

The Future of the Yucatan Peninsula Stingless Bees - Mexico

*An Interdisciplinary Exploration of the Diverse
Aspects Influencing Meliponiculture*

Orion Vienne



Master thesis in Culture, Environment and
Sustainability

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Abstract

Meliponiculture, or stingless bee domestication, is an ancient Maya practice that has been at the edge of disappearance in the past 20 years. Thanks to an alarming preoccupation of the future of stingless bees, many conservation programs have been developed in the past decade. This activity disappearance underlined another major issue, the depopulation of rural Mexico in a globalized world. This master thesis is focusing on the cultural, environmental, economic and sustainable aspects of the breeding of native stingless bees in the Yucatan Peninsula region, Mexico. This research consists of understanding the current situation of the (re-) development of meliponiculture in the Yucatan Peninsula - Mexico. By using the Sustainable Livelihood Approach, community and incentive based conservation; the reader will be introduced to a series of historical events that influenced the transition from traditional to modern meliponiculture. One will also see that stingless bees have a primordial role in the preservation of the Mexican biodiversity. Social links between what unite meliponicultors to stingless bees and cultural practices will be explored. Insight on the economic potential of the activity, notably through the variety of deriving products and access to markets will be given. One will also be informed of the role that cooperatives and funds can play in the development of this activity. Finally, the reader will be introduced to other aspects that can foster meliponiculture into a sustainable activity, such as education or ecotourism. Current limitations slowing down the process of implementation of the activity will be explored.

Key words: *Central America, Mexico, Meliponiculture, Stingless Bees, Sustainable Livelihood Approach, Maya Culture, Sustainable Development, Environmental Protection, and Ecotourism.*

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Orion Vienne



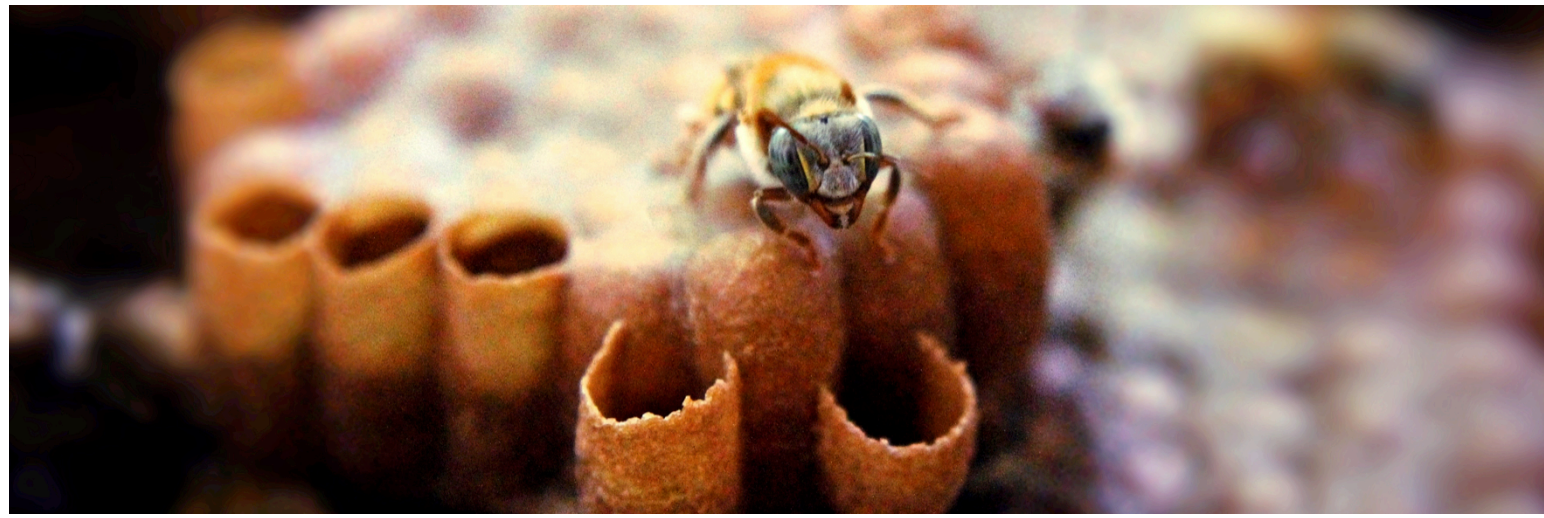
The author (Orion Vienne) accompanied by Wilberto Colli visiting ECOSUR Meliponary in Chetumal (Source: Author)

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Abbreviations & Glossary

AHB: Africanized Honey Bee

GIS: Geographic Information System

GMO: Genetically Modified Organism

ICA: International Cooperative Alliance

SLA: Sustainable Livelihoods Approach

UTOB Hive: Utrecht University Tobago Hive

WCS: World Conservation Strategy

Ah Muzen Cab: Beekeeping God

Becab: Cardinal Point

Jobon: log hive

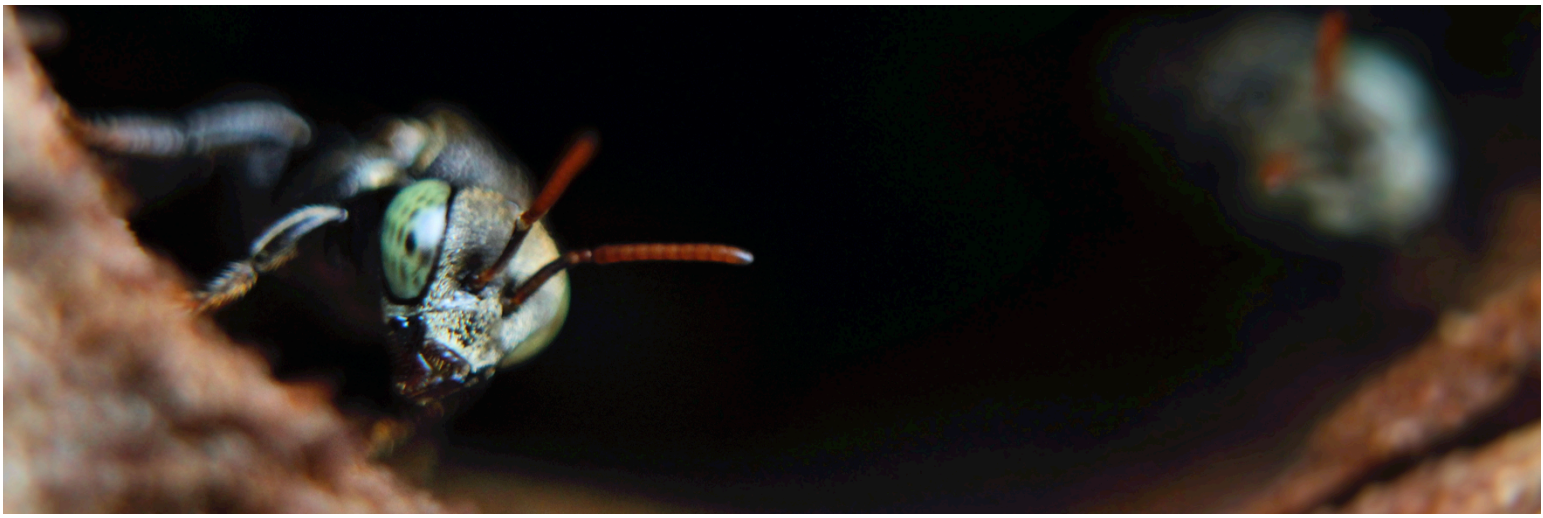
Meliponini: family of stingless bees

Meliponiculture: the breeding of stingless bees

Meliponicultor: person practicing meliponiculture

Meliponary: stingless bee apiary or roofed structure referring to the bee house

Xunan Kab: Melipona Beecheii stingless bee in Maya



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I. Introduction

Mexico is a large country bordered by the United States in the North and by Guatemala and Belize in the South with a population reaching 123 million in 2016¹. According to the World Bank, Mexico's GDP is significantly increasing though half of the population is still below the poverty line and corruption remains a large issue. It is a country that benefits from its cultural heritage and its coasts, from the Pacific Coast to the Gulf of Mexico Coast with its Caribbean Sea.

Mexico possess one of the world's richest examples of natural biodiversity, types of landscape, ranging from mountains and deserts to grassland and tropical forests. Mexico also possesses one of the richest examples of wildlife. It is not rare to encounter whales, turtles, jaguars but it also has a large diversity of plants, butterflies and native stingless bees. This thesis will focus on the breeding of native stingless bees without which the pollination of the Mexican plant diversity would not be assured. The native stingless bees, and more particularly the *Melipona Beecheii* bee, have been forming part of the Maya ancestral heritage. The *Melipona* bee is as ancient as the Mayan civilization and the Maya venerated this bee, notably for its honey. Beekeeping and honey production were important activities of Post-classic Maya Society. Sixteenth Century ethnographic evidence shows that:

"The Mayans prayed to the stingless bees and in the temple of the Descending or Diving God at the coastal ruins of Tulum and interior Coba, they carved stone relief images – with a depiction of Ah Mucen Kab, their gods of beekeepers, bees and honey" (Imre, Young and Marcus 2013).

¹ *The World Fact Book*, <https://www.cia.gov/library/publications/the-world-factbook/geos/mx.html>, Accessed on 13 April 17

Unfortunately in the last 25 years, there has been a massive decline (estimated to 90 %) of the *Melipona Beecheii* colonies and Meliponiculture in the Yucatán Peninsula (Cortopassi-Laurino, et al. 2006, 276). Nonetheless, there are currently several programs focusing on the conservation of the native stingless bee and are working towards the revival of the activity, especially by native Mayan (González-Acereto , Quezada-Euán and Medina-Medina 2006, 234).

This thesis will be divided in 10 Chapters (excluding appendixes). Chapters 1 to 3 will introduce the activity of Meliponiculture, the main research questions, the region of interest the methodology and the conceptual framework used throughout the entire thesis. Chapters 4 and 5 will provide the readers with a summarized history of the meliponiculture activity and how practices have changed over time. Chapters 6 and 7 will focus on the environmental and social importance of meliponiculture. Chapters 8 and 9 will focus on the economic benefits and sustainable developments of meliponiculture. Finally, chapter 10 will formulate concluding remarks and suggestions for further researches. All those chapters will be based on written works and data collected during the three months fieldwork research undertaken by the author.

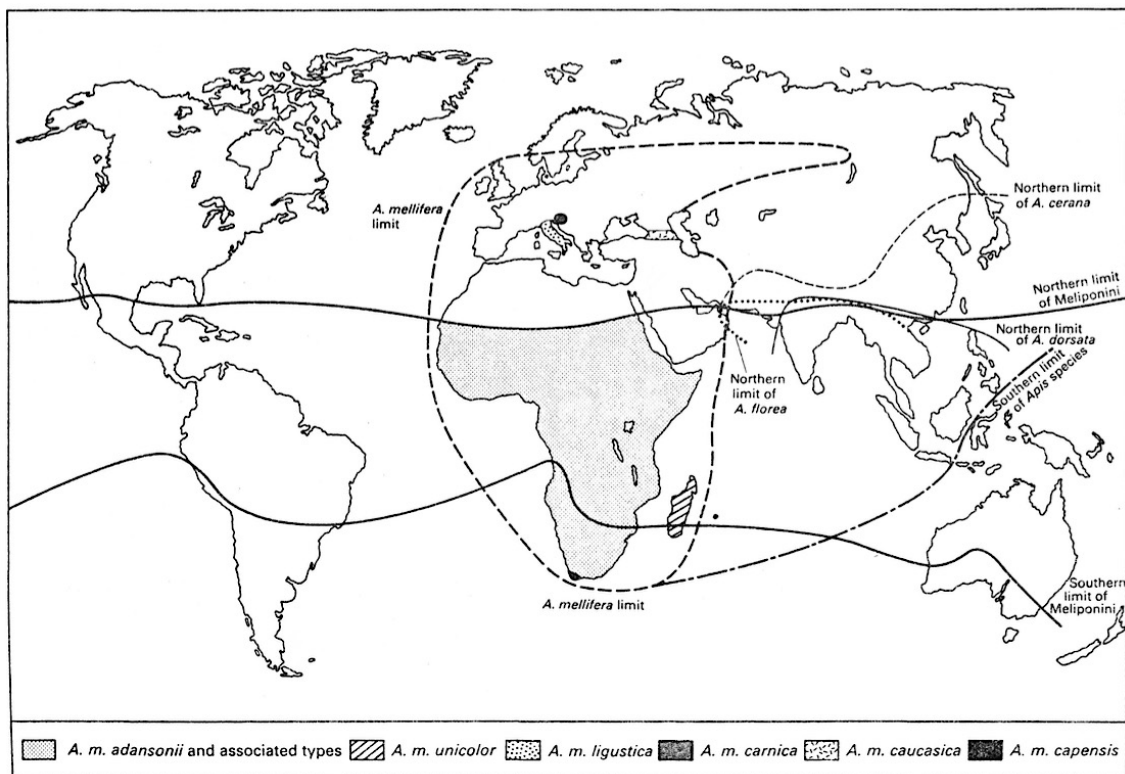
1. Definition of Meliponiculture

Before going any further into the research, it is important to define what meliponiculture is and how it differs from apiculture. Meliponiculture is referring to the activities of the rearing of stingless bees or meliponinos. Stingless bees “produce no venom, and cannot sting. To defend their nests, they bite, ejecting a caustic fluid, or irritate by crawling into eyes, ears, etc.” (Crane , Amerindian honey hunting and hive beekeeping 1998, 05). Meliponiculture is a term that was invented by Paulo Nogueira Neto exclusively for the management of stingless native bees (Sabino Cab Dorantes and Medina Escalante 2016). It is an activity practiced in the tropical zones of central and Latin America, Africa, Asia and Australia.

According to Fernandez, meliponicultor (persons practicing meliponiculture) in the region of Chetumal, the series of activities that need to be undertaken in meliponiculture are the followings: [1] systematic care to prevent from the infestation of

the nenem mosquito, especially after a transference, division of nuclei or during the harvesting period. [2] Transfers, divisions or harvest should be carried out after noon because in the morning the bees are more active outside the hive. So the population in the colony decreases allowing a management with few bees present in the honeycomb. [3] It is important to look out for potential invasion of ants in the meliponary (roofed structure referring to the bee house) by placing water at the base of the meliponary to prevent attacks to the colony. It is also important to scare away other predators such as frogs, iguanas or birds. [4] He also recommends having a sufficient amount of colonies to perform divisions and to feed them with honey from *Apis Mellifera*. [5] His last recommendation is to reproduce many nuclei in the fastest time to make the activity sustainable such as in the sale of honey, wax pollen or new nuclei (Manuel Torres Zapien 2014). While his definition has an economic perspective, the precautions principles remain unchanged. In fact, as we will see later, the activities and practices of meliponiculture have largely evolved since their ancestral meaning and beliefs to today's beliefs and practices.

2. Bees Used in Meliponiculture



Map 1: The natural distribution of the four honeybee species (*Apis*) and of the stingless bees (*Meliponini*) (Source: Crane, *Honeybees* 1984, 404)

“In the world it exists over 600 species divided in 56 named genera which live in tropical and subtropical areas of the world” (Cortopassi-Laurino, et al. 2006, 275). Map 1 represents the natural distribution of the four honeybee species (*Apis*) and of the stingless bees (*Meliponini*) in the world. In Mexico alone, based on Ayala, there are officially 46 species of stingless bees and 16 species are present in the Yucatán peninsula. Other meliponicultors told me that they count the presence of up to 20 or 21 species in the Yucatan peninsula; nevertheless those numbers are not officially confirmed (Leonardo: Interview 01/10/16). Stingless bees are very different from European honeybees not only because they have an atrophied sting, but also because they differ in size, behaviors, nest shapes, environment, etc.

“Stingless bees in the genus Melipona are found only in the Americas; they tend to have a relatively large-sized body (a few are as large as European honey bees), and where they occurred they were often the most frequently used by man. Species in the genus Trigona occur throughout the world's tropics; many are smaller, some only 2 mm long. All stingless bees in the Americas build a nest in a cavity, often in a lateral branch of a tree, underground or in a termite nest. Inside the nest, they store honey on each side of the central part where the brood is reared, in wax 'honey pots' not in parallel vertical combs as honeybees do.” (Crane 1998, 05)

In reality only a few species have been ancestrally domesticated and used in meliponiculture activity; the others are considered ‘wild species’ but their rearing could be conceivable. It is only 6 of the 11 genera present in Mexico that are considered large producers of honey and are hence recommended for the meliponiculture activity. Those genera are: *Cephalotrigona*, *Melipona*, *Nannotrigona*, *Scaptotrigona*, *Frieseomelitta* and *Trigona*, the latter genre only one specie is recommended for farming, *T. fulviventris* (Sabino Cab Dorantes and Medina Escalante 2016, 02). Today, the most relevant species used in meliponiculture are: *Melipona Beecheii* in the Yucatan peninsula, Tabasco, Chiapas and Veracruz, *Melipona Fasciata* in Chiapas and Guerrero, *Scaptotrigona Mexicana* in the Sierra Norte of Puebla, and in the region of Papantla in Veracruz and finally, with less emphasis, the *Trigona Angustata* in the state of Chiapas (Gonzalez Acereto and Araujo Freitas 2005, 11).

3. Research Aim & Questions

In order to understand the scope of this research, it is important to understand clearly the problematic around the activity of meliponiculture. Chapter IV retraces the history of meliponiculture. Over time, the activity of meliponiculture has evolved through what I would consider three main phases. The first one is corresponding to the large period of when the Mayan civilization largely practiced the activity of meliponiculture. This is the period when the importance of stingless bees and especially all the myths and rituals focusing on the *Melipona Beecheii* were created. A journalist from National Geographic, Melina Gerosa Bellows, followed the path of *Melipona* bees in the Yucatán Region. She noted that: “bees have symbolized the soul to many ancient cultures since the Stone Age. To the Maya, bees are imbued with mystical power, said to appear as messengers between the living world and the underworld²”.

After 1520 A.D, the activity of meliponiculture entered into a very chaotic period. The colonial period had drastic effects on the activity; contemporary Mayans were forced to use the products deriving from meliponiculture to pay tribute to the Spaniards. But the real disaster appeared when they introduced the European bees. The European bees are more productive than the stingless bees; they can produce up to 40 liters of honey compared to 1 to 3 liters of honey in the best conditions. This is the period when the contemporary Mayans made an important transition from meliponiculture to apiculture. While this transition took some time, the apiculture activity slowly took over the activity of meliponiculture. The touristic development of the Yucatan region also contributed to a disinterest in the activity. Consequently the rural population from Mayan villages slowly moved to pursue opportunities in cities like Cancun or Playa del Carmen deriving from this development (Villanueva-G, Roubik and Colli-Ucan 2005 , 39).

This is when we enter in the third phase, the focus of this research. It became evident that if nothing was to be done, stingless bees could become extinct. This extinction would have dramatic impacts on the Mexican landscape. The latter phase is one of the

² The Buzz in Mexico, <http://travel.nationalgeographic.com/travel/countries/mexico-honey-traveler/>, Accessed on 27 April 17

most exciting phases because the activity was re-conceptualized almost from scratch. This period marks an upheaval of the meliponiculture activity and the amount of researches around stingless bees and meliponiculture significantly increased. It is also the period when many projects of stingless bee conservation arose. It is perhaps difficult to know which ones have been successful. Beside the fact that all those projects have various angles of actions, they contributed to a new trend of making meliponiculture attractive again. The combination of the new popularity of meliponiculture, as well as its economic possibilities, has created a very complex situation where it is difficult to identify its effects. I have been particularly interested by this complex situation.

The general aim of this research is to understand **what is the current situation of meliponiculture in the Yucatan Peninsula of Mexico**, what modification this new trend brought and what are the problems and opportunities created by this new type of situation. In order to answer this general question, I have developed three sub-research questions. These questions will be useful to evaluate the situation and to gain a better understanding of future sustainable developments. Hence the thesis aims to answer the following sub-research questions:

- ❖ **How have Meliponiculture practices changed over time and what are the factors contributing to those changes?**
- ❖ **To what extent does Meliponiculture help the revival of the Maya Culture, the conservation of stingless bees and the preservation of the environment?**
- ❖ **How does Meliponiculture fit in long-term schemes for developing sustainable activities and what are the challenges that the activity faces?**

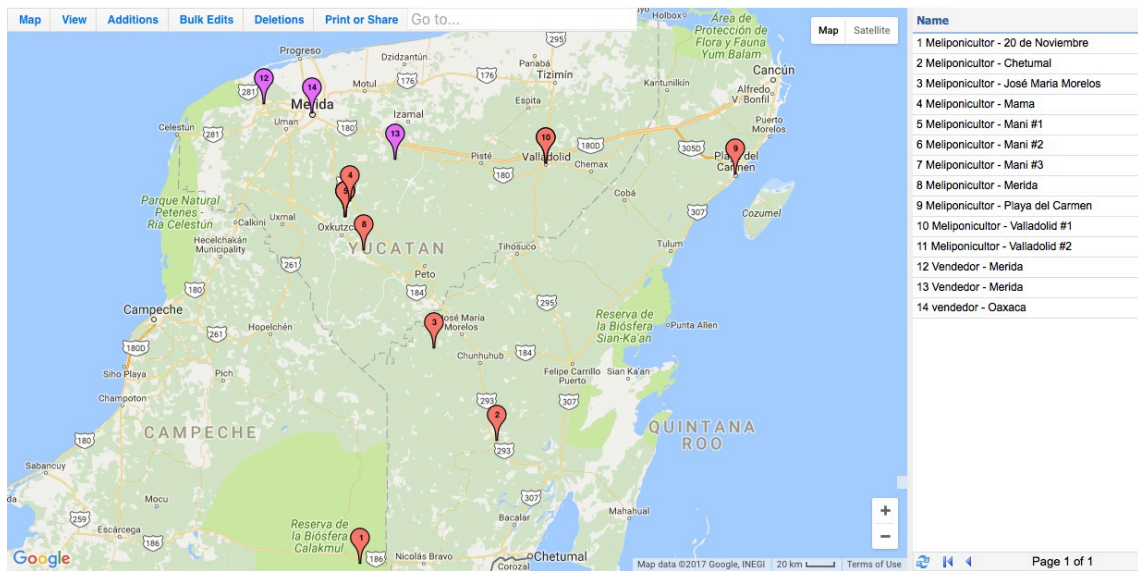
The first research question, with a practical angle, is important in order to grasp the evolution of meliponiculture, notably from traditional breeding in log hives to modern breeding in conventional hives. This question also has the aim to identify the historical factors that forced the activity to evolve. The second question, with a social and environmental angle, is important in order to understand which aspects of the Maya culture were retaken in the third phase of the evolution of meliponiculture. This question also aims at explaining why meliponiculture is a good practice for ensuring the

conservation of stingless bees and the preservation of the floral diversity of the Mexican environment. Due to the ancestral Mayan beekeeping activities, they consist an important part of the Mayan culture heritage and the bee is an integral social part of the True Maya values (chapter VII). The stingless bees are important for the environment as they are assuring plant reproduction but also sustain our food security (chapter VI). The third question puts the emphasis on the activity of meliponiculture as an economic activity; it also explores what are the challenges to transform it into a sustainable one (chapter VIII & IX). Meliponiculture potentially represent a sustainable activity that could be included into ecotourism or organic production activities. To summarize, those three questions combine five important aspects in regards to Meliponiculture in the Yucatan Peninsula of Mexico. As the research questions suggest, meliponiculture presents practical, environmental, social, economic and sustainable aspects that are all interlinked and contribute to the problematic researched.



II. Research Method

1. Region of Interest



Map 2: In red – the location of stingless bee colonies, based on data collected from meliponicultor. In purple – the location where the stingless bee products comes from, based on data collected from honey sellers (vendedor)

When I came across the topic of meliponiculture, I was faced with several possibilities on how to address the topic. I could have focused on a particular program, or a particular project, or go to a different part of Mexico, but instead I decided to focus my investigations on the Yucatan Peninsula. Meliponiculture evidence was found in the area making the practice of the activity incontestable. The Yucatan Peninsula was once populated by the Mayan civilization and today many archaeological vestiges can be found. It is also the region where we can meet the descendent of this great civilization. The Yucatan peninsula has shown the largest decrease in the native stingless bee population; “beekeepers using this bee, from the Mayan zone in Quintana Roo state, Mexico, testify to a 93% decrease in hives during the past one-quarter century”

(Villanueva-G, Roubik and Colli-Ucan 2005 , 35). While the factors causing this decrease are multiples, numerous programs and interventions are made to promote the rebirth of Meliponiculture in the Yucatan peninsula. I collected some extra data in a natural reserve of the state of Campeche and in Quintana Roo to gain a larger picture of the situation in the region and not just in the state of Yucatan (see map 1). In the map 1 we can see the places where my participants were located.

2. Field Research

The main field research methods consisted of *semi-structured interviews* and *open-ended questionnaires*, but also of *participant observation* and *photographic collection*.

In-depth interviews “can be defined as a qualitative research technique which involves “conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program or situation” (Boyce and Neale 2006, p.3)”. I opted for semi-structured interviews because “in semi-structured interviews interviewer prepares a set of same questions to be answered by all interviewees, however, additional questions might be asked during interviews to clarify and/or further expand certain issues” (Ibid.). This allowed me to receive answers on a certain problematic but also to ask for more details when I found it interesting or considered that it could add valuable information to the discussion (see Appendix 6).

Simultaneously to interviews, I was asking persons to fill in questionnaires in order to collect additional data. The questionnaires used in this research were both quantitative and qualitative and were “in house surveys”. Significant questions had to be answered by providing numbers and yes/no answers. This data obtained by using closed-ended questions allowed me to get a better representation of the activity and enabled me to construct pie-charts, bar charts and percentages that improve the validity of the analysis³. The answers obtained with the open-ended questions “involve discussions and critical analyses without use of numbers and calculations”⁴ (*please see Appendix 4 and 5*).

³ “Questionnaires”, <https://research-methodology.net/research-methods/survey-method/questionnaires-2/>, accessed on 31 October 2017

⁴ *Ibid.*

The participant observations were quite useful because they “increase the validity of the study, as observations may help the researcher have a better understanding of the context and phenomenon under study” (DeWalt and DeWalt 2002, 92). Furthermore participant observation “can be used to help answer descriptive research questions, to build theory, or to generate or test hypotheses” (Ibid.). By going on the field, attending events and seeing by myself how the activity is practiced, I could get a better understanding of the activity under investigation.

Furthermore during participant observation, I collected photographic evidences; “photographers use their cameras as tools of exploration, passports to inner sanctums, instruments for change. Their images are proof that photography matters now more than ever”⁵. These photographs are useful to generate representations of situations and the subject under study. It is believed that “photographic stories can alter perceptions and, at their best, change lives”⁶ and represent an integrative part of this research paper.

I have collected a total of 14 questionnaires, 11 from meliponicultors and 3 from bee products sellers. I have also collected a total of 12 interviews of participants with diverse background including meliponicultors, Foundation directors, engineers, eco park manager and enterprise directors. These participants contribute to the discussion centered on the topic of Meliponiculture (see table 1). The section VII.1 will be entirely dedicated to the portraits of who the meliponicultors are today because it is important to see how their stories play a role in the development of the activity.. Participant observations were collected in various areas, notably in rural communities near Coba, Xpujil and José Maria Morelos. These observations were useful to gain knowledge on the living conditions in rural communities, the activity of Meliponiculture and traditions.

#	Gender	Age	Participant city	Profession	Type(s) of data collected
1	Male	29	Valladolid	Chemical Engineer	Interview & questionnaire

⁵ “The Power of Photography”, <http://ngm.nationalgeographic.com/2013/10/power-of-photography/draper-text>, accessed on 31 October 2017

⁶ Ibid.

2	Male	55	Chetumal	Agronomist Engineer	Interview & questionnaire
3	Male	26	Mama	Agro ecologist	Questionnaire & Field Notes
4	Male	27	Santa Gertrudio	Farmer	Questionnaire
5	Male	57	Merida	Engineer	Interview & questionnaire
6	Male	31	Playa Del Carmen	Meliponicultor	Interview & questionnaire
7	Male	-	Oaxaca	Honey Seller	Questionnaire
8	Male	60	Merida	Beekeeping Professor	Questionnaire
9	Female	24	Valladolid	Computer Systems Engineer	Interview & questionnaire
10	Female	-	Calakmul	Meliponicultor	Interview & questionnaire
11	Female	30	Mani	Meliponicultor	Questionnaire
12	Female	58	Mani	Meliponicultor	Questionnaire
13	Female	53	Mani	Meliponicultor	Questionnaire
14	Female	-	Merida	Tourism Studies	Questionnaire
15	Male	-	Coba	Farmer	Interview
16	Male	-	Tulum	Biologist	Interview
17	Female	-	Merida	Honey Seller	Interview
18	Male	-	Tulum	Agro ecology	Interview
19	Male	-	Tulum	Foundation Director	Interview
20	Male	-	San Cristobal de las Casas	Researcher	Interview
21	Female	-	Rural community Coba	Meliponicultor	Field Notes
22	Female	-	Rural community Coba	Meliponicultor	Field Notes
23	Male	-	Rural community Coba	Farmer -Meliponicultor	Field Notes
24	Male	-	Rural community Coba	Farmer -Meliponicultor	Field Notes
25	Male	-	José Maria Morelos	Taxonomist	Field Notes
26	Male	-	Akumal	Foundation Director	Field Notes
27	Female	-	Mérida	Enterprise Director	Field Notes
28	Male	-	Tulum	Foundation employee	Field Notes

Table 1: Participants of the Research

3. Data Collection & Research Limitations

The methods to contact potential participants were various. I used mainly searches on the Internet including social media, such as Facebook or Instagram by using key words such as *meliponicultura*, *stingless bees*, *Melipona*, *etc.* These methods proved to be successful and enabled me to extend my network of people involved in stingless bee rearing. When meeting my participants, I asked if they knew other meliponicultors and several participants were recruited by using this method. I also met meliponicultors at ExpoFairs⁷. This variety of recruitment methods allowed me to have persons from diverse backgrounds and social classes. Nevertheless, one limitation from this recruiting method is that most of my participants had an Internet access or webpages. Therefore potential participants that did not have an Internet access were harder to find. This limitation might have an effect on the representation of the meliponicultors in the region of interest. I do however believe that the variety of participants allow the expansion of the research results to a larger population and is therefore de-centered from previous researches that focused only on a particular group.

4. Ethical Considerations

In this research there are several ethical consideration. The Norwegian Social Sciences Data Services (NSD) was informed of the research and approved the notification form. All participants interviewed, or asked to fill out the questionnaire, gave their consent both written and orally. There was no language barrier as all my participants could speak Spanish. The interviews have been transcribed and translated by the author. It is important to note that all the translations are based on interpretations by the author and reflects his understanding of the results found. In this research paper, in order to protect the identity of my interviewees, imaginary names were given to them. A potential limitation is that I do not speak the Maya language and could have missed on some valuable information.

⁷ *Expo Fairs are events taking place in various cities throughout the country where small producers have the chance to come and sell their products.*



III. Conceptual Framework

1. Towards Sustainable Development

In order to understand the optic of this master thesis, it is essential to retrace the origins of the term sustainable development. Integrating ideas of conservation to development was something completely new and perhaps unconceivable for many countries. Nevertheless, it became evident that the activities of humans on the planet were becoming destructive for the nature and the necessity to find new systems was urgent. Today, Sustainable Development has become the base for all sorts of programs and ensures the sustainability of future generations to come.

The definition and ideas of sustainable development were evoked for the first time during *the United Nations Conference on the Human Environment held in Stockholm in June 1972*. This date marks an important point in which the term sustainable development became accepted and integrated in new ideologies on development. Industrialized countries erected the initiative; especially after they noticed the effect that the pollution generated had on the environment (such as acid rain) (W. Adams 2009, 60). However not all countries did felt concerned by the aim of this conference. So called “developing countries” were “faced with urgent short-term problems of poverty, hunger and disease, longer-term environmental problems associated with industrialization seemed not only remote, but a possible means by which industrialized economies might wriggle off the hook of responsibility for supporting a rapid drive for development” (Ibid.). Nevertheless the conference was a success; the United Nations Environment Programme (UNEP) was created with the aim of acting as a governing council for environmental programs. As a result “a secretariat would focus environmental action

within the whole UN system and an environment fund would finance environment programmes” (Ibid., 63).

Following this important event, the *World Conservation Strategy (WCS)* was published in 1980 in the name of IUCN, UNEP and the World Wildlife Fund (WWF) (IUCN 1980).

This document “was the culmination of more than two decades of work by conservationists, especially through IUCN, to get conservation taken seriously in development. It argued for the maintenance of essential ecological processes and life-support systems, the preservation of genetic diversity and the sustainable use of species and ecosystems. It suggested that development and conservation could be made compatible through better and more timely planning” (W. Adams 2009, 84).

The WCS consisted of three parts. The first part was focusing on describing objectives for conservation, their relevance for human survival, and priority requirements for achieving them. The second part set out a strategy for action at national and subnational levels, and identified obstacles and possible ways to deal with them. Finally the third part outlined the international action required to stimulate and support action at smaller scales (Ibid., 66). Additionally to that, “The Strategy: explains the contribution of living resource conservation to human survival and to sustainable development; identifies the priority conservation issues and the main requirements for dealing with them and proposes effective ways for achieving the Strategy's aim” (IUCN-UNEP-WWF 1980, IV). Overall the WCS document was “seeking to show the relevance of conservation to the development objectives of others, in governments, industry and commerce, organized labour and the professions (Allen 1980)” (Ibid.).

It is few years later that the Brundtland Report, a UN Document entitled “*Our Common Future*”, was first published. This document has been and continues to be important because it helped to define sustainable development. In this report, the definition of sustainable development is the: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations 1987).

This report was an attempt “to locate the debate about the environment within the economic and political context of international development. [...] It argued that poverty drove environmental degradation and required multilateral (global) action” (W. Adams 2009, 84). It also tried to redirect the discussion around a “more equitable world economy” mentioning that with a proper economic growth, it could be possible to achieve environmental management (Ibid.).

The world Conservation Strategy (WCS) has developed two main arguments that were important in the creation of the definition regarding sustainable development. The two arguments were that “[1] all truly sustainable development depended on environmental conservation, specifically on the sustainable use of living organisms and ecosystems. [2] Development could be reconfigured to promote conservation” (Ibid., 275). Those two arguments are important because they shaped the actions to be undertaken to reach both conservation and sustainable development. In fact, the first definition was mainly focusing on conservation. Nonetheless it became clear that development could also be reached with such new system as the WCS had to offer. Based on Adams, this shift in the thinking in term of conservation could help meet the interests and needs of poor people, especially the one living in rural areas, who were the “victims of inappropriate development” (Adams 2009, 275). Hence this new definition was erected and as a result various types of conservation appeared. Not to be forgotten that the re-development of Meliponiculture in the Yucatan Peninsula of Mexico is the result of integrative programs that focused their aim on the sustainable development of rural populations. The next section III.2 will focus on the *Sustainable Livelihoods Approach*. This approach will bring an interesting framework to this research concerning the activity of Meliponiculture.

2. The Sustainable Livelihoods Approach

The *Sustainable Livelihoods Approach (SLA)* forms the best applicable approach to this research. In this section we will see how the activity of meliponiculture is challenged by external factors that are well represented in the SLA. According to the accepted

definition originally developed by Chambers and Conway (1992): “A livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with, and recover from, stresses and shocks and maintain or enhance its capabilities and assets, both now and in the future, while not undermining the natural resource base”. (Bradbear 2009, 17). Assets shape our livelihoods. These assets can be categorized into five fundamental categories: human, physical, financial, social and natural (Ibid.). Bradbear applied the SLA to the beekeeping activity. Considering that this research is focusing on the Meliponiculture activity, his example on beekeeping can be assimilated to the paper’s topic of research. The figure below (figure 1) represents the assets that Bradbear found for the activity of beekeeping.

<p>Natural capital <i>Needed for beekeeping:</i> bees, a place to keep them, water, sunshine, biodiversity, environmental resources.</p> <p>Social capital <i>Needed for beekeeping:</i> help from families, friends, networks. Membership of groups, access to wider society, market information, research findings.</p> <p>Human capital <i>Needed for beekeeping:</i> skills, knowledge, personal attributes like good health and strength, marketing expertise.</p> <p>Physical capital <i>Needed for beekeeping:</i> tools, equipment, transport, roads, clean water, energy, buildings.</p> <p>Financial capital <i>Needed for beekeeping:</i> cash, savings, access to credit or grants.</p>

Figure 1: The five types of capital assets applied to beekeeping (Source: Bradbear 2009, 18)

By analysing this figure, one can gain a better understanding of the types of beekeeping assets that can play a role for the development of a certain livelihoods. In fact it is important to notice that “beekeeping is a useful means for strengthening and creating people’s livelihoods because it both uses and creates a range of different capital assets. Successful beekeeping can be achieved by drawing upon all of the five categories of capital asset shown above” (Ibid.). Lets look at those five capital individually for our particular case on meliponiculture and their role in consolidating people’s livelihoods in the Yucatan Peninsula.

The *natural capital of meliponiculture* is consisted principally by stingless bees, their sources of food supply and water. In order for stingless bees to function well, they need a safe place to be kept, such as the meliponary, and a safe environment consisted of a

rich biodiversity, notably trees to find natural niches. Stingless bees, and the activity of meliponiculture, ensures the continuation of the natural assets by the pollination of wild and cultivated plants producing the food of today and the plants of tomorrow. Chapter VI of this thesis present in details the assets contributing to the natural capital of meliponiculture in relation to livelihoods consolidation.

The *social capital of meliponiculture* is consisted of the benefits that social resources can bring to the livelihood. For example, for the case of meliponiculture, having a particular vision to practicing this activity, as a community or as a group of friend can be beneficial. Creating networks, such as joining beekeeping associations or cooperatives, can help the development of meliponicultors. “Such associations provide the means for beekeepers to advance their craft, ensure protection of their bees, processing for honey and wax, access to markets, and marketing support” (Ibid., 18). In Chapter VIII, the assets resulting from the advantages of meliponicultors joining associations will be elaborated. We will see the limitations that can rapidly arouse, notably when the politics put their hand in or are corrupted.

The *human capital of meliponiculture* is concerning the traditional knowledge that people could have about the activity. In fact “traditionally many societies have good skills relating to bees, honey and in making other products” (Ibid.). In this research, traditional knowledge about meliponiculture are extremely important. This activity has directly been derived from the Maya civilization and with time has accumulated enormous sources of knowledge that need to be shared. For example, the ancestral medicine and the power to heal with stingless bees products has been passed from generation to generation. The creation of artifacts and cosmetics from stingless bee products are constantly evolving. In chapter IV,V,VII and IX, various aspects concerning the human capital will be presented and discussed contributing on how meliponiculture can influence and create sustainable livelihoods.

The *physical capital of meliponiculture* consist of an important part without which the activit could not function. The technical advancement of meliponiculture has encouraged a transition from log hives to rational hives permitting to the activity to develop and express its potentials. However this transition could not have been

conceivable without the help of other actors. These actors can make a profit of it; “indeed, beekeeping can stimulate many different sectors within a society: village traders; carpenters (making hives and stands); tailors (making veils, clothing, gloves); container-makers and sellers” (Ibid., 19). Chapter V will notably elaborate on the transition from log hives to modern hives that the activity in Mexico has faced. Other factors such as the infrastructure can also play a role. Lacking this capital could reduce the opportunities of meliponicultors of rural areas to reach markets to value their products and gain a better profit out of them. This issue will be explored to some extent in this paper, notably in chapter VIII.

The *Financial capital of meliponiculture* in this research concerns mostly the type of market aimed at and its marketing. Stingless bees, due to their natural conditions, cannot produce large quantities of honey hence the products are rare and unique. Nevertheless the derived products such as cosmetics or arts pieces can have an added value which is not negligible. In Chapter VIII, the sections 2 and 3 are focusing on this aspect.

The framework of the Sustainable Livelihood Approach (SLA) is here to “assist with

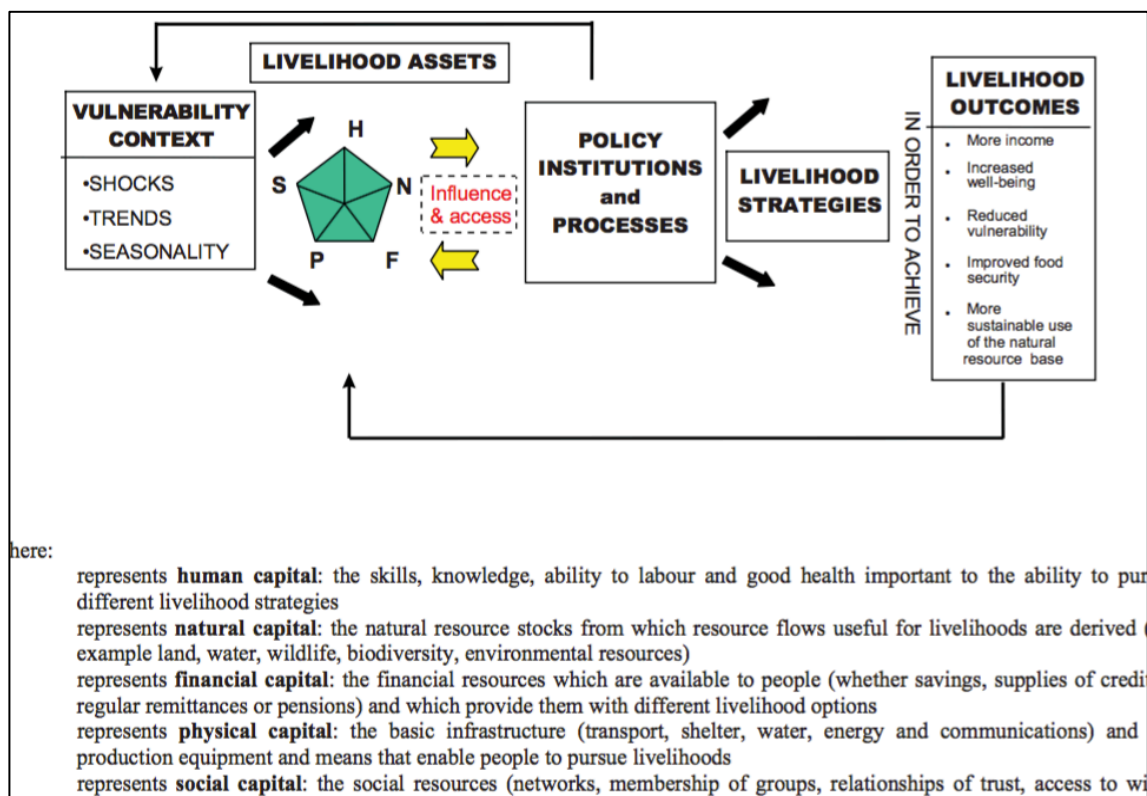


Figure 2: The Sustainable Livelihoods Framework (Source: Bradbear 2009, 19)

consideration of the various factors that constrain or enhance the livelihood of a beekeeper and his or her family” (Ibid.). The Sustainable Livelihoods Framework is explained in the figure 2 above.

In this Framework, sustainable livelihoods are classified into five categories. Those categories are: the vulnerability; the assets of people’s livelihood; policies, institutions and processes; livelihood strategies, and livelihood outcomes (Ibid.).

The first category of *vulnerability* is quite important for meliponicultors; in fact their activity of meliponiculture can be faced by external factors that could influence their livelihoods. The analysis of vulnerability beside evaluating the risks that meliponicultors could face, it also enables to identify the resilience that they would have to deal with with negative change in their environment, both short and long-term. These types of vulnerability corresponds to negative shocks, trends and seasonality (Ibid.). For example, hurricanes can have disastrous impacts on the activity (see chapter VI, section 2). Later on in this paper one will come across a disastrous experience by a meliponicultor due to a natural catastrophe. The colonization by africanized honey bee is another important type of vulnerability explored in chapter IV, section 5 and VI, section 4). Recently the introduction of large monoculture of Genetically Modified Organisms (GMOs) put a new vulnerability where the future impacts are uncertain (see chapter IX, section 3). Others aspects, such as the seasonality of the activity (harvest honey only two times a year) create pressures to meliponicultors.

The *livelihood assets* have been described previously to the framework and can be found along this research paper. The third part of the Framework representing the Policy, Institutions and Processes, “includes organizations large and small, institutions, legislation and the processes which link organizations, institutions and policies to people’s lives: these have a profound influence on people’s access to assets” (Ibid., 21). The three main impacts to remember from the Policy, Institutions and Processes on people’s livelihoods are [1] access to capital assets, the activity (meliponiculture) and decisions making bodies, [2] terms of exchange between different types of assets (for example making it difficult to market honey because traders lack access to credit), [3] The returns (economic or otherwise) achievable from any given livelihood strategy

(Bradbear 2009, 21). In this research we will see explore access to funds and the mexican government role to the activity. The Sustainable Livelihoods Approach will bring the necessary support along to paper in the understanding of its scope and results.

3. Incentive & Community based Conservation

The **incentive-based conservation** propose that ‘conservation can be best achieved by giving rural people a direct economic interest in the survival of species, thus literally harnessing conservation success to the issue of secure livelihoods (W. Adams 2009, 276). The incentive-based conservation is based on the idea that the duel strategy of protection and use can create new conservation gains (Leader-Williams and Hutton 2003). In order to reach these new conservation gains, incentives have to be created and they can take many forms. In fact, “they may be social or financial, where significant empowerment and livelihood benefits accrue to the rural poor who live side-by-side with the exploited species and on whom these species ultimately depend for their continued survival” (Leader-Williams and Hutton 2003, 220). It is very clear that the conservation of the stingless bees in Mexico could be best achieve when the locals are taking care of them. Once locals recognize the importance of their actions on the conservation of stingless bees, they will make it their priority. In chapter VI, section 5 and chapter VIII some examples will demonstrate this theory.

The idea behind the **community-based conservation** is that “ecosystem management and human well-being should be integrated, recognizing that biodiversity conservation and livelihood needs are ultimately complementary goals” (Berkes 2007 , 15192). The community-based conservation is complementary to the Sustainable Livelihood Approach because it “requires building the capacity to deal with multiple objectives, the use of deliberative processes, learning from commons research, and, in general, developing a complexity approach for commons governance” (Ibid.). Furthermore, Community-based conservation definition needs to be extended in order to embrace “natural resources or biodiversity protection by, for, and with the local community, taking into account drivers, institutional linkages at the local level, and multiple levels of organization that impact and shape institutions at the local level” (Ibid.). Through this master thesis, the reader will be driven by a series of aspects that are interconnected and

influencing the successful implementation of meliponiculture in the Yucatan Peninsula of Mexico. These aspects will not only be focused on biodiversity protection because there is more to it; there are social, economic and sustainable aspects that also influence the activity.

4. United Nation Sustainable Development Goals

There are various UN sustainable development goals (SDGs) that are applicable to this research. They are complementary to the previous approaches, notably because they set the framework to adopt when referring to the implementation of a sustainable activity. These goals also act as a reminder on the ideal situation to reach by 2030 and to set the elements to look at in this research. They are also useful to show how this research, and understanding of meliponiculture, can foster the achievement of many of United Nation Sustainable Development Goals. The following goals will be explored throughout the master thesis:

SDG number 2: “End hunger, achieve food security and improved nutrition and promote sustainable agriculture”

- **Target 2.3** (*By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment*),
- **Target 2.4** (*By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality*),
- **Target 2.A** (*Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance*

agricultural productive capacity in developing countries, in particular least developed countries.)

SDG number 12: “Ensure sustainable consumption and production patterns”

- **Target 12.2:** *“By 2030, achieve the sustainable management and efficient use of natural resources”,*
- **Target 12.8:** *“By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature”,*
- **Target 12.A:** *“Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production”,*
- **Target 12.B:** *“Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products”.*

SDG number 15: “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss and all its targets”⁸.

5. Literature Review

Although Meliponiculture is an activity closely connected to the Maya culture, it received only little interest from the research domain until recently when it became evident that stingless bees were presenting extinction risks. In fact, the activity of beekeeping became rapidly more important than Meliponiculture and hence contributed to its disinterest. Beekeeping has its own department in the ministry of agriculture whereas Meliponiculture is still struggling to be recognized as a professional activity by the government.

⁸“Sustainable Development Knowledge Platform”, <https://sustainabledevelopment.un.org/sdg15>, Accessed on 30.07.17

Nevertheless, there are some researches that appeared in the 90s centered on the activity of Meliponiculture; those researches are focusing on the shift from traditional to modern practices. Villanueva-Gutiérrez Rogel and Colli-Ucán Wilberto are two important researchers in the field of Meliponiculture from the university of ECOSUR in Chetumal. They have been focusing on the rebirth of the activity by creating a program since 2004 (Villanueva-Gutiérrez Rogel 2013). This program aimed at the promotion of the activity amongst small-scale producers in Mayan communities but also to save the knowledge of old meliponicultors regarding the breeding of *Melipona Beecheii*. Their program has been focusing on forming new meliponicultors in the management and conservation of stingless bees. In the latter phase of the program, they have been focusing on the formation of new meliponicultors that will be able to teach new persons to the activity; in other words they would become teachers themselves. Those researchers have been creating ways to evaluate the student knowledge of meliponiculture and hope that those new abilities will enable them to create new economic revenues in rural communities.



IV. History of the Meliponiculture Activity

The Maya civilization kept stingless bees, more particularly the *Melipona Beecheii*. They were amongst the first to practice the activity of meliponiculture. In fact, “historically, it was the only sustainable type of beekeeping anywhere in the world” (Cortopassi-Laurino, et al. 2006, 281). The activity has gone through three main phases that will be described in this part. The first one makes reference to the postclassical period of the Maya civilization; the second phase refers to the colonial period that contributed to a shift from Meliponiculture to Apiculture and the last phase to the revival of meliponiculture.

1. Archeology & Maya Civilization

The first remains showing that meliponiculture was practiced in the “New World” date back from approximately 1400 BC. In several archeological sites of Mexico, Belize and Guatemala, limestone discs that were used to close the wood log hives have been found. On the island of Cozumel, off the coasts of the Yucatan peninsula, “255 of the discs have been found. Also on Cozumel, a pottery incense burner in the form of the Maya bee god *Ab Mucan Cab* was found, dated to about A.D. 1400, which incorporates models of four hives that appear similar to those used today” (Crane 1992, 07). The figure 3 below shows the discs that have been found on Cozumel Island. The dotted lines join together 12 discs in pairs to show that they could have been log hives. The figure 4 below shows an example of limestone discs found in Belize.

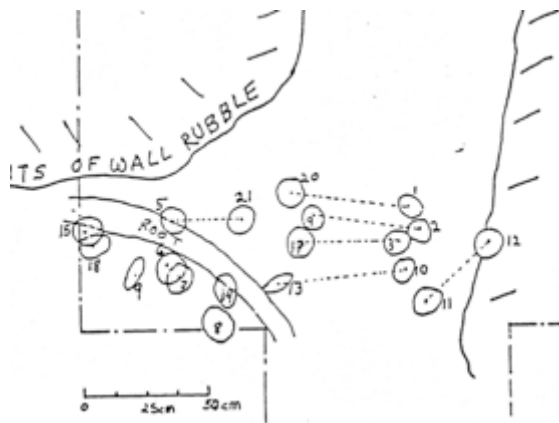


Figure 3: Plan of part of the excavated area at Buena Vista, Cozumel, Mexico, showing locations at which stone hive closures were found; those to the left of the root had been disturbed (Wallace, 1978 in Crane 1992, 07)

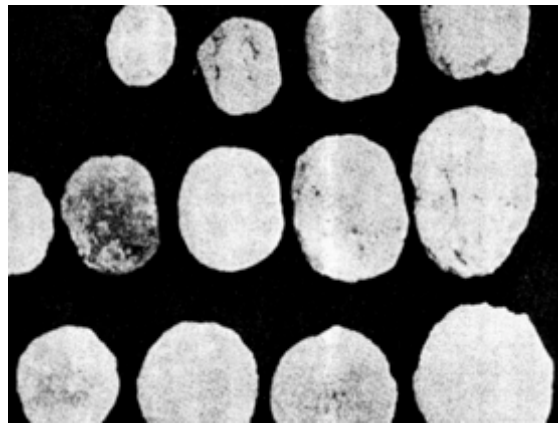


Figure 4: Thirteen of 37 hive closures excavated at Chan Chen, North Belize (photo: J. R. Andresen) (Crane 1992, 08)

Interesting remains of works written in Yucatan Maya language have been found in the third century, the classical period, which relates beekeeping practices by the Maya civilization⁹. The products deriving from the domestication of stingless bees had various uses; they were either used as aliments, for ceremonies and traditional medicines. Between the III and X century, the period when the Maya culture was at its maximum development, honey and the wax were two of the most abundant products that were the object of tributes and commercialization in the antiquity. This is a factor that encouraged the integration of the Mayan area in the Yucatan peninsula. In fact, Yucatan exported several goods such as wax, beans, honey, salt, dry fishes, henequen blankets and copal (A. Carrillo Magana 2004, 12). After the VIII century, the Maya civilization started to decline embracing the decrease of meliponiculture. In 1492, Cristóbal Colón reports the use of honey from stingless bees, but also from wax, used by goldsmiths. In a letter dated from the 20 of May 1506, he reported large quantities of honey. The forest already covered a large part of the Yucatan peninsula until the arrival of the conquistadores in 1521¹⁰.

⁹ "Apiculture Traditionnelle et Patrimoine - Amerique Precolombienne", <http://www.encyclopedie-universelle.net/abeille1/abeille-histoire-hommes-civilisations-apiculture-traditionnelle-amerique-du-sud.html>, Accessed on 2017-07-17

¹⁰ Idem.



Figure 5: Extract from the Madrid Codex, showing representations of the activity of meliponiculture. "Meliponas in Yucatan – Mexico", Source: www.uhbeeproject.com/materials/meliponas_in_yucatan_hawaii_2010.pdf, accessed on 2017-07-19

2. Madrid Codex

Fortunately, beside the fact that the Spanish colonizers have destroyed most of the pre-Columbian documents, the little we know shows in many cultures close links between bees, their honey and the mythology of autochthones from Mesoamerica¹¹. Notably, the famous French anthropologist and ethnologist Claude Lévi-Strauss (1908–2009) “exposed to the eyes of Western scientists the existence of indigenous knowledge about nature and its societies, what he called “sciences of the concrete” that is to say, traditional knowledge, with the aim of validating its principles and establishing its cultural rights” (Lévi-Strauss 1964) (D. Michener 2013,

254). Importantly, he was amongst the ones collecting popular knowledge about stingless bees. One of the greatest discoveries about the Maya civilization is probably the Mayan codices; “the Mayan codices are folding books written in Maya hieroglyphic script on paper-sheets obtained from the inner bark of wild-growing fig tree” (Ibid, 222). The original document (manuscript) is 6.7 m long and has a total of 56 leaves;

¹¹ Idem

their page dimensions are of 12 cm X 24 cm. at the origins the document was split in 2 fragments (Troano: pages 22–56, 78–112 and Cortesianus: pages 1–21, 57–77) both owned by the Spanish palaeographer Don Juan Tro y Ortolano. It is only in 1888 that Léon de Rosny found out that the 2 fragments were from the same book and was finally reunited in the *Madrid Codex* (D. Michener 2013, 222). This Madrid Codex is particularly important because 10 pages are dedicated to stingless bees and their management¹². In the figure 5, we can see symbols representing the *Melipona Beecheii* bee (top left bee icon in red). We can also observe in the center bottom of the figure a “god-like figure, holding stingless bee brood with the hands, like the Ah Mucen Cab censer” (Ibid.).

3. Colonial Period

In 1519, the general Hernando Cortès disembark on the Veracruz coast with 800 men, 20 horses and some canons¹³. The figure 6 is a representation of his disembarkation.



Figure 6: Representation of the disembarkation of General Cortès in Veracruz in 1519. Source: https://img.over-blog-kiwi.com/1/23/60/82/20161112/ob_ff326_rivera-cotex.jpg, accessed on 2017-07-19

One year later, in 1520, he noticed the trade of stingless bees in the Yucatan. He also sent

honey and stingless bees to the emperor¹⁴. In 1521, after a bloody siege, the Spaniards seized Tenochtitlan and destroyed it. They captured the last emperor Cuauhtémoc¹⁵. In

¹² “*Meliponas in Yucatan – Mexico*”, www.uhbeeproject.com/materials/meliponas_in_yucatan_hawaii_2010.pdf, Accessed on 2017-07-19

¹³ “*Periode Coloniale*”, <http://www.mexique-voyages.com/histoire/periode-coloniale.php>, Accessed on 2017-07-18

¹⁴ “*Apiculture Traditionnelle et Patrimoine – Amerique Precolombienne*”, <http://www.encyclopedie-universelle.net/abeille1/abeille-histoire-hommes-civilisations-apiculture-traditionnelle-amerique-du-sud.html>, Accessed on 2017-07-17

1529, in the « *Historia general de las cosas de Nueva España* », written by the Franciscan Bernardino de Sahagún, inform us that honey was commonly used in the ancient Mexican cuisine. In Xalisco the log hives were hung on the house and not left on the floor showing the importance that those bees had to the Maya civilization. Part of the production was kept for domestic uses and the other part exchanged against other goods¹⁶. Around 1535, old conquistadors such as Cortès, Anghiera, Oviedo, talk about the use of 3 types of stingless bees for the activity; two are kept in hives (probably referring to the *Melipona* and *Scaptotrigona*) and one small black wild bee that produce honey and wax. They also mention their important medicinal uses¹⁷. The first list of taxes that the spaniards demanded in 1549 to the indigenous was 94 percent paid in honey and wax. In total, apporximately 29,300 kg of wax and 3,300 kg of honey were asked (A. Carrillo Magana 2004, 18). It represents large quantities and shows the importance that meliponiculture had at the time.

4. The Shift from Meliponiculture to Apiculture

The Spaniard colonization brought changes in the way food was produced locally. In fact, the rich Spaniards coming from Spain started to implement systems of monoculture in large domains that could be hundred thousands hectares. They launched large animal production, sugar cane and agave plantations¹⁸. The introduction of the sugar cane contributed to the decline of the activity of meliponiculture because sugar was now substituting honey. Only in places (such as in the Yucatán Peninsula, the Sierra Norte in Puebla and in Veracruz) where the activity had large cultural values and a large quantity of colonies (thousands of them) the activity perpetuated (Gonzalez Acereto and Araujo Freitas 2005, 06). In 1616, “a ship also bound for Virginia took refuge in Bermuda during a hurricane. It earned hives of bees which were landed there, and the bees prospered (Hilburn, 1989)” (Crane 1992, 08). The bees spread on the island and consist of the first recorded “importation” of *Apis Mellifera* in the New

¹⁵ “*Periode Coloniale*”, <http://www.mexique-voyages.com/histoire/periode-coloniale.php>, Accessed on 2017-07-18

¹⁶ “*Apiculture Traditionnelle et Patrimoine - Amerique Precolombienne*”, <http://www.encyclopedie-universelle.net/abeille1/abeille-histoire-hommes-civilisations-apiculture-traditionnelle-amerique-du-sud.html>, Accessed on 2017-07-17

¹⁷ Idem

¹⁸ “*Periode Coloniale*”, <http://www.mexique-voyages.com/histoire/periode-coloniale.php>, Accessed on 2017-07-18

World. Nevertheless it is believed that the first *Apis Mellifera* bees arrived on the American continent in 1621. In 1621, the Council of the Virginia Company asked for the importation of bees, diverse seeds, fruit trees and pigeons; this is proven in a letter from London dated from the 5 December 1621 detailing the content of the embarkation¹⁹. Following this importation, it is around 1760 that the Spaniards introduced the black European bee (*Apis Mellifera Mellifera*). Later on in 1911, the first Italian yellow bees (*Apis Mellifera Ligustica*) were introduced²⁰.

5. The Arrival of Africanized Bees

In 1956, Brazil imported from Namibia 46 queen bees of the *Apis Mellifera Scutellata* specie to develop their beekeeping industry because this bee could adapt better to the local climate. Unfortunately 26 queens escaped from the experimental Centre where they were studied. These colonies spread easily in the entire continent²¹. The mix between the *Apis Mellifera Scutellata* and the *Apis Mellifera Mellifera* specie created new specie commonly know as the “Africanized or killer bee”. This new bee specie spread in Mexico from 1985 onwards, and being particularly aggressive, severally impacted the Mexican beekeeping activity. In few years the country lost half of its bee colonies until they changed practices and rebuild the beekeeping economy. In Mexico, there are now approximately 40 000 beekeepers compiling a total of 1.9 millions beehives. They produce approximately 56 000 tones of honey annually and more or less half of this production is exported to Europe²². In chapter VI.4, the drastic effects that this bee has on native stingless bees will be elaborated.

¹⁹ <http://etudescaribeennes.revues.org/6967>, Accessed on 2017-07-18

²⁰ “L'élevage des reines au Mexique”, <http://www.apiservices.biz/fr/articles/298-|-elevation-des-reines-au-mexique>, cessed on 2017-07-18

²¹ “Abeille Africaine”, <http://www.dinosoria.com/abeille.htm>, Accessed on 2017-07-18

²² “L'élevage des reines au Mexique”, <http://www.apiservices.biz/fr/articles/298-|-elevation-des-reines-au-mexique>, Accessed on 2017-07-18

6. The Revival of Meliponiculture in Mexico

It is at the end of the 20th century and beginning of 21st century that it became evident that the stingless bees, and more particularly the *Melipona Beecheii*, were at the edge of extinction from Mexico if no drastic actions were taken (see figure 7 for an example of *Melipona Beecheii* Nest). In fact, in the past half century, there a regional decline of over 90 % in managed colonies (Cortopassi-Laurino, et al. 2006, 282; E. Cairns, et al. 2005, 686). The reasons for this decline are various; we can notably count environmental issues, such as hurricanes, loosing tradition leading to a reduction in the number of colonies and that the colonies do not propagated in the nature (Cortopassi-Laurino, et al. 2006, 282).



Figure 7: The pyramid shape of a populous Melipona Beecheii nest. (Source: author)

In the first years of 2000, the first researches concentrating on the preservation of stingless bees started to appear. On a previous research by González-Acereto et al., “a detailed survey was conducted in 52 communities between June 2000 and September 2005. During these visits questionnaires were applied to also provide a background on the economic aspects and social characteristics of stingless beekeepers, a key factor to help in future planning of courses and extension work” (González-Acereto , Quezada-Euán and Medina-Medina 2006, 234). Similarly in a 2002 research, a group of

beekeepers and meliponicultors were interviewed to determine the effect Africanized bees in the traditional meliponiculture of stingless bees with the species *Melipona Beecheii* and to understand the driving forces behind the recent decline in meliponiculture in Quintana Roo (Cairns, Bray and Villanueva 2003, 58). In an interview with an ECOSUR researcher, he told me that “since we did the congress on natives bees in 2003, we were only 120 persons more like passionate persons, but it did not seem to have a future. But since 5 or 6 years, it is very impressive the amount of projects focusing on meliponiculture everywhere” (ECOSUR Researcher: Interview 15.11.2016).

The “*Foundation Melipona Maya –Tulum*”, which was inaugurated in 2013, also focuses on the revival of meliponiculture in the rural communities of the Yucatan Peninsula (see figure 8). The aim of the Foundation is to protect stingless bees, particularly for their environmental aspect but also due to the strong cultural and historical links that the Maya have with them. The Foundation programs aim at reintroducing meliponiculture to enhance its productivity and the cultural heritage of the Mayan communities (Foundation Director: Interview 05/10/16).



Figure 8: Development of Meliponary in Rural Communities, part of the “Fundación Melipona Maya” work. Source: author

In 2009, a project by ‘*The Travel Foundation*’, was born. This project was focusing on: “increasing the economic, social and cultural benefits to the Mush Meyer honey group and their families; to provide an incentive to support the conservation of the Melipona bee and the preservation of the Maya beekeeping cultural tradition; to provide a model of best practice for other communities, in relation to both beekeeping and business development”²³.

Those two projects are examples of actions that are currently undertaken and contribute to the increased popularity in the conservation of stingless bees. They can be beneficial to raise awareness on the problematic, namely the re-development of meliponiculture in the Yucatan Peninsula, and to improve the lives of less favored people. In fact the action undertaken by the 2 organisms are referring to the third part of the Sustainable Livelihood Framework representing the Policy, Institutions and Processes, “includes organizations large and small, institutions, legislation and the processes which link organizations, institutions and policies to people’s lives: these have a profound influence on people’s access to assets” (Bradbear 2009, 21). This chapter has shown how the activity has evolved with time and how the Maya ancestors, that can now be found through their descendant, created the human capital of meliponiculture. The following chapters will show how an incentive-based conservation can contribute to the creation of sustainable economies while protecting the biodiversity of the Yucatan Peninsula.

²³ “*Mexico Melipona Honey Project*”, <http://www.sostinternational.com/index.php/mexico-melipona-honey-project-2/>, Accessed on 2017-07-21



V. A Meliponiculture in Transition

In this research I came across 2 main types of stingless bees breeding that I qualify as “*traditional*” and “*modern*”. This chapter will be dedicated to both breeding methods.

1. Traditional Meliponiculture



Figure 9: Top-left: inside of a log hives (jobon), top-right: traditional meliponary, bottom left: mix of log hives (jobones) and modern beehives, bottom-right: tapped trunk (jobon) Source – author

The traditional meliponiculture consists of breeding stingless bees in an empty tree trunk where the extremities can be opened. Stingless bee nest were believed to be collected directly from the wild. Ethnographic evidences prove that:

“Among the Chiquito in Bolivia around 1840, nests were hunted for their honey from June to September by organized groups of 10 to 20 men. They searched through the forest and felled any tree containing a nest; they often took home the part containing a nest, to use as a hive” (Crane 1998, 08)

Both extremities are tapped with a rock, or a circular piece of wood, and a mixture of red mud called “Kankab” by the Yucatan Mayas (Gonzalez Acereto and Araujo Freitas 2005, 15). In the top left picture of the figure 9, we can see one of the extremity open. It is possible to observe the bee brood panels. These log hives can also directly be collected from the forest and brought back to the meliponary (*see bottom left picture of figure 9*). The top right picture of figure 9 represent a traditional meliponary encountered in a rural community of the Calakmul Reserve. Moreover, these log hives can directly be purchased for that purpose in beekeeping shops (*see figure 10*).



Figure 10: log hives that can be purchased in beekeeping shops (Source: author).

Furthermore some log hives have been modified for an easier opening. Additionally to the possibilities of opening the extremities, it is possible to open the top part for a direct access the bee colony (*see figure 11*).



Figure 11: Modern trunk with multiple openings (Source: author).

Since the introduction of ‘modern’ beehive, this traditional method is slowly losing popularity. Nevertheless some meliponicultors opt to keep this traditional method. Dolores, a woman meliponicultor from the rural community of Calakmul, explained me that “they putted 2 [colonies] in beehive but they did not feel comfortable, as if they did not like it”. But that they would like to “work with beehive because it is easier to extract [honey] but we have to find its medium one that they would like, one that is not too big or too reduced because we do not know what this bee like” (Dolores: Interview 20.10.16).

It is also argued that traditional meliponiculture and keeping stingless bees in trunk is counterproductive. Shakira, who has a sanctuary initiative in Valladolid, told me “ a lot of people say that it is how the Maya were doing, so it is this way that we should do it, but it is a long time ago. They [the Mayas] did not have the same technology that we have now, and now it is a situation that requires the intervention from some sort of technology to protect those bees (Shakira: Interview 04.11.16). She goes on by explaining that there is a conflict between the people that wish to keep the tradition, which she does not consider as bad, but it is not the way that it should be done; “it does not help the bees, keeping them traditionally, the bees do not give their full potential

because they exhaust themselves at other things than the honey production” (Shakira: Interview 04.11.16).

In fact it is argued that bees in traditional modes of production are putting more effort on isolating the colony (by collecting and producing more wax). Consequently, they produce less honey that could be exploited, from around 3 liters in modern hive to 2 liters in traditional hive (jobon). Furthermore, there are also technical aspects making the breeding in log hives less productive. Fernandez, from Chetumal, told me that “ in the nature the trunk are vertical, but now they are horizontal. Vertically the bees can put as many panels as they need” but horizontally they have limited space (Fernandez: Interview 17.10.16).

2. Modern Meliponiculture



Figure 12: Modern stingless bees beehive 25cm X 25cm X 25cm with a width of 3.5cm. Left picture show the hive open, top-right picture shows the entry of the hive, bottom-right shows beehives in a meliponary.

The other breeding method is in hives and it is considered to be a better breeding method. Those hives are made of wood with a hole in the middle showing the entry of the hive. Some of them are also decorated to keep the Maya traditions alive (*see top-right picture of figure 12*). Few models of stingless hive have been developed. The

Utrecht University has been designing a hive called the “Utrecht University Tobago Hive” - UTOB Hive (please see Appendix 8 for a representation of the UTOB Hive). The hive allows for quick and efficient harvesting (Sommeijer 1999, 78). Yet, there is no standardized hive and it remains unclear, the one better suited for the breeding of stingless bees. The figure 12 represent the stingless bees hive that I came across a lot and that could be considered the most common amongst the other type of hives.

Other shapes and sizes exist (see figure 13). As José from Mérida told me, he made his own design; “I have been experimenting, after 2 years and I arrived at a standard that I am now using” (José: Interview 01.11.16). He informed me that he uses this hive because “for space reasons; if I want to have 1000 beehives, how much space do I need? The squared one would need a lot of space and are less stable. Then if I ask the carpenter for something else than the Apis beehive, he will not do it. The hive I designed is more or less half of the Apis beehive” (José: Interview 01.11.16).



Figure 13: Stingless bees beehive made by José for honey production (Source – author).

Furthermore it exist other type of stingless bees hives with a rectangular shape. Some other native stingless bees, such as the *Plebeia Moureana*, can also be kept in such “modern” hive for conservation purposes (see right picture of Figure 14).



Figure 14: Left picture - Colony of *Melipona Beecheii*, Right picture - Colony of *Plebeia Moureana* (Source – author).

3. Innovation in the Activity

Moreover, innovations regarding the honey harvest do exist. In the traditional methods in trunks, honey pots are removed and pressed but in modern hives, the honey is extracted using a syringe improving its quality. Fernandez, from Chetumal, invented another method functioning the same way as a pump. He told me “once I was harvesting and I noticed that it is difficult, you have to make sure to keep the point of the syringe in the honey pot. [...] I hence looked at how to make a pump out of a fridge motor. It is a compressor that put pressure to refrigerate so I reversed it to aspirate [...] and now with this I harvest honey” (Fernandez: Interview 17.10.16).

Significant innovations have been made to the hives. Similarly to *Apis mellifera* hives, it is also possible to equip these hives with a shallow box where the bees can raise their circular bee brood panels and put their honey pots. These extensions can easily be removed to either make divisions or to collect the honey without disturbing the bee colony (*see figure 7*).



Figure 15: Left picture – shallow box for honey pots, middle- shallow box for bee brood panels, right- modern stingless hives with extensions (Source – author).

To conclude, there have been large changes in the activity of meliponiculture. What is important to notice is this existing ‘conflict’ between the traditional and modern method of breeding stingless bees. While almost all the persons interviewed in this research have or want to breed stingless bees in modern hives for practical and productive reasons, it seems that alternative methods are also rising where some aspect of the traditional are retaken in the modern practice. In fact, stingless beehives are still kept in a meliponary,

just like in the traditional time. Furthermore, some of them are still decorated traditionally as we could have see in figure 4. The method and boxes used to raise stingless bees are constantly evolving. These changes are necessary to foster the conservation of native stingless bees and to improve the productivity of the activity. The use of other equipment such as a pump to harvest, but also the use of shallow boxes, is important, as it is a proof that meliponicultors are improving the activity. If we are referring to the SLA, these changes increase the physical capital of the activity. The increased modernity of meliponiculture will enable meliponicultors to sustain this activity and to improve their revenues.



Figure 16: Meliponary with modern stingless beehives (Source – author).



VI. Environmental Aspects of Meliponiculture

This part is dedicated to the environmental aspects of meliponiculture, more particularly on how this activity can foster the conservation of native stingless bees and the preservation of the environment. In this chapter we will elaborate on: [1] the importance that stingless bees have on biodiversity (in the appendixes 1, one can see a list of trees and plants pollinated by the *Melipona Beecheii* stingless bee), [2] the perturbation caused by humans and natural disasters, [3] the diseases and predators having an impact on the activity, [4] the impact of Africanized bee on stingless bees but [5] the role that meliponicultors can play in environmental conservation, [6] the last section will focus on protected areas and on how GIS can be used for conservation. These sections will provide the reader with a better understanding of what consists the natural capital and social capital of meliponiculture.

1. Stingless Bees Importance to Biodiversity

“The bees evolved for 90 million years. Survived many changes, whether they were proactive or violent and unforeseen, climatic, geological and astrological. It is wiser to understand that Einstein – conscious of a set of parameters much broader than the simple and linear approach to the fecundation of the plant kingdom, is telling us that if a deep and radical disorganization would suppress an important and solid link in evolution of life on the planet, it is to be supposed that humanity, much more fragile and more recent on Earth, would not last long in the face of such disorder (only 4 years based on him)” (Domerego 2013, 43-44).

The bees, and other insects, are very important to the environment and to us. In fact “beside the fact that they [stingless bees] produce honey, and that they are pretty, the

important is that they help to pollinate, to reproduce plants, the plants that produce food, fruits, seeds [...] if they are no bees, there is no pollination. [...] Everything that we eat comes from the plants that the bees pollinate” (Marco: Interview 13.10.2016). Moreover, they are amongst the longest evolved bees; “stingless bees have been found preserved inside pieces of amber 80 million years old” (Bradbear 2009, 51). In fact, stingless bees spread before the continents drifted apart from each other and they are present in all tropical parts of the world (Ibid.). We estimate the amount of stingless bees species to be between 400 and 500 and new species are identified every year (Ibid.).

According to Alessandro, owner of a beekeeping Eco-park, *“before that the Apis arrived, the native bees existed, like Meliponas, they were responsible to pollinate the entire ‘camp’ (agricultural lands), all the peninsula. [...] We have observed that there are plants that are only pollinated by native bees; that the other bees do not enter. Hence here you can see the major importance no. And if one specie go extinct, by consequences certain species of flowers and plants will disappear or be affected”* (Alessandro: Interview 06.11.2016).

Based on Shakira, this is due to the fact that: *“the bees are adapted to the flora of the place were they are located. For example, they are not the same that are here or that are in Veracruz and other parts there. [...] They are all different, they are not the same that are in Colombia or in Brazil; they are tropical. They help to pollinate all the plants that are from here”* (Shakira: Interview 04.11.2016).

If native bees were to disappear, the forest would change gradually its structure, the plants that depends from those insects for pollination will reduce their capacity to produce fruits and seeds and in a relatively short time many vegetal species will disappear (Kerr, 1998; Michener, 2000 in Albores, et al. 2015, 08).

2. Perturbation Caused By Human Activity & Natural Disasters

One of the biggest threats to the conservation of stingless bees is the deforestation of natural areas to a conversion to intensive modes of agriculture. For large period of times, the natural areas had substantive changes due to the exploitation and use of natural

resources. Illegal logging, the traffic of wild flora and fauna, and wild fires, has caused the advances of the agriculture frontier. Agriculture and urbanization are the principal human activities contributing to the dis-functioning of the existing process of interactions of the implicated ecosystems (Albores, et al. 2015, 07).

Based on Roberta, who owns a beekeeping enterprise in Mérida, she told me that, regarding the problems that the activity of meliponiculture faces today, “*first than anything else, I think that the deforestation. Because recently, they have been deforesting a lot of the jungle in the entire peninsula to do intensive production. [...] In the entire peninsula especially in Campeche, which is an important mellifera area, they are planting soya. Monsanto want to enter to plant its transgenic soya and deforest huge area of the jungle. This is a preoccupation for meliponicultors because there are insufficient plants to collect nectar. Not only the deforestation but the contamination that those plantations generates, they are sprayed with pesticides and herbicides*”(Roberta: Interview 08.11.2016).

This feeling is also expressed by Alessandro who told me that “*I believe that the monocultures that destroy the natural forests and jungle by a change to an intensive agriculture, affects and they use a lot agrochemicals in one way or another the bees are going to consume more the nectar of these flowers. They go with a chemical bath and obviously it is going to affect them*”(Alessandro: Interview 06.11.2016).

With the arrival of the European bees at the end of the past century in the Yucatan peninsula, and modern beekeeping (*apis mellifera*) was encouraged by governmental and private movements. Along with this dynamics begins the process of deforestation, originated by various natural resource management policies. At the end of the last century these policies propitiated the take off of monoculture of the henequen as well as an intensive forest and cattle activity (A. Carrillo Magana 2004, 19). This change of practices, moving from traditional modes of productions, such as of ‘Milpa’ plantation to industrial modes of productions had a severe impact on the beekeeping and meliponiculture activities. Based on José, meliponicultor in the Merida’s region, he told me that there used to be larger production of honey. Before the Africanized bee, they could collect honey from October to July, only in August and September there was no

honey production. The situation has dramatically changed because now “there are no milpas, because ancestrally, those dates (between October to December) there were harvest of corn and there was entries of pollen which resulted in many colonies and a lot of bees and now no. [...] The production has reduce by more or less 50 %”(José: Interview 01.11.16).

Furthermore, recently (in the last four decades) the urban development, the creation of infrastructure (roads, Laying of power lines, etc.) and more recently the development of tourist centers have led to a process of deforestation that constitutes one of the great enemies, both for beekeeping and for meliponiculture (A. Carrillo Magana 2004, 19). Some do see touristic development as an advantage as well for the conservation of the activity and a potential for an attractive and alternative type of tourism. This advantage will be developed in Chapter IX section 3.

Meliponiculture and the survival of (stingless) bees can also be affected by natural disasters such as hurricanes and fires. In fact climate changes has severe impacts on bees due to long periods of drought coupled with periods of high precipitation, often heightened by the high incidence of hurricanes in the Yucatan Peninsula. Hurricanes Gilberto (1988), Roxana (1995), Opal (1995), Mitch (1998), Isidoro (2002), Emily and Wilma (2005) and Dean (2007) greatly affected beekeeping and meliponiculture in the area, Up to 50% the number of both Africanized and Meliponas colonies (Echazarreta-González et al., 2004, Villanueva-Gutiérrez et al., 2005b in (Villanueva-Gutiérrez, et al. 2013)). José told me “in 2002, cyclone Isidoro felt here in Yucatan, and all the bees we had in Apis are gone. It has destroyed all the hives “PAH”, and then at that time I started with the Meliponas”(José: Interview 01.11.16). Fires are also a threat to stingless bees. In fact, “slash and burn agriculture is common in Quintana Roo, and stingless bees are susceptible to fire as their queens do not fly and cannot escape” (Kerr et al. 1999 in E. Cairns, et al. 2005, 686).

3. Stingless Bees Diseases and Predators

Until now, the stingless bees do not present, or very few, types of bacterial or viral diseases (A. Carrillo Magana 2004, 36). Yet, the stingless bees have some natural enemies and meliponicultors have to look after them to prevent possible invasions. These predators are principally insects, reptiles, batrachians, birds and mammals. This is one of the reasons why ancestrally, in order to avoid the damages caused by these predators, the Mayas kept their colonies in their home garden of the community. Today, colonies are kept in the home garden to not only protect them from their natural predators but also to reduce the risks of robbery.

There are two main insect predators and one mammal predator:

-A carnivore ant (*Ecitton burchelli parvispinum*) called in maya *Xulab* and the *Saakal* ant (un-determined specie) (A. Carrillo Magana 2004, 36) that generally attack in large group and can destroy the colony in no times,



Figure 17: A carnivore ant (*Ecitton burchelli parvispinum*) (source: Author)

-A small fly called vinegar fly or in Maya *X-neném* / *Nenem* (*Pseudohypocera kerteszi* Worth) (A. Carrillo Magana 2004, 36) that leaves its larva inside stingless bee colonies in pollen and honey pots,

-A mammal Mustelidae, called “Cabeza de Viejo” or in Maya *Sanjool* (*Eyra Barbara*) that particularly like bee brood and honey from stingless native bees (Gonzalez Acereto and Araujo Freitas 2005, 15).

Fortunately there are some ways to prevent their invasions. For the prevention of carnivore ants, the best method observed on the field is the creation of a circular hole filled with water at the base of the Meliponario (see Figure 18). It is also recommended by A. Carrillo Magana 2004, to use the physical medium consisting of sprinkling

around the apiary wood ash, or to apply on the ants soapy water with detergent powder but also to burn them directly with fire (A. Carrillo Magana 2004, 37). The meliponicultors are particularly scared by a possible infestation by the *X-neném* fly. The stingless bee colonies that have a large population and are well organized are not easy to attack. Generally, the bees being attacked would eliminate the flies that entered the hive and would destroy the potential eggs that these fly would have deposited in the colony. The colonies that are really vulnerable to the attack



Figure 18: Meliponary with water base to avoid invasion of carnivore ants (pointed by red arrow).

of this fly are the one having a low population, recent transfers of colonies (for example from log hives to modern hives) that are not yet properly installed, divisions that have not developed sufficiently or well attended and colonies that present residues of honey and pollen after harvest (Gonzalez Acereto and Araujo Freitas 2005, 42). *X-neném* fly is particularly attracted by the odor of pollen. It is very important to regularly control stingless bee colonies in order to avoid any infestation. Concerning the control of the fly Nenem, there are 2 methods that are both complimentary and that can be used simultaneously. The most traditional one consist of using the aromatherapy and natural control by using natural wild plants that are capable to mask the odor of the honey and pollen, especially after the harvest or colony divisions. The plants mostly used are: leaves of Chaká (*Bursera simaruba*), leaves of Nabanché (*Elaphrium Pubescens*), leaves of Ik'jaban (*Croton humillis*), and the leaves of Chaya (*Dnidoscolus chayamansa*). The following traditional method is used: one takes a branch of leaves from one of the previous plants and impregnates the interior of the log hive, or modern hive, being divided. The same applies to the extremities of the hive once closed. This method ensures a larger impregnation and would remove the odor of pollen and honey (A.

Carrillo Magana 2004, 37). A. Carrillo Magana 2004, argues that this traditional method is more cultural than really efficient. Nevertheless, I have seen meliponicultors using both the 'traditional' and the 'modern' method simultaneously. The second method that could be seen as more 'modern', and described in A. Carrillo Magana 2004, consist of using transparent plastic recipients of 4 cm by 4 cm with a hermetic cap from the same material. Then one has to fill $\frac{3}{4}$ of the recipient with apple vinegar. On the cap, many holes have to be made but not too large to ensure that only the Nene fly entire and not the stingless bees. Depending on the degree of infestation, few recipients can be used. The recipients will be placed inside the beehive and every two to three days, one has to remove the fly that ended in the vinegar. The process is renewed until no more flies are present. This method enable the stingless bees to clean with efficiency the areas infested with eggs and larvae of the Nene fly (Gonzalez Acereto and Araujo Freitas 2005, 42-43). I have also seen meliponicultors in rural areas placing glass jars with a holed tap around stingless bee colonies (see figure 19).



Figure 19: Glass jar filled with vinegar and trapped Nene flies (Source-Author).

4. Effects of Africanized Honeybees on Stingless Bees

Previously, in the historical part of this thesis, we have seen the arrival of the Africanized bees in Mexico and the effects that this species had on European bee population. According to some research by E. Cairns, et al. 2005, Africanized honeybees (*Apis mellifera scutellata*) also have an impact on stingless bees. They are "tough competitor for floral resources, capable of out-competing many native species of Neotropical stingless bees (subfamily Meliponinae) for desirable floral resources" (Roubik 1978 in E. Cairns, et al. 2005, 686). The aim of the research was to:

"Documents the stingless bees' (Meliponinae) recent displacement in the Yucatan (Quintana Roo, Mexico) and the effects of human-induced ecosystem disturbance on bee diversity. Point observations of flower-visiting bees were made along transects in three

communities with different degrees of human-induced ecosystem disturbance. The community with the greatest anthropogenic disturbance had lower overall species richness of stingless bees and the highest degree of dominance of the Africanized honeybee (Apis mellifera scutellata), while the area with the most intact ecosystem had the highest diversity of stingless bees, though A. mellifera was still the dominant species. We observed aggressive competitive behavior involving physical attacks by A. mellifera against stingless bees, indicating that Africanized honeybees are adopting new behaviors to compete better with dominant native pollinator species”(E. Cairns, et al. 2005, 686).

They noted eight aggressive behaviors from Africanized honeybees on stingless bees; “the physical contact involved a brief but forceful high-speed tackle by the aggressor AHB [Africanized Honeybee]. The attacked bee was displaced from the flower or water resource” (Ibid., 688). Furthermore, based on their findings, the researchers noted that stingless bee in environments pressured by human activities, and the presence of competitive new subspecies (such as the Africanized honeybee), may have changed the dynamics of interactions in native bee communities. It seems that native species facing difficulties in term of competition in disturbed environments are becoming extremely rare (such as the *Melipona Beecheii*). Other native species that are better adapted to disturbed environments (some *Trigona* spp.) are persisting and perhaps increasing (E. Ibid., 690). Moreover, one alarming fact in this research is that “Some stingless bee species, including *M. beecheii* and *Trigona buyssoni*, now have population numbers so low they were barely detected by our sampling, and four other stingless bee species known to be present in the region were absent in our samples” (Ibid.). Hence this research not only proves the conservation importance of native stingless bees but it also shows the impact that invasive species and human have on the natural biodiversity.

5. Individual Contributions to Conservation

“The natural environment can only be maintained in a healthy state through the interest and active involvement of local people. Beekeeping is a good way for people to earn an income without damaging the environment, at the same time honeybees and other pollinators play an important role in the conservation of plant resources by providing pollination services. These services also support diversification, which is

necessary for the process of evolution. Much of the time, conservation of wild flora is an 'unnoticed' activity that happens under the cover of bush, canopy, and the darkness of the forest; pollinators participate by supporting the gene flow, which is a vital process of life" (Ahmad , Joshi and Gurung 2007, 12).

In my fieldwork, I came across several actions that were undertaken by meliponicultors, or persons working with stingless bees. By following an incentive-based conservation approach, the protection of stingless bees could become an advantage for the creation of sustainable source of revenues; notably for persons with low employment opportunities.

In a rural community of Campeche, Dolores told me "to us, well I think that each of us can say that we know that when we install a tree, or that we are cutting a tree that gives his flowers, we are removing the aliments of the bees. Well me, for my part, I do not to cut trees, this tree give flowers, we are not going to cut it but we are going to plant more! Before, we were spraying the fields with fungicides and herbicides and now we make sure not to spray them because we know that we are affecting bees, it affects if we are spraying the plants that the bees aliments themselves from, and this is contamination, the bees die. Hence we are not doing this anymore" (Dolores: Interview 20.10.16).

Fernandez, meliponicultor in Chetumal region, has a very special idea that he wants to develop at the same time of keeping stingless bees. He wants to develop an agroecology plantation where one plant would help at other plants. He wants to plant coconut trees, fruit trees such as citrus, mangos, lychees, and avocados in 2 hectares. He told me that with those plants he also what to produce organic insecticides and fungicides. He told me that his project is 'innovation' and he looks at making it sustainable. He wants to put *Melipona* colonies for the persons of communities do not leave it. The pineapple, coconuts and papaya produce a lot of pollen. "For example, coconuts trees blooms and produce pollen and nectar all year long. If there is not sufficient pollen, the population of bees reduce"(Fernandez: Interview 17.10.16).

Furthermore, Shakira make sure to protect the bees that she owns by "protecting them from the sun and the rain; we put everything they need water, flowers and people who care and feed them" (Shakira: Interview 04.11.16). Furthermore she told me that she does not like when people tell her that they have to remove these bad grasses because

those plants produce a lot of flowers for the bees because some types of bees will visit those flowers (Shakira: Interview 04.11.16). I asked whether those ideas of ‘bad grasses’ are brought from other countries, but she told me that “no there are ideas from here, people from the cities do not want to have land in their garden also because they do not have time now with their work” (Shakira: Interview 04.11.16).

6. Protected Areas & The Potential of GIS for Conservation

Protected areas play a major role in the conservation of stingless bees. In fact, the majority of the plants that they pollinate is located in these areas and is essential to their survival. Yet, the “current targets to include 10% of the earth’s surface within protected areas are largely political, whereas species-area curves suggest that a 50% coverage is needed to conserve most global biodiversity” (Leader-Williams and Hutton 2003, 219). It looks rather difficult to achieve a “50% coverage of exclusive protected areas, at least not without imposing considerable state-led coercion, and disenfranchising rural people from traditional practices and losing their co-operation, as so often happens when such areas are established”(Ibid.). The best manner to foster the creation of protected areas and the conservation of stingless bees is by working with locals, notably through the incentive based conservation approach.

But this is not the only manner; technological innovation seems promising for the conservation of stingless bees. At a conference that I attended at the University Intercultural Maya of Quintana Roo, I had the chance to meet a Geospatial Engineer Antonio Iturbe Posadas. Antonio Iturbe Posadas presented the advantages that GIS can offer in term of innovation in beekeeping. For example, the GIS tool can be useful in determining the soil changes, the level of pollution, to create updated maps of reserve, land and type of plants present but also find GMO plantations. Moreover this tool can also be used to measure the flight distance of bees to find suitable location for good production or the installation of meliponary and apiaries. Based on Antonio Iturbe Posadas, and on what we have discussed on section 2 of this chapter, the Yucatan peninsula is subject to hurricanes. With this tool we can evaluate the impact that hurricanes could have on bees. It is also interesting to analyze the development of cities, such as for example Playa del Carmen, and erect scenarios on how the city will expand.

This would enable meliponicultors to find suitable places to set their meliponarios. Beside the advantages that this technology present, it is important to make sure that the information published is kept safe and not divulgated to bad hands as it could be wrongly used. The limitation of this technology is that it is expensive and hence small or poor producers cannot access this technology. It is a tool that can be used by the Mexican Government to monitor its protected areas and foster the economic development of rural zones of Mexico and help the implementation of the meliponiculture activity.



VII. The Social Aspect of Meliponiculture

1. Who Are The Meliponicultors Today?

I had the opportunity to meet various meliponicultors during my stay in Mexico and I was amazed to discover who they were. This section will draw the portrait of persons that I found particularly interesting, remarkably by their knowledge or story.

When I went to visit the rural communities around Coba, I had the chance to meet Miguel who is in his 50s. He is a meliponicultor and head of an 8 persons family. This is probably one of the poorest families that I met on my 'jungle exploration'. They do not have a great house; the kitchen is outside and



Figure 20: Miguel with stingless bee hives (Source: Author)

consists of a fire pit protected by a leaf roof. They eat essentially what they produce, consisting mainly of tortillas, chili and beans. He owns 30 stingless beehives (5 in trunks) that he doubled in 2 years time. He also owns 20 beehive of *Apis Mellifera* for honey production. They say that the most important is to live in harmony with nature and that it is not just about professional experience. For example, his entire family always had bees and that is how they got the experience. His son, who is in his 30s, is interested in the activity of meliponicultor and wants to pursue it. One of the daughters is making dresses with her mum but she miss an access to the market to sell them. The

cooperative that the foundation supporting them is putting in place will help them, particularly by offering the opportunity to sell their products. She has a bachelor and the family thinks that she could manage the future business. Even if they are poor, they seem to be very happy (Author: Field Notes 07.10.16).

In Playa del Carmen I came across Leonardo. Leonardo, who is 31 year old, is a meliponicultor but also work part time in maintenance work. His grandfather offered him his colonies. His grandfather was 'chiclero', a person who extracts the gum of Sapote trees for the production of rubber and he



Figure 21: Leonardo, his baby and stingless bee hives (Source: Author)

often came across stingless wild nests. He told his grandchild to follow ceremonies and make offerings. Leonardo is particularly interested in the conservation of stingless bees and has over 50 colonies of 8 different species. He keeps part of his productive colonies in a ranch where there are sufficient flowers. His aim is to dedicate himself only to meliponiculture but the problem is that he has a family and there is currently no markets resulting in unsecure entry of money (Leonardo: Interview 01.10.16).



Figure 22: Carlos with open stingless beehive (Source: Author)

One day I followed Carlos, an agro-ecologist and meliponicultor who is 26 years old, in what they call 'el campo'. El campo is the rural area where they keep their bees or do their agriculture. We crossed a field buzzing of bees because of the high wild flower blooming. I remember it as if it was yesterday because the air was very humid and hot. He owns 72 colonies of stingless bees (60 Meliponas and 12 Trigonas) and 150 colonies of Apis Mellifera. He showed me his field of Milpa,

where he produces corn and other vegetables such as beans and zucchinis, and one of his *Apis Mellifera* apiaries. One of the bees came to pursue me, even from a 50-meter distance showing the Africanized traits that these bees have. After this visit we return to his house where he keeps his stingless bees. After checking few hives, we find some that have an invasion of larvae from the Nene fly. We hence cleaned the affected areas and removed the parasites. We have to be careful because such invasion can destroy an entire colony. After discussing with few of his farmer friends, I heard that twice they have been removed of the land that they were exploiting. The arguments were that beehives do not constitutes an exploitation of the land in an agriculture form and is a ‘loss of land’ for agriculture purposes that is why they have to be precautious and even plant some fruits or vegetables (Author: Field Notes 09.11.16).

During my fieldwork, I also came across few women meliponicultors. In the natural reserve of Calakmul, I met Dolores, in her 40s who, with 7 other colleagues, work with stingless bees. They own a total of 43 colonies of 2 different species (*Melipona Beecheii* and *Melipona Yucatanica*). Dolores



Figure 23: Dolores and a colleague controlling a hive. (Source: Author)

told me “we are housewives. Most of the members do not have studies or profession to do a job in the city. But this being seen as already, a part of which we can also employ us. Also apart of the fact that we have our family, we can work here in this Meliponary. That is our source of employment to help our family.”(Dolores: Interview 20.10.16). Even though it is recent, their cooperative seems to work well. They produce mainly honey but also soaps, creams and insect repellent. They hope that this activity will continue to progress and become a full time job. They also want to increase the number of colonies that they own so they can produce more. Nevertheless the current situation is difficult; even if Dolores told me that they see potential in the future, She told me

that they are waiting for tourists to come visit them to create sustainable revenues (Dolores: Interview 20.10.16).

2. Vision of the Links Between Humans & Nature

Something struck me when I was conducting my fieldwork; I kept on hearing people say that it is important to “*live in harmony*” with nature. After reflections, it became evident that those people built intimate links with bees and nature. It is like the humans protect the elements of nature, such as curing stingless bees, and in return nature, or stingless bees in this case, will ensure plant pollination and the production of food in order to survive. In this conception humans are not superior of nature but are an element of nature. In fact, “humans, and nature have always been and continue to be entangled in varied and complex ways” (Turnhout, et al. 2012, 158). Actually, “researchers are beginning to document the many, even myriad, kinds of different relationships that have been crafted over millennia between humans, nonhumans, and things which involve many other qualities besides that of counting or commodification” (Ibid.). The following example is a great representation of this phenomenon.

In the northern mountain of Cameroun, the Mofu, grain producers, “*consumers of millet, a cereal to which they devoted themselves to a genuine cult, had understood the importance of certain insects for the valorization of their harvest as the danger that some others represented for this same harvest. As a result, they had gathered a great deal of knowledge about insects, both beneficial and malignant, and were able to deal with appropriate practices with both, in a close relationship or even intimacy. Authors point out that this knowledge is gradually being lost, insofar as the Mofu abandon more or less the culture of millet and leave the mountains to go to work in the cities*” (Gaulin-Schellenberg 1996, 05)²⁴.

Another famous ethnographic research by Paige West “*Conservation Is Our Government Now*”, regarding “the history of an integrated conservation and development project in the Crater Mountain region of Papua New Guinea. [...] She describes the varied ways in which culture and environment are constructed by the Gimi people of Maimafu

²⁴ For other examples please have a look at the article (in French) presenting other human-nature relations.

village, and by the western conservationists who initiated the Crater Mountain project during the early 1980.” (West 2006, 107). This project had the aim of protecting the biological diversity of the area by creating revenues from the project outcomes. These new revenues created some forms of conflict with other villagers. This conflict, “also led, West argues, to the erosion of the values attached to eagles within Gimi society, including the relations of reciprocity that structure human/eagle interactions” (West 2006, 107).

It is hence interesting that similar trends can be found in northern Cameroun, Papua New Guinea and in the Yucatan peninsula of Mexico. More noticeable is that the strong links that those populations kept with elements of nature are slowly being broken. People tend to abandon their culture to go live and work in cities. What contributed to break those existing links are probably “fundamental assumptions concerning the “modern” separation between humans and nature and the ideals of comprehensive knowledge, control and commodification” (Turnhout, et al. 2012, 158). Modernity and “development” have to be thought differently. Careful evaluations of traditional knowledge have to be taken into account in the creation of (rural) development programs. In fact, as the example in northern Cameroun above and this research of stingless bees in Mexico shows, “people in a variety of places shape their relations with nonhuman biodiversity in multiple ways and practices that go far beyond counting, controlling of commodification” (Ibid.). Such programs have to understand the “underlying motivations and satisfactions that make people feel that what they are doing is worth something” (Ibid.). If such knowledge is taken into account, “conservation could help meet the true interests of poor people, and particularly the rural poor, who were themselves often victims of inappropriate development” (W. Adams 2009, 275). Paige West research in Papua New Guinea “also leads to the conclusion that western conservationists and scientists need to become more sensitive to the fact that their conservation ideologies are culturally constructed and embedded in western worldviews that can be destructive of both cultural and biological diversity in rainforest settings” (West 2006, 107).

The attachments that meliponicultors keep with stingless bees and their environment are quite notable. Based on research by Landa, “some observed tended apiaries, drawing

honey and wax from the hives in ways that preserved the bee colonies and established a symbiotic relationship. The bees and their honey were considered sacred and valuable. Another important historical source is Diaz and Oviedo descriptions of few visits to this island” (A. Carrillo Magana 2004, 42). The next sections of this chapter will look at ancestral beliefs regarding stingless bees and their evolutions. Ancestral medicine will also be explored.

3. Historical Beliefs

“In the myths regarding the creation of the Yucatan Maya, the first inhabitants were the Zayawinicob, these humans were very industrious and they had the same eyes as the one of the bees, then the gods transformed them into bees in order for them to escape their castle” (Thompson 1975 in A. Carrillo Magana 2004, 15).

Stingless bees are associated with many ancestral beliefs and myths. For example, the “Bacabes’, the gods that sustained the world, were also the bee gods, Hobnil, was the principal of them, god of the bee colonies and director of the beekeepers (meliponicultors)” (Thompson 1975; Vredeling, 1996 in A. Carrillo Magana 2004, 15. In the etymology of Xunan Kab in Maya language corresponding to of Melipona Beecheii from “Xuna’an”: the woman and *kab* (*kaab, cab, chab*) or *colel-kab, kolel’kab* ou *po`ol-kab*. Depending on the context, *cab* is the bee, honey, the nest, but as well the earth and field. *Caban, kab’an* is also corresponding to the world of the underground, of the deaths, of the obscurity. Cabinal, the feminine god of the earth and the fertility is also the beehive protector because the bee is born or comes for the earth and has to go back to it after its death. It is for this reason that for the Mayas, the bees create fertility and that all dead bees must be with the dead in order for them to recreate life based on dead elements. It is for this reason that the meliponicultors hide dead bee corpses under rocks²⁵. The Madrid Codex (see chapter IV.2), also shows the evident importance of the signification if the Melipona bee with the Maya civilization. The last pages of this manuscript are dedicated to the activity of meliponiculture. In this Madrid

²⁵“Apiculture Traditionnelle et Patrimoine - Amerique Precolombienne”, <http://www.encyclopedie-universelle.net/abeille1/abeille-histoire-hommes-civilisations-apiculture-traditionnelle-amerique-precolombienne3.html>, Accessed on 2017-08-26

Codex we can see the beekeeping god 'Ah-Muzen-Cab', he was before all the god of life. He was protecting his stingless bees that were producing the sacred substance for offers and rituals (Domerego 2013, 34). This god was associated with the fecundity, and the creation of it, with the Sacred Divinity of the feminine. The Meliponas Beecheii and him constituted together, one and same unit (Ibid., 37). It is also believed that the nest of the Melipona Beecheii stingless bees was the inspiration for the Mayas pyramids (Ibid., 70).

Moreover, it is believed that the Mayas organized their civilization based on the four cardinal points (called becab) based on the Mayan Codex and designated a specific activity for the work of the stingless bees. The city of Ek Balam represents the northern becab where the bees look for resin (propolis). The city of Tulum, eastern becab where the bees look for honey. The city of Coba represents the southern becab where the bees look for pollen. Finally Mayapan represent the western becab indicating the origin of the colonies (Manuel Torres Zapien 2014, 02). At the entrance of every log hives a cross (+) was carved in the wood. Based on Marco, "we place a cross that represent the four cardinal points. This one represents the Melipona Cross" (Marco: Interview 13.10.16). Today, the activity of meliponiculture remains almost unchanged compared to the meliponiculture that was practiced ancestrally by the Maya Civilization. A research by Villanueva, and the archeological evidence found on island of Cozumel (see chapter IV.1), shows "the continuity of a practice that has endured for pressures working against it" (Imre, Young and Marcus 2013, 43). Nevertheless has we saw in Chapter V, the activity is seeing some drastic modernization and the breeding in log hives start to be less favored.

4. Meliponiculture Ceremonies

"The bees and their colonies were considered as something sacred in which the producer [meliponicultor] had to unconditionally put himself to their service, taking care of his beehives, making offers after harvesting them and to the adequate expression of the flowering. He [meliponicultor] was the servitor in all his form of the word meaning that the owners of these insects were directly the gods. The bees represented a way through which, the indigenous producer would connect with the divinity and an important element

to interpret his magical conception of the reality" (Gonzalez Acereto and Araujo Freitas 2005, 05).

The Mayas celebrated only two festivities, dedicated notably to ask for a good flowering and an abundant honey harvest (A. Carrillo Magana 2004, 15). It is believed that "incense was burned and pictures were painted on the incense boards, using honey as paint" (Imre, Young and Marcus 2013, 43). Stingless bee honey was used to create a type of wine, "brewed with the bark of the balché tree; heavy drinking of this beverage concluded the ceremony" (Ibid.). Based on the ethnographer Robert Redfield, this ceremony called the U Hanli Cab (*hanli*: festive meal; *cab*, here the bee: the meal of the bee) is dedicated to the bee gods. To celebrate this ritual, two times a year, an altar was prepared and a priest conducted the ceremony. The *Men* (Hmen, Ah Men: "the one that do, execute"), who sing, light candles, drink a ritual beverage (balché wine) called *sakah* (*saká*, *zacá*) do offers to the gods asking the permission to harvest honey. During this ceremony the following text is read:

" Sea saludado tres veces Nohyumcab cuando mis palabras lleguen a él, en su templo derruido, en su roto banquillo ; sean saludados tres veces los Mulzencaboob cuando mis palabras lleguen a ellos ; sean tres veces saludados los Balames cuando mis palabras lleguen a ellos ; el dios Bolonhobon, el tigre Hakmadz, sean saludados tres veces cuando mis palabras lleguen a ellos ; el Gran Señor Balam, en las cuatros esquinas del cielo, sean saludados tres veces allá en Cobá ; el Gran Chac, el Gran Baïam sean saludados tres veces en la Cámara de Audiencia de Chichén". (" Chan Kom, a Maya Village". Dr. R. Redfield, Carnegie Inst, Washington cited in Calero 1977, 13).



Figure 24: "Los Borrachos" Vase, 19 x 16 x 50,5 cm Source: <http://www.encyclopedie-universelle.net/abeille1/abeille-histoire-hommes-civilisations-apiculture-traditionnelle-amerique-precolombienne3.html>

Following the ceremony, the participants have to drink in order to establish a peace pact and harmony pact with the beekeeping gods. It exist an illustration representing this ceremony called "*The Drunk People*" (*Los Borrachos*)²⁶ (see figure 24). Moreover, meliponicultors had to prepare "during the month of Zotz for the feasting ritual held the following month, Tzec" (Imre, Young and Marcus 2013, 43). The activity of meliponiculture is also based on the solar system. When I visited the rural communities around Coba, Pietro, the person in charge of assuring the good management of stingless bees colonies told me that we have to do division in full moon. Based on him, in the crescent moon the bee brood is going to grow in width or in height.

When interrogating meliponicultors regarding the meliponiculture ceremonies, the opinions were divided. Only a few kept this tradition alive (see table 2).

#	Gender	Age	Participant city	Participation to Beekeeping Ceremonies	Importance to Participant
1	Male	29	Valladolid	Yes, During the harvest period, in May we do it	It is a way to thanks for the fruits of the earth; in this way we can receive greater harvests.
2	Male	55	Chetumal	Occasionally (When they invite me)	Yes, because it preserve the culture and the ceremonies.
3	Male	26	Mama	Yes	Yes
4	Male	27	Santa Gertrudio	No	Yes, it is part of the tradition and Mayas culture.
5	Male	57	Merida	No	None
6	Male	31	Playa Del Carmen	Yes	His grandfather told him to do offering to the gods.
9	Female	24	Valladolid	No	None
10	Female	-	Calakmul	No	None
11	Female	30	Mani	Yes	Yes
12	Female	58	Mani	Yes	Yes
13	Female	53	Mani	Yes	Yes

Table 2: Participation to beekeeping ceremonies and their importance to meliponiculture. (Result based on meliponicultor questionnaire)

Out of the 11 respondents to my questionnaire, 7 participate to beekeeping ceremonies; one occasionally, 1 did not participate but saw the value in those ceremonies and 3 did

²⁶ *Idem*

not attend ceremonies nor found them important. Based on Roberta, she told me “there are persons that keep practicing ceremonies in many small villages, they do the Milpa, shamanism” (Roberta: Interview 08.11.2016). She thinks that it is important to keep practicing them because “it is a way to connect with the nature and it is a way to pay respect to the nature that gives you something that you would benefit” (Roberta: Interview 08.11.2016). When I visited the rural communities of Coba, I met an interesting meliponicultor, Ushaka, who felt spiritually connected to the gods. He is one of the *Men* (priest) executing beekeeping ceremonies. I joined him on a ceremony praying the gods for having the opportunity to receive me in his particular home. After his small ceremony, he told me that:

“I want to share our (Maya) habits, our consciences, that is what the nature wants. Hence for me, it is very pleasant that you are here, that I receive you, from thousands ways, you are here you are my small brother. He followed by telling me that: “For me, I have the capacity to explain, to teach to the children what I know, to share our culture in order for them to have a future for everyone of us, and for this it is the base here (pointing the nature around us), this is the idea that my brothers can have” (Ushaka: Interview 08.10.16).

Similar feelings were shared with Alessandro who told me that yes it is important for him and “in general all [his] family has this idea that you have to be thankful for everything that you receive. The best way to thanks is by giving back. There are more benedictions” (Alessandro: Interview 06.11.16). Nevertheless, I met meliponicultors that value the ancestral beliefs and history from the Maya Civilization but that stopped to practice its ceremonies for various reasons. For example, Dolores from the Xpujil community told me that:

“Yes we have been invited [to ceremonies], and I think that some have seen how they do it and everything but for us we think that yes, it is creation of god and that it is wonderful to have them, and that we know how to work with them but not exactly we can believe that these Maya gods are like a ritual or a legend but we believe that there are not only created by only gods. We are not doing it like the Mayas do it normally

because I do not think that it is only a god that created everything” (Dolores: Interview 20.10.2016).

I also met meliponicultors that did not believe in those ceremonies. When I asked José if he was following any of the beekeeping ceremonies he told me that for him “ no, no, there were traditions. There are persons that say the energy and I don’t know what, that the moon or whatever. From my point of view it is technical and nothing else” (José: Interview 20.10.2016). Furthermore for him those ceremonies are kept alive more for touristic attractions; the Mayas did not dress like that or did not do those things. Because for him and where he comes from, the ceremonies are done differently from what is done in Quintana Roo and he sees the difference (José: Interview 20.10.2016). Similar feelings were shared with Leonardo that keeps practicing ceremonies but who do notice that there are slowly being used as a touristic attraction (Leonardo: Interview 01.10.2016).

What we can see in those different points of views is that the beliefs and practices of beekeeping ceremonies are being slowly challenged and are evolving. What we also see is that practices enable cultures to evolve but not necessarily to be forgotten. Keeping practicing ceremonies, having strong links with nature, in relation with the activity of meliponiculture can be kept alive. To support this argument, Roberta told me “the use of log hives we can say that it was before, the traditional and we have to admit that there are other ways, more practical that we can change but we can keep other elements such as the ceremonies” (Roberta: Interview 08.11.16). This section 4, show the importance of history in developing traditional knowledge. This knowledge can be converted as human capital and can help towards the creation of sustainable livelihoods.

5. Ancestral Medicine

One important aspect regarding the products of meliponiculture is that they are believed to possess curative properties. In almost all rituals, and in the creation of the Mayas, we encounter the same qualities such as the good feeling, the protection and the spirituality, related to medicinal preparation. The apitherapy, which consist of using as medicines the products for the beehive, persisted in the ancestral medicine since the first

civilization of the earth (Domerego 2013, 40). It was believed in other civilizations that honey cleaned the body and the spirit of persons, that were gods themselves, and through this divine elixir, people would access this same cure (Ibid., 37). These sacred curative virtues showed the strong spiritual link with stingless bees (Domerego 2013, 40). When asked about the use of stingless bees products as medicine, all my participants agreed that they do use them. I also asked them about the curative properties of the products that they used. Generally their knowledge about apitherapy medicine was quite exhaustive and it showed the value that they bring to the stingless bee products (*see table 3*).

Gender	Age	Participant city	Use Stingless bees products as Medicine	Curative properties of these stingless bees products
Male	29	Valladolid	Yes	For eye infections, cataract, cough, corpulence, conjunctivitis, skin infections; for all of this Melipona honey is used.
Male	55	Chetumal	Yes	The view, cicatrize, stretch marks
Male	26	Mama	Yes	To cure cuts, for the eyes and alimentary supplement.
Male	27	Santa Gertrudio	Yes	Cough, throat pain, eyes cataracts, etc.
Male	57	Merida	Yes	Antibacterial (throat, intestine, foot, skin, eyes etc.)
Male	31	Playa Del Carmen	Yes	Honey of Melipona Beecheii for the eyes and honey from Trigonas for the throat
Female	24	Valladolid	Yes	Eye infections, dermatologically, problems with the respiratory ways
Female	-	Calakmul	Yes	Cough, disinfection, cicatrize, cataract and eyes infections, Folic Acid, gastric ulcer
Female	30	Mani	Yes	Honey: headache, vomiting, cicatrize and antibiotic; pollen: seasick, tiredness and prostate cancer
Female	58	Mani	Yes	They have many medicinal properties it is good for the health. Propolis of jarabe is good for the cough and respiratory ways
Female	53	Mani	Yes	Respiratory ways

Table 3: Use of Stingless bee products as medicine and their curative properties, based on Meliponicultor questionnaire

Based on an undergraduate research by Genevieve Dezso, “*Maya people have a long history of treating themselves with the plants that surround them. Traditional Maya medicine is relied upon in areas where it is well-known and available, and where resources for western medicine are lacking. The money and time required to travel away from home, visit a doctor, and purchase pharmaceuticals, often renders it simply not an option*” (Dezso 2014, 19).

When I visited people living in rural communities around Coba, I could see the precarious conditions in which they were living. I remember that one of the women had

the dengue. Figure 25 represents one of the best types of housing consisting of 2 rooms with a TV and a water tank outside. I noticed a child drinking directly for the tap of the tank that was on the ground. Lack of clean facilities can increase their risks to sickness and diseases.



Figure 25: A modern house found in Rural Mexico (Source: Author)

Furthermore, it cost a lot of money to have a doctor deliver a child (around 7000 pesos / ~583 US\$). Therefore many pregnant women in rural areas opt for a cheaper local option. In an interview by Dezso, she noted, “7,000 pesos is a lot. So sometimes at home a senora does a favor for you, for around 500 or 600 pesos (\$40-\$50 US). So, it is a fortune” (Dezso 2014, 20). Honey from stingless bees is particularly important during pregnancies and is used to help the delivery of the baby. Based on Dezso, “the honey has been used to stop miscarriages, to alleviate cravings, to deliver the baby, and to promote lactation” (Ibid., 16). Moreover, Ushaka told me “if the child is not well oriented to be born, it takes it. It is a medicine but sacred. Very sacred, one time that the child took it, he will turn and look for the way. [...] She [the pregnant woman] takes the juice of honey. Then the child put himself well” (Ushaka: Interview 08.10.16).

Stingless honey possesses many curative properties (see the list in Appendix 2). Based on Marco, “this honey is principally used for its medicinal properties and people pays it as medicine not to be consumed directly!” (Marco: Interview 13.10.16). Its other main use is for eyes issues and diseases. Based on Ushaka, “ It gives you the view. Every spoon that you eat before, it gives you the view” (Ushaka: Interview 08.10.16). Based on Roberta, “the people associate many medicinal properties to the honey of the Melipona. For example they use it a lot for the eyes. That is why we put it in drops. Because people comes and buys it for curing the conjunctivitis for cataracts or for eyes infections”(Roberta: Interview 08.11.16). She goes on mentioning “it is a good source of revenues for ‘camp’ (rural) people. They can sell it at a good price, much more higher than the *Apis Mellifera*. Look those small bottles we have it for 270 pesos when a kg of honey we sell it 75 pesos. Yes it is much more expensive and it is appreciated” (Roberta: Interview 08.11.16).

In this section VII focusing on the social aspect of meliponiculture, portraits of meliponicultors have been presented. It is possible to notice that relationships between meliponicultors and stingless bees are slowly decreasing. This is seen by the frequency of attendance to meliponiculture ceremonies. Meliponicultors start to move away from those practices. It could be interpreted by the fact that globalization encourages meliponicultors to move from a product that is considered as a medicine to a product that can be considered as an exportable commercial good. Nevertheless, as Roberta mentioned, rural people, through meliponiculture, can achieve to create extremely valuable and unique products. These products have medicinal properties and their prices represent an important asset. This chapter demonstrated the cultural importance of meliponiculture to the Maya descendants and the social angle that contribute to construct sustainable livelihoods. The next chapter will be entirely dedicated to the economic advantages of the Meliponiculture activity.



VIII. Economic Aspects of Meliponiculture

“Beekeeping can contribute to securing sustainable livelihoods by transforming vulnerabilities into security, an idea incorporated in ICIMOD’s Strategic Plan 2003–2007. It can be carried out by small farmers, and is particularly suitable for under-privileged, landless, and low-income groups as well as women as it requires minimal start up investment and generally yields profits within the first year of operation” (Ahmad , Joshi and Gurung 2007, 07-08).

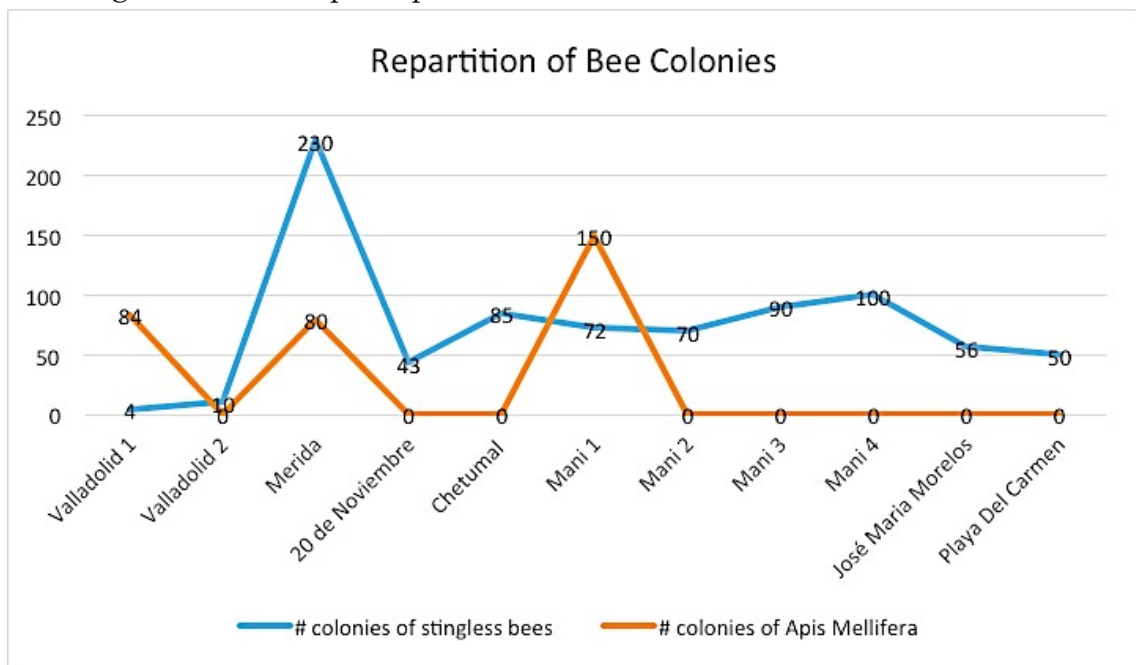
One of the arguments putted forward in the theory of ‘incentive-based conservation’ is that in order to encourage the conservation of endangered species by locals, they have to receive some forms of benefits from this conservation. The stingless bees, and more particularly the one producing honey, can present economic benefits. This section will focus on what are the economic benefits that can be derived from meliponiculture, whether they are in forms of services, marketed products, or even funds.

1. Differences between the Activities of Meliponiculture and Apiculture

Since 1760, when the Spaniards introduced the black European bee (*Apis Mellifera Mellifera*) in Mexico, as we saw in section IV.4, the transition from the use of stingless bees to the European bees had large repercussions on the population of the native Mexican stingless bees. Just to give a representation, it is estimated that there are today around 500 meliponicultors in Mexico representing a total of 8000 stingless hives or log hives (A. Carrillo Magana 2004, 19) compared to 16000 beekeepers in the Yucatan Peninsula alone (J. Güemes Ricalde , et al. 2003, 119). Other source mentions that in 2001, “in Yucatan it is calculated that less than 500 stingless bee beekeepers remain with

an average of 10 colonies each” (Javier G Quezada-Euan , De Jesus May-Itza and A Gonzalez-Acereto 2001, 163). In fact, the Yucatan peninsula is an important productive honey region. 95 percent of the honey produced in the region, is exclusively exported to the international market, especially to Europe and the United States. In 2003, the Yucatán region accounted for 31.7% (22 000 tones) of the total volume of honey produced in México (J. Güemes Ricalde , et al. 2003, 120). Based on Fernandez, the annual production of stingless bees honey in Quintana Roo is of approximately 1500 kg (Fernandez: Interview 17.10.16). The difference between the two activities (apiculture and meliponiculture) is quite important. Nevertheless, some of the meliponicultors that I had the chance to meet opt for keeping both types of bees. The situations are quite mixed as some meliponicultors always had both or recently (re-) used stingless bees.

In the questionnaire filled by meliponicultors, several questions were referring to the economic benefits deriving from the activity of apiculture and meliponiculture. The graph below (*graph 1*) is a representation of the number of stingless bee colonies and Apis Mellifera colonies that each meliponicultors possessed. The cities correspond to the living location of the participants and not the colonies’ location.

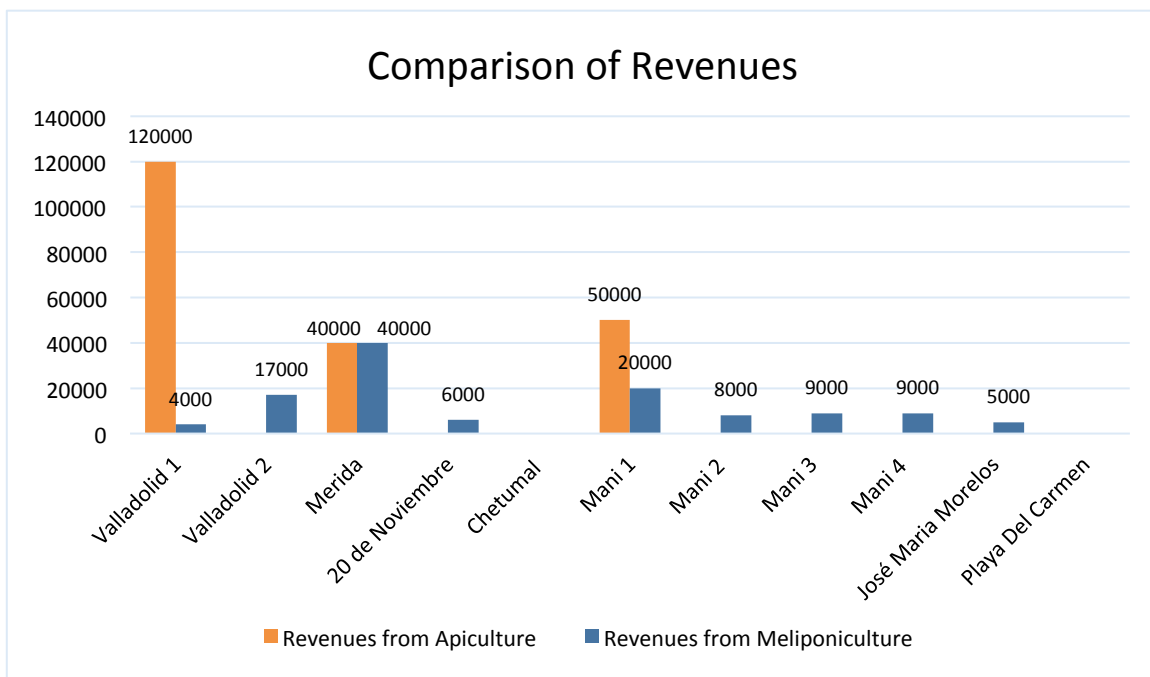


Graph 1: Number of Stingless and European bee colonies based on meliponicultor questionnaire

In this graph 1 we can see that out of the 11 meliponicultors, 3 had both stingless bee colonies and Apis Mellifera colonies and 8 only had only stingless bee colonies. What is also interesting to notice is that all participants combined comprise a total of 314 Apis

Mellifera colonies and 810 stingless bee colonies. Those 810 colonies represent approximately 1/10 of all domesticated stingless bee in Mexico. It seems that the average number of stingless bee colonies that meliponicultors own is on average between 40 and 100 colonies. There are two extremes; the meliponicultor in Merida had 230 colonies and one in Valladolid only had 4. Those numbers are explained by the fact that the meliponicultor in Merida started to keep stingless bees since 2002, after that the Isodoro Cyclone destroyed all his *Apis Mellifera* colonies (José: Interview 01.11.16) hence he has been dividing his colonies for more than 15 years. The meliponicultor in Valladolid 1, owner of a beekeeping park, only had 4 colonies because he recently opened his business. He told me that “we opened the last Sunday of March of this year and the project has a little bit more than 6 months” (Alessandro: Interview 06.11.16) but wish to increase this number.

The next graph, graph 2, compares the revenues resulting from both activities of meliponiculture and apiculture.



Graph 2: Comparison of Revenues between Apiculture and Meliponiculture

Some participants did not receive any benefits from any or one of the two activities because their reasons to keep stingless bees are more for a personal consumption or by pure interest in the bees and conservation (‘Playa del Carmen’ and ‘Chetumal’). What is important to see and to compare is the revenue derived from both apiculture and meliponiculture to the amount of bee colonies that both participant had. *Apis Mellifera*

honey in the Yucatan region has increased in price during the years of 2002, 2003 and 2004, reaching the price of 27 pesos/kilogram (J. Güemes Ricalde , et al. 2003, 122). This price keeps on evolving; in 2016 Roberta told me that she sells 1 kg of *Apis Mellifera* honey for 75 pesos (Roberta: Interview 08.10.16). The price of stingless bee honey is not fixed; based on an ECOSUR Researcher, “5 years ago the price was of 200 to 300 pesos the liter now is it of 2000 to 3000 pesos. It was multiplied by 10 in 5 years” (ECOSUR Researcher: Interview 15.11.16). Furthermore, based on all the interviews collected, the price of the kilo of Melipona honey varied from 600 to 3000-pesos per kilo. However it seems that the current price is of more or less of 2000 pesos per kilo. Shakira told me “the [stingless] bees produces, when they are modern hives, 3 liters per season (there are 2 seasons) 6 liters per year and when they are traditional, in log hives, they produce 1 liter per season so there are 2 liters or a bit less per year” (Shakira: Interview 04.11.16). The Foundation Director, focusing on the conservation of stingless bees and their reintroduction in rural communities, told me “if we let them produce and that we don’t divide them, they produce at best 3 kg of honey per year” (Foundation Director: Interview 05.10.16). The differences between the 2 mode of breeding either in modern hive or in log hive, has an impact on the amount produced. Even though it is unclear how much honey stingless bees can produce, the revenues that they could generate is high.

Based on the graph 2, we can conclude that if a liter/kg of Melipona honey is sold around 2000 pesos, the 118 000 pesos resulting from the activity of meliponiculture correspond to more or less 60 liters of Melipona honey. This makes an average of 5.45 liters or kilos per meliponicultor. If we conclude that the liter/kg of *Apis Mellifera* is of 75 pesos, the total amount of 210 000 pesos corresponds to 2 800 liters/kg of *Apis Mellifera* honey. We need approximately 27 liters of *Apis Mellifera* honey to receive the same revenue from a liter of Melipona honey. It seems that the full potential of honey production is not fully exploited. This can be explained by the fact that:

“In the Yucatan peninsula, the model of rural beekeeping has kept going on for years as a source of auto employment that generated money for the entire rural family and kept living in the camp (Godoy Montañez, 1999). Sands (1984) explains that beekeeping from this region correspond to a different logic that the one of market economy, that it is

an activity not practiced for obtaining large economic benefits. [...] Beekeeping is a complementary activity with other source of subsistence, like agriculture, animals forestry” (J. Güemes Ricalde , et al. 2003, 121-122).

The economic advantages that could derive from it are extremely high. With a better valorization of Melipona products and services it could easily overpass the benefits deriving from apiculture and the turn the activity into a sustainable one.

2. Types of Products Derived from Meliponiculture

“Bee products such as propolis, royal jelly, beeswax, and bee venom are also high-value low-volume green products. In addition to the direct income from bee products, beekeeping generates off-farm employment opportunities in many fields including hive carpentry, honey trading, renting and hiring of bee colonies for pollination, and bee-based micro-enterprises” (Ahmad , Joshi and Gurung 2007, 14).

Considering the fact that meliponiculture is slowly being launched towards an economic vision, and remains at a low development stage, the full potential of the activity are under exploited. In the table below (table 3), based on the meliponicultor interviews, one can see the various products deriving directly or indirectly for the activity of meliponiculture and their respective prices.

Products Deriving from Meliponiculture	Price of Products in Mexican Pesos
Apis Mellifera Honey	Between 45 to 60 Mex\$ the kg
Melipona Honey	Between 500 to 2000 Mex\$ the liter
Honeycomb	200-300 Mex\$
Propolis	1500 Mex\$ per kg
Pollen	Sold between 120 to 400 Mex\$ the liter
Soap	35 Mex\$
Creams	Sold between 35 Mex\$ to 40 Mex\$
Mask	55 Mex\$
Repellent	30 Mex\$
Bee Colony	Between 1500 to 3000\$ depending on the bee population

Table 4: Products deriving from Meliponiculture and their respective prices (in Mexican pesos). Source: Meliponicultor Questionnaires

The main product deriving from the stingless bees is without question the honey. “Honey is the product issued from the transformation of nectar from plants, after being operculated and transported to the colony in the mellifera stomach of the worker bee, it

is stocked in the hive to serve as aliment to the bees and its colony” (Codex Alimentarius Commission, 1990 in Fonte, et al. 2013, 347).

This honey is quite particular because it possesses a higher percentage of humidity compared to Apis Mellifera honey. In the table below from Fonte, et al. research, we can see the physical-chemical and organoleptic characteristics of *M. Beecheii* honey.

Indicador	Colmena	Indicador de referencia para <i>Melipona</i> (Vit et al., 2004)
Contenido de agua (g/100 g = %)	24,0	30,0
Acidez libre (meq/100 g)	35,0	70,0
pH	3,6	-
Sólidos solubles (g/100 g = %)	74,6	-
Sacarosa (g/100 g)	6,54	6,0
Aspecto	Ligero turbio	-
Olor	Característico	-
Sabor	Ácido	-
Textura	Viscosidad moderada	-
Color	Extraclaro ámbar (ELA)	-

Figure 26: physical-chemical and organoleptic characteristics of *M. Beecheii* honey. Source: (Fonte, et al. 2013, 347)

We can notice that the humidity of *Melipona Beecheii* honey is of 24 percent. Moreover, “Internationally, stingless bee honey is virtually impossible to trade because, in accordance with the Codex Alimentarius, only honey from *A. mellifera* is considered for human consumption” (Javier G Quezada-Euan , De Jesus May-Itza and A Gonzalez-Acereto 2001, 163). In order to be considered as honey, the humidity level must be below 20 percent (Foundation Director: Interview 05.10.16).

Based on the research by Fonte et al., beside the fact that stingless bee honey has a relatively high percentage of humidity, compared to the *Apis Mellifera* honey, and that it makes it more vulnerable to fermentation processes, taking into account that there are no norms of extraction and a base of quality, it present an excellent quality, and that it did not suffer any apparent degradation. It can be considered as a fresh honey, which can be considered as an aliment for human consumption (Fonte, et al. 2013, 349).



Figure 27: Cosmetics deriving from Stingless Bee Products (Source: Author)

Other products such as the wax, pollen, Propolis and all cosmetics deriving from the activity of meliponiculture can be exploited and could represent a marketable resource. The wax of stingless bees has been used ancestrally for trade and artisanal products. The wax of stingless bees has been used during the colonial period as

a good for trade. In fact the wax was used to cover the boats of Spaniards (Pedro: Questionnaire).

Based on an interview with Shakira, “the Huichol culture, there are not Mayas, they are Huichol actually there they do those artisanal works “Chaquira” small things of nice colors, and they paint it with this wax; they put this wax in the vase and in it” (Shakira: Interview 04.11.16). I found this remark



Figure 28: Example of “Chaquira Art” (Source: <http://bisuteria-aguascalientes.blogspot.fr/2014/12/la-chaquira-en-el-mexico-indigena.html>), Accessed 30.10.17

relevant because it shows the potential of stingless bee wax for the creation of artwork. Meliponicultors could develop extra benefit by selling this product to artists, and contributing to the creation of new jobs or activities.

The pollen and Propolis are under exploited but remain interesting resources, especially due to their medicinal values. Those products can be used in the production of cosmetics just like soaps or shampoos. Based on Roberta, she uses the pollen and Propolis of stingless bees to do soaps.

3. Type of Market Aimed & Its Marketing

Now comes the question of the market. Considering the fact that meliponiculture is slowly being transformed from an activity that used to be familial into an activity that has an economic importance, it is vital to secure the market of stingless bee products. Following the target 2.3 of the Second Sustainable Development Goal, securing access to markets is a necessity if we want to double the agricultural productivity and incomes of small-scale food producers, in particular women and indigenous peoples by 2030²⁷. Nevertheless, at the present time stingless bee products still face the problem of marketing.

When interrogating meliponicultors about their opinions regarding the market of stingless bee products, it was clear that they were not satisfied with the current situation and think that the market of stingless bee products is abroad. Alessandro told me:

“Above all, look, I think it's a difficult market, it's the foreigners who value and pay more for the products. Organic, natural, not the local market, sometimes they [locals] do not know the advantages, do not know the properties that natural and organic products have for the health. As they do not know it, they do not want to pay for it. Then they do not consume it, the potential market I think is abroad” (Alessandro: Interview 06.11.16).

Many are unsure of their future because of this difficult market situation. Leonardo told me “well the market, there are no fixed price and no fixed buyer. This takes time because there is not a book that would tell you everything you should do. You have to learn and there is little information available. That's what I've learned, but I've made a lot of mistakes too, and some hives are gone” (Leonardo: Interview 01.10.16). Taking into account that most meliponicultors are living in rural areas, it is difficult for them to access local markets or to have the required resources necessary to access international markets. Fortunately there are honey resellers that can play an important role for the meliponicultor lacking those resources. Roberta, who owns a honey shop in Merida, told me that what she does is to “buy them [meliponicultors] honey when there is

²⁷ Please refer to Chapter III Section 3 for more details concerning Sustainable Development Goals.

something to offer and I help to market it. I am a marketer, so I look for customers in other parts of the country, I give an image to the products, and I promote and advertise them. I also advertise it on different virtual platforms like eBay but local. The free market and things like that” (Roberta: Interview 08.11.16).

I also had the chance to meet another women, Lara, who also own a honey products enterprise but her focus is on the international market. Lara who is a reseller of Apis Mellifera honey, stingless bee honey and of transformed products such as insect repellent, she told me that for her studies she went to meet people in rural communities and saw their poor living conditions. The meliponicultors with whom she works are located in a reserve that is car free. The options for the people living there are very limited. She decided to create her micro business, which is in a fair trade ideology and for the benefit of the community. She goes to them with a refract meter to see the percentage of



Figure 29: Melipona honey dropper 10 ml (Source: <https://www.queenbee-honey.com>)

humidity in the honey, to control the honey and see if it is not fermented or at the fermenting stage. There is a fermenting time that happens just after the harvest and after that it should not ferment anymore. She wants to create a trendy marketing program; her clients will be higher classes or persons that are looking at new products with nutritional benefits (see Figure 29). Hence she created a product, which is pretty and has a good taste. Her clients are from around the world as she sells her products online. She has an Instagram account for people to share her pictures. It is important to build trust with the producers and clients because it can be a problem. By going directly to the communities, she shortens the selling chain and enables them to get a better price for their products. She also provides information about Meliponiculture and as a result enables the empowerment of meliponicultor women in order for them to become the sellers of their products and ensuring their development. She exports her products outside Mexico but to Europe it remains difficult (Lara: Interview 10.11.16). This difficulty is mostly due to the legislation of Melipona honey as honey. As seen previously in Codex Alimentarius Commission, stingless bee honey is not considered as honey and cannot be sold as such.

The final issue regarding the market of stingless bees, and especially stingless bee honey, is that the demand is larger than the production. But the small amounts produced and the lack of characterization prevents the establishment of a secure and large-scale market (González-Acereto, Quezada-Euán and Medina-Medina 2006, 238). José told me that “People from Europe have come to ask me but they ask me for barrel of honey, I told them they are not barrels, they are bottles. They do not want a container. We are talking about 10 000 liters / 50 000 liters there is not so much stingless bee honey I told them” (José: Interview 01.11.16). Meliponicultors and honey resellers are well aware of this issue and work towards increasing their production, notably by increasing the number of bee colonies that they own. The future seems promising as if the demand is high but that little is available, the price of stingless bee honey and its deriving products, will remain high securing the lives of many rural meliponicultors. To ensure the durability of the activity, it seems that the main issue to be solved is to have a secure access to international market. This brings us to the next section focusing on the activity of meliponiculture. This section will try to identify if meliponiculture alone constitutes a job by itself or as a complementary activity to other jobs.

4. Can We Live Only From Meliponiculture?

One important point of this research was to evaluate the level to which the activity of meliponiculture could become a viable source of revenues and a job on its own. When interrogating meliponicultors about their feeling regarding this hypothesis, their opinions were quite various but followed the same line. Currently the situation does not allow them to live only from this activity and rare are the one only living from it. Based on Alessandro who own a Beekeeping park, “all beekeepers in the area, are engaged in beekeeping as a secondary activity. They have a main job, and the bees are apart. For example in Valladolid, there are many who are teachers, taxi drivers, farmers and have bees, or have a business and bees. Few people are dedicated only to bees” (Alessandro: Interview 06.11.16). The questionnaires and field observations in the Yucatan Peninsula show that the meliponicultors I met are involved in agricultural activities and kept animals. The food that they produced was mainly for auto consumption rather than for being sold on markets. They have an autonomist optic of life. The limitations

mentioned in the previous section (little honey production from stingless bees and poor access to international markets) slow down the development of the activity. In order to cope with this issue, meliponicultors in the Yucatan region are placing their efforts on increasing the number of colonies that they possess and to diversify the products that they could create.

Alessandro told me: "Look if you really know, if I am a producer who really knows how to do it and I have enough hives, I produce enough honey, I can harvest pollen, propolis, and wax and transform it and today if I market it, one can live from this. But only from the production of honey I would say no. Why, because the harvest periods are very short it is only twice a year that you can harvest. If you have more money in two periods for, you are going to spend it. Well, lets say you have a production of more products that you can sell year long, you will have more money and constant. But only from the honey production I think it is very complicated" (Alessandro: Interview 06.11.16).

In some cases the activity already represents a vital source of extra income. In the rural community of Xpujil where women are taking care of stingless bees, this activity is complementary and enables their empowerment. Dolores told me that beside the family that they have to take care of, this activity is a way to employ themselves. They consider this activity as "their source of employment to help the family" (Dolores: Interview 20.10.16). Following the sustainable livelihoods approach, we can notice that the financial capital appears weak, notably to the difficulty of making enough savings. Nevertheless not everyone is at the same level and the results prove that the financial capital is already contributing to the people's livelihood. An example will be shown in the next section.

5. The Role of Cooperatives & Beekeepers Association

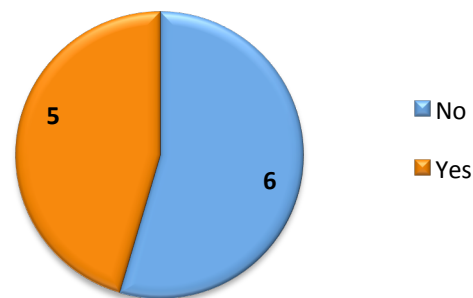
A topic that was explored in this research was the role of cooperatives in regards to the activity of meliponiculture. The International Cooperative Alliance (ICA) define a cooperative as "an autonomous association of persons voluntarily brought together to satisfy their common economic, social and cultural aspirations and needs through a

collectively owned enterprise where power is exercised democratically " (Touzard and Vandame 2009, 37). Based on an interview with a research at ECOSUR, a cooperative was behind the buzz regarding the activity of meliponiculture. It contributed to making it attractive again.

"Those who have radically changed things are a cooperative called "Tosepan Titataniske" located in the Sierra Norte, not far from Mexico City. At the base it is a coffee production cooperative. They branched out in all sorts of things and after the congress in 2003 in Tapachoula, they said well and in fact we feel that there is a potential in meliponiculture. They started to receive honey from the partners. They bought 4 tons of honey, which is huge for stingless bee honey. , They invested a lot of money in it, and after they had a stock, they started selling it. They sold it in pots. There is an alternative medicine lab that makes candies based on this honey notably for the throat creams, etc. I think their sales turns around cosmetics and sweets, due to the medicinal importance. It was them who launched the machine"(ECOSUR Researcher: Interview 15.11.16).

But this is not the only impact that cooperative can have. During this research, meliponicultors were asked in the questionnaire to mention if they were involved in a beekeeping association or cooperative (see graph 3). In the graph 3 we can see the representation of the participants involved in such

Meliponicultor Participation to Beekeeping Association or Cooperative



Graph 3: Meliponicultor participation to beekeeping association or cooperative (Source: Meliponicultor questionnaire)

associations. Out of the 11 participants, 6 did not participate in any and 5 did participate in one. Their reasons to join one were various. Alessandro explained me that "you get better prices for buying honey from stock"(Alessandro: Interview 06.11.16). Being part of an association increase the power that you can have as a group and shorten 'the roads' between the rural and urban promoting the different products made in communities. Meliponicultors also benefits from forming cooperatives as they can help

each other's by providing advices and increase their stock of honey (Shakira: Interview 04.11.16).

The second reason for forming cooperatives is to get funding, notably from the Mexican Government. Fernandez told me that his reason to form a cooperative was “to gain access to government resources. If you are not in an organization, or a cooperative or a rural production association, the government does not support you” (Fernandez: Interview 17.10.16). This can be an advantage in many cases but, as we will see in the next section 6, getting funds from the Mexican Government can be challenging and not always the best decision.

Nonetheless, in the long run, a cooperative increase people economic chances by developing “economic units of modest size, individual or family exploitations. This inclusion effect can be advantageous for the members because of the economies of scale and variety (reduction of transformation costs, increase of the negotiating power, complementarities of products, etc.) (Touzard and Vandame 2009, 37)”. This is very important to alleviate poverty in often-underprivileged areas. In the sustainable livelihoods approach, cooperative provides some social capital enhancing meliponicultors lives.

6. Role of Mexican Government & Private Funds

This section will provide positive and negative views on external funds that can potentially be used by meliponicultors to set their business. In fact, almost unanimously meliponicultors told me that the Mexican Government does not help them and that even if they did, they would not want their help. In fact the Mexican Government is un-trustful.

A Foundation director focusing on reintroducing meliponiculture in rural areas of Mexico told me “we are faced by a very corrupted system of government, or even if there are funds, they never arrive. It is often diverted, or if they arrive, they are conditioned to the political color or to vote, you vote for me, you are part of my structure”. We do not work with any government, or local, or estate, or federal, on any

types of funding. It also agrees best with communities, because if you say that you work with this person or this person, there are some people that refuse your support. Government representatives have them sign papers, when there are so-called tenders to put up projects, that never happens. (Foundation Director: Interview 05.10.16).

Following on the remarks of the Foundation Director, Alessandro who experienced funding from the Mexican Government explained me his bad experience, and of beekeepers in his region. His experience is presented here:

“Basically the state of Yucatán change of administration every six years and the government apply its own politics. From the 2001 to 2007 administration, there was a lot of support to beekeepers. They helped them so much, you could not imagine; helping them both in production and marketing. They were in training, in workshops; they invited them to organize sales in other parts of the country. They gave them support. But when this administration was finished, the financial supports that the one I saw and that the current one gives are now very low. You can already say that it is like 15% of what they gave before. Two governments back, and at the moment, the association to which my family participates was affected by a scam. Part of the government where they asked for money before as an advance so that they could have a bigger investment, the bigger support never arrived leaving us with our advance that we [cooperative members gave] gave. And this was more than five years ago. And it's one of the government's faults. They do not recognize it, and do not want to recognize it. It affected all these beekeepers because the money came out of the pocket of each of them. Then we have gone manifesting in the government palace in Merida, and no, they do not listen to you. There comes the question of corruption the bad government that is in place. So now beekeepers expect nothing from the government.”(Alessandro: Interview 06.11.16).

When meliponicultors are faced with such realities, they decide to focus their source of financial supports to Foundation that are generally more trustful and hence avoid the problems that getting public funds could create.

Among the meliponiculture exploitation visited in this research, I came across a group of 8 women that formed a meliponicultor society in the Natural Reserve of Calakmul.

Their story is interesting because they could start their activity of meliponiculture with funds from private foundations. Dolores from the meliponicultor group told me that “here we were received the support of ADO Foundation and of the foundation "Haciendo Mundo Maya", and let's say that to be able to do finance this project, its thanks to ADO and IRISAR. They made us discover the Hacienda Mundo Maya Foundation” (Dolores: Interview 20.10.16) (see Figure 30 for an example of facility built thanks to private funds). These private foundations helped them by giving them the financial resources necessary to get stingless beehives, to build the “palapa” (roof leaves). Dolores said that “they [Private Foundations] gave the economic import and we give aside our desire of work to do everything else. All the materials such as the cement, or the wood they built it” (Dolores: Interview 20.10.16).



Figure 30: A Meliponiculture facility financed by Private Foundations (Source: Author)

In the context of this research, the examples described in this section demonstrate the difficulties to find trustful source of financial supports. When meliponicultors hear and see the corruption that reigns in the Mexican Government, they will choose other ways to start their activity, such as personal contribution or funds from private organisms. These types of difficulties slow down the development of the activity. Those initial

external financial supports are very important to develop projects centered on the activity of meliponiculture and in order to become a self-sustaining activity.

This great example is also going towards the UN SDG number 2, **Target 2.3**, which is by 2030 to “*double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment*”²⁸.

The group of 8 women that formed a meliponicultor society in the Natural Reserve of Calakmul is a great example on what financial capitals can bring to people livelihoods. The next chapter will focus on the sustainable aspects of the activity and the vulnerabilities that could influence it. The popularity of the activity will be discussed. One will see the importance of traditional knowledge and education in the development of meliponiculture. Finally some examples of ecotourism opportunities will be developed.

²⁸ “Sustainable Development Knowledge Platform”, <https://sustainabledevelopment.un.org/sdg15>, Accessed on 30.07.17



IX. Sustainable Aspects of Meliponiculture

1. A Popularity That Kills

Besides recognizing the conservation importance of stingless bees, the revival of meliponiculture has created a new popular trend of keeping stingless bees. This popularity has also caused harms to native stingless bees. In fact more and more bad practices were observed. These bad practices are a threat to the durability of the activity, especially if it wants to develop into sustainable economies.

1.1. Poaching Of Wild Nests

In fact, based on Lara, the owner of a honey selling company in Merida, there is a new trend that is the illegal collection of wild trunks from the jungle. Beside the fact that it consist of some forms of illegal poaching and that it is often driven by ambitious ideas, the reality is that the people doing that often take poor precautions and end up by destroying the colony (Lara: Interview 10.11.16). Dolores from the rural community of the Calakmul reserve, who is aware of this issue, told me that she does not want to go “look for them in the forest, it is not what we want. What we have here, we are going to take care of them, so that we can make divisions and with time increase those hives. Not to cut those that are in the forest, but those that we already have to multiply them” (Dolores: Interview 20.10.16). I also met a meliponicultor who told me that he sometimes goes in the jungle to collect some colonies. He told me that to limit the negative effects, he would only takes some bee brood to bring back to his own stingless colonies and would not destroy the nest. He is doing that to renew its genetic stock. Pedro, the director of a foundation having diverse conservation projects, told me that he is not against creating revenues from the activity of meliponiculture. Nevertheless he is

afraid that large hotels (and others) would go to the jungle to cut trees where bee nests are located and destroy part of the jungle (Pedro: Interview 25.10.16). Considering the importance for the biodiversity depopulating colonies from the jungle can have a major impact for assuring the pollination of wild trees and on a long-term impact on the landscape.

1.2. Robbery Of Stingless Bees Colonies

The second issue, who affects already installed meliponicultors, is the stealing of stingless colonies left unattended. In fact, in order to produce honey, it is recommended to leave the colonies near large areas of forest where they have sufficient flowers to visit. Based on Leonardo, “Not in any place you can leave it, you have to know the ranch where you are going to leave it, if they are left in one side, they can get stolen or taken away, if there are animals they can eat it or destroy it. If you know that its price is high, they will steal it”(Leonardo: Interview 01.10.16). Moreover Leonardo was not the only meliponicultor to be affected or aware by this issue. In fact, José told me “in the mount you cannot leave it, they will steal it. A colony cost 2000 to 3000 pesos and it does not sting so” (José: Interview 01.11.16). When I asked him if someone could steal his, he told me “ it is a problem to have him or her, I have it in cage. No, they are guarded. What happens is that it is not much known. But since there is more this knowledge, here in Merida in fact a person to whom I sold him some, he has it near the city and they stole it. They took them hehe ” (José: Interview 01.11.16). Stingless bees, as its name suggest, are harmless and cannot protect themselves from external predators, including humans. This, combined with an expensive value due to a new trend, make them at risks.

1.3. Production of Fake Stingless Bees Honey

The popularity of meliponiculture and its honey has encouraged people to create fake honey, or honey that has been mixed to a sugar based ingredient whether it sugar syrup or *Apis Mellifera* honey. José, who is a *Melipona* honey producer see it has a big problem.

He told me *“it is a very big problem because the temptation is high yes. If I say to a peasant I’ll buy you a liter for 300 pesos and he has Apis honey, he can put a quarter of that and I make the mixture and he will not sell you a honey of quality. In fact there are in small amounts but there are people who make that trap we would need to have certified producers”*(José: Interview 01.11.16).

This feeling as also been shared by other meliponicultors that I met; Alessandro told me that “it is the buyer that needs to know who is the person selling its products in order to trust the products that he sell him and to be 100% sure that it is not fake, because it is possible to find mixes”(Alessandro: Interview 06.11.16).

It exist another issue related to fake honey, which is more difficult to avoid. In low blooming period and when the stingless bees are in scarcity of nectar, the meliponicultor is obliged to feed its colonies with Apis mellifera honey. After ‘transforming’ this honey, they will stock it in honey pots. In harvesting periods, if the meliponicultor extract every single pot and if this ‘fake honey’ is still present, they will affect the quality of the honey. Based on a foundation director in Tulum, the problem is that this mixed honey will be sold at the price of Melipona honey (100 pesos for a kg of Apis Mellifera honey against 2000 pesos for a kg of Melipona honey). Whether this mix is voluntary or involuntary, it consists of some types of fraud that cannot really be controlled. Shakira, from Valladolid, told me: “I saw in Campeche a cooperative that do a mix of Apis and Melipona honey but they give it a new name; it is like ‘innovation’ that they say ahah. I think it can be a problem for the future, the falsification of products”(Shakira: Interview 04.11.16). Based on Alessandro, the only way to know if the honey that is being purchased is real Melipona honey is to be able to differentiate stingless to Apis bees honey notably by the taste. At the client level, the only official way would be to pay a laboratory to do analysis (Alessandro: Interview 06.11.16).

Stingless bee honey is so rare and popular that its price has been booming in the recent years. Based on an ECOSUR Researcher, he does not think that it is a good idea; “ the price of honey as been multiplied by 10 in 5 years. [...] And it is based on nothing. It is based on the fact that it became more known and that there is demand, with a new

trend, so you can sell it 2000 pesos it will leave. I did not think that, this price is too high” (ECOSUR Researcher: Interview 15.11.16).

2. Traditional Knowledge & Education

2.1. Sharing Knowledge

Ancestral knowledge about the activity of meliponiculture needs to be shared. According to an employee of a foundation specialized in the promotion of meliponiculture, Indians or people who used to live in the jungle, knew how to preserve the honey in order to avoid its fermentation. In fact it takes 2 weeks for it to ferment. He also told me that there is a lot of lost knowledge and that is why the Melipona bees, and the activity of meliponiculture, is a good way to promote a life mode that is social and where we feel Maya (Arturo: Interview 07.10.16). The language barrier between people who speak Maya or Spanish language is a key factor in the loss of traditional knowledge. This has been noted by Shakira who told me that: “there are people who know for example, there are people who are very old and speak Maya and then it is very difficult to know that knowledge or to transmit it.”(Shakira: Interview 04.11.16).

The other side of the story is that only a small percentage of the Mexican population (and world’s population) is aware of stingless bees and their important role to the environment. Shakira think that it’s “missing diffusion exactly because there are many people here in Yucatan who ask me if they know the Meliponas and they do not have ideas that it exist. But they live here near us”(Shakira: Interview 04.11.16). The same can also apply at the rural community level:

“People’s awareness in the field is missing; that they see the importance of rescuing bees. Because sometimes, if they do not have an interest, if they do not know why it is important, it will not interest them. If the government comes and gives them meliponas hives, wait a few weeks and then they sell it and return to their normal lives. It needs to have a lot of awareness” (Alessandro: Interview 06.11.16).

Education and sharing knowledge on the activity would enable the spread of knowledge among more people and could as a result improve practices. Improved practices could

help rural communities, and more particularly meliponicultors, to improve their economic situations. As a comparison the activity of beekeeping is quite known and it would be interesting to have the same level of awareness with meliponiculture.

2.2. Education To Improve Practices

The popularity of the activity has enabled an increased interest in meliponiculture but one of the current issues is that the lack of meliponiculture knowledge leads to bad management. A focus has to be made on this issue in order to avoid unwanted losses.

In fact, as Alessandro told me, *“sometimes people can have them [stingless bee colonies] but they do not know how to make divisions. They do not know the harvesting process, if they do not know this, they are going to extract the honey but they do not have the care with the vinegar fly for example, you need to have good practices so that your product is hygienic and adequate for consumption. I think all of that is the most fundamental”*(Alessandro: Interview 06.11.16).

It is sometimes difficult for new meliponicultors to find the answers to their questions. Shakira think that in order to improve the activity of meliponiculture more training have to be offered because: “as we [Shakira and her colleague] are new in this activity, there are times we have doubts and we do not know where to find the answer. And more about handling.”(Shakira: Interview 04.11.16). The solution to these problems is by increasing the availability of meliponiculture resources through education.

2.3. Education To Improve the Activity's Future

In order to avoid such difficulties the solution consists of creating courses of meliponiculture and guides. Until today the activity of meliponiculture was relatively unknown but more and more universities start to develop programs and courses about it. In all parts of the country meliponicultor training is appearing. For example, ECOSUR, “*Colegio de la Pantera Sur*”, present in Chetumal, Quintana Roo gives some courses of Meliponiculture (Fernandez: Interview 17.10.16).

People reasons to attend these courses are various; *“since August there has been a training in meliponiculture in the northern part of Chiapas. And in the people who*

participate if you ask them their motivation, and in their ideas it is to have many colonies, honey etc. There are others to know a lost practice and to know the resources of the territory. There are still some people, not many, but who participate because they are interested in bees simply”(ECOSUR Researcher: Interview 15.11.16).

I had the chance to follow part of a traineeship for meliponicultors entitled “*Consolidation of the rebirth of the meliponiculture in the peninsula of Yucatán - training of trainers in meliponiculture Maya*” in the “*Intercultural Maya University of Quintana Roo*”²⁹. Students are introduced with a variety of topics, such as the taxonomy and biology of stingless bees, innovation in the activity of meliponiculture, laboratory analysis (see figure 31), sustainable development through ecotourism, creation of derived products, etc.



Figure 31: Professor giving a course of Taxonomy to future meliponiculture experts. (Source: Author)

This traineeship is coupled with practices in the field making it extremely useful for meliponicultors. These courses would often lead to an official diploma in Meliponiculture developing experts in the field. The persons lacking knowledge are often the victims; “the producer sometimes has no knowledge in the elaboration of products, so he cannot commercialize it. That way they charge very little for their work and the last one that sells is the one that receives the greatest amount of money” (Alessandro: Interview 06.11.16). With this additional knowledge, meliponicultors will be able to make their own products and decisions in order to increase their chances to create sustainable revenues. Nevertheless, there is a limitation to these courses because “most of the population that is in the labor force, they do not have the money to pay and to take days to get to Merida and to do the courses. It is not in free access to the population. There is much left in this part to the university and the government”(Alessandro: Interview 06.11.16).

This section has shown us that there is a necessity to share traditional knowledge and modern management of stingless hives, notably through university traineeships, to

²⁹ Please see Appendix 7 to visualize an example of the program that meliponicultors follow.

augment the chances of meliponicultors to develop their activity into a sustainable one. These results prove that in order to reach the target 12.8 (“By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature”) of the UN SDGs number 12, more efforts has to be placed on education to create sustainable livelihoods.

3. The Relations Between Tourism & Meliponiculture

An important aspect of this research was focusing on what tourism can bring to the activity of meliponiculture. This section will elaborate on the limitations and benefits of it. Another part of this section will evaluate the potential of creating ecotourism activities deriving from the meliponiculture activity. This part will contribute to support **Target 12.B:** “Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products ” and see what remains to be done...

3.1. Limitations of Tourism on Meliponiculture Activities

There are two faces to the touristic development of the Yucatan peninsula. Meliponicultors and professionals around the activity have expressed few concerns regarding this development. The first impact is the desertification of young people of the rural areas moving to urban areas:

“What is happening is that in the communities there are only the elderly, who are taking care of the bees, the young people are interested in making quick money. They work in the cities, in the hotels and they are forgetting their traditions. When the grandfather dies, the bees are lost because you have to take care of bees” (Marco: Interview 13.10.16).

This ageing situation can have a severe impact, as it would mean that the perpetuation of rural communities is not ensured. Arguably these issues can also be seen as an advantage depending on the position that one takes. The touristic development of the Yucatan Peninsula created many job opportunities. Yet the sustainability of those

opportunities is questionable... The effect of tourism on the environment, which is an important issue of the activity, explored previously (please see Chapter 2 of part VI).

Many meliponicultors interviewed in this research do want to work with the tourism sector but the major problem that they face is that almost no one visits the rural areas. The meliponicultors that I have encountered in the natural reserve, beside that they possess the facilities to receive groups of visitors, still find challenging to create ecotourism opportunities.

Dolores told me “here it is not easy, now what we are looking for is that the tourists arrive. They [tour operators] are doing some events in order to know us. It is like the tourist conference that brought people to discover our territory, our municipality and since they, as they are tourist guides, they are going to bring after people I suppose. But there is nothing yet, I don’t know if they are making those events” (Dolores: Interview 20.10.16).

This underline a major issue regarding how tourism has been created in the Yucatan Peninsula of Mexico. Based on a foundation director, there are two types of tourism; one for the wealthier that spend their time at hotel and the more adventurous tourism first for discoveries. Arturo provided me with an interesting analysis of the tourism development of the Yucatan Peninsula.

“I think the problem is not tourism but it is the form of tourism. I think the peninsula, in the Caribbean in the Mayan Riviera; there is a blurred tourist development. Like Cancun for example, it is very large, large hotels, shopping centers. And it is a system that does not see beyond, and there are other ways to do tourism, which are more like in relation with nature, relations with the sacred, relationship with the ancestor I think you can not open that. I see it as an opportunity too, to me, I have been living here for a short time but I really enjoy living here. So I think it's important to take responsibilities, from the place and habitat you live in, it can be to have a minor impact but you can do something for the place where you live, no? Then I believe that Tulum could grow with an ecological and responsible tourism”(Arturo: Interview 07.10.16).

In fact the Yucatan Peninsula and especially Cancun, is known for its massive tourism industry. Some large Hotel resorts have incorporated meliponiculture to their resorts but it is often exaggerated and the locals do not benefit from it. Based on Lara, tourism can only be beneficial to meliponicultors if it is well managed and takes into account the type of visitors, in order to disturb at the least stingless bees (Lara: Interview 27.10.16). José told me that too often when that is done [meliponiculture ceremonies], “they no longer stick so much to the ritual but more on what the tourist wants to see in order to the tourist to get “aaaaah woaw”. It would originally be a more selective tourism, maintaining the originality.”(José: Interview 01.11.16).

3.2. Advantages of Tourism on Meliponiculture Activities

Beside the disadvantages listed above, tourism brings large potential to the activity, notably it could ensure the sustainability of it. First of all Arturo thinks that “it's a super nice theme that will appeal to many people! Also, going to a meliponario, seeing a job is nice. Yeah, I think it's a good way to discover something” (Arturo: Interview 07.10.16). Marco also sees future in the development of ecotourism activities around meliponiculture; for him it can be though “guided tours, you can have a place that has plantation / plants, and you can see what is the Mayan culture, also the conservation and management of native bees of Mexico. What we are doing is preserving and making divisions to make new colonies” (Marco: Interview 13.10.16). In this subsection two examples of ecotourism activities will be described. This will enable one to gain better ideas of ecotourism activities that can be made.

3.2.1. Xkopez Beekeeping Park

During this research, I interviewed Alessandro, the manager of this interesting ‘Beekeeping Park’ project. This park is based on the concept of Apitourism. Apitourism is “a new tourism discipline and very fresh approach to sustainability. It aims at raising awareness as to the importance of bees to mankind, enriching knowledge about the use and effects of bee products and apitherapy, and enhancing people’s well being”³⁰.

³⁰“Apitourism – A Fusion of Apiculture & Sustainable Travel Experience”, <https://beetime.eu/apitourism-travel-experience/>, accessed on 15 October 17

At the time of the interview the project was only 6 months old. This is a familial project directly financed by them. They do not have any financial help from the government or from any other organisms. They did however try to look for funds but nothing worked out. He said that it is slower to develop but more secure.

The park was created in response to the large interest that clients of his family had towards the activity. His family dedicated themselves to beekeeping and the commercialization of bee products. He told me that those clients wanted to “know more about the work with



*Figure 32: Alessandro guiding me through the Beekeeping Park
(Source: Author)*

bees. They no longer wanted to only consume honey but they also wanted to know how honey is produced” (Alessandro: Interview 06.11.16). At few occasions they brought people to apiaries and because of this high interest, they decided to transformed the land that they had into a beekeeping park with the optic that the visitors have a larger interactions between them and the bees. Alessandro also told me that “the route that we do in general, it is not only about the bees but we do a mixture with Mayan culture. That is the traditions, that is local, Mayan traditions we are also commenting with the Mayan vision” (Alessandro: Interview 06.11.16). Alessandro told me that now he will place his focus on the consolidation of his meliponary.

Visitors of this park can embrace themselves with nature. Anecdotally, “there were people from Canada who came and it was the mango periods and they can take it directly from the tree was a unique experience” (Alessandro: Interview 06.11.16). People could directly take the eggs from the chicken coop and make breakfast and this is also wonderful because people are now in big cities and are accustomed to go to the supermarket for anything. It is the idea that Alessandro and his family have, “if we

manage many things in a sustainable way in a way that we also contribute to nature to our traditions and everything” (Alessandro: Interview 06.11.16). Alessandro also thought at managing compost, solar energy and all these new technologies but unfortunately this energy is expensive and he cannot install it without outside financial help.

Since they opened, they have learned so much on how to improve the Park, the interactions with clients and visitors, services and the organization. For them, it is so great to see that people enjoy the experiences that we give them.

This project has benefited from the touristic development: “Valladolid has had a tourist interest due to Chichén Itzá. It already received the title of ‘wonder of the world’ and Valladolid also has had the title of ‘Magic Town’. Then an extension in the tourist part started. So for us it was a plus because people are getting here. It is a question of knowing us, but in rural communities off the beaten tracks it is more difficult. Because sometimes there is no means of transportation, there are not the services that sometimes visitors needs ” (Alessandro: Interview 06.11.16).

The Beekeeping Park is the first camping of Valladolid; “it is an advantage because many people like this experience. In Cancun, Playa del Carmen, Tulum yes there is. But they are not in the in nature, they are not in the field, they do not have animals ... It is a more intimate experience with nature (Alessandro: Interview 06.11.16). The publicity of the park is mostly made online; “currently we have through social media, a Facebook page and Trip Advisor. So most people contact us that way. Perhaps we will have a web page and increase the services we can offer, well the food, rooms etc.” (Alessandro: Interview 06.11.16).

This beekeeping park, which regroups both the activity of apiculture and meliponiculture, proves that tourism can easily be combined to a meliponiculture or beekeeping activity. Such parks play an essential role to raise awareness on the importance of bee conservation but also to reconnect people with nature and its elements. The concept of Apitourism encourages a new vision of development and sustainable development ideas. Visitors of this park are specific people, concerned to learn more on the activity of meliponiculture as could have explored in the previous

sections. This project has not been funded by outside funds, which confirms what has been seen in chapter VIII, section 6, that governmental funds and other organism funds are difficult to access. It is a real issue slowing down the sustainable implantation of meliponiculture in the Yucatan Peninsula of Mexico. Additionally, it proves that:

“The type of relationship and focused strategies that the actors carry out are not enough for ecotourism to have a positive impact on communities, especially indigenous communities, thus persisting with high rates of marginalization and poverty. The success of ecotourism depends on the interests and types of linkages that actors establish to achieve the conservation and welfare goals of communities” (Araújo-Santana , et al. 2013, 669).

This project is also a success because it benefits from a great location, where tourists show interests to visit. Its publicity is mostly made by using online tools and has a larger impact than people unaware of the technology. Overall this beekeeping park shows a perfect type of sustainable livelihood as it regroups all the elements necessary to make one, based on the Sustainable Livelihood Approach.



X. Concluding Remarks

This research, focusing on the activity of meliponiculture in the Yucatan Peninsula of Mexico, had the aim of understanding what the current situation of meliponiculture is, especially after that this one was affected by an increased popularity. This research also had the aim to evaluate the challenges that it faces. The results show that the current situation of meliponiculture is extremely unsecure and chaotic but is positively developing into a sustainable activity. This popularity brought a number of bad practices that are direct threats to the conservation of stingless bees. But this popularity also enabled an increased awareness in bee conservation and a unique interest in the activity of meliponiculture. Young people have started to be interested in the activity and see its future potential. Nevertheless, meliponicultors are afraid of their future and cannot live only from this activity. That is why many diversify their activities; for example they combine meliponiculture to agricultural or ecotourism activities. Putting education at the center of priority has proven to be successful as people gain added knowledge making them independent and avoiding bad practices that could influence the activity.

The first research question focusing on “*how have Meliponiculture practices changed over time and what are the factors contributing to those changes*” was answered in the chapters IV and V. This research, has demonstrated that its historical background contrasts the re-development of the activity of meliponiculture. The historical elements brought us back to the pre-colonial period of the Maya civilization. We can notice a radical change of practices from log hives to modern beehive, yet some still opt for a traditional meliponiculture. This transition is due to extended researches on the topic and a will to improve meliponiculture practices, notably to improve production and its economic opportunities.

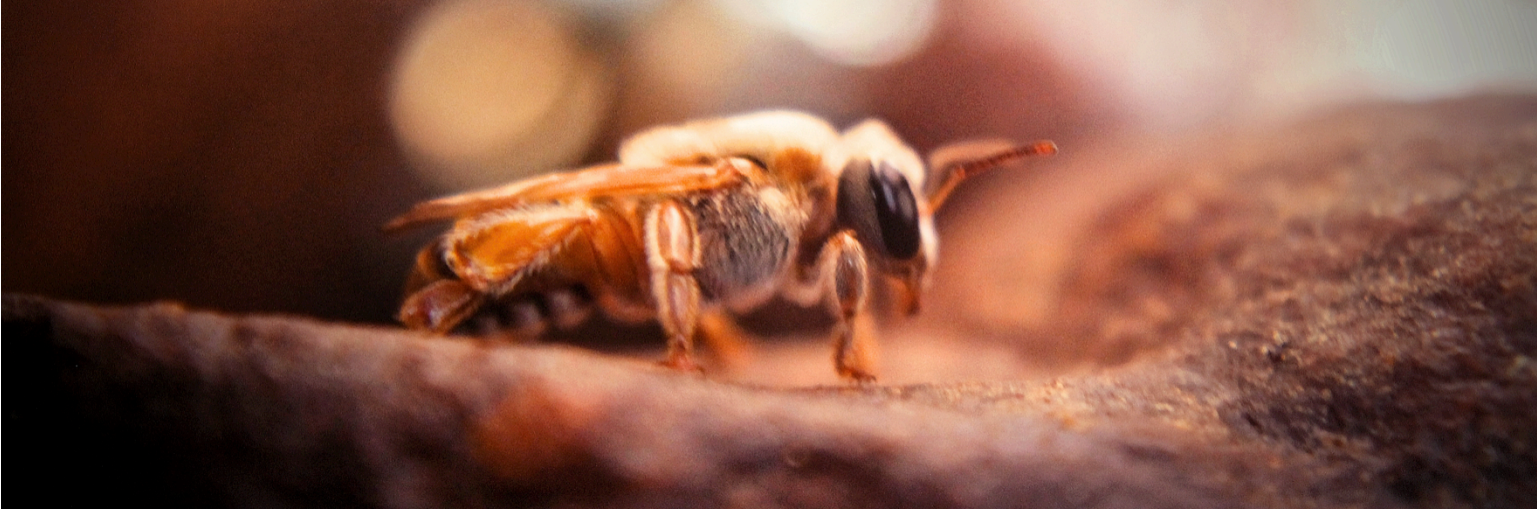
The second research question focusing on “*to what extent does Meliponiculture help the revival of the Maya Culture, the conservation of stingless bees and the preservation of the environment*” was answered in the chapters VI and VII. The activity of meliponiculture is a great manner to raise awareness for environmental protection and the conservation of stingless bees. Meliponicultors are the first key actors at undertaking actions towards the direct conservation of their stingless bees. Stingless bees do play an enormous role in the stability of ecosystems and the Mexican jungle, remarkably by pollinating the flowers present in the jungle canopy. Bad behaviors such as intensive agriculture, large hotel resorts, deforestation, poaching are threats to this equilibrium. Meliponicultors links with stingless bees is kept high and some ancestral practices, such as beekeeping ceremonies, are still performed. These practices are nevertheless evolving and fewer meliponicultors are fully practicing them. Nonetheless, meliponicultors are well aware of their cultural heritage. It proves that development does not necessarily go against traditions. Cultures are constantly evolving and adapting to the new situations created.

The third research question focusing on “*How does Meliponiculture fit in long-term schemes for developing sustainable activities and what are the challenges that the activity faces*” was answered in the chapters VIII and IX. The analysis of the revenues generated by the total numbers of *Apis Mellifera* and stingless bee colonies that meliponicultors possess shows various situations. It seems that meliponicultors who are benefiting from good access to markets, notably due to their distances to urban cities or to a particular knowledge or advantages, such as being the member of a cooperative, would tend to make greater revenues than meliponicultors in rural communities. The demand for stingless bee products is constantly rising but the production is low. That is the reason why most meliponicultors are into a multiplication optic in order to counter this issue and rebalance the supply/demand. Several deriving products can be made as a complementary of revenues and need to be developed but today the activity of meliponiculture cannot be considered as an activity by itself. The market is not strong enough and it seems that the potential of meliponiculture products is outside Mexico, at the international level. The lack of support from governmental organization is a key issue in this research because it slows down the good re-development of the activity and slows down the process to transform it into a sustainable activity. The other issues lay

around education; lack of knowledge and traineeships create bad practices and unwanted losses of stingless bee colonies. Meliponiculture activity can foster gender equalities; more and more women are developing their own businesses and hence contributing to their familial economy. Another positive outcome is that meliponiculture has the potential to be coupled with eco-touristic activities creating a diversity of revenues but also a source of reflection on people's harmonious relationships with nature.

Prospects For Further Research

There are other facets of this problematic that could be explored in depth. A larger focus should be placed on the curative properties of stingless bee products in order to improve medical advancements and perhaps to increase the importance of the conservation of stingless bees. A deeper knowledge on the role of that cooperatives and certification can play in the re-development of this ancestral activity could be interesting to collect because as this research demonstrate, their roles seems essential. Additionally it would be extremely valuable to explore the activities that could be coupled to the activity of meliponiculture. In the interviews collected, several participants mentioned alternative and more resonated production systems, such as agroecology or agroforestry. Unfortunately, during my fieldwork I could not collect sufficient information about the subject to be able to include it in this research paper. Furthermore it would be interesting to focus more researches on the routes that private and governmental funds take to reach the development of such activities of meliponiculture. These researches would be beneficial to identify exactly where the access to public funds is blocking and on how it would be possible to counter this issues. Other researches focusing on the access to international market regarding meliponiculture products would also be interesting to explore in order to identify the exact solution to these issues of production and exportation. Much more need to be discovered in order to evaluate the progress of the redevelopment of meliponiculture and the future impact that it will have, notably on the rural development of the Yucatan Peninsula.



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Appendix



Tabla 1. Principales plantas nectaríferas y polinizadas de la abeja xunucub (*Melipona beecheii*) en la Península de Yucatán; las especies están enlistadas en orden decreciente de importancia.

No.	Nombre común	Nombre científico	Familia	Forma de vida	Recurso que proveen
1	Tatzelche	<i>Gynopogon floribundum</i>	Polygonaceae	Arbol	Nectar y polen
2	Chochon	<i>Mezopium brownei</i>	Anacardiaceae	Arbol	Nectar y polen
3	Chaka, Chak chakaj	<i>Borreria simarubia</i>	Burseraceae	Arbol	Nectar y polen
4	Tajonal	<i>Vigiera dentata</i> var. <i>helenioides</i>	Asteraceae (Compositae)	Hierba	Nectar y polen
5	X-k'an lol, Ek'k'akil	<i>Cyrtia posonis</i>	Bigoniaceae	Bejuco	Nectar y polen
6	Xabentun, Campanilla	<i>Turbina corimbosa</i>	Convolvulaceae	Hierba	Nectar
7	Flor de San Diego, Campanilla, chak lool makal	<i>Antigonon leptopus</i>	Polygonaceae	Bejuco	Nectar
8	Ja' abin	<i>Pithecia pitcupia</i>	Fabaceae (Leguminosae)	Arbol	Nectar
9	Boonillo, Tabche'	<i>Conocarpus erectus</i>	Comberaceae	Arbol	Nectar
10	Gupabillo, X-pichit' che'	<i>Bidifolium sarotranum</i>	Myrtaceae	Arbol	Polen
11	Tsalun, Boox tsalun	<i>Lysidomus lediifolium</i>	Fabaceae (Leguminosae)	Arbol	Nectar y polen
12	Ya anik	<i>Vitex gasteri</i>	Verbenaceae	Arbol	Nectar y polen
13	Pisoy, guetma	<i>Galearia subgibula</i>	Sericeaceae	Arbol	Nectar
14	Pichit che, Sak loob	<i>Eugenia burxipia</i>	Myrtaceae	Arbol	Nectar y polen
15	Ich' yuj, kis yuuk	<i>Eugenia axillaris</i>	Myrtaceae	Arbol	Nectar y polen
16	Sidimach	<i>Solanum lanceifolium</i>	Solanaceae	Hierba	Polen
17	Ts' inche'	<i>Pithecolobium dulce</i>	Fabaceae (Leguminosae)	Arbol arbusto	Nectar y polen

18	Almendro	<i>Terminalia catappa</i>	Comberaceae	Arbol	Nectar y polen
19	Ya'ax che'	<i>Cela panamla</i>	Bombacaceae	Arbol	Polen
20	Sitote	<i>Conia dolocandia</i>	Bombracaceae	Arbol	Nectar y polen
21	K' rai' oox, Corzón azul	<i>Suaeda calcensis</i>	Fabaceae (Leguminosae)	Arbol	Nectar y polen
22	Sak' mui, Sak' pok' tes, box pool	<i>Alternanthera ramosissima</i>	Amaranthaceae	Hierba	Polen
23	Coocero	<i>Coccoloba</i>	Asteraceae (Palmae)	Arbol	Nectar y polen
24	Katin' ek'	<i>Pithecolobium keyense</i>	Fabaceae (Leguminosae)	Arbol	Nectar
25	X'okob, Santa María, X'okoban ab'	<i>Smilax spissia</i>	Smilacaceae	Arbusto	Nectar y polen
26	Subinde', Granada	<i>Polyalthia yucatanum</i>	Fabaceae (Leguminosae)	Arbol	Nectar
27	Balche'	<i>Landibocarpus longylyus</i>	Fabaceae (Leguminosae)	Arbol	Nectar y polen
28	Chic, palma	<i>Trinax radiata</i>	Asteraceae (Palmae)	Arbol	Polen
29	K'anchunup	<i>Tournefortia caracasana</i>	Scrophulariaceae	Arbol	Nectar
30	Chen pe' ek', X-ch' emak'	<i>Sesuvium yucatanensis</i>	Scrophulariaceae	Hierba	Nectar
31	Boob, Sak loob, boob dit' kah	<i>Coccoloba cocciniferia</i>	Polygonaceae	Arbol	Nectar
32	Vergonzosa, X-wene xiw, X-mil' uis	<i>Mimosa pudica</i>	Fabaceae (Leguminosae)	Hierba	Polen
33	Sak' kaatin	<i>Mimosa bahamensis</i>	Fabaceae (Leguminosae)	Arbol y arbusto	Polen

Appendix 1: List of the principal plants producing nectar and pollen of the *Melipona Beecheii* stingless bees in the Peninsula of Yucatán; the species are listed in a their decreasing order of importance (Roubik, et al. 2005).

MIEL MELIPONA

Las meliponinis son un grupo de abejas que viven en colonias perennes de regiones tropicales y producen una calidad de miel inigualable, a estas abejas se les conoce como "abejas mayas" porque ellos las domesticaron. la miel obtenida de estas abejas que no tienen aguijón era utilizada para aliviar y prevenir numerosas enfermedades así como complemento alimenticio y restablecimiento de la salud.

se recomienda como coadyuvante de las siguientes enfermedades y alteraciones.

- 1- catarata ocular, conjuntivitis infecciosa o traumática, heridas y úlceras oculares. modo de empleo: una gota aplicada en cada uno de los ojos si el ardor resulta intolerable, la miel melipona se puede diluir al 50% con agua destilada o hervida, se debe aclarar que el tratamiento se alarga de esta forma, disminuir el agua en la medida en que se aumente la tolerancia a la miel melipona. aplicar cuando menos dos veces al día.
- 2- úlceras y llagas en la piel de difícil cicatrización. se lava y se seca perfectamente el lugar afectado y se aplica la miel melipona. repetir el tratamiento tres veces al día puesto que la melipona se absorbe y en 15 días se ven los resultados.
- 3- inflamación de hemorroides: se aplica la miel directamente en la zona afectada, el resultado es aliviador inmediatamente.
- 4- manchas en el cutis: ya sea hepáticas, de gestación o solares. modo de empleo: se unta generosamente en la cara dejándose 20 minutos y se retira con agua tibia.
- 5- dientes flojos: se frota las encías con la miel 3 veces al día, después de lavarse los dientes. los resultados son realmente extraordinarios, por lo que además previenen las caries dentales.
- 6- problemas de vías respiratorias como laringitis, sinusitis, etc. modo de empleo: una cucharada mediana 3 veces al día.
- 7- anemia: estimula la producción de glóbulos rojos hasta la normalización modo de uso: tomar una cucharadita cafetera 3 veces al día.
- 8- úlceras gástricas y gastritis. modo de empleo: tomar una cucharada sopera por las noches pues propicia una rápida cicatrización.
- 9- prostatitis: favorece una rápida y eficaz desinflamación de la próstata y previene la inflamación de la misma. modo de empleo: tomar una cucharada al día.
- 10- debilidad física y mental: provoca una sensación de bienestar y rejuvenecimiento, sobre todo en personas de edad avanzada. modo de uso: tomar una cucharada diaria preferentemente antes del desayuno.
- 11- normaliza las disfunciones hepáticas o intestinales ayudando a un mejor funcionamiento del hígado y del intestino.

Appendix 2: List of Curative properties of Melipona honey, based on Seller Questionnaire.

Table 40.1 Country of origin and estimated honey production by native stingless bees

Country	Species	Pot-honey annual yield
Australia	<i>Trigona carbonaria</i> (s.l.) = <i>Tetragonula carbonaria</i> <i>Austroplebeia australis</i>	1 kg (Wikipedia 2011)
Brazil	<i>Melipona asilvai</i>	1 l (Carvalho et al. 2003)
Brazil	<i>Melipona fasciculata</i>	3–4 l (Magalhães and Venturieri 2010)
Brazil	<i>Melipona flavolineata</i>	2–3 l (Magalhães and Venturieri 2010)
Brazil	<i>Melipona mandacaia</i>	2.0 l (Carvalho et al. 2003)
Brazil	<i>Melipona quadrifasciata anthidioides</i>	2.0 l (Carvalho et al. 2003)
	<i>Melipona quadrifasciata quadrifasciata</i>	2.0 l (Carvalho et al. 2003)
Brazil	<i>Melipona rufiventris</i>	3.0 l (Carvalho et al. 2003)
Brasil	<i>Melipona scutellaris</i>	2–15 kg (Alves, personal observation)
Brazil	<i>Melipona subnitida</i>	2.5 kg (Bezerra 2002)
Brazil	<i>Scaptotrigona</i>	3.0 l (Carvalho et al. 2003)
Brazil	<i>Tetragonisca angustula</i>	1.0 l (Carvalho et al. 2003)
Costa Rica	<i>Melipona "fasciata" = M. costaricensis</i>	2.5 kg (Cortopassi-Laurino et al. 2006)
Costa Rica	<i>Melipona beecheii</i>	2.5 kg (Cortopassi-Laurino et al. 2006)
Indonesia	" <i>Trigona</i> " (s.l.)	1 kg (Soekartiko 2011)
Mexico	<i>Melipona beecheii</i>	2.5 kg (Cortopassi-Laurino et al. 2006)
Paraguay	<i>Scaptotrigona</i>	3.0 l (Carvalho et al. 2003)

Appendix 3: Country of origin and estimated honey production by native stingless bees. (Source: (D. Michener 2013, 543)

Cuestionario Meliponicultor / *Questionnaire Meliponicultor*

1. Nombre / <i>Name</i>	
2. Edad / <i>Age</i>	
3. Sexo / <i>Gender</i>	
4. Profession / <i>Profession</i>	
5. Lugar donde Vive/ trabajas / <i>Place where you live/ Work ?</i>	
6. ¿Cuántos Niños tienen ? <i>How many children you have ?</i>	
7. ¿Cuántos Colonias de Meliponas y de que especies ? <i>How many melipona colonies you have and what species ?</i>	
8. ¿Dónde están los apiarios de Meliponas? <i>Where are the apiaries of Meliponas ?</i>	
9. ¿Aproximadamente cuánto dinero per Año resultando de Meliponicultura ? <i>Approximately how much money results from Meliponiculture per year ?</i>	
10. ¿Cuántas colonias de Apis Mellifera ? <i>How many colonies of apis Mellifera you have ?</i>	
11. Dinero per Año resultando de Apicultura (apis Mellifera) <i>How much money results from apiculture (apis mellifera) ?</i>	
12. ¿Dónde están los apiarios de Apis Mellifera ? <i>where are the apiaries of apis mellifera ?</i>	
13. ¿Que productos apícola producen y cual es el precio ? <i>Which beekeeping products are produced and what is its price ?</i>	
14. ¿Dónde los Venden ? <i>Where do you sell them ?</i>	

Appendix 4: Example of questionnaire to Meliponicultors – Page 1/2

15. ¿Participe en una Asociacion de Apicultors ? <i>Are you a member of a beekeeping association ?</i>	
16. Donde es la asociacion ? <i>Where is the association ?</i>	
17. ¿Se cultivan verduras / frutas ? <i>Do you produce vegetables/ fruits ?</i>	
18. ¿Cuales y a que precios ? <i>Which and at what Price ?</i>	
19. ¿Participen en ceremonias de apicultora ? <i>Do you participate in beekeeping ceremonies ?</i>	
20. ¿Es importante para tu ? <i>Is it important for you ?</i>	
21. ¿Utilice los productos de las Meliponas como medicamentos ? <i>Do you use Meliponas products as medicines ?</i>	
22. ¿Qué productos tratan a qué? <i>What produces cures what ?</i>	
23. Algo que quieres Informar me ?	

He recibido informaciones sobre el proyecto y quiero participar en este estudio:

I have received information about the project and am willing to participate:

Algunos Comentarios? *Any Comments?*

(Nombre, fecha, firma) / *(Name, date, signature)*

Cuestionario Vendedor / *Questionnaire Seller*

1. Nombre / <i>Name</i>	
2. Edad / <i>Age</i>	
3. Sexo / <i>Gender</i>	
4. Profesion(es) / <i>Profession(s)</i>	
5. Nombre de la empresa y en qué consiste ? <i>Name of the enterprise and what is its aim ?</i>	
6. Lugar donde Vive/ trabajas / <i>Place where you live/ Work ?</i>	
7. De donde viene los productos que venden ? <i>Where are the products coming from ?</i>	
8. ¿Que productos apicola producen/ venden y cual es el precio ? <i>Which beekeeping products are produced /sold and what is its price ?</i>	
9. ¿Donde los Venden ? <i>Where do you sell them ?</i>	
10. Aproximadamente cuanto dinero per Año resulta de su venta ? <i>Approximately how much money results from your sells per year ?</i>	
11. Participe en una cooperativa ? <i>Are you a member of a Cooperation ?</i>	
12. SI, porque ? <i>If yes, why ?</i>	
13. ¿Se venden otros productos non-apicultora como verduras / frutas ? <i>Do you produce vegetables/ fruits ?</i>	
14. ¿Cuales y a que precios ? <i>Which and at what Price ?</i>	
15. Sobre te es importante la Meliponicultura y porque ?	

16. Ve a algunos cambios con el tiempo y si cual son ? <i>Did you see any changes over time and if yes which one ?</i>	
17. Hay un mercado suficiente para los productos apícolas/ Melipona ? <i>Is there a sufficient market for bee/Melipona products ?</i>	
18. Que falta por tener una economía durable ? <i>What is missing to have a durable economy ?</i>	
19. Como tu empresa ayuda a los meliponicultores ? <i>How is your enterprise helping meliponicultors ?</i>	
20. Te ayuda el gobierno Mexicano (o otro organismos) por el trabajo que haces y como? <i>Does the Mexican government (or other organisms) help you for the work you do ? How ?</i>	

Estoy de acuerdo que mi información personal y fotos puede ser publicado / salvado después de la finalización del proyecto (círculo). *I agree that my personal information and pictures may be published/saved after project completion (circle)*

SI / NO

He recibido informaciones sobre el proyecto y quiero participar en este estudio:
I have received information about the project and am willing to participate:

Algunos Comments? *Any Comments?*

(Nombre, fecha, firma) / *(Name, date, signature)*

Interview Guide

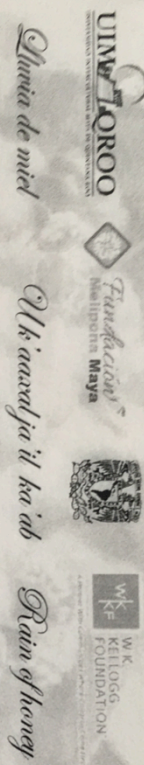
1. Puedes presentarte ?Can you present yourself ? Como te llamas ? *What's your name ?* Cual es tu Profession ? *What is your profession ?* Cual es tu Edad ? *What is your age ?* De donde eres ? *In which city do you come from ?*
2. Porque te Practica la Meliponicultura ? *Why do you practice meliponiculture ?*
3. Hace mucho tiempo que te practica meliponicultura ? *Since when ?*
4. Tienes hijos ? Y tus hijos trabajan con Meliponas ? *Does your children work with meliponas too ?*
5. Cuanto dinero aproximamente resulta de la Meliponicultura y a que serve ? Es suficiente ? *How much money approximately result from the Meliponiculture and what does it serve for ?*
6. Cuentas colemanas tienes y de que especies ? *How many colonies do you have and from which species ?*
7. Has cambiado el modo de criar a las meliponas y porque /como. Puedes explicarme? *Did you change the way of breeding meliponas and why /how ?*
8. Tiene Abejas Apis mellifera Tambien? SI/NO y porque ? *Do you have Apis Mellifera bees too ? YES/NO*
9. Cuantas colonias de abejas Apis Mellifera ? *How many colonies of Apis Mellifera Bees do you have ?*
10. Participes en una asociacion de Apicultores y cual es el nombre de la asociacion y porque ? *Are you a member of a Beekeeper Association and what's is name ?*
11. En tu opinion, como es la situacion sobre la Meliponicultura en Quintana Roo ? *In your opinion, how is the situation of Meliponiculture in Quintana Roo ?*
12. Ve algo cambiar ? *Have you noticed any changes ?*
13. Como contribuyes a este cambio ? *How do you contribute to these changes ?*
14. Sobre la ceremonias de Meliponicultura algo cambié ? *Regarding the ceremonies around Meliponiculture has anything changed ?*
15. Puedes imaginar un dia vivir solamente de la Meliponicultura ? Y porque ? *Can you imagine one day live only from Meliponiculture ? And Why ?*
16. Que te falta para solamente vivir de este actividad ? *What is missing to live only from this activity ?*
17. Como te parece el desarrollo de la region rural de Quintana Roo ? *In your opinion, how does the development of the rural region of Quintana Roo looks like ?*
18. Cual son los problemas en relacion a este desarrollo ? *what are the problems associated with this development ?*

19. Cual son los ventajas de este desarrollo ? *What are the advantages with this development ?*
20. Trabajas con el turismo? *Do you work with tourism ?*

Questions to NGOS (or Enterprise)

1. Porque trabajas en un ONG? *Why do you work in a NGO ?*
2. Cual es el objetivo de la ONG ? *what is the objective of the NGO ?*
3. Como se ayudan a los meliponicultores? *How do you help meliponicultors ?*
4. Cual son los problemas en relacion a la meliponicultura ? *What are the problems in relation to Meliponiculture ?*
5. Porque es importante la conservacion de la abejas sin aguijon ? *Why is the conservation of stingless bee important ?*
6. En tu opinion, como es la situacion sobre la Meliponicultura en Quintana Roo ? *In your opinion, how is the situation of Meliponiculture in Quintana Roo ?*
7. Ve algo cambiar ? *Have you noticed any changes ?*
8. Como contribuyes a este cambio ? *How do you contribute to these changes ?*
9. Sobre la ceremonias de Meliponicultura algo cambié ? *Regarding the ceremonies around Meliponiculture has anything changed ?*
10. Como te parece el desarrollo turistico de la region (rural) de Quintana Roo ? *In your opinion, how does the development of the rural region of Quintana Roo looks like ?*
11. Cual son los problemas en relacion a este desarrollo ? *What are the problems linked with this development ?*
12. Cual son los ventajas de este desarrollo ? *What are the advantages of this development ?*

Muchas Gracias por tu contribucion, Hasta Luego. *Thank you very much for your contribution, bye.*


UIM Tzucacab
 UIM Tzucacab
 FUNDACIÓN MELIPONERA MAYA
 Fundación Meliponera Maya
 Rain of Honey

“Consolidación del Renacimiento de la Meliponicultura en la Península de Yucatán”
 Formación de capacitadores en Meliponicultura Maya

Programa

Segundo Seminario “Biodiversidad, biología y taxonomía de abejas nativas sin aguijón”.

- Viernes 14 de Octubre de 2016

9:00 a 10:00 Registro y desayuno

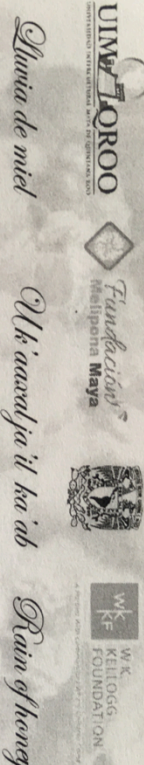
10:00 a 11:00 **Introducción al tema de las abejas**
Dr. Ricardo Ayala Barajas.

11:00 a 14:00 **Biología de las abejas Hymenóptera**
Dr. Ricardo Ayala Barajas.
- *Reconocimiento de abejas nativas*
- *Diversidad de abejas nativas*

14:00 a 15:00 **Comida**

15:00 a 16:00 **Meliponicultura: Producto potencial de turismo rural, en mujeres de Tzucacab, Yucatán**
Lic. Tomás Alejandro Canul Ku.

16:00 a 18:00 **Biogeografía de las abejas nativas**
Dr. Ricardo Ayala Barajas.


UIM Tzucacab
 UIM Tzucacab
 FUNDACIÓN MELIPONERA MAYA
 Fundación Meliponera Maya
 Rain of Honey

“Consolidación del Renacimiento de la Meliponicultura en la Península de Yucatán”
 Formación de capacitadores en Meliponicultura Maya

Programa

Segundo Seminario “Biodiversidad, biología y taxonomía de abejas nativas sin aguijón”.

- Sábado 15 de Octubre de 2016

8:00 a 9:00 Desayuno

9:00 a 11:00 **Familias de abejas nativas**
Dr. Ricardo Ayala Barajas.
- *Géneros más diversos*
- *Familias de abejas polinizadoras*

11:00 a 12:00 **Innovaciones en el sector apícola**
M. en Sig. Antonio Iturbe Posadas

12:00 a 14:00 **Biología de las abejas sin aguijón**
Dr. Ricardo Ayala Barajas.

14:00 a 15:00 **Comida**

15:00 a 18:00 **Práctica en laboratorio**
Dr. Ricardo Ayala Barajas.
- *Identificación de abejas nativas*
- *Reconocimiento taxonómico de abejas sin aguijón*

Appendix 7: Program of the training of trainers in meliponiculture Maya (Page 1/2)

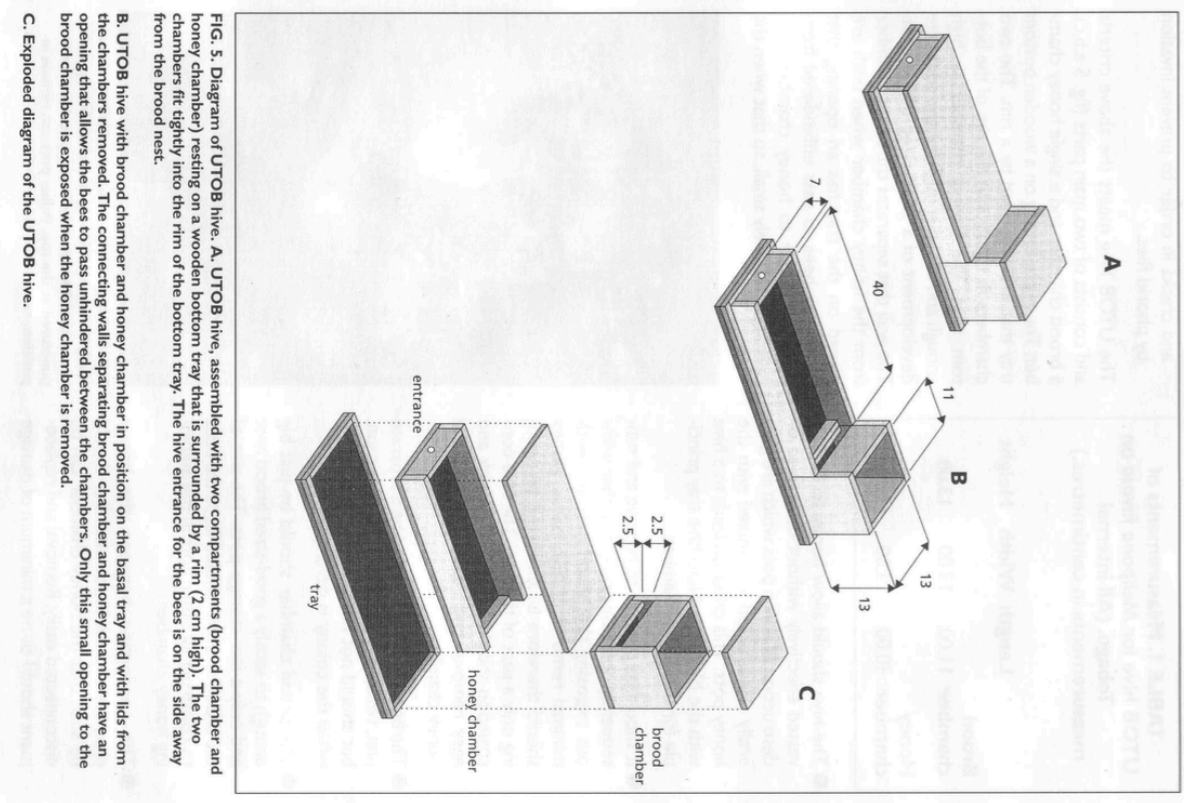
“Consolidación del Renacimiento de la Meliponicultura en la Península de Yucatán”

Formación de capacitadores en Meliponicultura Maya

Programa

- Domingo 16 de Octubre de 2016
- 8:00 a 9:00 Desayuno
- 9:00 a 13:00 **Vista a meliponario**
Dr. Ricardo Ayala Barajas.
-Reconocimiento de especies
-Diversidad de abejas
-Plática con interesados
- 13:00 a 14:00 **Testigo de interés**
C. Federico Berrón Autrique
- 14:00 a 15:00 **Comida**

Appendix 7: Program of the training of trainers in meliponiculture Maya (Page 2/2)



Appendix 8: The Design of the UTOB Hive