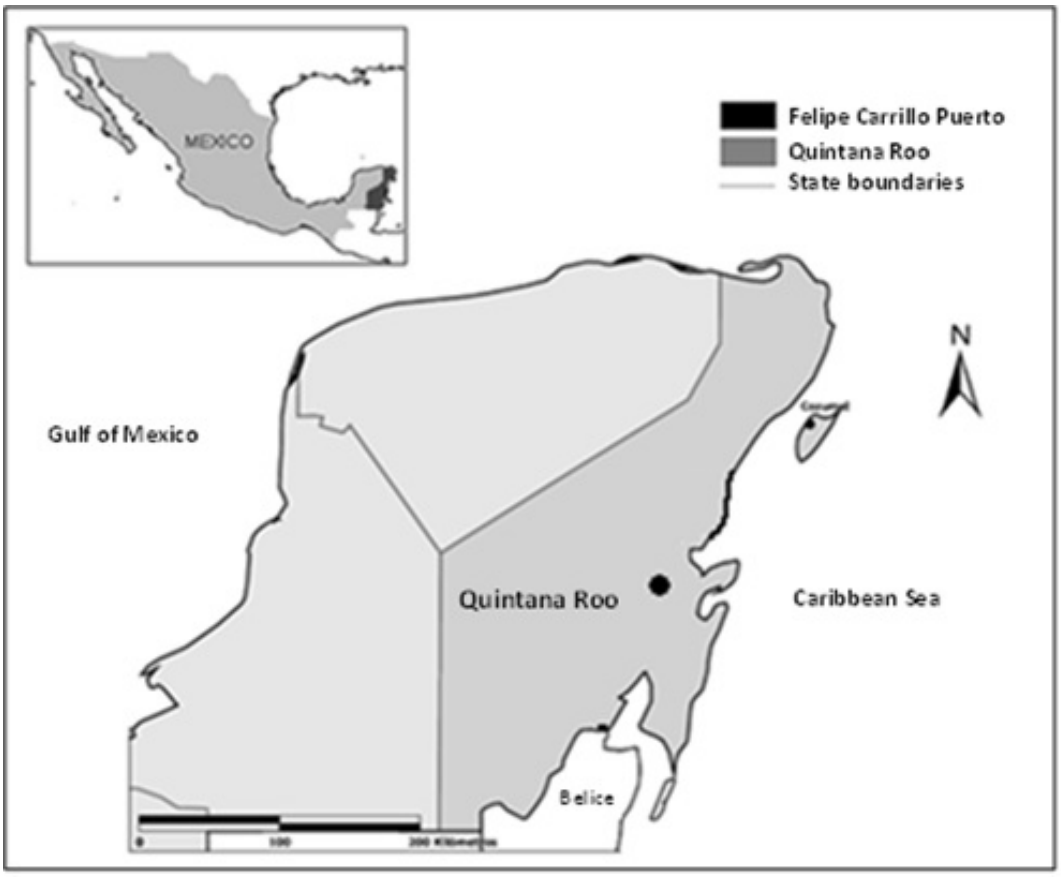

Figure 1: Figure showing the study area of the municipality of Felipe Carrillo Puerto in Quintana Roo, Mexico

C. Methods

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

Focus groups were used to corroborate the data collected through field observations with information on indigenous knowledge related to the functional diversity and management strategies used for the maintenance of their own home gardens. Focus groups were chosen for two reasons: to allow for communication between participants for data creation (Kitzinger, 1995), and to allow for a widespread understanding of common management strategies and knowledge that is consensual, such that individual biases are openly revealed by and to participants. Focus groups are increasingly used to generate data on sustainable management of natural resources as the approach allows for a better understanding of how communities manage their own resources (Raymond et al., 2010; CBD, 2001; UNEP, 2012). Focus groups were also used to explore questions of social welfare and community relations 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. This allowed 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 in advance of the research.

The research also involved the participation of translators (Mayan to Spanish) as the participants in the focus groups were of Mayan origin, and their level of comfort with Spanish was very limited. This in-

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formation was then translated into English for data analysis. The translators consisted of a group of students from the Felipe Carrillo Puerto University who were confident in both Spanish and Mayan dialect.

Evaluation of the study methodology

Although focus groups are becoming increasingly important in the study of social views, 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, including 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 gender-disaggregated 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 for household consumption. Not only this, but a gendered perspective would have also shed light on the ways in which subsections of society relate to one another. For example, women's relationships, knowledge sharing and well-being are more intrinsically related to home gardens than men's, partly because men also have their work spaces to discuss amongst themselves.

Aside from the addition of a gendered understanding of home garden practices and social importance, selective rather than random sampling could have improved 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 and cities which could have an effect on home garden practices, views and relationships.

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 likely influenced 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. Though there was no alternative, it is crucial to note these potential limitations when considering the results and conclusions.

Findings

A.Production Components and Structural Complexity
Data gathered on the production components, the various strata and plant diversity of the home gardens, shows two key results. Firstly, there is a high number (that is 4-5 strata) of architectural types and different life forms of plants. Secondly, more than 95% of the studied households contain both domestic and wild animals. These constituents of production serve a variety of purposes, including the provision of food, fodder, medicines and many others, as outlined below in Table 1.

The home gardens also contained vertically stratified plant species, with each stratum containing plants that belong to a specific life form. This trend is recognized in other home gardens (e.g. De Clerck & Negreros-Castillo, 2000).

In this sense, the Mayan home garden is an integral production system which combines agricultural, forestry, pastoral, fisheries, honey-bee, and aquaculture components and is managed within the household through family labour.

The households studied showed diverse foci of production: certain households specialized in animal production (around 82%, as animals are the main source of protein) whilst others on traditional medicine (around 90%, so as to reduce cost of medicinal care and provide immediate relief) and yet others on food production (100%, divided on vegetables or fruit trees). Therefore, the Mayan home gardens consist of highly complex, highly diversified species

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Table 1: Common plant species found in home gardens in the state of Quintana Roo, Mexico outlining their uses

Local Name	Sientific Name	Family	Uses
Chincuya	*Annona purpurea*	Anonaceae	Food, aromatic, handicrafts, domestic construction, fuel wood and timber
Achiote	*Bixa orellana*	Bixaceae	Food, aromatic, ceremonial, dye, condiment, industrial use, fuel wood and medicinal
Chaka	*Bursera simarouba*	Burseraceae	Handicrafts, hedge, ceremonial, soil binding , instruments, fuel wood, timber , medicinal, tannin
Nance	*Byrsonima crassifolia*	Malpighiaceae	Food, handicrafts , ceremonial, dye, construction, fodder, soil binding, firewood, timber , medicinal, ornamental
Papaya	*Carica papaya*	Caricaceae	Food, beverage, industrial, medicinal, ornamental
Cedro	*Cedrela odorata*	Meliaceae	Handicrafts, timber, soil binding, fuel wood, repellent, ornamental
Limón dulce	*Citrus limonia*	Rutaceae	Food, aromatic, beverage, seasoning, firewood, medicinal and ornamental.
Pajarito	*Cordia alliodora*	Boraginaceae	handicrafts, instrument, firewood, timber, medicinal, ornamental
Jícara	*Crescentia cujete*	Bignoniaceae	Food, ceremonial , construction material, domestic appliances, instruments, medical, honey production
Cocoíte	*Gliricidia sepium*	Fabaceae	Fodder, crafts, hedge, dye, nitrogen fixing, firewood, medicinal, repellent, shade, tannin, ornamental.
Aguacate	*Persea americana*	Lauraceae	Food, cosmetics , condiment, industrial use, medicinal, timber

with flexible management strategies and minimal external input.

B. Utilities obtained from traditional home gardens

One of the key findings 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 and small-scale sales for disposable income creation. This suggests that the management strategy of the home

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gardens is flexible and usually managed within the household through family labour with little external input.

In terms of the products obtained from the home gardens themselves, most of the food products are used for household consumption. Only a small proportion of the surplus is sold, with the excess being occasionally shared with neighbours and other community members. This is a common Mayan tradition whereby households are expected to share their home garden produce for religious festivities. This serves to preserve culture, identity and tradition whilst also encouraging social cohesion and social reproduction. 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 another important consideration discussed in the focus groups.

The role of home gardens in creating social networks, cohesion and community building was considered to be important during the group discussions. During focus group discussions, participants highlighted the importance of home gardens in day to day activities as well as a starting point in creating rapport for people within each community to relate to one another. This is an important finding, as the mainstream international political agenda neglects the different ways through 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.

In this sense the functions of the home gardens can be considered under the spectrum of security, including financial, nutrition, social, and health security. 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 (flavourings, 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

In addition to identifying the various uses of the products grown in home gardens, the focus group discussions also considered a series of other home garden functions as units in themselves. These include (1) services of provision: products obtained from the ecosystem, (2) services of regulation: the benefits of regulating 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 other ecosystem functions such as soil conservation, photosynthesis and nutrient cycles. These services were outlined using the fourfold classification of the Millennium Ecosystem Assessment (MEA) of 2001 (MEA, 2005).

Discussion

Home gardens are complex systems. They are resilient, "time-tested strategies" (Galhena et al., 2013) and consist of flexible management strategies at the household level (Caballero, 1992). The home gardens practiced by Mayans in Quintana Roo conform to a very specific type of home garden (Lope-Alzina & Howard, 2012). This is because the home gardens of the indigenous communities include 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 plant species are arranged

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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 & Thuillet (2014) noted similar patterns of family farming in different parts of the world.

The diversity of functions of home gardens reveals three key findings. Firstly, home gardens play an important role in creating economic and food security which in turn 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.

Bearing in mind that food security encompasses the notions of availability, accessibility utilization and stability, it is possible to understand the ways in which this research corroborates the mainstream discourse on home gardens: that 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 (FAO, 1996; Caballero, 1992).

Aside from the recognition of home gardens as a source of food, it is important to consider their social functions too. Home gardens represent an instance of bottom-up development, because communities initiated the practice themselves. This implies that home gardens are a practice and approach that allows local communities and players to express their concerns and knowledge to define developmental pathways (European Commission, 2015). This is exemplified by the active involvement in the management of home gardens by the various family members. Focus group discussions about different management methods showed how home gardens are key in allowing communities to become agents of their own change. Communities have control over their food, economic, livelihood and social security, and are flexible and adaptable to changing conditions. The role of home gardens is different depending on whether they are analysed holistically or through an analysis of its diverse components and functions. The home garden, as a unit, has important social meanings and its symbolic use is key in creating conversations, relations and shared notions of identity. By considering crops individually, on the other hand, the key role of home gardens is production of crops to alleviate social inequalities and poverty by providing food, medicine and ornaments. Home gardens can be classified not only in terms of soil, produce, size and yield but also in terms of the management methods used. This in turn places emphasis 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. More importantly however, consideration of the various functions of the home gardens places indigenous communities as agents of their own well-being and security.

It is also important to consider the limitations in the practices of home gardens in the Mayan context. Firstly, there is nobody such as a cooperative to whom communities can sell their excess produce. For this, perhaps the establishment of an association or a communal body can improve access to markets and other public institutions, to reduce the costs associated with the selling of produce. This could also facilitate the finding of new demand opportunities as well as to obtain training and technical knowledge and expertise from outside bodies such as government agencies, which could in turn help increase 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 through new methods and enterprises.

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Lastly, it is important to remember that home gardens allow for flexibility, culture, identity and resilience. In this sense, governmental bodies ought 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.

Conclusions

Home gardens are a traditional source of food production for various indigenous communities around the world. Home gardens play a crucial role for the Maya communities of Quintana Roo as they serve to provide food, economic and social security. This is because they provide a diversity of crops, high yields and year round production but also imply a flexible space for the production of varied and nutritious food. Indeed, they consist of high species diversity, complex structures, minimal external input and flexible management systems to combine agricultural, forestry and animal components. Home gardens also serve communities by means of traditional, plant-based medicinal care which helps deal with unforeseen crises as well as a cost-efficient, self-sufficient immediate relief. Perhaps more noticeably, the research also shows that home gardens also allow for social resilience and community building through the provision of spaces for knowledge sharing and the exchange of goods. This in turn allows for the modernization and rapid diversification of secluded communities which has implications for bottom-up rural approaches to development. The research also shows that in fact, most of the communal and personal daily activities take place around the home garden, allowing it to play the role of an entity and space for development. In this sense, it is possible to argue that home gardens tap into all three recognized spheres of development: social, economic and environmental, suggesting that the home garden literature thus needs to consider more precise understandings of the role they play at the grassroots level where communities and people use home gardens to empower themselves as drivers and actors of their own change.

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Conflict of Interests

The authors hereby declare that there is no conflict of interests.

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