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Filling Gender Gaps: Determining How Traditional Knowledge of Lacandon Maya Women Shape the Diet and the Landscape in Lacanja Chansayab, Mexico

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FILLING GENDER GAPS: DETERMINING HOW TRADITIONAL KNOWLEDGE OF LACANDON MAYA WOMEN SHAPE THE DIET AND THE LANDSCAPE IN LACANJA CHANSAYAB, MEXICO

by

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Abstract

L. Pérez-Volkow. Filling Gender Gaps: Determining How Traditional Knowledge Of Lacandon Maya Women Shape The Diet And The Landscape In Lacanja Chansayab, Mexico, 130 pages, 10 tables, 5 figures, 2020. APA style guide used.

Women's knowledge and work in agroforestry food systems is poorly represented in the literature. I investigated women's role in the food system, their relationship to food, and how Lacandon Maya women manage the landscape in Lacanja Chansayab, Mexico. Qualitative research included interviews and participant observation. Quantitative research included plant community surveys of plots managed by women and men. Women's roles in food systems are central; they transform ingredients into meals and for agroforestry management. They express their relationship to food as a source of empowerment, as memory, a relationship to non-humans, and as a source of discrimination. No differences were found in terms of diversity and richness of ethnotaxons in agroforestry systems by gender. However, composition of ethnotaxons differs, a difference driven by the amount of maize, squash and disservice plants. This difference corresponds to unique management techniques. Women are producing and conserving diverse landscapes and diets in Lacanja Chansayab.

Keywords: traditional knowledge, gender, agroforestry systems, food systems, women

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1. Introduction

1.1 The story behind this thesis

Finishing a bachelor's degree in Biology, knowing a lot about Nature but not understanding what my relationship with Nature could be, was my main motivation to study a master's degree. I felt that in my life in the city I was surrounded by so many urgent situations, small fires that I had to constantly put out, that I had no time left to think about things that felt very important, but very distant. I wanted to have the time and energy to explore how we can relate in positive ways with living beings that are not human. A tendency is present in the media to simplify our relationship with Nature; on one extreme we believe Nature would be best without humans, and on the other extreme we see Nature as a necessary loss for "development". Neither of these extremes satisfied me, so I decided to explore other possibilities.

I wanted to be guided in this exploration by Indigenous knowledge. Indigenous knowledge has been shown to be an invaluable foundation for managing land over the long term, with high diversity, and with mutual nourishment provided (Kimmerer 2013). We have lost Indigenous knowledge due to systemic racism. Knowledge survival is itself a measure of its incredible power. My decision to study this knowledge was not with the purpose of owning it, but with the intention to offer respect by learning.

I want to share that throughout this process I have felt always a feeling of discomfort doing research with Indigenous knowledge, as often research has promoted its destruction. At some points I felt it was best not to work with Indigenous peoples. Nevertheless, now while writing this document, I think being uncomfortable is necessary; it has forced me to think about every step and, to the best of my ability, take me where I need to go.

Within Indigenous knowledge systems, I became fascinated by traditional agroforestry systems (TAFS). These spaces provide multidimensional benefits. Many of these TAFS offer healthy diets, meaningful work,

diverse landscapes, fertile soil, revitalization of language and culture, medicine, construction material, ornamental plants, aromatic plants, sense of place and, very importantly, a deep relationship with Nature. Their benefits can also be considered at a larger scale, where TAFS could provide the foundation of a "new" agricultural paradigm where land is not destroyed but managed and where we promote diversity in terms of Nature and culture.

I had done previous research into how agroforestry systems provide bioenergy through charcoal and was interested in exploring them in terms of food. This exploration would allow me not only to consider my relationship with Nature, but also my relationship with food —the daily act of nourishment— together with my own conceptions of womanhood and cooking. This last aspect was personally very important to me. It has always intrigued me that the way my family remembers both my grandmothers is often through their food. Cooking their meals is a way of bringing memory of them to life, as if their tenderness will remain as long as their recipes are cooked. I believe this connection is powerful. Women are disrespected historically for not having left behind as many great books or buildings. Women were and are dedicated to their home, and too often the choice of what to leave behind was not theirs to make. I believe it is time to recognize the value and history of domestic work in new ways, never forgetting historic vulnerabilities as we value what was produced. My grandmothers left us an infinite source of care through their recipes.

The other personal story behind this thesis is the story of the migration of my family. One part of my family is of Russian descent. Almost all that is left from this heritage is an old recipe of borsch and my name. Now from Mexico for two generations, we had lost contact with the family until very recently. We lost the language and many traditions. Cooking this recipe of borsch is among the only times it makes sense to me to have a last name Volkow next to Pérez, speaking once again to the power of recipes and cooking.

My path to working with the Lacandon Maya was not always clear. Sometimes I would find myself questioning another study of the Lacandon. However, in reading past ethnographies it became very clear to me. Researchers had mostly described food as a list of ingredients, barely speaking of recipes, and barely letting women speak. I understand many circumstances would cause this history. I do not intend to blame

anyone for not conducting this work before; I just thought it was time and necessary to dive into the complexity of women's perspective, food and cooking.

While doing this work, the history and present conquest of America (the continent) was constantly on my thoughts. Incessant quests have sought treasures: precious stones, ancient cities, modernity and also the American dream. A quote from *The Country of Cinnamon* comes to mind: *"something in my blood tells me that what we destroyed was more beautiful that what we were looking for"* (Ospina 2008, 338). True treasures are within our biocultural diversity. Luckily not everything is destroyed, and we can be involved in actions to break this destruction. I see this work as a small, imperfect action to prevent this destruction. As a final remark for new students, and as a future reminder to myself, I would like to share that before beginning this work I did not have a clear picture of what I was looking for, as sometimes not until you find it do you understand your search in a deeper way.

1.2 Literature Review

1.2.1 Rethinking our relationship with food

All humans need food to survive. Food is for some merely a source of the mundane activity of eating or another commodity, "*far too common and quotidian to be taken seriously*" (Nestle and McIntosh 2010, 163). But, for many others, food provides physical, emotional, and spiritual nourishment. Food is an agent that shapes relationships (Karaosmanoğlu 2020); creates stories; reflects social imbalances of societies such as class, gender, race, and ethnicity (Iwasaki-Goodman 2017); an object of aspirations, memories, nostalgia, status, prestige (Gálvez 2018). This spectrum of understandings creates diversity in how living beings relate to the land.

Historically, food studies have biased away from the knowledge of taste, smell, and touch (Abarca 2006). This bias results from their being "lower" senses: part of women's knowledge of food and therefore irrelevant (Abarca 2006; Karaosmanoğlu 2020). It has affected the way society perceives those food activities attached to women's labor, in particular cooking. Today scholars are challenging this approach

— re-thinking cooking as the creativity that requires knowledge and skill, a form of artistic expression. This frame describes the kitchen as a vital space. The historical erasure of the importance of eating leads to the erasure of women. The memory and stories of many women are only alive through the recipes they handed down, their *culinary memoir*, or their only autobiography (Abarca 2006).

Food is also traditionally a form of medicine. This idea has been coopted by food product developers, where additives address special dietary needs, such as rice for chronic kidney disease or mental health (Watanabe et al. 2016). However, food as medicine is far from new. Countless communities see the food they eat as the best way to combat disease, and perhaps more importantly, the core of their cultural identity. Food contains cultural knowledge, traditions, histories, and spiritual relationships that tie communities with their land and ancestors (Huambachano 2019). The COVID-19 pandemic has further made evident the need to restore food systems. People suffering from metabolic, diet-related diseases are more susceptible to infection, the development of serious illness, and even death (Fan et al. 2020).

Food is a living expression of the link between the biodiversity of a place and the traditional knowledge of the people. Through the continuous gathering of ingredients, cultivation, observations of the area, and cooking of ingredients, a strong relationship between a particular place and the people living there is created (Herminingrum 2019). Such relationship is never static. Innovation is continuous. New ingredients and new ways of mixing them are always present. This relationship between the land and what we eat has been eroded in both urban and rural areas, and it is through this erosion that many have come to think of food simply as a commodity. Not knowing where your food comes from may cause ecological blindness to the consequences of your choices. It is here that food can become an ecological and political act, where food becomes a way of nourishing yourself and the land.

1.2.2. Women and food

Women globally have historically played a central role in managing and preparing food. In many cultures, gender roles have located women in the domestic sphere, placing them in charge of caring activities, such

as preparing food for the family. Women have a particular role in society's nutritional health since their health is connected to the health of the whole community. This connection has two primary pathways. First, for direct biological reasons like reproduction and lactation, the health of the mother will directly impact the health of the child. Second, through their domestic labor, women are traditionally in charge of preparing food and ensuring proper nutrition in their families (Bellows and Jenderedjian 2015). Women's participation in food systems is therefore vital; excluding them from decision-making, hinders food sovereignty and society reaching its full potential (Declaration Nyéléni 2015; Navin 2015; Park, White, and Julia 2015; Lau 2020).

Cooking and kitchen activities have been related to women's oppression. One reason is that women often do not have the option to perform other activities. Also, for many years domestic work was not even considered a job, but a duty all women had to do. There is therefore a tendency to underestimate the importance of domestic labor, which is labor largely done by women, such as the preparation of food (Suárez Gutiérrez et al. 2016). Some have posited that praising women's uncompensated and unrecognized domestic work reaffirms their subordination and is antifeminist (Navin 2015). Nonetheless, despite inherent oppression, women have been able to find self-worth, recognition, pride, power, and happiness through their activities in the kitchen and the house. Spaces like the kitchen or activities like cooking have given women power.

Women's relationship with food is far beyond the preparation of meals. Women worldwide are important food producers but this central role was not acknowledged until recently (Quisumbing et al. 2014). One problem was that many researchers, practitioners, and policymakers assumed that men were primarily in charge of managing the landscape for producing food. Consequently, women's knowledge and work on food production are largely absent from the literature (Quisumbing et al. 2014; Cabrera, Martelo, and García 2001). This omission has led naturally to a paucity of information about the ways in which women are managing the landscapes, their agroforestry systems, and in general all their traditional ecological knowledge (Howard 2006).

The integration of this missing knowledge needs to be a step taken without treating women as a homogenous group, acknowledging preconceived notions of gender relations, and without expecting women to be independent drivers of conservation (Doss et al. 2018). To address women´s omission the importance of producing gender-disaggregated data, where information is collected from and about women as well as men, has been recognized (Padmanabhan 2011; Twyman, Muriel, and Garcia 2015).

Despite this general lack of information, important contributions have started to shed light on the relationship between women, food production, and agroecosystem management. Notable is the book *Women and Plants* compiled by Patricia Howard, where several authors describe women's relationship with plants in different parts of the world, such as Yucatán, México, southern Italy, Eastern Nepal, and Zimbabwe. In the compilation, it is possible to recognize the immense complexity of the knowledge women have regarding agroecosystems management and food production: familiarity with ecosystems, geographic features, climate, moon cycles, winds, weather, ecological succession, habitat, lifecycles of species, ecological indicators, in-depth knowledge of names and categories of culturally important plants and animals and vocabulary, recognition of poisonous plants, just to mention a few. This knowledge and work allow the persistence of the genetic and ecological diversity of landscapes, continuation of local cultures and languages, and culinary traditions (Howard 2003).

Another field that has pushed forward the understanding of women´s role in food production and landscape management is Agroecology. The book *Agroecology in Feminine* is a compilation of different organizations of women in Latin America boosting agroecological management. The book fights for making women visible in the fields, but also within academia. Case studies range from Brazil, Mexico, Bolivia, Colombia, to Nicaragua, and clearly show how women are paramount in food production within Latin America (Sánchez, Catacora-Vargas, and Siliprandi 2018).

1.2.3 Transformation of Indigenous food systems, a global approach

Food systems include processes, activities, and infrastructure for growing, harvesting, processing, and transporting food. We seek to understand from the seed to the table how a population is fed, and the health, environmental and economic consequences of the system. Studying food systems offers a holistic approach to more conventional categorization of processes like agriculture and preparation of food, as well as understanding the multiple systemic consequences.

Many Indigenous food systems were traditionally understood in a holistic way (González 2001). For example, in *Zapotec Science,* González writes of an example in a Zapotec community that uses the term *mantenimiento,* which encompasses all the work involved in the household maintenance: harvesting, cooking, cleaning, and taking care of the land and people.

Indigenous communities around the world have been subject to dramatic changes in their diets, often converting from a reliance on traditional food to becoming a part of the industrial systems. Dietary changes from traditional to store-bought foods in Indigenous communities have been linked to higher rates of malnutrition, diabetes, cancer, and cardiovascular diseases (Bordeleau et al. 2016; Hopping et al. 2010). Nonetheless, blame is often not placed on this converted food system, nor the social and economic inequality, poverty, and daily stress of this life people live. Instead, in error, responsibility for the higher prevalence of diet-related diseases in Indigenous communities is often placed on individuals — a biological determinism underwritten by racists assumptions (Montoya 2007). Change in diet is the fundamental problem, and genetic predisposition might make problems more acute. Through study of Indigenous food systems, we can help determine how their revitalization could lead to a more sustainable global food system.

Underlying systemic causes have led to change in the Indigenous diet, such as the history and current colonization, as well as associated land theft. Direct causes are also promoting a shift in Indigenous diet. For example, environmental pollution has made it unsafe to eat some traditional food in affected places, in particular larger animals, because of bioaccumulation (Bordeleau et al. 2016; Whyte 2015). In many parts

of the world, new jobs related to globalization are developing in communities; people are moving from harvesting their traditional food to harvesting cash crops or to tertiary activities like tourism and textile industry work. Park et al. (2015) has shown that higher cash income does not necessarily translate to better access to food because the food to which they now have access is of worse quality or higher priced. Traditional hunting and fishing become more limited, reducing the number of traditional foods people can consume. Cooptation and commodification of traditional seeds, as well as a promotion of Western agricultural methods, cultivars, and recipes have further limited availability of these foods (Hoover 2017). Finally, Climate change-related migration from urban to rural areas have led to people more basing their diet in processed food.

1.2.4 The impact of changing in the food system in bodies, daily meals, and land in Mexico

Mexico is an example of a country that has experienced a massive change in the food system, particularly since the North American Treaty (NAFTA) was signed in 1994. After the treaty, Mexico transformed its strategy of self-sufficiency to import dependency (Kinchy 2012). Diet changed from *milpa*-based (traditional polyculture) to one based on processed food (Gálvez 2018). Price lowering for sugar-rich foods as a consequence of NAFTA increased obesity, type 2 diabetes, and hypertension (Gracner 2015).

Sugar-sweetened beverages became more available; they are now one of the main calorie sources in Mexico (Sánchez-Pimienta et al. 2016). Mexico is today on a per capita basis the largest consumer of sweetened beverages in the world (Gálvez 2018). In 1980, before NAFTA, the main cause of death was accidents; diabetes occupied the 9th position. By 2000 diabetes mellitus had risen to the primary cause of death for Mexicans and, along with heart disease, remains at the top (INEGI 2015b; Perdigón-Villaseñor and Fernández-Cantón 2008).

Negative effects of NAFTA were not only felt in the body but also seen in their economic capacity. The agreement drastically lowered the price of corn, sharply increasing poverty in rural areas, migration to cities, and to the United States (Kinchy 2012). Small producers or farmers went from being important

providers of basic food to cheap labor for large industries (Ortega Hernández, León Andrade, and Ramírez Valverde 2010). Currently, 42% of the population of Mexico lives in poverty, with even higher rates in Indigenous populations (CONEVAL, 2018).

Due to new patterns of migration, rural areas in Mexico have seen a process of aging and feminization (Preibisch, Herrejón, and Wiggins 2002; Luiselli C. 2017). A 2012 survey of the agricultural sector, found that 1% of farmers were less than 26 years old, while 40% were over 60. This same survey found that between 18 and 27% (ranged by state) of farmers were women (CONEVAL 2016). At this same time, women have experienced increased violence. *Feminicidios*, or killing women due to their gender (Castaneda Salgado 2016), now averages 10 women daily (INEGI 2015a). We must rethink and re-evaluate women's role in Mexican society to counter this violence and better represent the current roles that women play.

Traditional ingredients in Mexico are now scarcer, reduced to communities that still harvest their own products or specific organizations that promote them. Fortunately, organizations like the Slow Food Movement or Alianza por la Salud Alimentaria, are making accessible local food and traditional recipes in Mexico. Another promoter of traditional cuisine, are upscale restaurants, although they have been criticized for making traditional food only available to wealthy populations as well as profiting off traditional cuisine without returning anything to communities those recipes come from (Gálvez 2018).

The shift in diet has been described as a form of unintentional but systemic violence against the population, where the food system reduces health in communities and shifts that health to the wealthy class (Gálvez 2018). It is ironic that Mexican food is not eaten in the communities it originated, but instead at restaurants capitalizing upon terms such as "rediscovering" and "rescuing" traditional food.

Consequences of changes to food system are also felt in the land. New food systems advanced lockstep with the Green Revolution. This conversion to agrochemical farming and mechanization was a set of political, scientific, and technological initiatives with a goal of optimizing the yields using high-energy

inputs, modified seeds, new machinery, and infrastructure. This change yielded large environmental consequences, such as river eutrophication, soil erosion, and the loss of native seeds. Governments with neoliberal agendas further promoted land-use change from forest to cattle ranching to increase meat production, intensifying after NAFTA.

Deforestation due to the Green Revolution and government programs supporting land-use change was particularly intense in tropical regions of Mexico (Durand and Lazos 2004; 2008). It has been estimated that 95% of the rainforest in the country has been cleared (Durand and Lazos 2004). Mexico, a megadiverse country, has converted many of its most diverse landscape to structurally simple monocultures and ranches, all the while failing to decrease hunger and poverty.

1.2.5 The Lacandon Maya and their agroforestry system

The Lacandon rainforest in Mexico is one of the last remnants of tropical rainforest in Mexico and one of the world's Biodiversity Hotspots (Myers et al. 2000). It also hosts some of the most important Mayan archeological sites such as Palenque, Yaxchilan, and Bonampak. The Lacandon are a Maya Indigenous group, with a distinctive Lacandon Maya language and are one of Mexico's smallest ethnic minorities (Trench 2008). They have been studied by several anthropologists since the 1930s and became famous worldwide based on unfounded beliefs that they were the "authentic Maya" (all Mayan groups descend from the ancient Maya) and because of their close relationship to Nature. The problem with how sometimes this information was used is that Lacandons are often portrayed as innate environmentalists and Chols and Tzeltals (other Indigenous inhabitants of the Lacandon Rainforest) as trespassers and destroyers (Trench 2002; 2008; Durand 2019). Notions of the depth of the environmental and agricultural knowledge of Lacandons with their territory do not come unfounded. This knowledge naturally does not mean that *all* Lacandons hold this knowledge and manage their landscape based upon it, but families are still basing their foodways and management upon traditional knowledge.

Lacandon agroforestry is a multistage successional system that “begins” with an intentional burning to start a polyculture and "ends" after ~40 years with a secondary forest (Diemont and Martin 2009). But, the system is truly a cycle. The system consists of seven stages called in Lacandon Maya as: *kor, robir, jurup che, pak che kor, mehen che, nu kux che,* and *tam che*. *Kor* is a polyculture based on maize known in Spanish as *milpa*. *Robir* and *jurup che* are the first two fallow stages, each of them lasts about 2 years. The secondary forest stages are *pak che kor* (takes about 7 years from the burn), *mehen che* (10 years), and *nu kux che* (20 years). *Tam che* is the name given to the primary forest.

Methodological Western scientific research documenting Lacandon Maya agroforestry began during the 1970s with Nations and Nigh (1980), who proposed that their agroforestry could be a point of departure for sustainable rainforest ecosystem management because it does not destroy the tropical forest. In that study, the authors found an incredible diversity of plants within the Lacandon *milpa* (maize polyculture) and documented the complexity of its management. Levy Tacher et al. (2002) quantified 480 different plant species in the system, where 73% of them were useful.

Diemont et al. (2006) found that by analyzing the system based on embodied energy (emergy), the Lacandon system sustainability in emergy terms was considerably higher than other farming systems, but sustainability relied heavily on systems being intact. An in-depth description of the agroforestry system showed a high diversity of plants and uses in each stage and how soil organic matter and nitrogen increased steadily with the successional stage (Diemont and Martin 2009). Specific plants in the agroforestry system that restore soil fertility (Diemont et al. 2006) and increase soil nutrient levels (Falkowski et al. 2016) were reported.

The initial burning in land management has been controversial since traditional knowledge in the community dictates that the burning is beneficial for the production, whereas the government and other stakeholders claim it only increases pollution levels. Nevertheless, the importance of using fire in the system appears to contribute to the nutrient flow and long term carbon storage (Nigh and Diemont 2013). The

agroforestry system is critical for ensuring food sovereignty as an average-sized *milpa* meets daily value nutritional requirements using only culturally-relevant food (Falkowski et al. 2019).

Nonetheless, the study of the Lacandon agroforestry system has not escaped global patterns of omitting information regarding women's management and their role in food production. This omission is despite early records of women who were producing food by themselves, or directly helping their husbands and family (McGee and Gonzaléz 1999). The inclusion of women in my and in future studies will increase our understanding of the Lacandon Maya agroforestry, and agroforestry more generally.

1.2.6 What is traditional food?

Agroforestry systems are a central part of the culture of place in southern Mexico. Their growth recreates traditions, native seeds, local language, and traditional food. Language matters and terminology carry political and social consequences. Several terms could be used when we refer to food culturally bounded to a people, place, and time:

Traditional food: *"evokes cultural heritage, the know-how shared and transmitted, quite often by word of mouth, amongst a more or less wide group of people, territory, country or geographical area.* […] *They suggest an extensive past which defines them as being tasty, healthy and in harmony with nature"* (Sebastia 2016, 2)

Ethnic food: *"foods originating from the heritage and culture of an ethnic group who use their knowledge of local ingredients of plants and/or animal sources"* (Kwon 2015, 1)

Indigenous food systems: *"specific collective capacities of particular Indigenous peoples to cultivate and tend, produce, distribute, and consume their food, recirculate, refute and acquire trusted foods and ingredients from other populations"*(Whyte 2015, 6–7)

Spirit food: *"Is the food that feeds your spirit (however you envision what this looks like)"* (Reinhardt 2015, 83)

In Lacandon Maya culturally-bounded food is called *hach o chi uch men* "true food of the past." Another common term that is used to refer to food, in particular tortillas which is a staple, is *hach waj* "true tortilla" and refers to tortillas that are handmade with local corn that has been nixtamalized (maize cooked and soaked in an alkaline solution). This tortilla is juxtaposed with tortillas bought in store and made with a dehydrated corn flour called Maseca (the brand name).

I decided to use the term traditional food in this document as it is the way Lacandon People refer to their food in Spanish. I recognize that this term has limitations; it has been used to assign cultural practices as something authentic that cannot be changed, performed, recreated, or modified, as criticized by Nohelani Teves (2015). Even though *hach o chi uch men* literal translation to "true food of the past" might suggest it has no place in the present, it should instead be interpreted as highlighting a long history.

1.3 Positionality

I need to consider my background and privilege as I describe my work. I am a non-Indigenous researcher working with an Indigenous community. This situation has been historically very problematic. It has sometimes led to the production of racist literature that imposed cultural views into populations.

Author Audra Simpson uses the term "anthropological desire" to explain the problematics of previous research *"anthropological desire: a desire for other, for purity, for fixity, and for cultural perfection that at once imagined an imminent disappearance immediately after or just within actual land dispossession"* (Simpson, 2014, p. 70.).

In the community where I worked, in the year 2015, all research was prohibited, except by members of my laboratory. I interpret this act as one of refusal as developed by Audra Simpson where the community is refusing to delegate their knowledge production to foreigners or people that do not adhere to a respectful relationship (Simpson 2014).

We are responsible for the trust the community of Lacanja Chansayab gave our group. My university offers a process through the Institutional Review Board that aids in assuring responsible, ethical, and respectful

research. But, particularities of working with Indigenous communities need to be addressed at a higher level. The community of Lacanja Chansayab does not have an explicit Research Code, but I will use previous work as reference (Harding et al. 2011) and in particular, my work adheres to the Ethics Code for Ethnobiological Research in Latin America (Villamar et al. 2018). None of the information collected will be shared without the approval from participants. Approval will be acquired at the beginning of each interview and throughout the participant observation process.

In addition to the codes my work will adhere to, I will define key concepts that will shape my methods and future interpretations. These concepts, ideas, and interpretations come from Native Feminist Theories and Critical Indigenous Theory. I chose these disciplines as a framework because they recognize the intersectionality of being a non-Indigenous person and a woman, recognizing Indigenous ways of knowing and question academic participation in Indigenous dispossession (Arvin et al. 2013).

Culture as Performance

The idea that culture is authentic is problematic because it impedes people from changing, recreating themselves, being internally diverse or contradictory (Nohelani Teves 2015). I will instead view tradition as something that is performed, changing, and practicing (Nohelani Teves 2015).

Critical Archival and Literature Analysis

Whenever doing the literature review of Indigenous women in the area, I want to have a critical eye while reading previous research. With this perspective in mind, I am not assuming all the work I will be reading will be problematic, but I want to have in mind that following Trouillot's ideas that historical narratives come with the position and are collective (Trouillot 1995). This historical narrative may have preconceived ideas of gender, relationships with the land, nonhuman beings that are not accepted by the community. By acknowledging this historical process, it is possible to move away from the study of culture as something authentic into the knowledge and critics that Indigenous people are articulating (Simpson 2014).

Knowledge production

I would like to move beyond looking at Indigenous Studies as cultural differences between science and traditional knowledge or Western and non-Western culture, but rather develop a site of knowledge production that encompasses Indigenous and non-Indigenous knowledge. Importantly, non-Indigenous scholars can engage with traditional knowledge, but not produce that knowledge (Moreton-Robinson 2016).

Sovereignty

Sovereignty in Indigenous communities is a paramount concept and can be understood beyond having the authority of their territory but also, having the authority in their bodies, mind, and knowledge system (Betasamosake Simpson 2015). Respect of sovereignty includes acknowledging that a vast quantity of knowledge I encountered and describe, belongs to the community.

1.4 Chapters

The goal of this thesis is to describe women's role in managing land and diet in Lacanja Chansayab. Chapters 2 and 3 are written as manuscripts for publication. The second chapter considers: 1) the relationship Lacandon women have with food, 2) how this relationship links biodiversity with diet, and 3) how traditional food can become an agent for biocultural restoration. The third chapter presents Lacandon women's management of land. For this description a plant community ecology perspective was taken, where a comparison of plots managed by women and men was completed in terms of richness, diversity, ethnotaxon composition, and management practices. I include a description of three stages of the Lacandon agroforestry system managed by women. The final chapter is a summary of the primary contributions of this work, its limitations, and recommendations for future work.

1.5 References

Abarca, Meredith E. 2006. Voices in the Kitchen: Views of Food and the World from Working-Class Mexican and Mexican American Women. Texas A&M University Press.

Arvin, Maile, Eve Tuck, and Angie Morrill. 2013. “Decolonizing Feminism: Challenging Connections between Settler Colonialism and Heteropatriarchy.” Feminist Formations, 8–34.

Bellows, Anne C, and Anna Jenderedjian. 2015. “Violence and Women’s Participation in the Right to Adequate Food and Nutrition.” In , 54.

Betasamosake Simpson, L. 2015. “"The Place Where We All Live and Work Together: A Gendered Analysis of ‘Sovereignty’.” In Native Studies Keywords. The University of Arizona Press.

Bordeleau, Serge, Hugo Asselin, Marc J. Mazerolle, and Louis Imbeau. 2016. “‘Is It Still Safe to Eat Traditional Food?’ Addressing Traditional Food Safety Concerns in Aboriginal Communities.” Science of the Total Environment 565: 529–538. https://doi.org/10.1016/j.scitotenv.2016.04.189.

Castaneda Salgado, Martha Patricia. 2016. “Feminicide in Mexico: An Approach through Academic, Activist and Artistic Work.” Current Sociology 64 (7): 1054–1070.

CONEVAL. 2016. “Medición de La Pobreza, Estados Unidos Mexicanos, 2010-2015.” Mexico: CONEVAL.

Declaration Nyéléni. 2015. “Declaration Nyéléni.” Development 58 (2): 163–68. https://doi.org/10.1057/s41301-016-0014-4.

Diemont, Stewart AW, and Jay F. Martin. 2009. “Lacandon Maya Ecosystem Management: Sustainable Design for Subsistence and Environmental Restoration.” Ecological Applications 19 (1): 254–266.

Diemont, Stewart AW, Jay F. Martin, and Samuel I. Levy-Tacher. 2006. “Emergy Evaluation of Lacandon Maya Indigenous Swidden Agroforestry in Chiapas, Mexico.” Agroforestry Systems 66 (1): 23–42.

Diemont, Stewart AW, Jay F. Martin, Samuel I. Levy-Tacher, Ronald B. Nigh, Pedro Ramirez Lopez, and J. Duncan Golicher. 2006. “Lacandon Maya Forest Management: Restoration of Soil Fertility Using Native Tree Species.” Ecological Engineering 28 (3): 205–212.

Durand, Leticia. 2019. “Power, Identity and Biodiversity Conservation in the Montes Azules Biosphere Reserve, Chiapas, Mexico.” Journal of Political Ecology 26 (1): 19–37.

Durand, Leticia, Fernanda Figueroa, and Tim Trench. 2014. “Inclusion and Exclusion in Participation Strategies in the Montes Azules Biosphere Reserve, Chiapas, Mexico.” Conservation and Society 12 (2): 175. https://doi.org/10.4103/0972-4923.138420.

Durand, Leticia, and Elena Lazos. 2004. “Colonization and Tropical Deforestation in the Sierra Santa Marta, Southern Mexico.” Environmental Conservation 31 (1): 11–21.

———. 2008. “The Local Perception of Tropical Deforestation and Its Relation to Conservation Policies in Los Tuxtlas Biosphere Reserve, Mexico.” Human Ecology 36 (3): 383.

Falkowski, Tomasz B., Adolfo Chankin, Stewart AW Diemont, and Robert W. Pedian. 2019. “More than Just Corn and Calories: A Comprehensive Assessment of the Yield and Nutritional Content of a Traditional Lacandon Maya Milpa.” Food Security 11 (2): 389–404.

Falkowski, Tomasz B., Stewart AW Diemont, Adolfo Chankin, and David Douterlungne. 2016. “Lacandon Maya Traditional Ecological Knowledge and Rainforest Restoration: Soil Fertility beneath Six Agroforestry System Trees.” Ecological Engineering 92: 210–217.

Fan, Yang, Yue Zhang, Akash Tariq, Xiaolan Jiang, Zeeshan Ahamd, Zhang Zhihao, Muhammad Idrees, Azizullah Azizullah, Muhammad Adnan, and Rainer W. Bussmann. 2020. “Food as Medicine: A Possible Preventive Measure against Coronavirus Disease (COVID-19).” Phytotherapy Research.

Gálvez, Alyshia. 2018. Eating NAFTA: Trade, Food Policies, and the Destruction of Mexico. Edición: First. Oakland, California: University of California Press.

González, Roberto J. 2001. Zapotec Science: Farming and Food in the Northern Sierra of Oaxaca. 1st ed. Austin: University of Texas Press.

Gracner, Tadeja. 2015. “Bittersweet: How Prices of Sugar-Rich Foods Contribute to the Diet-Related Disease Epidemic in Mexico.” Job Market Paper.

Harding, Anna, Barbara Harper, Dave Stone, Catherine O’Neill, Patricia Berger, Stuart Harris, and Jamie Donatuto. 2011. “Conducting Research with Tribal Communities: Sovereignty, Ethics, and Data-Sharing Issues.” Environmental Health Perspectives 120 (1): 6–10.

Herminingrum, Sri. 2019. “The Genealogy of Traditional Javanese Cassava-Based Foods.” Journal of Ethnic Foods 6 (1): 15. https://doi.org/10.1186/s42779-019-0015-5.

Hoover, Elizabeth. 2017. “‘You Can’t Say You’re Sovereign If You Can’t Feed Yourself’: Defining and Enacting Food Sovereignty in American Indian Community Gardening.” American Indian Culture and Research Journal 41 (3): 31–70.

Hopping, B. N., E. Erber, E. Mead, T. Sheehy, C. Roache, and S. Sharma. 2010. “Socioeconomic Indicators and Frequency of Traditional Food, Junk Food, and Fruit and Vegetable Consumption amongst Inuit Adults in the Canadian Arctic.” Journal of Human Nutrition and Dietetics 23 (s1): 51–58. https://doi.org/10.1111/j.1365-277X.2010.01100.x.

Huambachano, Mariaelena A. 2019. “Indigenous Food Sovereignty: Reclaiming Food as Sacred Medicine in Aotearoa New Zealand and Peru.” New Zealand Journal of Ecology 43 (3).

INEGI. 2015. “Población. Número de Habitantes.” 2015. http://www.cuentame.org.mx/poblacion/defunciones.aspx?tema=P.

———. 2018. “Estadísticas a Propósito Del Día Internacional De La Eliminación De La Violencia Contra La Mujer (25 De Noviembre)”.” 592/19.

Iwasaki-Goodman, Masami. 2017. “Transmitting Ainu Traditional Food Knowledge from Mothers to Their Daughters.” Maternal & Child Nutrition 13 (S3): n/a–n/a. https://doi.org/10.1111/mcn.12555.

Karaosmanoğlu, Defne. 2020. “How to Study Ethnic Food: Senses, Power, and Intercultural Studies.” Journal of Ethnic Foods 7 (1): 11. https://doi.org/10.1186/s42779-020-00049-1.

Kinchy, Abby. 2012. Seeds, Science, and Struggle: The Global Politics of Transgenic Crops. MIT Press.

Kwon, Dae Young. 2015. “What Is Ethnic Food?” Journal of Ethnic Foods 2 (1): 1.

Lau, Jacqueline D. 2020. “Three Lessons for Gender Equity in Biodiversity Conservation.” Conservation Biology, February, cobi.13487. https://doi.org/10.1111/cobi.13487.

Levy Tacher, Samuel Israel, J. Rogelio Aguirre Rivera, María Magdalena Martínez Romero, and Alejandro Durán Fernández. 2002. “Caracterización Del Uso Tradicional de La Flora Espontánea En La Comunidad Lacandona de Lacanhá, Chiapas, México.” Interciencia 27 (10).

Luiselli C. 2017. Agricultura y Alimentación En México. Siglo Veintuno Editores.

Maass, J. Manuel, Patricia Balvanera, Alicia Castillo, Gretchen C. Daily, Harold A. Mooney, Paul Ehrlich, Mauricio Quesada, Alvaro Miranda, Victor J. Jaramillo, and Felipe García-Oliva. 2005. “Ecosystem Services of Tropical Dry Forests: Insights from Long-Term Ecological and Social Research on the Pacific Coast of Mexico.” Ecology and Society 10 (1).

Montoya, Michael J. 2007. “Bioethnic Conscription: Genes, Race, and Mexicana/o Ethnicity in Diabetes Research.” Cultural Anthropology 22 (1): 94–128.

Moreton-Robinson, Aileen. 2016. Critical Indigenous Studies: Engagements in First World Locations. University of Arizona Press.

Nations, James D., and Ronald B. Nigh. 1980. “The Evolutionary Potential of Lacandon Maya Sustained-Yield Tropical Forest Agriculture.” Journal of Anthropological Research 36 (1): 1–30.

Navin, Mark. 2015. “Food Sovereignty and Gender Justice.”

Nestle, Marion, and W. Alex McIntosh. 2010. “Writing the Food Studies Movement.” Food, Culture & Society 13 (2): 159–179.

Nigh, R., and Stewart AW Diemont. 2013. “The Maya Milpa: Fire and the Legacy of Living Soil - Google Académico.” https://scholar.google.com/scholar_lookup?title=The%20Maya%20milpa%3A%20fire%20and%20the%20legacy%20of%20living%20soil&author=R.%20Nigh&publication_year=2013&pages=E45-E54.

Nohelani Teves, S. 2015. “Tradition and Performance.” In Native Studies Keywords. The University of Arizona Press.

Ortega Hernández, Alejandro, Marilú León Andrade, and Benito Ramírez Valverde. 2010. “Agricultura y Crisis En México: Treinta Años de Políticas Económicas Neoliberales.” Ra Ximhai 6 (3).

Ospina, William. 2008. El Pais de La Canela/The Country of the Cinnamon. Editorial Norma.

Park, Clara Mi Young, Ben White, and Julia. 2015. “We Are Not All the Same: Taking Gender Seriously in Food Sovereignty Discourse.” Third World Quarterly 36 (3): 584–599.

Perdigón-Villaseñor, Gerardo, and Sonia B. Fernández-Cantón. 2008. “Principales Causas de Muerte En La Población General e Infantil En México, 1922-2005.” Boletín Médico Del Hospital Infantil de México 65 (3): 238–240.

Preibisch, Kerry L., Gladys Rivera Herrejón, and Steve L. Wiggins. 2002. “Defending Food Security in a Free-Market Economy: The Gendered Dimensions of Restructuring in Rural Mexico.” Human Organization, 68–79.

Quisumbing, Agnes R., Ruth Meinzen-Dick, Terri L. Raney, André Croppenstedt, Julia A. Behrman, and Amber Peterman, eds. 2014. Gender in Agriculture. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-017-8616-4.

Reinhardt, Martin. 2015. “Spirit Food: A Multi-Dimensional Overview of the Decolonizing Diet Project.” In Indigenous Innovation, 81–105. Brill Sense.

Sánchez-Pimienta, Tania G., Carolina Batis, Chessa K. Lutter, and Juan A. Rivera. 2016. “Sugar-Sweetened Beverages Are the Main Sources of Added Sugar Intake in the Mexican Population.” The Journal of Nutrition 146 (9): 1888S-1896S. https://doi.org/10.3945/jn.115.220301.

Sebastia, Brigitte. 2016. “Eating Traditional Food: Politics, Identity and Practices.” In Eating Traditional Food, 15–33. Routledge.

Simpson, Audra. 2014. Mohawk Interruptus: Political Life across the Borders of Settler States. Duke University Press.

Suárez Gutiérrez, Gloria Mariel, Eduardo Bello Baltazar, Rosa Elba Hernández Cruz, and Allan Rhodes. 2016. “Ecoturismo y El Trabajo Invisibilizado de Las Mujeres En La Selva Lacandona, Chiapas, México.” El Periplo Sustentable, no. 31.

Trench, Tim. 2002. “Conservation, Tourism and Heritage: Continuing Interventions in Lacanjá Chansayab, Chiapas, Mexico.” PhD Thesis, University of Manchester.

https://www.academia.edu/24990511/CONSERVATION_TOURISM_AND_HERITAGE_Continuing_interventions_in_Lacanj%C3%A1_Chansayab_Chiapas_Mexico.

———. 2008. “From ‘Orphans of the State’ to the Comunidad Conservacionista Institucional: The Case of the Lacandón Community, Chiapas.” Identities 15 (5): 607–34. https://doi.org/10.1080/10702890802333827.

Trouillot, Michel-Rolph. 1995. Silencing the Past: Power and the Production of History. Beacon Press.

Villamar, Arturo Argueta, Olga Lucia Sanabria Diago, Eréndira Juanita Cano Contreras, and Armando Medinaceli. 2018. “Código de Ética Para La Investigación Etnobiológica En América Latina.” Ethnoscientia 3 (2).

Watanabe, S., A. Hirakawa, C. Nishijima, K. Ohtsubo, K. Nakamura, S. Beppu, P. Tungtrakul, J. Q. Sun, E. S. Tee, and T. Tsuno. 2016. “Food as Medicine: The New Concept of ‘Medical Rice.’” Adv Food Technol Nutr Sci Open J 2 (2): 38–50.

Whyte, Kyle. 2016. “Indigenous Food Systems, Environmental Justice, and Settler-Industrial States.”

CHAPTER 2

From rainforest to table: Lacandon Maya women are critical to diverse landscapes and food in Lacanja Chansayab, Mexico

2.1 Introduction

Domestic activities have throughout history and among many if not most cultures been considered women's exclusive responsibility. Domestic work includes food preparation, caring for family, and cleaning. All those activities entail a great amount of complex knowledge. Nonetheless, it is a set of skills that due to societies' own bias for undermining domestic work has failed to see and study, let alone value. Today scholars are challenging this perspective and are re-thinking the domestic sphere as a vital space for physical, emotional, and spiritual wellbeing. Preparation of food, for example, is a source of health, aspirations, memories, history, nostalgia, status, prestige (Gálvez 2018), and a form of artistic expression that requires creativity (Abarca 2006; Karaosmanoğlu 2020).

A second fault of arbitrarily placing women in the domestic sphere is that women are rarely exclusively working inside their houses. Women are performing activities that complement domestic ones, and yet this work has been historically erased. This bias is evident when studying food systems, where women are many times assumed to be exclusively involved in the preparation of meals; literature is lacking in the study of women's management of land, cultivating and harvesting (Howard 2003; Quisumbing et al. 2014), which are themselves activities vital for food preparation. Thus, culinary traditions have the potential to illustrate the strong link between culture and biodiversity, where the kitchen is a space for holistic nurturing and biodiversity conservation (Howard 2010).

The present work aims at providing information on women´s role in the food system, using the Lacandon Maya as a case study. The Lacandon Maya are an Indigenous community who live in the Lacandon tropical rainforest of the state of Chiapas, Mexico. Their traditional food system has been studied for more than 40 years, where special emphasis was given to understanding their traditional management of the rainforest and how it could serve as a point of departure for proposing a sustainable food system (Nations and Nigh

1980; Diemont and Martin 2009; Nigh and Diemont 2013; Falkowski et al. 2019) as well as documenting ethnobotany (Levy Tacher et al. 2002; Diemont 2006; Diemont and Martin 2009; Cortés et al. 2013; Cortés, Méndez-Mariaca, and Farrera-Pérez 2015; Ford and Nigh 2015; Nations and Valenzuela, Chan K'in Jose 2017; Cortés, Mariaca-Méndez, and Pérez Farrera, Miguel Ángel 2018). However, this emphasis has left behind how these edibles are transformed into daily meals and all the work, skills, and cultural meanings behind them. Culinary diversity has been shown in other systems to be an important driver to maintaining high biodiversity (Howard 2003; Nabhan, Walker, and Moreno 2010a). Traditional knowledge has been shown to be heterogenous among gender and other factors, such as age and principal occupation (Howard 2006). Given this finding and because almost all previous research with Lacandon has been done exclusively with male informants, it is critical to rectify this gender gap and work with Lacandon women.

Information about Lacandon women's role in the food system has been scarce (Nečasová 2010). Research has documented their role as primarily devoted to the preparation of meals since this is the activity that consumes much of their daily time (Soustelle 1933; Suárez Gutiérrez et al. 2016). A small part of conducted research has documented women's participation in cultivating ingredients, particularly work done by older widows or unmarried women, even though crop cultivation is an activity traditionally related to manhood (McGee and Gonzaléz 1999). Ensuring daily meals are provided by Lacandon women not only involves cooking, but also many other activities such as gathering or buying necessary ingredients, harvesting and caring for the patio garden, and caring for chickens. Many Lacandon women, especially younger generations, also prepare food for tourist groups in local restaurants.

Working in the rapidly-developing tourist sector has been one of the greatest changes Lacandon women have faced in the last years (Nečasová 2010). In addition to preparing meals for tourists, women work in other roles, such as cleaning and giving tours. Suárez Gutiérrez et al. (2016) criticized how women mostly work in jobs that reflect the domestic sphere and have few opportunities to go beyond those roles. Another important change in women's roles in the food system has been the shift from traditional food to processed food, especially in younger generations.

Nonetheless, Lacandon Maya women's role in their food system is largely absent from the literature. Lacandon women's stories, their work, and their memories are not to be found in ethnographies. Stories are, however, still told in the kitchen, and traditional work remains. Reclaiming women's stories will require exploring their recipes (Williams-Forson 2006), as cooking is the activity that still dominates their time.

Given this knowledge gap, the objective of this work is to describe Lacandon Maya women's roles in the food system. Women manage biodiversity to later transform it into the diet of the people in Lacanja Chansayab, Chiapas, Mexico. I use a qualitative approach to determine how Lacandon Maya women are part of the food system; I explore the ways their knowledge and skills link biodiversity with food and finally how women propose to maintain their traditional food as a way of restoring their community bioculturally.

2.2 Methodology

2.2.1 Study site

Lacandon Maya live in three communities, Lacanja Chansayab, Naha, and Metzabok. Lacanja Chansayab is itself subdivided into three different localities called San Javier, Bethel, and Lacanja Chansayab. Field research was conducted in the locality called Lacanja Chansayab, located at 16.6026°N, 90.9149°W. Lacanja Chansayab is in the Montes Azules Biosphere Reserve region in the state of Chiapas, Mexico. It is a tropical moist forest and has an elevation of 500m. Rainfall averages approximately 2300 to 2600 mm per year, and the mean temperature is 24.7 °C (Falkowski et al. 2019). According to the data from July 2019 at the community health center, the total population of Lacanja is of 588, the number of women ≥20 years old is 173.

2.2.2 Description of the Lacandon Maya food system

The Lacandon Maya food system currently brings together the traditional agroforestry system and externally-processed foods (**Figure 2.1)**. The traditional agroforestry system is a multistage successional and cyclical system that "begins" with an intentional burning to start a polyculture and ends with a secondary forest, but returns to polyculture. It takes about 40 years to complete a full cycle (Diemont and

Martin 2009), but few systems still cycle back from the most advanced stages. The system consists of seven cycling stages referred to in Lacandon Maya as: *kor, robir, jurup che, pak che kor, mehen che, nu kux che,* and *tam che*. *Kor* is a polyculture based on maize known in Spanish as *milpa*. *Robir* and *jurup che* are the first two fallow stages, each of them lasts about 2 years. The secondary forest stages are *pak che kor* (takes about 7 years from the burn), *mehen che* (10 years), and *nu kux che* (20 years). *Tam che* is the name given to primary forest. The agroforestry system also includes the house patio garden (hereafter patio), which is external to the successional areas. The patio is a place where families cultivate plants from the whole agroforestry system and tend them near their homes. Women and men oversee the agroforestry system. Traditionally this labor role was mainly for men, but single women (because they never married or are widows) survive by producing their food through this system.

Locally cultivated and wild foods that are a product of the agroforestry system are processed in (sometimes open-air) kitchens to prepare traditional food; this role is a labor exclusive to women. The agroforestry system and the meals it produces are embedded in a reciprocal relationship with the sociocultural system, where reproducing it simultaneously strengths their local language, culture, and local economy.

Convenience stores in Lacanja mostly sell processed foods like sodas, cookies, potato chips, candies, pasta, and canned food. They occasionally also sell fresh products, especially onions, tomatoes, and garlic. Consumption of processed food is extensively advertised through the television, internet, and signs within and outside the stores.

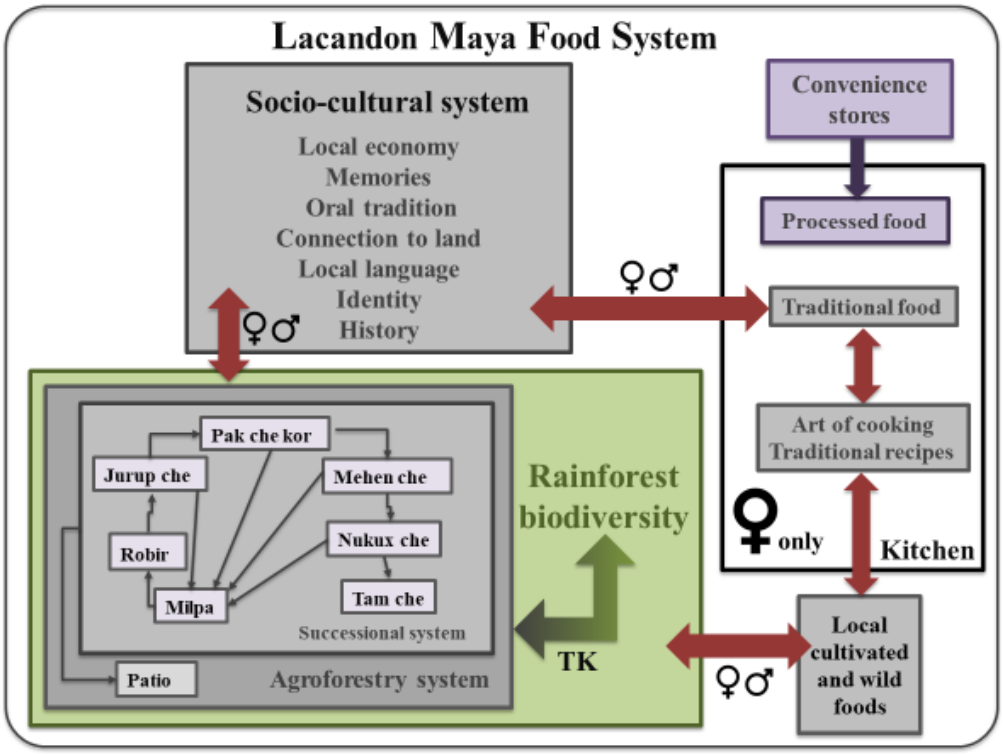

Figure 2.1: Lacandon Maya food system in Lacanja Chansayab

2.2.3 Field methods

2.2.3.1 Participant observation and conversation

Fieldwork lasted for 3 months in the summer of 2019; a second short visit was made in January 2020. Information was initially gathered as a participant-observer, taking daily notes from the fieldwork experience. This participant-observer was mainly within individual households foraging food, weeding, and cooking together with women in the community. At a more community level, I attended graduation ceremonies of primary and secondary school and gave a seminar to students from secondary school. Note-taking and coding of the notes were complemented with a weekly memo writing as suggested by Grounded Theory (Charmaz 2006). The initial strong emphasis on participant observation, note-taking, coding, and memo writing was intended to aid in the development of a list of the most relevant issues to be furthered explored in conversations. This project, including the conversations for this paper, was approved by the Syracuse University Institutional Review Board for research involving human subjects.

In total, I had 15 conversations (which incorporated two interviews) with key informants: 10 participants identified as cisgender women, and 5 participants identified as cisgender men of Lacanja Chansayab. As the main objective of this study was to gather women's perspectives, interviews with men were completed to contrast information; their views do not constitute the focus of the analysis. I employed purposive sampling to identify relevant individuals who represented a heterogeneous sample. Once interviews began, additional informants were recruited through snowball sampling. I worked toward heterogeneity in sampling, ensuring a wide age range from 25 to 90+ years of age (participant is unclear of birthdate), with the average age of women of 49.5±20.3 (±SD) and men of 37.8±9.9. Heterogeneity in women was also sought in terms of marital status. I included single, married and widowed women; in terms of the main occupation, where some women are completely devoted to their traditional agroforestry system and other women only work at restaurants, and one of them owned a restaurant.

Conversations were designed in two parts: first a semi-structured interview and second a non-structured interview. The semi-structured section gathered general information of participants and their agroforestry system if existent. The non-structured section aimed at capturing information on three themes: 1) relationship of the participant with food, 2) changes of food over time and current access to traditional ingredients, and 3) actions for the biocultural restoration of the community through traditional food. Biocultural restoration was defined as the *"*process to integrate human values in ecological restoration to increase long-term restoration success*"*(Greenlaw et al. 2009, 4). In particular, I was looking for locally-relevant reciprocal actions aimed at strengthening cultural identity, the local language, improving nutrition and food sovereignty, while also increasing native biodiversity (Kimmerer 2013; Bremer et al. 2018).

A general interview procedure was used, beginning with an informed consent document and establishing permission to audio record the interview. These conversations were designed using "decolonizing methodologies" (Smith 2001) trying to think of women as critical thinkers and not just informants. The design was intended to create an informal atmosphere to allow women to feel more comfortable. I do not

claim to speak for the Lacandon women, but instead, relate the knowledge shared by them as a basis to understand their role in managing the food system.

To protect the anonymity of participants, names are omitted and instead numbers were assigned to each person. I report the gender of the participant, accompanied by their assigned number, and then their age. For instance, (W1, 25) refers to a woman who is 25 years old. It was often the case that older women felt less comfortable speaking Spanish. A bilingual woman translator provided simultaneous Lacandon-Spanish translation in these cases.

2.2.3.2 Recipe collection

Twenty Lacandon Maya traditional recipes were collected with six women. Three of these women participated in the conversations described above. Those who did not participate in these conversations declined because they were not comfortable with audio recording, were too busy working with tourists, or could not find the time for another reason. Recipe processes were documented from the gathering of the ingredients through the dish being served to try to reflect as much the complete food system. Due to this extended process, some recipe collection took several days to complete. Women who shared the recipes chose the recipes themselves. They chose them purposefully to display a variety in collection time, preparation, processing difficulty, personal preferences, and ingredients. Recipes that include wildlife were excluded to prevent non-Lacandon use of the information (e.g., by tourism focused on hunting of wild and rare species) that might negatively affect wildlife populations. Each recipe includes general information about the dish and cultural information.

2.2.4 Analysis

I transcribed the audio recordings verbatim with the help of an undergraduate research assistant (Grace Taylor). Texts were uploaded to the R package RQDA (Huang, R. 2016) and then coded in Spanish. I developed an initial set of codes related to food preferences, benefits, and observed differences of traditional food and processed food. I reviewed the final code reports by hand, analyzing the text for the emergence of

key themes such as changes of the food system in time, different types of relationships to food, and biocultural restoration through traditional food.

2.2.5 Researching with Lacandon Maya women

Researching in a community where women are not accustomed to speaking to strangers, or in some cases voicing their opinions, presents challenges, and to a feminist researcher, moral dilemmas. It happened several times that whenever I wanted to interview women, men in the house would come out, curious as to what was going on (naturally, as a stranger is coming to your house). When it was mentioned that my interest was to ask women questions, they would say things like "they don't speak Spanish well", "they didn't go to school", or "they do not know many things." However, when I further explained that the topic of our research was food, men stopped their objections and accepted that women in the house were more knowledgeable than them in this area. Sometimes he would then refer me to elder female family members who could also participate in the research. After this exchange, the men would leave to continue with their other activities, permitting direct conversation with women. Interviews were conducted by a researcher who is a woman to allow women to feel more comfortable and safer. I recognized food systems as a vehicle to speak to women in the community, a theme and place where women not only feel empowered, but also where men recognize their power. Given this distinction, food can become an entryway to women's opinions, stories, perceptions, such as previously reported in Abarca (2006). Many times, women used the space and time provided in these conversations to talk about personal or social problems that women faced in the past or were facing currently. These stories made evident the violence that women face in the society, with issues like forced marriage, rape, placing women's value on virginity, and society giving responsibility of children to women and never men. I will not discuss these issues in detail because they are outside the scope of my work, but reflect the cultural violence that women face, their vulnerabilities and limitations. This cultural violence is the *"structural or direct violence that is legitimized under terms of cultural practice, tradition, and institution"* (Galtung 1990, 291).

2.3 Results

Themes resulting from this work were in several major categories, the first one involves the rich and profound relationship women have with food. The second explains how women link the biodiversity of the rainforest with a diverse diet. The final category is an exploration of ways to promote biocultural restoration through traditional food.

2.3.1 Lacandon Maya women's relationship with food

Women's relationship to food in Lacanja is complex and diverse. Preparing food is the activity that takes most of their day because women have the responsibility of feeding all others. This responsibility carries not only the physical and mental burden of feeding their families, but also feeding tourists. Four of the participants' (in conversations) primary work is cooking for tourists; one of them owns a restaurant. I will describe four different facets of the relationship they have with traditional food: as a source of empowerment, to create mutual relationships with non-humans, to remember women and food as a source of social discrimination. I chose these areas as they were the most salient throughout conversations.

2.3.1.1 Food as a source of empowerment

I noted often during fieldwork that the kitchen was a space where women were most comfortable and free. It was in the kitchen that they seemed to relish this space of their own, and topics of conversation changed. They would talk about their dreams and future plans; how they see the future of their kids; and complain about their partners, their parents, and politics. Women gather around the kitchen while they cook and it is mainly within food spaces that they can voice their opinion, and their opinion will be heard. Traditional food is a medium by which many women shape their identity in these places: *"Our traditional food I feel is unique, I haven't tried it in any other place"* (W9, 25). This stance is important because it helps younger generations to find meaning and importance in their cultural traditions.

The cultural tie to their food is not only present in the preparation of the dishes, but several women cultivate their products. Many of these women are widowed or decided not to remarry. As shared by a 68-year-old

widow: *"I am old now, I get tired working in the milpa because I work alone; nobody helps me. I like to work in the milpa; I like to spend time in the milpa, because I like to harvest maize, because if I do not grow maize, what would I eat? I also like to spend time in the milpa"* (W1,68)**.** Harvesting their products is a way these women have found to be independent and survive. Despite it being strenuous work, especially for a woman of her age, she finds joy and meaning in growing her food. Older unmarried woman often lack access to money, some of them see growing their food as an easier way to guarantee enough food and leave money they have to buy those products they cannot produce, such as for health issues or family emergencies: *"I prefer traditional food because it is easier, because for the store food you need money. Since I am a woman, it is difficult to work. Only sometimes can I buy food from the stores, mainly tomatoes" (*W5, 49).

This activity also allowed a woman to decide against marrying, a rare case in the community. One woman said that she made this decision she was *"scared; maybe he hits me"* [referring to a potential husband] (W5, 49). Through her work in the field, she was able to break from something culturally expected, like that all women need to marry a man. Cooking has also granted economic independence to women from selling food to tourists. This revelation has been life-changing for many of them; it has opened up opportunities that were previously out of reach. For example, many women are now able to live as single mothers and raise their kids without being forced to live with a man, which can have other negative consequences because men are culturally excluded from the financial burden to support their kids.

2.3.1.2 Food to create mutual relationships with non-humans

Food is a medium from which women establish mutual relationships with non-humans. They are considered mutual relationships because they are reciprocal actions between one another. In the case of edible plants, women tend them. By caring for them, plants receive all that is needed (enough sun, water, nutrients), and in exchange plants provide an enormous diversity of nutrients, flavors, and cultural meanings. Such relationships are constantly experienced by women. Women give much of their day to their relationships with non-humans beings. For instance, they walk in the rainforest to forage food, take care of plants and

domestic animals in the patio, gather food in the *milpa*, and for those that manage their agroforestry system, all the work the harvest implies. Traditional food that makes this relationship more vibrant drives this interaction. Processed food eliminates some aspects of these interactions because, even though many women combine traditional ingredients with processed food, processed food lacks any mutual interaction. Relationships with non-humans are a source of joy to Lacandon women that can be expressed at the moment of eating, *"the food I like, and I almost daily eat"* (W1,68), and the joy can also be expressed at the moment of creating this mutual relationship *"I also like to spend time in the milpa"* (W1,68)**.**

This mutual relationship also guarantees a sense of security. Because women have contributed to the growth of their food, they are sure about all that they contain. A 90+-year-old woman, who by herself cultivates her *milpa* shared what traditional food is for her: *"food I like and it is natural because you can find it in the milpa, like the mushroom, epazote and some other from the jungle"* (W2,+90). The fact that food is "natural" was a common idea that women mentioned as important to them; this provided them a sense of safety from the unknown: *"*[traditional food] *has no chemicals, you are not using anything coming from the store, everything is natural"* (W9, 25). Additionally, they argued that traditional food is healthier for them: *"traditional food does not cause disease, is better for me, the best for health"* (W7,57).

2.3.1.3 Food to remember women

All the time and work that women put into food leaves a mark within their families. When talking about why women choose cooking traditional food, many claim that they eat it because it reminds them of their mothers: *"*[traditional food] *is important because it reminds me of my mother, my mother used to like cooking traditional food"* (W1,68). All the time spent together cooking develops a strong bond between women, particularly between mother and daughter.

It is also the way men remember women. The mother of W6 passed away and this event has been very difficult for her father. The family has given him a lot of support, and they have found that he only wants to eat traditional food, the same his wife used to cook. *"Ever since my mom passed away, my dad cannot*

eat everything; he can't eat soup (pasta soup), nothing. What we do for him is boil chayote, just that, we add onion, just like that, no oil. There is another one in the milpa, purslane. We always go and look for that one to cook over here and then I give it to my dad […]. *He can eat that; it doesn't make him feel bad, he eats that"* (W6, 40). Food is a way to remember women even after they have passed away.

2.3.1.4 Social discrimination and traditional food

Throughout the interviews, informants mentioned discrimination and shared experiences of bullying for eating traditional food instead of store-bought food. In an interview with a 90+ year-old, she shared with me, *"People laugh about the food I eat. Most people are now used to seeing food from the store" (*W2, 90+). She mentioned that she receives negative comments from her grandchildren. Another woman with younger kids said that they do not want to eat traditional food. She shared with me, *"Now people mock traditional food because they do not like it; they say it does not have flavor, that comes with a lot of smell. I now eat traditional food by myself"* (W7, 57). She still cooks traditional food, but not as often as before, since it would imply preparing several dishes. The consensus among older participants was that many kids and younger generations feel disdain for traditional food.

Younger women that still want to cook traditional food receive social pressure to buy store-bought food since that indicates having the financial power to do so: *"They mock traditional food; they say it is not delicious; people eat it because of lack of money.* […] *The same thing, if you invite someone home to eat; if they see traditional food, sometimes they do not like to eat.* […] *They prefer soda and food from the store"* (W10, 30). This woman has also received comments from having "coarse" hands as she makes tortillas by hand, and it involves handling a very hot pan to cook them.

2.3.2 From the rainforest to the table: food as the link between biodiversity and a diverse diet

Cooking a traditional meal involves having access to the traditional food system. Without access to the traditional food system, it would be impossible to continue with the culinary heritage. This relationship is because the ingredient variety is the result of a diverse landscape, and it changes with the seasons.

Traditional Lacandon management consists of successional stages, each of them providing an array of ingredients that may sometimes be found in more than one part of the system. But some ingredients are exclusive to a particular stage of the agroforestry system and to a particular time of the year. Those parts of the system that are notably providing more edibles are the *kor* (*milpa*) and patios. The diversity of the landscape is translated into a diverse diet, where one depends on the other to exist. You need ingredients from different sections of the agroforestry system to cook traditional food, and it would not make sense to have a complete agroforestry system if you are not going to cook the food that it provides.

To exemplify this intricate relationship, **Table 2.1** shows an example of two different traditional dishes and the origin of each ingredient. Traditional food is seasonally-bound, meaning that some ingredients are only found during a certain time in the year, some of them only one single night a year. Many ingredients can be found in several systems simultaneously. For example, bananas are often found in patios, *kor,* and *robir*.

Cooking food involves a deep knowledge of the land, biodiversity, and seasons. Women need to be familiar with the ecosystems, geographic features, ecological succession, lifecycles of species, ecological indicators, techniques of harvesting and processing food, timber and fuel, famine foods, food safety, and the potential toxicity of plants. For instance, in October and February river snails and crabs should not be eaten because they taste bitter. This bitterness is because a tree called *ek' ba' che'* (*Guatteria anomala*) sheds its leaves and flowers that are eaten by the snails and crabs, consequently changing their flavor to unpalatable. Women need to know this information and always be observant of the leaves found in the ground. When gathering the snails and crabs, women are careful to not take the smaller ones, as they know this harvest will deplete the population. Women take their kids, especially girls, on these walks to harvest the ingredients and later participate in the cooking.

Conversations around traditional foods were always filled with listings of favorite traditional ingredients and their favorite recipes. This listing would come spontaneously, without a specific question that triggered it, even if it meant an abrupt change of topic. Many times, even after saying goodbye or during the next visit, a woman would remember an old recipe her mother used to make or the name of an ingredient she

previously could not recall. I interpreted this unprompted participation as a need they had of remembering the food and sharing their knowledge and also an example of the abundant diversity of traditional meals.

Table 2.1: Ingredients and their origin for two traditional recipes

Recipe	English	Lacandon Maya	Latin binomial	patio	kor	robir	mejen che	tam che
 **Snail with *herba santa***	river snails	t'unu	*Pachychilus indiorum*					x
	hoja santa	jobé	*Piper auritum*	x	x	x		
	tomato	p'ak	*Solanum lycopersicum*	x	x			
	onion	ts'ak'ek'en	*Allium spp.*	x	x			
	thorns	k'ek'	*Citrus aurantiifolia*	x				
 **Chicken tamales**	chicken	kax	*Gallus gallus domesticus*	x				
	achiote	kuxú	*Bixa orellana*	x				
	peppermint	ts'ak kax	*Mentha spicata*	x	x			
	onion	ts'ak'ek'en	*Allium spp.*	x	x			
		ch'amak w'a	unknown	x			x	x
		sak goro	*Heliconia sp.*	x	x			
		ja' c'hor	*Heliconia sp.*	x	x			
	maize	nar	*Zea mays*		x			
	tomato	p'ak	*Solanum lycopersicum*	x	x			
	chili	ik	*Capsicum sp.*	x	x			

2.3.4 Biocultural restoration of traditional food

To propose biocultural restoration methods, it is important to understand the implications of the loss of traditional food for people. As shown in the previous section, the loss of traditional food will have several personal and cultural effects on women and people in Lacanja. In this section I first explore benefits that people receive from keeping the traditional food system and second, I share concrete actions that could be made to promote its biocultural restoration.

2.3.4.1 Implications of shifting diet in Lacanja

Preoccupation is present within the community that people are shifting their diets from traditional products to those that are sold in the stores. This change worries many people in the community because of the observed increase in associated diseases, an increase in pollution, and a loss of identity that comes with processed food. Every participant reported still eating traditional food and that it is the food that they most like. The knowledge and practices are there, and women are important carriers of that knowledge. But, even if knowledge is there, people are not necessarily using it.

Increase in associated diseases permeated conversations about the loss of traditional foods, and it is a source of constant fear. Women refer to traditional food not only as one that will not cause disease, but also food as medicine: *"There are times that disease is caused by this food* [store food] *because before medicines were found in medicinal plants before the medicine was in the medicinal plants and now things have changed and food causes disease"* (W1, 68). The fact of the increase of disease is also a reason why a woman hoped that people will go back to traditional food: *"I think things will go back* [to traditional food] *because a lot of people die now and before it was not that way. For example, now I see that many people suffer from diabetes; everyone who is older has high blood pressure, that is what I see, and before it was not like that. This is what my father tells me before they did not use to eat food from the outside like now, people eat lots of grease, as you see, chips, soda; soda is very bad, it is truly bad, yes very bad"* (W6, 40).

The main staple in Lacanja is maize tortillas, so changes in this staple are symbolic of other changes in the community. Tortillas were originally made from corn harvested in the community. Now, some people, especially younger generations, prefer tortillas made with dry maize flour that only needs to be hydrated and then cooked to be eaten, locally called by the brand name Maseca. Women buy Maseca to prepare the tortillas themselves, or daily buy tortillas already made. Buying Maseca eliminates the main use of corn for people and the time-consuming process of growing enough maize for the year and the preparation of tortillas through nixtamalization. Women mentioned that especially kids prefer Maseca tortillas over those made by their locally grown corn: *"Kids like that it is softer; they say it melts easier, but true maize is better because*

if you put it in a soup it doesn't melt easily; you can eat it" (W10, 30). However, many women claim that Maseca tortillas cannot replace traditional tortillas as they have a bland flavor and are not as filling: *"I don't like, pure Maseca I do not like it, just what is made here"* (W6, 40).

As easy as it is to buy Maseca tortillas and other processed food from the stores, it is very hard to buy traditional food; convenience stores do not sell it. If anyone wanted to buy traditional ingredients, they would need to go directly to producers to see if they have a surplus to sell. Rarely it is the case, as producers tend to only harvest for direct consumption for their families. Many producers even if they have a surplus will only sell it to family members, as they highly value their products.

Loss of traditional food would have important emotional and cultural implications for women. Participants reported being sad about this possibility: *"I become sad if people stop eating traditional food"* (W10, 30). They also claim that this loss will not happen because they will continue with the tradition: *"I become sad* [when talking about the loss of traditional food]. *I will not lose it. I will still cook traditional food"* (W5, 49). This reported sadness is not something minor. Food is attached physically, culturally, and spiritually to the people, so its loss would be traumatic in all spheres of life in Lacanja.

2.3.4.2 Actions for the biocultural restoration of Lacandon food

Planning restoration for local culture needs to come from the community. I asked participants what actions people could take in Lacanja to restore traditional food without compromising their current activities. I heard three main ideas: reinvigorate the cultivation of traditional agroforestry systems, promote oral transmission of culinary knowledge, and offer traditional foods to tourists.

The first thing that all participants agreed upon was that women and men need to continue growing the agroforestry system and care for the rainforest to ensure the supply of ingredients and guard their seeds: *"men need to have their milpa, or ask their grandfather, his father, harvest beans, onions, vegetables"* (W5, 49). Here it is important to note that even though men are traditionally the ones in charge of growing

the ingredients, and women of preparing them, several women in Lacanja manage their agroforestry system, thus cultivating and preparing food by themselves.

The second is that women's role in contemporary Lacandon society is transmitting the traditional recipes to younger generations since women are holders of the knowledge of traditional cuisine. It was clearly stated by all participants that women need to teach the recipes to younger generations by cooking together: *"*[women] *need to ask their aunt, grandmother, mother to learn and recover* [the recipes], *maybe that they even prepare meals together, that she starts liking it* [traditional food]*"* (W4, 64). Although women in the community and I recognize that a physical book does not replace oral tradition, we documented twenty traditional recipes from the community (see Appendix 3 for an excerpt).

The last idea was that participants thought tourists should be offered traditional food instead of "tourist food" as a form of culinary tourism and as a way to promote the preservation of the food system, as one participant mentioned: *"Tourists ask to eat traditional food* […] *they want to eat something natural from Lacanja*" *(*W2, 90+). There were many perceptions and opinions among participants regarding how tourists relate to traditional food. Some argued that tourists are very curious and keen to try and eat traditional food. Others claimed that tourists do not like to try traditional food and prefer to eat what people refer to as "tourist food" which is fried chicken, quesadillas, fried potatoes, steak, etc. Some women who work in restaurants even recall experiences when they cooked for tourists, and they received negative comments, which were deeply offensive. Despite it being a contentious theme, many people agree that it would be a good idea to offer traditional food to tourists, especially if they have a recipe book where they can show beforehand pictures and the ingredients of the traditional recipes.

2.4 Discussion

By focusing on women's perspective in this work, I was able to gain insight into the complexity of the relationship between Lacandon Maya and their food, as well as women's fundamental role in this relationship. Women's daily work with food connects them in intimate ways with those who they feed (Allen and Sachs 2007), but also with the land.

2.4.1 Lacandon Maya's women relationship to food

2.4.1.1 Food as a source of empowerment and meaning

Women's domestic work has been rightfully claimed by feminist literature as one of the main sources of gender imbalances between women and men. Women are socially forced to be responsible for domestic work, many times without the choice to do so, and also despite in many cases working another full-time job (Nieto 2004). This structure seems the case for most of the women in Lacanja. As reported in previous research, in tourism activities in Lacanja women are mostly in charge of preparing food and cleaning; both activities are strongly linked with their traditional role as care providers, and they are generally excluded from being in a position of making decisions (Suárez Gutiérrez et al. 2016). This undoubtedly puts them in a disadvantaged position relative to men.

The fact that domestic work and cooking is a source of oppression does not mean that women are unable to find power and meaning from it. Most women recognize benefits from working at restaurants, such as earning their own money, supporting their children's education, developing new abilities, talking to tourists, and having more control of their time (Nečasová 2010; Suárez Gutiérrez et al. 2016; Abarca 2007). Cooking traditional food also empowers women as proud carriers of the tradition, skills, and knowledge; it has also been considered an act of resistance to cultural hegemony as it goes against globalization trends (Blend 2001; Parveen 2016). However, often women are constrained to the extent that they are only considered reproducers and not shapers of the tradition (Blend 2001). Denying the importance of women's domestic work blinds society to the value of work and knowledge that women have provided throughout generations of feeding themselves, their families, and now tourists.

The kitchen epitomizes a space of contradictions for Lacandon women because it can be a place for personal nourishment, recognition, and creativity but can be simultaneously an enclosing and narrowing place, as women do not have the option to leave (Blend 2001). Despite its contradictions, the kitchen is the center of life for many women, serving as a room of her own, the closest they have to what Virginia Woolf proposed

(in: Woolf 1929): the place where they have control of the narrative and can be creative. It is no surprise that most of the conversations with women were in the kitchen or directly outside of it. A pressing question for Lacandon women will be how to gain more control and power in their lives without sacrificing appreciated culture and history.

2.4.1.2 Creating mutual relationships with non-humans and land

Lacandon Maya women do not traditionally adhere to a Western world view that understands "Nature" and "culture" as opposing realms. They instead understand human beings as part of Nature, the same way many other Indigenous communities do. The creation of mutual relationships with non-humans also develops an important attachment to their land (Fletcher 2017). Nature, which is the rainforest for the Lacandon, is not only the context where they live, but also a continuous process where land is a source of conducting relationships, knowledge, and understanding (Wildcat et al. 2014; Betasamosake Simpson 2015). This fundamental difference makes the relationships with non-humans and their land something essential in the life of Lacandon people. Traditional food is an important expression of this relationship.

Traditional food is a source of well-being and health in a profound way for Lacandon women. Traditional food not only involves this spiritual relationship to their land and non-human beings but also culturally because it gathers important elements like language, tradition and physical health.

Cultivating their food then eating from it has a deep spiritual significance for the Maya as an important definer of identity (de Frece and Poole 2008; Isakson 2009). Watching how plants grow and nurture from the products of their own or family labor is a source of pleasure and meaningful work for people involved in those activities (Isakson 2009; Timmermann and Félix 2015). This pleasure and meaningfulness are linked to the relationships the work allows them to establish with non-humans and humans. When Lacandon women say that traditional food is better for their health, this assertion involves physical, spiritual, and cultural aspects. Giving a lot of value to food quality has also been reported in other Indigenous

communities in Mexico, like among Zapotec, where quality is more valued than quantity and adjectives like “clean” are used to describe their traditional food (González 2001).

2.4.1.3 Food and memory

The circular and cyclical nature of domestic work gives the impression that nothing concrete is left behind, and all the work has vanished (Christensen 2001; Woolf 1977). Women cook, food is eaten, dishes are cleaned to later be dirty again. However, a powerful connection exists between food and memory, and precisely its cyclical nature makes it reproducible. Food not only has cultural, spiritual, and personal meanings but also invites other senses that transmit cues like taste and smell, creating an intense bodily reaction (Holtzman 2006; Parveen 2016). Given that many women are traditionally connected to food and providing food, food is a vehicle for particularly feminine forms of memory (Holtzman 2006). Remembering women through their food was constant throughout all the conversations. Women cook dishes that remind them of their mother or recreate those that her mother used to make them as an act of self-care, restoring their memories through food (Christensen 2001). The case of a man who lost his wife and would refuse any food from elsewhere shows that solely by eating traditional food that his wife used to cook to him can his family nourish him during his grief. This nourishment is something powerful, as if women’s tenderness could be felt so long as those traditional dishes can be cooked. Evoking culinary tradition also implies invigorating the memory of past generations of women (Abarca 2006; Parveen 2016), where the kitchen becomes a repository of memories (Christensen 2001).

Food can also elicit many different types of memories, and maternal memories and nostalgia may also be heavily linked to childhood and a lost past. Lacandon people have experienced a massive change in their lifestyles in the past four decades, particularly due to the entrance of tourism and globalization. Food that was previously eaten, particularly traditional food as opposed to processed food, can elicit a sense of place and identity that can be maintained and performed when eating (Holtzman 2006).

2.4.1.4 Food source discrimination and resistance

Mexico has had a complex relationship with pre-Hispanic food. Some dishes and ingredients were fully adopted and still feed the nation, such as maize tortillas, while others, like the amaranth, were initially prohibited and then had a relative resurgence (Lozano 2016). Another example is the case of pulque. This traditional drink consists of the fermented sap of the agave. Pulque during the 20th century had a great boom as the most consumed alcoholic drink. However, its consumption and production later collapsed due to a vast campaign of discredit led by the beer industry and the government (Álvarez-Ríos, Figueredo-Urbina, and Casas 2020). In this complex relationship with pre-Hispanic food, a tendency has developed to show disdain for certain products and recipes, particularly those regularly eaten in rural communities, where subsistence agriculture is the main economic activity. Such ingredients and dishes are often referred to with negative connotations related to poverty, unsanitary conditions, and malnutrition through TV, social media, and governmental programs. For example, Progresa, the national program to combat poverty, has implicit ideas of the "correct diet", that come with racialized assumptions of the inadequacy of peasant diets that assume they are not nutritious (Gálvez 2018). Such ideas indicate that Indigenous diet and lifestyle is backward.

Systemic discrimination against traditional food is reinforced in a community where stores, social media, and television produce desire and demand for processed foods through constant marketing (Gálvez 2018). Status, prestige, and modernity are associated with those that have the money to pay for those products, especially among the youth. It is a common scene to find young men drinking soda and eating potato chips outside their houses with music at high volume, showing that they have the financial power to do so. Eating unprocessed food or little meat are seen in the community as linked to poverty. Some people in Lacanja resist these ideas by continuing to grow and prepare their traditional foods. Some decide traditional foods will be their daily diet. Others acknowledge that for them due to a changed community of tourism and other outside influences, daily traditional cooking it is no longer possible. However, whenever they have the opportunity, especially during low tourist season, they cook these foods.

2.4.2 From the rainforest to the table: food as the link between biodiversity and a diverse diet

Preparation of traditional foods by Lacandon Maya women rarely simply involves the mixing of ingredients. Preparing a meal requires ample knowledge of biodiversity and how to manage this diversity. A strong relationship ties together biodiversity, culinary traditions, and cultural identity (Howard 2006). Historically, scholars have failed to recognize that women are active cultivators and managers of ecosystems and thus important to ensuring sustainable management and conservation of ecosystems worldwide (Howard 2003). Moreover, women's culinary work, either directly cultivating food or by ensuring they have all the ingredients required for their meals, is important for the conservation of crop genetic diversity, a cornerstone for local and global food sovereignty.

Research has shown a tremendous diversity of edible plants in the traditional Lacandon agroforestry system. Levy Tacher et al. (2002) found 96 plants of the system were edible, representing 20.7% of the total percentage. Edible plants were found in all the stages of the agroforestry system, but *Kor* is the stage with the highest prevalence of edibles and also the stage that requires the most time for management (Diemont and Martin 2009). The two recipe examples shown in **Table 2.1** have ingredients coming from four different stages, one comprised of five plant ingredients and the other of eleven plants. Ethnobotanical listings are an important first step into showing the extensive traditional ecological knowledge of the Lacandon, but this perspective misses an opportunity in describing knowledge for preparing these edibles into culturally-relevant and delicious meals. An inherent relationship links traditional food with traditional agroforestry systems that provide all the ingredients; one requires the other to be sustainable.

In a study that measured the agricultural yields and nutritional content of all foods (crops and wild game) harvested from the *kor* system, it was found that nearly all nutritional requirements are met for a family of 5.3 members on a little over 2 ha (Falkowski et al. 2019). In this same study, it was found that *kor* may only be unable to provide sufficient saturated fat, calcium, cholesterol, sodium, and iodine among all the nutrients analyzed. These deficiencies, as mentioned in the article, are not only overcome by additional

foods provided by other stages, but also by the preparation process. Preparation of food changes the nutrient availability of food by increasing or decreasing its contents through different processes like boiling or roasting. Nevertheless, cooking also adds additional nutrients to food. For example, calcium carbonate rock is mixed with maize for the preparation of tortillas or iodized salt for daily use, adding required calcium and iodine, respectively. Traditional cuisine not only conserves the knowledge to gather ingredients from all the agroforestry systems, but preparation also increases the potential for providing the nutrients that meet family needs.

2.4.3 Biocultural restoration through traditional food

2.4.3.1 Moving from traditional to processed food

Abandonment of traditional agroforestry systems to other activities like tourism, leading to a rising accessibility of cash, has led to a divergence from traditional food to industrially produced food among the Lacandon. This diet shift represents an important cultural loss for the community, as traditional food involves cultural knowledge, traditions, histories, spiritual relationships that tie communities with their land and ancestors (Huambachano 2019) and are a product of potentially thousands of years for the development of knowledge systems (Diemont and Martin 2009). Industrial food also exacts an environmental toll through packaging waste, energy, water, transportation, and related pollution. In health terms, dietary changes from traditional food to store-bought foods in Indigenous communities have been linked to malnutrition, diabetes, cancer, and cardiovascular diseases (Bordeleau et al. 2016; Hopping et al. 2010). Research has shown that higher cash income does not necessarily translate to better access to nutritious food; food to which they now have access is sometimes of worse quality, or food prices rise (Park, White, and Julia 2015).

The change in economic activities has provoked an increasing availability of cash for the Lacandon in the past years. Together with activities related to tourism, people in the community receive money from government programs. One such program was discontinued in 2019, Prospera, a nationwide poverty relief

program through conditional cash transfers. Another important program is payments for ecosystem services (PES). In Prospera direct transfers were delivered to women in the households so long as they participated in mandatory workshops on nutrition, health, and education (Barajas Martínez 2016). Programs with these characteristics have been criticized for increasing the unpaid household care responsibilities of women and placing children's well-being over women's accomplishments (Molyneux 2006; Gálvez 2018). Receiving money from PES by women is only common for widows, as losing their husbands is the only way women gain access to land tenure. Such programs have also provided benefits to the communities by decreasing the economic burden of sending kids to school; many participants mentioned that it has helped to increase access of girls to education.

Shifting traditional diet to processed food is something that has been reported in the other Lacandon communities like Metzabok (Sharif 2012), and is a phenomenon happening throughout Mexico (Gálvez 2018). However, the transition from a traditional diet to processed food does not happen without resistance. For example, in the case of Maseca tortillas, resistance to the flavor of tortillas by campesinos and even protests against the brand have occurred (Pilcher 2006), similar to the way some women in the community put their time and energy into cooking handmade tortillas as a conscious decision for their families, rather than feeling imposed upon.

2.4.3.2 Actions for biocultural restoration through traditional food

The restoration of traditional food systems and cultural identity can be motivated through the importance of traditional food (Nabhan, Walker, and Moreno 2010a). Balsanelli (2017; 2019) documented how traditional diet is fundamental for Lacandon cosmovision and identity. Cooking and eating traditional food encapsulates a biocultural restoration step for the community (Kimmerer 2013). Restoration of land mainly comes through the growth of traditional agroforestry; it is highly sustainable with limited external inputs (Diemont et al. 2006, Falkowski et al. 2015). The traditional food system also leads to conservation and restoration of local seed and gene banks (Arslan and Taylor, E. 2009). Language is the principal vehicle for communication of this knowledge (Howard 2010). Because Lacandon Maya is orally communicated, its

traditional food also provides revitalization for language, related perhaps to biodiversity's strong correlation with linguistic diversity (Upadhyay and Hasnain 2017). Traditional food provides more nutrients and physical benefits to communities than outside foods. One example compared traditional tortillas with dry corn flour tortillas, showing that the former is a healthier option given that it has higher content of nutritional and bioactive compounds (Colín-Chávez et al. 2020).

Lacandon Maya recipes are part of a collective tradition, the persistence of which depends upon their ability to transmit traditional knowledge to future generations. Their continuity requires conserving and restoring interpersonal relationships within families and the community. Valuing traditional food is directly valuing women's work in the community. Lastly, traditional food system provides people a guarantee for a sustenance strategy within current uncertain economic, health and climatic times (Isakson 2009; Eakin et al. 2014); its restoration is a financial safety net.

Traditional food could become an agent of change in dynamics between the community and tourists. Offering traditional food to tourists could become a way to share knowledge of the Lacandon people about the region as well as providing bonds between local people and tourists through the pleasure of eating (Karaosmanoğlu 2020). Sharing Lacandon food at events such as the Fiesta Maya (December 25th) or during Easter could be a way of recognizing themselves as a group, sharing dishes that symbolize their cultural heritage and reaffirms their belonging to a distinct cultural group (Iwasaki and Goodman 2017). It should be noted that offering traditional foods to tourists could have negative impacts because traditional diet could become more available for those from outside the community than within the community because of its high prices. In the Lacandon community of Naha, the government did a traditional recipe book as a vehicle for culinary tourism (De la Cruz Guillén, Guadalupe 2004). This initiative was welcomed by the community and is a useful example for work in Lacanja.

The recipe book that I created with participants in Lacanja (see Appendix 3) differs from the one in Naha in the sense that recipes in our book were not discussed by several women to reach a consensus. Rather in our recipe book, each woman was considered the author of the recipe. I acknowledge the collective nature

of traditional cooking, and that ownership of a recipe is absurd, but at the same time I wanted to recognize the personalized innovations each woman has given to the recipes and their time and energy in creating the book. Since many women who worked with me do not read, we made a recipe book that has several pictures that show the process. Finally, our recipe book is conceived as a vehicle for biocultural restoration, and the promotion of culinary tourism is considered a potential paired benefit. I believe the traditional recipe book is important because we mean to: i) counteract industrial food propaganda in the community, ii) praise women's value and knowledge, iii) promote cooking traditional food when people look at the pictures and read the content iv) show the intricate relationship between the rainforest, the agroforestry system, and the recipes v) promote traditional recipes with tourists (here special attention was given to exclude any recipes that include wildlife species).

I see with concern the entry of industrial food to Lacanja and how it is eroding Indigenous food. Traditional systems have been able to survive globalization because of ample benefits in terms of health, identity, and the environment that it provides to the people that maintain them. Maintaining traditional food is an act of resistance by this community (Calvo and Rueda Esquivel, Catriona 2015). Losing traditional systems could have traumatic consequences for community members and the land.

The process of biocultural restoration should not be evaluated solely with the benefits of the end project. Rather it has been shown that the most important benefits are associated with the process of restoration (Bremer et al. 2018). The conversations and ideas brought forward by women in the community have an enormous value that could trigger larger action. Food sovereignty is fundamental for communities; relying on importing food is too risky. Modern food systems are destroying habitats and are party to chronic diseases that makes the health of the whole system vulnerable to collapse in times of crisis. Re-establishing healthy relationships with the land and decolonizing food systems is an excellent beginning. Women and men engaging in a traditional agroforestry system in Lacanja contribute to breaking this cycle of external change and degradation.

2.4.4 Limitations and future research

This work was based on conversations about food with a few Lacandon women. The number of conversations represents approximately 6% of the population. I concentrated on developing depth in relationships over increased participant numbers. Expanding the number of participants is a natural next step to this work to better represent the entire population of Lacanja. Fieldwork was conducted between June and August, which is the season with the highest tourism. Women who work in restaurants often could not find the time and energy to participate in conversations and audio recordings. Interviews conducted at other times of the year would provide a better description of the overall views of women in Lacanja.

This work documents part of the relationship some women in Lacanja have with food. I am certain that there are many aspects of this relationship not represented. I recognize that some women in the community dislike cooking, had no interest in participating in the project and prefer processed food for several reasons. This work, therefore, biases towards positive relationships that women have with food. Themes touched upon in this article are complex. It is the goal of this work to provide a general platform to initiate further discussion and study.

It would be valuable to conduct geographically-expanded research, including in Lacandon communities of Naha and Metzabok, to better understand the relationship of Maya women with food in other parts of Mesoamerica. Next steps could explore in more detail the socioeconomic factors affecting the consumption of traditional food to understand drivers of the shift in diet. It would also be important to study how cultural and structural violence against women limits their access to basic rights, adequate food and nutrition, and other opportunities for self-development as well as suggestions for actions to overcome this gender imbalance (Bellows and Jenderedjian 2015).

2.5 Conclusion

Lacandon Maya women are fundamental to the continuation of traditional food systems in Lacanja Chansayab, Mexico, as they oversee the translation of rich edible biodiversity into meals. Such meals are

full of cultural meanings and personal memories that are an important part of Lacandon identity. Traditional food also promotes local biodiversity and agrobiodiversity conservation.

The relationship between food and women is complex and rich. I found that food is a source of empowerment for women, as their work is valued by their families. By cooking, some of them have been able to become economically independent. Traditional food involves a way to create relationships with non-humans beings and other women. Women are often remembered through the food they cook, leaving an important mark upon their family members. I found that younger generations increasingly prefer store-bought food as it implies social status; these values are being reinforced by television, internet, advertisements, and government programs that make cash more available. Traditional recipes are a fundamental part of the traditional agroforestry system; they serve as a motor to reproduce the complex system. Those recipes are a source of physical and spiritual nutrition for the people.

To boost a biocultural restoration through traditional food, participants thought it necessary to maintain the traditional agroforestry system, the oral transmission of traditional recipes and that traditional recipes be offered to tourists, a practice that is not common. It is important to defend and appreciate the dignity of women's work and knowledge since it is critical to achieving food sovereignty, social justice, and environmental restoration.

2.6 References

Abarca, Meredith E. 2006. Voices in the Kitchen: Views of Food and the World from Working-Class Mexican and Mexican American Women. Texas A&M University Press.

———. 2007. "Charlas Culinarias: Mexican Women Speak from Their Public Kitchens." Food and Foodways 15 (3–4): 183–212.

Allen, Patricia, and Carolyn Sachs. 2012. "Women and Food Chains: The Gendered Politics of Food." Taking Food Public: Redefining Foodways in a Changing World, 23–40.

Álvarez-Ríos, Gonzalo Daniel, Carmen Julia Figueredo-Urbina, and Alejandro Casas. 2020. “Sistemas de manejo de maguey pulquero en México” 18: 3–23.

Arslan, A., and Taylor, E. 2009. “Farmers’ Subjective Valuation of Subsistence Crops: The Case of Traditional Maize in Mexico,” 18.

Balsanelli, Alice. 2017. “La comida del otro: el papel del régimen alimenticio en la formación de identidad y alteridad entre los mayas lacandones.” Perifèria. Revista d’investigació i formació en Antropologia 22 (2): 68. https://doi.org/10.5565/rev/periferia.614.

———. 2019. “Cuando la comida tiene alma: reflexiones en torno a las prácticas cinegéticas lacandonas.” Maguaré 33 (1): 47–73. https://doi.org/10.15446/mag.v33n1.82406.

Barajas Martínez, Gabriela. 2016. “Prospera, Programa de Inclusión Social:?` Una Nueva Estrategia de Atención a La Pobreza En México?”

Bellows, Anne C, and Anna Jenderedjian. 2015. “Violence and Women’s Participation in the Right to Adequate Food and Nutrition.” In , 54.

Betasamosake Simpson, L. 2015. “"The Place Where We All Live and Work Together: A Gendered Analysis of ‘Sovereignty’.” In Native Studies Keywords. The University of Arizona Press.

Blend, Benay. 2001. “‘I Am an Act of Kneading’: Food and the Making of Chicana Identity.” In Cooking Lessons: The Politics of Gender and Food, 41–61. Lanham, MD: Rowman & Littlefield.

Bordeleau, Serge, Hugo Asselin, Marc J. Mazerolle, and Louis Imbeau. 2016. “‘Is It Still Safe to Eat Traditional Food?’ Addressing Traditional Food Safety Concerns in Aboriginal Communities.” Science of the Total Environment 565: 529–538. https://doi.org/10.1016/j.scitotenv.2016.04.189.

Bremer, Leah L., Kim Falinski, Casey Ching, Christopher A. Wada, Kimberly M. Burnett, Kanekoa Kukea-Shultz, Nicholas Reppun, Gregory Chun, Kirsten LL Oleson, and Tamara Ticktin. 2018.

"Biocultural Restoration of Traditional Agriculture: Cultural, Environmental, and Economic Outcomes of Lo ʻi Kalo Restoration in He ʻeia, O ʻahu." Sustainability 10 (12): 4502.

Calvo, Luz, and Rueda Esquivel, Catriona. 2016. Decolonize Your Diet: Plant-Based Mexican-American Recipes for Health and Healing. Place of publication not identified: Arsenal Pulp Press. http://ebook.3m.com/library/sttammany-document_id-kgxtpz9.

Charmaz, Kathy. 2006. Constructing Grounded Theory: A Practical Guide through Qualitative Analysis. Sage.

Christensen, Paul. 2001. "Mac and Gravy." In Pilaf, Pozole and Pad Thai: American Women and Ethnic Food, 17–39. University of Massachusetts Press Amherst.

Colín-Chávez, Citlali, Jose J. Virgen-Ortiz, Luis E. Serrano-Rubio, Miguel A. Martinez-Tellez, and Marta Astier. 2020. "Comparison of Nutritional Properties and Bioactive Compounds between Industrial and Artisan Fresh Tortillas from Maize Landraces." Current Research in Food Science.

Cortés, L.E.U.C. 2018. "Importancia y Uso de Las Palmas Entre Los Mayas Lacandones de Nahá, Chiapas." Etnobiología 16 (1): 19–30.

Cortés, L.E.U.C., L.C. Barrera, M. Fernández-Aliphat, and R. Méndez-Mariaca. 2013. "Manejo de Los Agroecosistemas En La Comunidad Lacandona de Nahá, Chiapas." Etnobiología 11 (3): 34–44.

Cortés, L.E.U.C., R. Méndez-Mariaca, and M.A. Farrera-Pérez. 2015. "El Proceso de Sucesión Ecológica Entre Los Lacandones de Nahá, Chiapas, México." Etnobiología 13 (2): 49–62.

De la Cruz Guillén, Guadalupe. 2004. "El Recetario Lacandón."

Diemont, Stewart AW. 2006. "Ecosystem Management and Restoration as Practiced by the Indigenous Lacandon Maya of Chiapas, Mexico." Doctoral, The Ohio State University.

Diemont, Stewart AW, and Jay F. Martin. 2009. “Lacandon Maya Ecosystem Management: Sustainable Design for Subsistence and Environmental Restoration.” Ecological Applications 19 (1): 254–266.

Diemont, Stewart AW, Jay F. Martin, and Samuel I. Levy-Tacher. 2006. “Emergy Evaluation of Lacandon Maya Indigenous Swidden Agroforestry in Chiapas, Mexico.” Agroforestry Systems 66 (1): 23–42.

Eakin, Hallie, Hugo Perales, Kirsten Appendini, and Stuart Sweeney. 2014. “Selling Maize in Mexico: The Persistence of Peasant Farming in an Era of Global Markets.” Development and Change 45 (1): 133–155.

Falkowski, T.B., Martinez-Bautista, I. and Diemont, S.A.W, 2015. How valuable could traditional ecological knowledge education be for a resource-limited future?: An emergy evaluation in two Mexican villages. Ecological Modelling, 300, pp.40-49.

Falkowski, Tomasz B., Adolfo Chankin, Stewart AW Diemont, and Robert W. Pedian. 2019. “More than Just Corn and Calories: A Comprehensive Assessment of the Yield and Nutritional Content of a Traditional Lacandon Maya Milpa.” Food Security 11 (2): 389–404.

Fletcher, Robert. 2017. “Connection with Nature Is an Oxymoron: A Political Ecology of ‘Nature-Deficit Disorder.’” The Journal of Environmental Education 48 (4): 226–33. https://doi.org/10.1080/00958964.2016.1139534.

Ford, Anabel, and Ronald Nigh. 2016. The Maya Forest Garden: Eight Millennia of Sustainable Cultivation of the Tropical Woodlands. Vol. 6. Routledge.

Frece, Annabel de, and Nigel Poole. 2008. “Constructing Livelihoods in Rural Mexico: Milpa in Mayan Culture.” The Journal of Peasant Studies 35 (2): 335–52. https://doi.org/10.1080/03066150802151090.

Galtung, Johan. 1990. “Cultural Violence.” Journal of Peace Research 27 (3): 291–305.

Gálvez, Alyshia. 2018. Eating NAFTA: Trade, Food Policies, and the Destruction of Mexico. Edición: First. Oakland, California: University of California Press.

González, Roberto J. 2001. Zapotec Science: Farming and Food in the Northern Sierra of Oaxaca. 1st ed. Austin: University of Texas Press.

Greenlaw, Suzanne, Samantha Knowlden, Catherine Landis, and Tyler Talucci. 2009. "Biocultural Restoration in an Urban Watershed."

Holtzman, Jon D. 2006. "Food and Memory." Annual Review of Anthropology 35 (1): 361–78. https://doi.org/10.1146/annurev.anthro.35.081705.123220.

Hopping, B. N., E. Erber, E. Mead, T. Sheehy, C. Roache, and S. Sharma. 2010. "Socioeconomic Indicators and Frequency of Traditional Food, Junk Food, and Fruit and Vegetable Consumption amongst Inuit Adults in the Canadian Arctic." Journal of Human Nutrition and Dietetics 23 (s1): 51–58. https://doi.org/10.1111/j.1365-277X.2010.01100.x.

Howard, Patricia. 2003. "Women and the Plant World. An Exploration." In Economic Botany. Vol. 58. https://doi.org/10.1663/0013-0001(2004)058[0486:DFABRE]2.0.CO;2.

———. 2006. "Gender Bias in Ethnobotany: Propositions and Evidence of a Distorted Science and Promises of a Brighter Future." In Proceedings of the International Society of Ethnobiology 9th International Congress and Society for Economic Botany 45th Annual Meeting.

Howard, Patricia L. 2010. "Culture and Agrobiodiversity: Understanding the Links." Nature and Culture: Rebuilding Lost Connections, 163–184.

Huambachano, Mariaelena A. 2019. "Indigenous Food Sovereignty: Reclaiming Food as Sacred Medicine in Aotearoa New Zealand and Peru." New Zealand Journal of Ecology 43 (3).

Huang, R. 2016. "RQDA: R-Based Qualitative Data Analysis." R package version 0.2-8. http://rqda.r-forge.r-project.org/.

Isakson, S. Ryan. 2009. “No Hay Ganancia En La Milpa : The Agrarian Question, Food Sovereignty, and the on-Farm Conservation of Agrobiodiversity in the Guatemalan Highlands.” The Journal of Peasant Studies 36 (4): 725–59. https://doi.org/10.1080/03066150903353876.

Iwasaki-Goodman, Masami. 2017. “Transmitting Ainu Traditional Food Knowledge from Mothers to Their Daughters.” Maternal & Child Nutrition 13 (S3): n/a–n/a. https://doi.org/10.1111/mcn.12555.

Karaosmanoğlu, Defne. 2020. “How to Study Ethnic Food: Senses, Power, and Intercultural Studies.” Journal of Ethnic Foods 7 (1): 11. https://doi.org/10.1186/s42779-020-00049-1.

Kimmerer, Robin Wall. 2013. Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants. Milkweed Editions.

Levy Tacher, Samuel Israel, J. Rogelio Aguirre Rivera, María Magdalena Martínez Romero, and Alejandro Durán Fernández. 2002. “Caracterización Del Uso Tradicional de La Flora Espontánea En La Comunidad Lacandona de Lacanhá, Chiapas, México.” Interciencia 27 (10).

Lozano, Ana María L. Velasco. 2016. “Los Cuerpos Divinos: El Amaranto, Comida Ritual y Cotidiana.” Arqueología Mexicana 23 (138): 26–33.

McGee, R. Jon, and Belisa Gonzaléz. 1999. “Economics, Women, and Work in the Lacandon Jungle.” Frontiers: A Journal of Women Studies 20 (2): 175–189.

Molyneux, Maxine. 2006. “Mothers at the Service of the New Poverty Agenda: Progresa/Oportunidades, Mexico’s Conditional Transfer Programme.” Social Policy & Administration 40 (4): 425–449.

Nabhan, Gary Paul, DeJa Walker, and Alberto Mellado Moreno. 2010. “Biocultural and Ecogastronomic Restoration: The Renewing America’s Food Traditions Alliance.” Ecological Restoration 28 (3): 266–279.

Nations, James D., and Ronald B. Nigh. 1980. “The Evolutionary Potential of Lacandon Maya Sustained-Yield Tropical Forest Agriculture.” Journal of Anthropological Research 36 (1): 1–30.

Nations, James, and Valenzuela, Chan K'in Jose. 2017. Lacandon Maya: The Language and Environment.

Nečasová, Lucie. 2010. "Las Mujeres Lacandonas: Cambios Recientes." LiminaR 8 (1): 80–103.

Nieto, Mercedes Pedrero. 2004. "Género, Trabajo Doméstico y Extradoméstico En México. Una Estimación Del Valor Económico Del Trabajo Doméstico." Estudios Demográficos y Urbanos, 413–446.

Nigh, R., and Stewart AW Diemont. 2013. "The Maya Milpa: Fire and the Legacy of Living Soil - Google Académico." https://scholar.google.com/scholar_lookup?title=The%20Maya%20milpa%3A%20fire%20and%20the%20legacy%20of%20living%20soil&author=R.%20Nigh&publication_year=2013&pages=E45-E54.

Park, Clara Mi Young, Ben White, and Julia. 2015. "We Are Not All the Same: Taking Gender Seriously in Food Sovereignty Discourse." Third World Quarterly 36 (3): 584–599.

Parveen, Razia. 2016. "Food to Remember: Culinary Practice and Diasporic Identity." Oral History, 47–56.

Pilcher, Jeffrey M. 2006. "Taco Bell, Maseca, and Slow Food: A Postmodern Apocalypse for Mexico's Peasant Cuisine?" Food and Culture: A Reader, 400–410.

Quisumbing, Agnes R., Ruth Meinzen-Dick, Terri L. Raney, André Croppenstedt, Julia A. Behrman, and Amber Peterman, eds. 2014. Gender in Agriculture. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-017-8616-4.

Sharif, Aisha. 2012. "Cultural Change in Economy and Diet in the Lacandon Community of Mensäbäk." Master of Arts, San Marcos, Texas: Texas University.

Smith, Linda Tuhiwai. 2001. Decolonizing Methodologies, Research and Indigenous Peoples, 3 Rd Impression. Zed Books Ltd./University of Otego Press, London, New York, Dunedin.

Soustelle, Jacques. 1933. “Notes Sur Les Lacandon Du Lac Peljá et Du Río Jetjá (Chiapas).” Journal de La Société Des Américanistes 25 (1): 153–180.

Suárez Gutiérrez, Gloria Mariel, Eduardo Bello Baltazar, Rosa Elba Hernández Cruz, and Allan Rhodes. 2016. “Ecoturismo y El Trabajo Invisibilizado de Las Mujeres En La Selva Lacandona, Chiapas, México.” El Periplo Sustentable, no. 31.

Timmermann, Cristian, and Georges F. Félix. 2015. “Agroecology as a Vehicle for Contributive Justice.” Agriculture and Human Values 32 (3): 523–538.

Wildcat, Matthew, Mandee McDonald, Stephanie Irlbacher-Fox, and Glen Coulthard. 2014. “Learning from the Land: Indigenous Land Based Pedagogy and Decolonization.” Decolonization: Indigeneity, Education & Society 3 (3).

Williams-Forson, Psyche A. 2006. Building Houses out of Chicken Legs: Black Women, Food, and Power. Univ of North Carolina Press.

Woolf, Virginia. 1929. A Room of One’s Own. London: Triad Grafton

CHAPTER 3

Lacandon Maya women and agroforestry systems in the rainforest of Chiapas, Mexico

3.1 Introduction

Women's traditional knowledge (TK) of agroforestry systems is largely absent from the literature. Moreover, few agricultural and ethnobiological studies incorporate a gendered perspective in their analysis (Howard 2003; Quisumbing et al. 2014). Agricultural studies are an area that have been traditionally male-dominated, where women's knowledge in producing food is undervalued. Often their role in food chains is assumed to be exclusively in the preparation of the meals (Allen and Sachs 2007; Suárez Gutiérrez et al. 2016). Ethnobiology has previously been accused of gender bias because it has failed to include gender diversity in research, as well as a gender lens in its analysis (Howard 2006).

Such omission has contributed to creating misunderstandings of the relationship between Nature and humans particularly problematic in TK work because it is not homogeneous within communities, and gender is one of the main dividers of knowledge (Howard 2010). Another issue is that researchers have been predominantly men, which has created an innate bias where women have rarely been included in the inquiry about TK in food production, both in terms of researcher and community participants (Quisumbing et al. 2014; Howard 2006).

It is critical to understand the role of women in managing the landscape and diet for at least three reasons. First, it will enhance our understanding of traditional management of ecosystems and TK since it will incorporate the other half of the population. This knowledge has previously proven to be useful for sustainability and climate change mitigation (Martin et al. 2006). Second, it will serve to give visibility, voice, and value to women's work and knowledge. Finally, this knowledge will help to protect women by understanding their vulnerabilities and needs to further help them flourish.

Balancing planetary resources while offering people a healthy diet is one of today's most pressing issues. Traditional diets and associated ecosystem management systems have been highlighted by many

researchers as a sustainable pathway given the benefits they offer to ecosystem integrity, as a source of meaningful work, human healthy diets, local culture, spirituality, relationship to land, identity, and wildlife while requiring low energy input (Perfecto and Vandermeer 2008; Altieri and Toledo 2011; R. Kimmerer 2011; Nabhan, Walker, and Moreno 2010b; Timmermann and Félix 2015; Kuhnlein 2020).

These traditional diets and ecosystem management systems are part of TK and are present in Indigenous communities worldwide (Berkes et al. 2000). TK is an important contributor to science and a provider of values. These contributions in part are because TK promotes the idea that reciprocity to land is fundamental; people are not only concerned about what they can take from Nature, but also what they can give back (Kimmerer 2011).

Tropical systems harbor most of the species richness in the world (Hillebrand 2004) but also contain ecosystems with the highest rate of deforestation (Hansen et al. 2013). Arroyo Rodríguez et al. (2020) concluded that a design that would allow for rainforest biodiversity protection and food production is one where about 40% of a forest cover is kept, and this patch is connected with evenly-dispersed smaller patches with semi-natural treed elements such as vegetations corridors of agroforestry systems. Traditional agroforestry systems are a repository for biodiversity (Perfecto and Vandermeer 2008; Falkowski et al. 2020) and of crop genetic diversity, which is contingent on food sovereignty (Isakson 2009). The proposed design above, together with all these benefits of traditional agroforestry systems, positions them as one of our main hopes for a sustainable future.

In terms of traditional agroforestry systems in tropical ecosystems, the Lacandon Maya are notable for managing high biodiversity (Levy Tacher et al. 2002), being highly sustainable (Diemont, Martin, and Levy-Tacher 2006; Toledo and Barrera-Bassols 2008), restoring soil fertility (Diemont et al. 2006; Falkowski et al. 2016), and offering healthy diets by daily meeting nutritional requirements (Falkowski et al. 2019). Most of the information, however, has been collected exclusively from men. Women have been grossly underrepresented in previous scientific research in this area of inquiry. This omission has happened

despite having early reports of widowed or unmarried women producing their own food, and reports of finding different plants in the plots managed by women (McGee and Gonzaléz 1999).

Given the absence of literature about Lacandon women management of agroforestry systems, the objectives of this work were to first quantify differences and similarities in plant communities in plots managed by Lacandon women and men in terms of plant richness and diversity, plant communities, and management. The second object was to describe the plant community and traditional uses of plants in plots managed by women in three different stages of the agroforestry system.

3.2 Materials and Methods

3.2.1 Field location

Field research was conducted in Lacanja Chansayab (hereby Lacanja) located at 16.6026°N, 90.9149°W. Lacanja is part of the Montes Azules Biosphere Reserve in the state of Chiapas, Mexico. It is a tropical moist forest and has an elevation of 500m above sea level. Rainfall averages approximately 2300 to 2600 mm per year and the mean temperature is 24.7 °C (Falkowski et al. 2019).

3.2.2 Lacandon Maya agroforestry system

The Lacandon agroforestry system is a multistage successional and cyclical system that "begins" with a maize polyculture, also known as *milpa* (Nations and Nigh 1980; Diemont and Martin 2009). This "first" stage, created through a prescribed burn, is usually created in a site that was a regenerating forest derived from previous agroforestry management cycling. Burning is primarily done to decrease the amounts of weed and release soil nutrients (Nigh and Diemont 2013).

The successional system has been described as consisting of seven stages called in Lacandon Maya: *kor, robir, jurup che, pak che kor, mehen che, nu kux che,* and *tam che* (Diemont and Martin 2009; Falkowksi et al. 2017). In total, more than 400 plants are managed by the Lacandon (Levy Tacher et al. 2002). *Kor* is the Lacandon name for *milpa*; it is the "first" stage of a cycle that begins after a burn. *Kor* is used primarily

for food production and contains about 60 useful plants (Levy Tacher et al. 2002; Diemont 2006). *Robir and jurup che* are the first two fallow stages, each of them lasts about 2 years. The secondary forest stages are *pak che kor* (which lasts about 7 years after the burn), *mehen che* (10 years), and *nu kux che* (20 years). *Tam che* is the name given to primary forest.

During the fallow stages, the farmer is still managing the land, different plant species are used to accelerate forest regeneration, replenish soil organic matter and improve weed control. Some examples are *Ochroma pyramidale, Poulsenia armata, Cedrela odorata, Enterolobium cyclocarpum, Swietenia macrophylla, Lonchocarpus guatemalensis,* and *Heliocarpus appendiculatus* (Levy Tacher et al. 2002; Diemont 2006; Nigh and Diemont 2013; Falkowski et al. 2016).

Within the Lacandon agroforestry system, the house patio garden (hereafter patio) is an important stage that is not part of the main successional system, as it functions independently. Lacandon Maya patios have previously been described (Cortés et al. 2013; Cook 2016; Contreras-Cortés and Mariaca-Méndez 2016), but to our knowledge, no quantification of the structure of the plant community in the patio has been conducted.

3.2.3 Plant ethnotaxon community Sampling

Fieldwork was conducted during June and July 2019. A second short visit was made in January 2020, mainly to verify the information. Plant ethnotaxon community sampling was performed as per Diemont and Martin (2009). Ten *kor* (5 women and 5 men), six *pak che kor* (3 women and 3 men), 9 patio (4 women, 5 couples) were sampled, view **Table 3.1** for details. Participants referred as women identified as cisgender women and participants referred as men identified as cisgender men. For this paper, I studied women's and men's traditional division of labor in the community. I recognize that not all people identify as men or women and some do not fit into this binary gender framework. Field stages were classified by Lacandon Maya farmers. Parcels used in the project were rented from the participants with a single payment for the entire sampling period.

Table 3.1: Information about managers, and the total area they manage in three stages of the Lacandon agroforestry system

Gender	Age	Partners	total *kor* (ha)	total patio (m2)	total *pak che kor* (ha)
W1	64	no	2	5000	10
W2	49	no	1	5000	1
W3	57	no	0.75	2500	2
W4	68	no	0.5	5000	-
W5*	90+	no	0.5	-	-
M1	30	yes	1.5	5000	2
M2	42	yes	1.5	1125	2
M3	53	yes	2.5	1000	3
M4	29	yes	0.5	900	-
M5	35	yes	1.5	5000	-

W refers to woman, M to man. *This participant only had 70m^2 of patio because she donated the rest of the terrain to her family, given this I decided to exclude this patio from the analysis. The partners column refers whether the participant is single or has a partner.

Sampling locations in *kor* and *pak che kor* plots were determined using a transect method, with 10 samples collected at intersections of a 20-m grid. Two nested sampling quadrats of different sizes, 1 m^2, and 20 m^2, were assessed for plant community at each sampling point. All ethnotaxons were identified by Lacandon name, and those plants previously studied were cross-referenced with species lists in previous literature (Nations and Nigh 1980; Nations and Valenzuela, Chan K'in Jose 2017; Cook 2016; Diemont and Martin 2009; Levy Tacher et al. 2002; Durán-Fernández et al. 2016) to obtain their scientific name. Ethnotaxons in the flowering season that were not previously studied were collected and identified by the Institute of Ecosystems and Sustainability at the National Autonomous University of Mexico in Mexico City (IIES UNAM), and later deposited in National Herbarium (MEXU) of the Institute of Biology, UNAM. Lacandon maize was reported to be planted in groups so that four to seven plants grow together (Diemont and Martin 2009); given this, maize was counted as groupings and to obtain individual plants, grouping was multiplied by 5.5.

Kor: all plants in the 1 m^2 quadrats were identified, distinguished as cultivated or non-cultivated, and traditional uses were noted by a Lacandon Maya expert. **Table 3.2** has a detailed classification of all uses

which was based on previous work (Blancas et al. 2010; Rangel-Landa et al. 2016). In these quadrants, percent disservice plant cover was also estimated. I defined disservice plants as those known by local experts to decrease productivity or that in some circumstances may outcompete with cultivars in the *kor* (Zhang et al. 2007). In the 20-m^2 area, all plants with a basal diameter larger or equal to 1.5 cm were counted, identified and their traditional use noted.

Pak che kor: in the 1-m^2 quadrats all plants with a basal diameter larger or equal to 1 cm were identified and counted, and its traditional use noted. In the 20-m^2 quadrats, all plants with a basal diameter larger or equal to 5 cm were identified, counted and their traditional use noted.

Patio: all useful plants in the patio were counted, identified and their use noted. The size of the patios was highly variable ranging from 900m^2 to 5000m^2 with an average size of 3391.67m^2(±1961.98). Given this variability and to normalize results, I performed a cross multiplication and equated all patios to 200m^2. Patio excludes the garden, which is a smaller-sized *kor* nearby the house.

Table 3.2: Classification of ethnotaxon uses

Use	Description
aromatic	plants valued for their perfume for personal use or the surroundings
bioindicator	presence or phenologic event is used an as indicator for biotic, abiotic or cultural events
construction	plants used for construction of infrastructure (walls, ceiling, etc.)
disservice	plants that are unwanted in the milpa because they out-compete other more desired plants
ecological	plants used to enhance soil properties (increase organic matter, increase seed bank, attract pollinators)
edible	any part of the plant is used to eat, prepare food or beverages, also plants that are used to wrap food
fiber	plants that provide fibers
firewood	plants used to generate fire
fishing	plants that aid in fishing
forage	plants that are used to feed domesticated animals
handicraft	plants used to create decorative objects
hunting	plants that aid in hunting
jewelry	plant used to make jewelry (necklace, bracelet, earrings)
living fence	plants used to limit space
medicinal	plants used to treat and/or cure, and/ or prevent human diseases
musical instrument	plants used to make musical instruments
nervous alterer	plants that alter the human nervous system
ornamental	plant is recognized to have an aesthetic value
poison	plants that are used to harm other plants, animals, fungi (insecticides, fungicides…)
reforestation	plants used with the objective of reforestation
resin	plants that their resin can be extracted
storage	plants that help in the storage of seeds, other plants, things
tincture	plants used to create colors
tool	plants to elaborate practical objects
toy	plants used to elaborate toys
tutor	plants used as tutor, support or nurse to another plant of interest
unknown	no known use

Comparisons were done between male-headed and female-headed households. According to the European Institute for Gender Equality, female-headed households are those in which an adult woman is the sole or main income producer and decision-maker. In the case of Lacanja, in male-headed households, both spouses are present, while female-headed households have no husband. Woman households included those where women were widowed or decided not to remarry and those women who never married (although this

situation is uncommon in Lacanja). Women in the male-headed household's main activities are taking care of children, cooking, cleaning, caring for chicken, caring for the patio; some women also work making jewelry and sculptures to sell to tourists. In some families, women work with the men in the *milpa*, especially those without small children. Most women tend to daily go to the *milpa* to gather specific ingredients for the meals. In the case of the systems that I measured, male-headed families rely on men's work to care for the *milpa* and agroforestry system; except for the patio, where both work on maintenance. Given this difference, I decided to compare female- and male-headed households for *kor* and *pak che kor* and partnered and woman households for patio. Information about the participants and the total area of the agroforestry systems they manage can be found in **Table 3.1**.

3.2.4 Data Analysis

All data analysis was completed using R software version 3.6.3. I used an alpha value of 0.1, higher than the convention of 0.05. Sample size was limited due to the few women who manage their own agroforestry systems. This alpha was therefore used to reduce the probability of missing a relevant effect (Type II error). In this case, my aim was to determine differences in plots according to gender using plant ecology proxies. I was working as well with highly variable systems, due to the nature of the biodiversity in the rainforest, changes in the season, seeds used by farmers, rain patterns, and soil changes, further justifying prioritized avoiding Type II error (false negative) over Type I error (false positive).

Comparisons in *kor*, *pak che kor*, and patio were done using three different ecological parameters: richness, diversity, and ethnotaxon composition. Because differences were found in *kor*, I decided to also evaluate management practices for this system to understand their origin.

Richness (total number of ethnotaxons) and diversity (using Shannon-Weaver and Simpson index) were compared using a Generalized Linear Model (GLM). Repetitions in each plot were added and not counted as separate to avoid sub-estimating total richness of each producer; therefore also hierarchical mixed models were considered disadvantageous.

To compare ethnotaxon compositions a non-Metric Multidimensional Scaling (nMDS) was done using ethnotaxons abundance as parameters. The abundance of ethnotaxons was standardized by square rooting and obtaining the Bray distance of values. The multivariate spread was checked to be homogeneous, and a PERMANOVA was done to look for differences between men and women.

To compare management by men and women in *kor* I checked for differences in disservice plant coverage and differences in abundance of specific ethnotaxons. The mean, median, and standard deviation of disservice coverage were calculated for women and men and then a Mann-Whitney test was done. Ethnotaxons that presented a median of more than five in either a women's or men's *kors* were tested with Mann-Whitney.

Description of plots managed by women in three different stages of the agroforestry system were completed by calculating: 1) total number of ethnotaxons, 2) dominance for each plant in every woman and then generating an average for all of them, 3) counting total number of ethnotaxons that have a particular use and 4) counting the total number of ethnotaxons that have more than one use.

3.3 Results

Results are presented in two sections: comparisons between plots managed by women and men or single women with partners, followed by a description of plots managed by women in terms of diversity of ethnotaxons, the most dominant plants and their uses.

3.3.1 Comparison of plots managed by women and men

3.3.1.1 Richness and Diversity

No significant differences were found between the richness and diversity (using Shannon and Simpson index) between plots managed by women and men (in case of *kor* and *pak che kor*) or women and partners (in case of patio); analyses results are shown in **Table 3.3.**

Table 3.3: Mean richness and diversity in each system.

System	Scale (m2)	Measure	Female mean	Male/ Partners mean
		richness	25.2±5.26	20.2±8.07
		H	1.870±0.38	1.920±0.32
	10	D	0.706±0.13	0.742±0.08
		richness	19.8±10.66	16.2±5.54
		H	0.663±0.29	0.709±0.10
kor	200	D	0.236±0.09	0.311±0.06
		richness	8±3.46	8.333±2.52
		H	1.876±0.61	1.960±0.32
	10	D	0.802±0.14	0.832±0.06
		richness	16.333±3.21	16±3.46
pak che		H	2.460±0.25	2.308±0.41
kor	200	D	0.886±0.3	0.836±0.10
		richness	42.5±12.15	37.2±9.26
		H	3.075±0.28	2.841±0.37
patio	200	D	0.919±0.04	0.882±0.08

[1]H is Shannon Diversity Index, [2]D is Simpson Diversity Index, ± represents standard deviation, p values were not reported since none was significant

3.3.1.2. Ethnotaxon Composition

I first conducted a nMDS between plots managed by gender **Figure 3.1**, shows differences in gender where each point refers to a participant. Hulls (ellipses) were drawn connecting participants among gender. The two-dimensional (2D) nMDS solution was acceptable, where stress values ranged from 0.05 to 0.14. This low-stress values indicate that the nMDS was a useful ordination approach for extracting ethnotaxon composition from the observed data. To statistically evaluate whether the ordination of ethnotaxon composition presented differences among gender, a permanova was done and it is shown in **Table 3.4.** Differences were found exclusively in the system of *kor*.

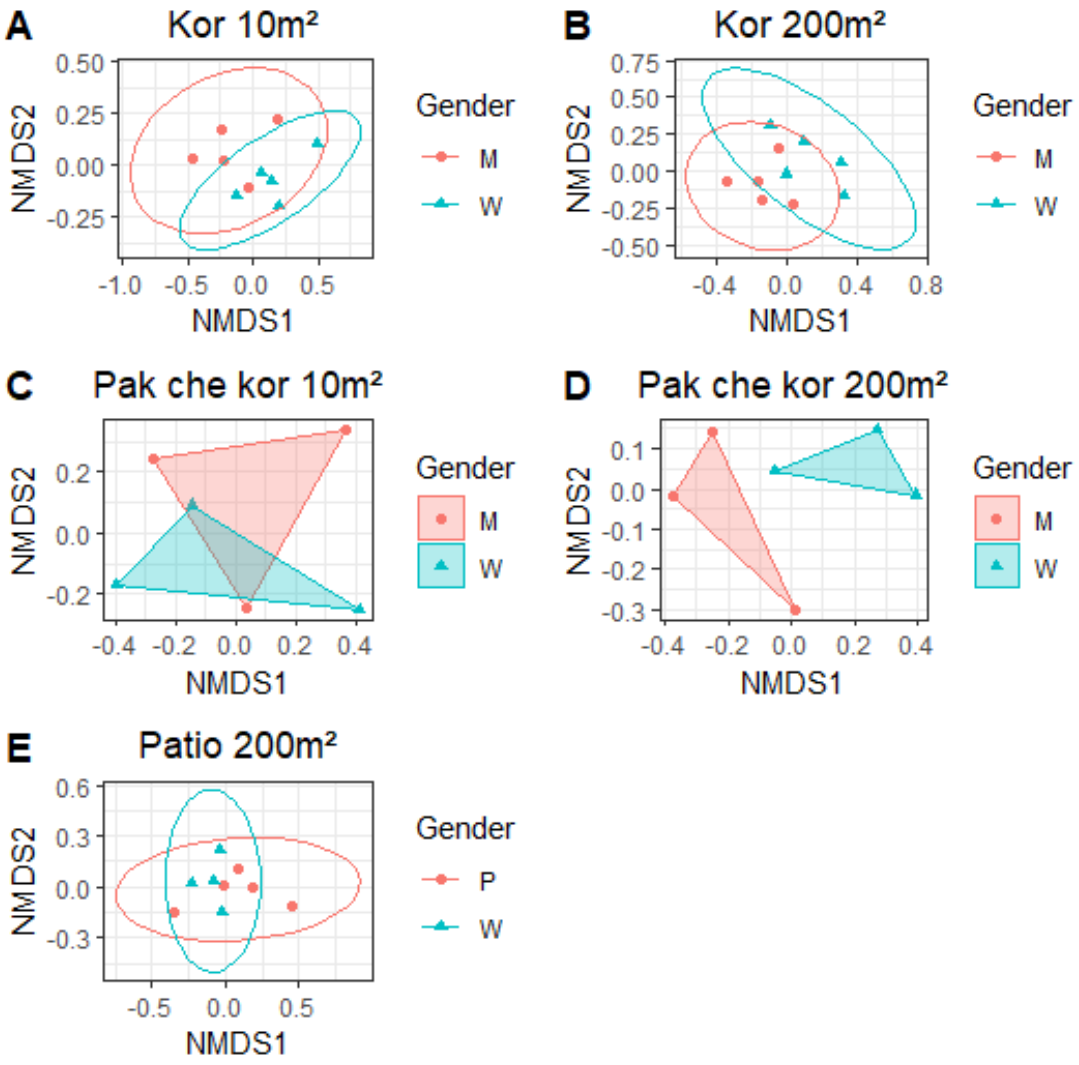

Figure 3.1: nMDS for each system showing ethnotaxon composition among gender

W=women, M=men, P=partners

Stress values of nMDS: A=0.065, B=0.139, C= 0.053, D=0.053, E=0.108

Table 3.4: Permanova analysis of nMDS

System	Scale (m^2)	R^2 (Gender)	p value
kor	10	0.171	0.066*
	200	0.142	0.082*
pak che kor	10	0.154	0.800
	200	0.254	0.200
patio	200	0.113	0.697

*p<0.1

3.3.1.3 Management practices in kor

Given that it was only in *kor* that I found differences in ethnotaxons composition, I studied this system in greater detail by checking differences in disservice plant coverage and abundance of high dominance plants.

Disservice plant coverage

Results of disservice plant coverage are shown in **Table 3.5**; there are no significant differences for median and mean between women and men. However, the standard deviation is significant with a p-value of 0.095 and a W=21. This result means that although women and men have on average the same amount of disservice coverage, the distribution is different. In plots managed by women, the standard deviation of disservice coverage is larger, meaning that the plot fluctuates from having almost no disservice plant coverage to fully disservice plants coverage. In plots managed by men, the standard deviation of disservice coverage is smaller, meaning that throughout the plot there is a homogenous distribution of disservice plants.

Table 3.5: Reported values of percentage of disservice plant coverage

Gender	Median (%)	Mean (%)	Standard deviation
W1	65.0	59.0	33.1
W2	20.0	21.0	11.0
W3	35.0	37.5	23.7
W4	12.5	33.3	38.8
W5	45.5	49.3	51.4
mean W	**35.0**	**40.0**	**31.6**
M1	1.0	2.2	3.0
M2	1.0	2.8	3.3
M3	40.0	40.1	34.4
M4	20.0	16.7	10.2
M5	90.0	84.0	12.6
mean M	**20.0**	**29.2**	**12.7**

High abundance ethnotaxons in kor

In **Table 3.6**, I show ethnotaxons in *kor* that presented differences in plots managed by women and men in terms of number of individuals. The ethnotaxons, *nukuch xamuk*, and *mejen xamuk* are both considered disservice plants that are only found in *kor* $10m^2$; both were only present in plots managed by women. In both *kor* $10m^2$ and $200m^2$, it can be observed that women are managing more *Zea mays*, but less *Cucurbita argyrosperma*, which is a squash with a variety locally known as chigua. **Figure 3.2** provides a visual representation of how management practices vary between women and men in the case of *kor*.

Table 3.6: Ethnotaxons in *kor* with a median higher than five that presented significant differences

Scale (m^2)	Ethnotaxon (English)	Latin binomial	women median	men median	p-value
10	nar (maize)	*Zea mays*	60.5	44	0.046**
	nukuch xamuk	unknown	14	0	0.045**
	mején xamuk	unknown	13	0	0.072*
	sikir (squash)	*Cucurbita argyrosperma*	5	22	0.036**
200	nar (maize)	*Zea mays*	825	682	0.056*
	sikir (squash)	*Cucurbita argyrosperma*	28	53	0.056*

*p<0.1, **p<0.05

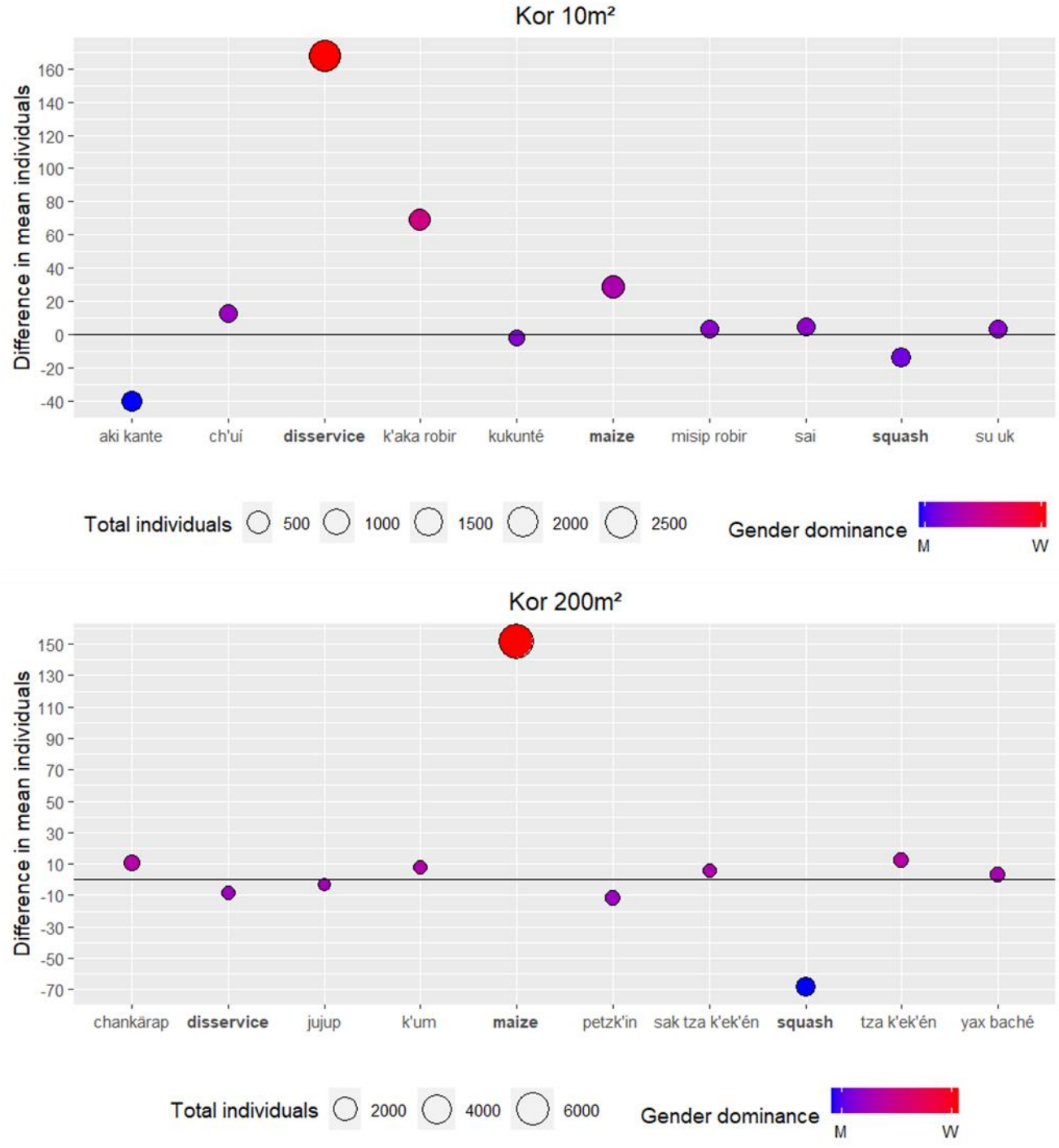

Figure 3.2: Management differences by gender in *kor*.

Plants above represent 80% of all detected individuals for *kor* 10m^2 and 96% of all detected species in *kor* 200m^2. Y-axis shows the difference in the mean individual ethnotaxons of women minus mean individual ethnotaxons of men. The color and position of circles in the graph show the dominance of particular ethnotaxons. Ethnotaxons that are in the positive y-axis and have a strong red color, are more prevalent in women's plots, whereas ethnotaxons in the negative y-axis and blue color are more prevalent in men's plots. The size of the circle represents the total number of individuals found in women and men plots. For more information on ethnotaxons see **Table 3.6**.

3.3.2 Description of stages managed by Lacandon women

In this section, I describe in detail women's agroforestry production in Lacanja Chansayab.

3.3.2.1 Kor

In *Kor* 10m^2 I found a total of 77 ethnotaxons; most dominant plants are shown in **Table 3.7**. *Zea mays* was evenly distributed in all the *kors*; *Cucurbita argyrosperma* was not found in the *kor* of two women. Of all the different ethnotaxons in this system, six of them have unknown use but were not considered a disservice, and 22 are considered disservice plants; some of the disservice plants have other valuable uses. It is only when their population is too big that they are removed from the *kor*.

In *Kor* 200 m^2 I found a total of 63 ethnotaxons, where only one of them had unknown use, and four of them were considered potentially disservice plants. The most dominant plants are shown in **Table 3.7**. Uses of ethnotaxons and multipurpose ethnotaxons are shown in **Figure 3.3** and **3.4**. The use with the highest number of ethnotaxons was edible with more than double the number in disservice.

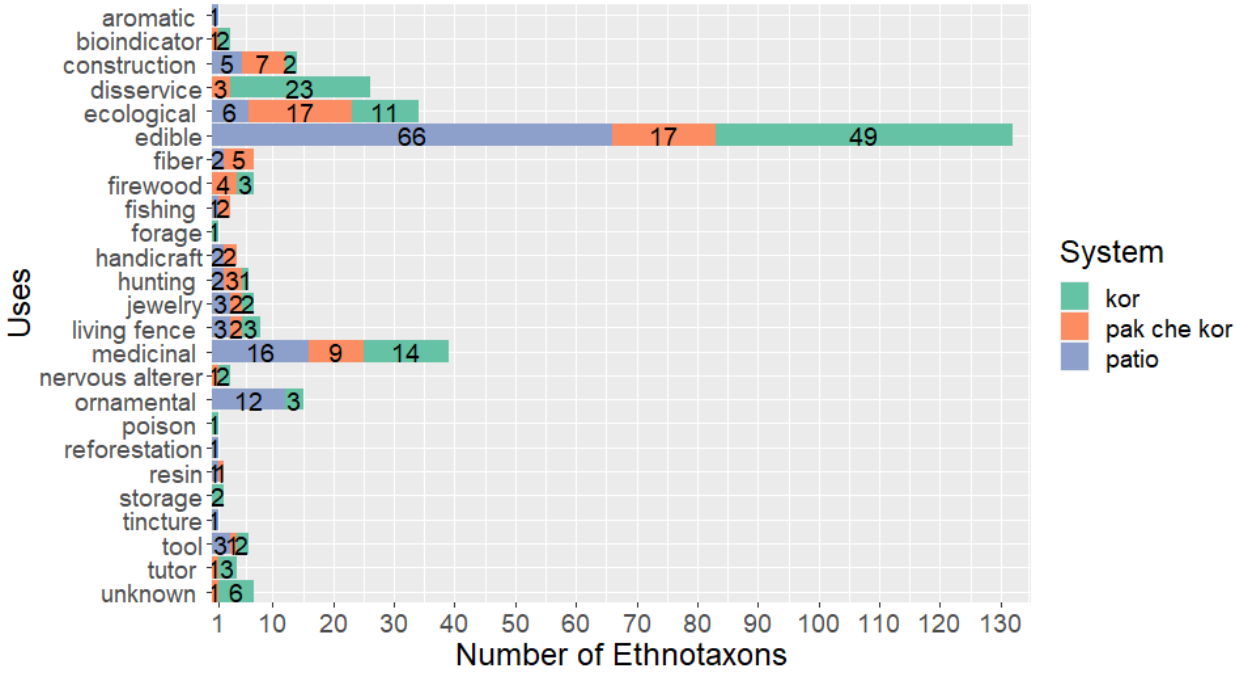

Figure 3.3: Uses of ethnotaxons in *kor*, *pak che kor* and patio

Table 3.7: Dominant ethnotaxons found in *kor*

kor (m2)	Ethnotaxon (English)	Latin binomial	Dominance (%)	Uses
	nar (maize)	*Zea mays*	16.05	edible, firewood, forage, medicinal, storage, tutor
	kux nok	*Bidens odarata*	13.28	disservice
	k'a ka robir	unknown	12.22	medicinal
	mején xamuk	unknown	10.92	disservice
	ne sabin	unknown	9.90	disservice
	nukuch xamuk	unknown	8.71	disservice
	misip robir	unknown	2.82	tool
	ch'uí	*Androlepis skinneri*	2.68	bioindicator
	sai	unknown	2.68	unknown
	mején kuutsi	unknown	1.51	disservice
	su uk	Poaceae	1.36	unknown
	sikir (squash)	*Cucurbita argyrosperma*	1.24	edible
	cháuk (black nightshade)	*Solanum nigrenscens*	1.18	edible
	tzak k'akir	*Stigmaphyllon dichotomum*	1.15	disservice, medicinal
10	tzosé ruum	unknown	0.93	bioindicator
	nar (maize)	*Zea mays*	87.09	edible, firewood, forage, medicinal, storage, tutor
	sikir (squash)	*Cucurbita argyrosperma*	2.21	edible
	chankäp (indian shot)	*Canna indica*	1.80	disservice, jewelry
	tza k'ek'én (chives)	*Allium porrum*	1.23	edible
	k'um (pumpkin)	*Cucurbita pepo*	0.93	edible
	yax baché (turtle bone)	*Lonchocarpus guatemalensis*	0.92	firewood
	sak tza k'ek'én (white onion)	*Allium sp.*	0.76	edible
	box bú (blackeyed pea)	*Vigna unguiculata*	0.54	edible
	mäcär (capote)	*Xanthosoma robustum*	0.35	edible
	pa'ach (pineapple)	*Ananas comosus*	0.33	edible
	akí kajbé (velvet bean)	*Mucuna pruriens*	0.26	ecological
	xir	unknown	0.26	edible
	jamá (hibiscus)	*Hibiscus sabdariffa*	0.24	edible
	is (sweet potato)	*Ipomoea batatas*	0.23	edible
200	tzin (yucca)	*Manihot esculenta*	0.23	edible

3.3.2.2.Pak che kor

In *Pak che kor* 10m^2 I found a total of 22 ethnotaxons, the most dominant ones are shown in **Table 3.8**. The two most dominant ethnotaxons, *mején yax mak'urám* and *Costus spicatus*; both are trees that are thought

to increase soil fertility. None of the plants found had an unknown use. Plants uses were predominantly edible and ecological, meaning enhancing the fertility of the soil or providing other types of ecological benefit.

In *Pak che kor* 200m^2 I found a total of 34 ethnotaxons, the two most dominant ethnotaxons were *Spondias mombin* and *Piper aduncum* both are multipurpose trees. One ethnotaxons had an unknown use. Information on ethnotaxons with different uses and multipurpose ethnotaxons can be found in **Figures 3.3 and 3.4** respectively.

Table 3.8: Dominant ethnotaxons found in *pak che kor*

pak che kor (m2)	Ethnotaxon (English)	Latin binomial	Dominance (%)	Uses
	mején yax mak'urám	unknown	27.14	ecological
	nukuch pasak (spiked spiralflag)	*Costus spicatus*	10.00	edible, medicinal
	k'uut	*Calathea macrosepala*	5.56	edible
	ts'u tok	*Hampea nutricia*	5.56	fiber
	sa' sap robir	unknown	5.13	ecological, disservice
	jaach kix	unknown	3.33	disservice
	machich	*Lonchocarpus rugosus*	3.33	firewood
	ak' j'uun	*Poulsemia armata*	2.78	edible, fiber
	akin téj	unknown	2.78	edible, medicinal
	chechém (Browne's poisonwood)	*Metopium brownei*	2.78	ecological, firewood, fishing
	jujup (yellow mombin)	*Spondias mombin*	2.78	ecological, edible, medicinal, living fence
	k'ik (castilla)	*Castilla elastica*	2.78	edible
	muxam che	*Alchomea latifolia*	2.78	ecological
	yax baché	*Lonchocarpus guatemalensis*	2.78	firewood
10	chum ak (purple grandilla)	*Passiflora edulis*	2.56	edible
	jujup (yellow mombin)	*Spondias mombin*	14.42	ecological, edible, medicinal, living fence
	mak'urám (higuillo de hoja menuda)	*Piper aduncum*	9.78	ecological, medicinal, tutor
	chúkun	*Ochroma puramidale*	8.50	ecological
	ko'och (trumpet tree)	*Cecropia obtusifolia, C. peltata*	8.39	ecological, nervous alterer
	jobé (hierba santa)	*Piper auritum*	6.62	ecological, edible
	chechém (Browne's poisonwood)	*Metopium brownei*	4.76	ecological, firewood, fishing
	ukanté	*Sapium lateriflorum*	4.58	ecological, handicraft, hunting
	muxam che	*Alchomea latifolia*	4.24	ecological
	chak rá	*Bursrera simaruba*	4.09	living fence, medicinal
	kokojche	unknown	4.09	edible
	sa' sap robir	unknown	3.33	ecological, disservice
	puná (mohagany)	*Swietenia macrophylla*	3.15	construction, ecological, medicinal
	sa sak che	*Eupatorium nubigenum*	2.93	ecological, edible
	ts'u tok	*Hampea nutricia*	2.38	fiber
200	bitz (river koko)	*Inga vera, I. pavoniana*	1.59	edible

3.3.2.3 Patio

In total, I found 96 different ethnotaxons. The most prevalent type of use is edible, the most dominant ethnotaxons are shown in **Table 3.9**. The patio was the system that presented the highest number of edible ethnotaxons.

Table 3.9: Dominant ethnotaxons found in patio

Ethnotaxon (English)	Latin Binomial	Dominance (%)	Uses
ch'uum jará (bamboo)	Bambusoideae	6.33	construction, ornamental
k'uut	*Calathea macrosepala*	6.33	edible
mején china (tangerine)	*Citrus sp.*	4.65	edible
murix (lime)	*Citrus sp.*	4.31	edible
ch'iip	*Chamaedorea alternans, C. tepejilote*	4.24	edible
pox (soursop)	*Annona muricata*	4.23	edible
ts'ibaré ché	*Astronium graveolens*	4.04	living fence, ornamental
kokó (coconut)	*Cocos nucifera*	4.01	edible
akin téj	unknown	3.80	edible, medicinal
maguey (boatlily)	*Tradescantia spathacea*	3.25	Medicinal
on (avocado)	*Persea americana*	3.12	edible
chak top che (shoeblackplant)	*Hibiscus rosa-sinensis*	3.01	living fence, ornamental, tool
patam (banana)	*Musa sp.*	2.82	edible
chiná (orange)	*Citrus sinesis*	2.68	edible
bitz (river koko)	*Inga vera, I. pavoniana*	2.43	edible

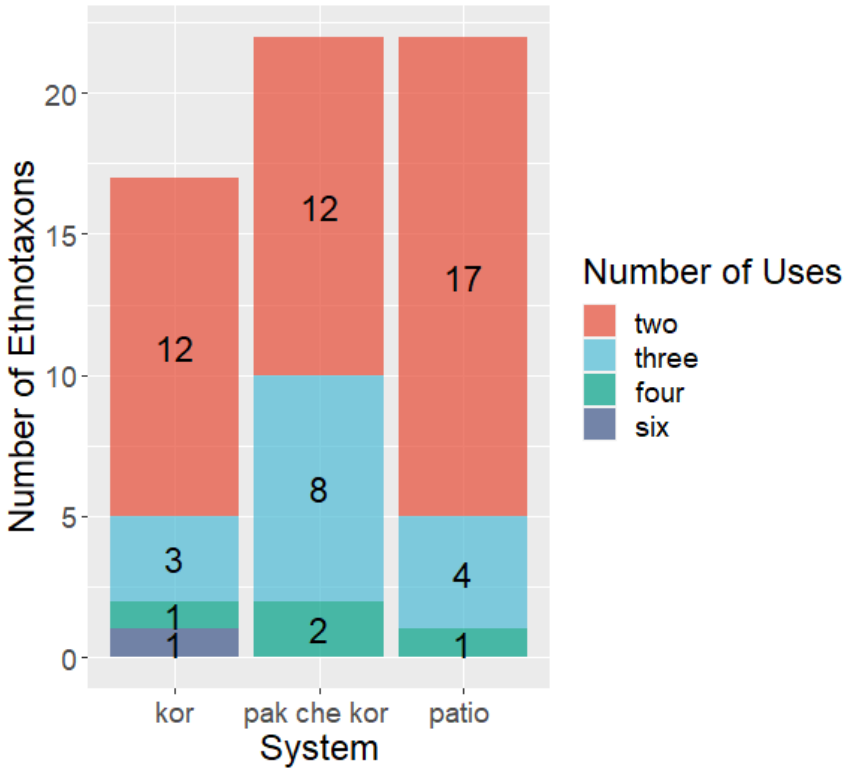

Figure 3.4: Number of multipurpose ethnotaxons in each system

3.4 Discussion

I found an exceptional diversity in the Lacandon Maya agroforestry system managed by women. The diversity was present not only in terms of varieties of plants but also the different uses they have. These agroforestry systems are a reserve of biodiversity and traditional knowledge. Women are actively participating in agroforestry and biodiversity conservation.

3.4.1 Women are producers and conservers of agrobiodiversity

Data disaggregated by gender allowed me to determine that women are actively contributing to food production and conservation in Lacanja. Their plots showed no significant differences in terms of richness and diversity from that of men. They are producing a similar amount of biodiversity within their agroforestry systems as men. It is important to stress that this finding does not mean that plots divided by gender are equal. Statistical differences were found in ethnotaxon composition in the system of *kor*. An

important limitation is that my methodology does not include the diversity of varieties, which can be another important source of diversity. Previous literature has recognized women as drivers of the diversity of varieties as they require a variety of culinary diversity (Nabhan, Walker, and Moreno 2010a; Skarbø 2014), for this, I expect that plots managed by women can have a higher number of diversity of ethnotaxon varieties.

In the case of *kor*, differences in ethnotaxon composition are explained by management strategy that differs between men and women. Disservice plant coverage presented different patterns. Distribution of disservice plants in women's plots had a higher standard deviation, meaning that some sections were with few disservice plants and others full of disservice plants, whereas the distribution of disservice plants in plots managed by men was more evenly distributed.

I explain this difference through field observations. Women preferred to remove disservice plants completely from a section and then move to the next. Thus, over time some sections had no disservice plants and others had many. Whereas men tended to remove disservice plants more uniformly at a constant pace. Another explanation for this difference is that men were planting more *Cucurbita argyrosperma* than women. *Cucurbita argyrosperma* is a creeper that reduces the number of other disservice plants, as well as the effort of weeding (Fujiyoshi, Gliessman, and Langenheim 2007). As a tradeoff for this management, men have fewer individuals of *Zea mays* in their plots (Adolfo Chan k'in, pers. comm., Lacanja Chansayab, Mexico).

The difference in management between women and men also might be determined by their possibility of finding paid work. Women who manage their systems are dedicated fully to them and their domestic activities, as they have very few other sources of income. Some of them sell handicrafts, some cash crops (like chilis), or chicken. They, however, tend to be older, and none of them speaks Spanish fluently which makes it harder for them to have outside work. This limitation permits them more time for the food system and allows them to be more careful about eliminating disservice plants. The case of men is different, as throughout the season they might take other jobs in addition to managing their fields; some of them own a

convenience store, drive a taxi, fish, support in research activities, or work in construction. It is more convenient for them to grow *Cucurbita argyrosperma* that will reduce the burden of weeding and open time for other employment.

The fourth explanation for the differences in management of milpa between women and men is that *Cucurbita argyrosperma* that is mainly planted by men, is grown for seed production. Each squash grows to be very heavy (about 5 kg each); the seeds need to be extracted and collected in sacks that weight about 50kg. These sacks need to be transported to the city. For these reasons, planting squash is not convenient for women, unless they receive help from men. It is strenuous work and requires having transportation to the city, both greater obstacles for women (especially elderly women). Even though not planting *Cucurbita argyrosperma* involves an increase in weeding effort, women might have more time than they are willing to dedicate to the *kor* and would find *Cucurbita argyrosperma* a less convenient cash crop.

A previous description of the Lacandon Maya agroforestry system was done exclusively with men. In the case of *kor*, I found 49 useful plants in plots managed by women. The first published article on the matter showed 56 useful plants in *kor*. However, no sampling method was reported. It is very likely that the sampling methods they used were a census among several plots. Which explains why they have the highest reported number (Nations and Nigh 1980). 26 useful species were found by Diemont and Martin (2009) in the *kor* using similar methods as in the present article. In another article, a total of 37 useful plants were reported on *kor* managed by one man (Falkowski et al. 2019).

In the case of *pak che kor*, this study is the first that this successional stage is explicitly reported for dominance, although other stages have previously been measured (Diemont and Martin 2009), and species have been listed (Nations and Nigh 1980). *Pak che kor* showed the same amount of edible and ecological uses of plants. Ecological uses were all those that increase the fertility of soil directly by shedding leaves or indirectly by attracting other animals like birds. The high presence of ethnotaxons known to increase the fertility of soils has been previously reported in other studies (Falkowski et al. 2016; Falkowski et al. 2019).

This study is to the best of my knowledge the first in which a Lacandon patio has been measured through field assessment; previous information has been collected in the form of surveys, interviews, and participant observation (Cortés et al. 2013; Cook 2016; Contreras-Cortés and Mariaca-Méndez 2016). Patios, also known as *solares* for the Maya in the Yucatan peninsula, are an important biocultural reservoir. For instance, more than 484 species have been found in Amazonian homegardens (Caballero-Serrano et al. 2016), they are considered a refuge for wildlife (Perfecto and Vandermeer 2008); it is an area for experimentation with domestication and where agricultural practices are tested (Larios et al. 2013); it has been reported to provide the largest amount of edible, medicinal and ornamental ethnotaxons.

Women are important to agrobiodiversity conservation in Lacanja. Agroforestry systems have proved to be valuable to conserve planned and associated biodiversity (Perfecto and Vandermeer 2008) sometimes even comparable to undisturbed areas (Rendón et al. 2020; Falkowski et al. 2020). Although women's work regarding the conservation of biodiversity is still scarce, research has shown that women are active managers of biodiversity (Howard 2003; Padmanabhan 2011; Momsen 2007) and also indirect managers, as they hold decision power in what is being planted (Chambers and Momsen 2007).

3.4.2 Women are equally capable but more vulnerable

Having found little gender difference in agroforest does not mean that women and men farmers are working with equal opportunities and vulnerabilities. Women are more vulnerable than men because the whole food system depends on them. They must harvest the food, prepare it, together with the rest of domestic work. In the case of men, they are almost exclusively removed from the burden of processing the food and other domestic chores. When a man comes back to his house after a long day of working in the *kor*, the food is ready. Women when they come back from work, they will need to start the fire and then cook. It is therefore important to consider that in the case of Lacanja, women that produce food by themselves will need more support, as they are vulnerable. For the previously-mentioned reasons, it is also harder for them to find paid employment. This difference calls for policy interventions that implement gender-differentiated impacts (Momsen 2004; 2007; Bock and Shortall 2017).

Another important difference is that women will not have access to land tenure and manage their system until they become widows, which usually means that they are older. This lack of tenure makes them more susceptible to diseases and injuries, a characteristic that has been previously noted in Mexico (Cabrera, Martelo, and García 2001). Many of the women that participate say that sometimes male family members help them with the most physically demanding stages of the production. Women who hold land tenure may also receive government aid through payment for ecosystem services, which they can later use to pay for extra help or in case of disease, however, not all women receive this benefit, as not all of them hold tenure rights. Older women in the community did not have access to school and thus many of them do not speak Spanish, another important obstacle they have in supporting their household food system.

Women and men have different ways of relating to Nature that is not necessarily reflected in ecological measurements like richness or diversity and are still important. According to the theory of intersectionality, gender is one of many sociocultural aspects that can shape people's relationship to land and other beings; there are other structures that can impact them, however, including land tenure, number of households, education.

3.4.3 Limitations and Future research

An important methodological limitation was that all the naming of the ethnotaxons was exclusively done by a male expert. This promotes the homogenization of the naming of the plants but could have prevented learning gender-specific knowledge.

The diversity of varieties within the agroforestry system was not included in the listing of ethnotaxons. During fieldwork, not all ethnotaxons were fruiting or showing the phenological characteristics necessary to be able to distinguish between varieties of the same ethnotaxons. Given this limitation, I underestimate the richness of ethnotaxons within the plots. Previous literature has recognized women as drivers of the diversity of varieties as they require a variety of culinary diversity (Skarbø 2014). Completing a study in

terms of productivity and not on field limitations, could lead to understanding better diversity and richness at the level of varieties.

I had a low number of women participants in the study. This number reflects the fact that the number of women managing their land ownership is low. A possible explanation is that women generally only have access to land tenure after they are widowed.

Greater understanding of women´s traditional knowledge in agroforestry systems remains a critical need. Further ecological assessment is vital. However, by understanding social and cultural context we can better determine how women's role in conserving food systems and landscape is shaped by access to land, government support schemes, and markets for selling their products.

3.5 Conclusion

Women's role in the food system is not only cooking and processing the ingredients but also cultivating products; this work has been historically erased. I was able to determine that plots managed by women and men have equal richness and diversity of ethnotaxons. Differences were found in ethnotaxons composition in the system of *kor* (in Spanish *milpa*), which corresponds to different strategies followed to manage a *milpa* between women and men. It is important to incorporate gender perspective when studying the management of agroforestry systems since traditional knowledge is heterogeneous and power imbalances related to gender exist that tend to make women more vulnerable.

3.6 References

Allen, Patricia, and Carolyn Sachs. 2012. "Women and Food Chains: The Gendered Politics of Food." Taking Food Public: Redefining Foodways in a Changing World, 23–40.

Altieri, Miguel A., and Victor Manuel Toledo. 2011. "The Agroecological Revolution in Latin America: Rescuing Nature, Ensuring Food Sovereignty and Empowering Peasants." Journal of Peasant Studies 38 (3): 587–612.

Arroyo-Rodríguez, Víctor, Lenore Fahrig, Marcelo Tabarelli, James I. Watling, Lutz Tischendorf, Maíra Benchimol, Eliana Cazetta, et al. 2020. "Designing Optimal Human-Modified Landscapes for Forest Biodiversity Conservation." Ecology Letters n/a (n/a). https://doi.org/10.1111/ele.13535.

Berkes, Fikret, Johan Colding, and Carl Folke. 2000. "Rediscovery of Traditional Ecological Knowledge as Adaptive Management." Ecological Applications 10 (5): 1251–1262.

Blancas, José, Alejandro Casas, Selene Rangel-Landa, Ana Moreno-Calles, Ignacio Torres, Edgar Pérez-Negrón, Leonor Solís, et al. 2010. "Plant Management in the Tehuacán-Cuicatlán Valley, Mexico1." *Economic Botany* 64 (4): 287–302.

Bock, Bettina B., and Sally Shortall, eds. 2017. Gender and Rural Globalization: International Perspectives on Gender and Rural Development. Boston, MA: CABI.

Caballero-Serrano, Veronica, Miren Onaindia, Josu G. Alday, David Caballero, Juan Carlos Carrasco, Brian McLaren, and Javier Amigo. 2016. "Plant Diversity and Ecosystem Services in Amazonian Homegardens of Ecuador." Agriculture, Ecosystems & Environment 225 (June): 116–25. https://doi.org/10.1016/j.agee.2016.04.005.

Cabrera, Isidro Rimarachín, Emma Zapata Martelo, and Verónica Vázquez García. 2001. "Gender, Rural Households, and Biodiversity in Native Mexico." Agriculture and Human Values 18 (1): 85–93.

Chambers, Kimberlee J., and Janet Henshall Momsen. 2007. "From the Kitchen and the Field: Gender and Maize Diversity in the Bajio Region of Mexico." Singapore Journal of Tropical Geography 28 (1): 39–56.

Contreras-Cortés, U., and R. Mariaca-Méndez. 2016. Manejo de Los Recursos Naturales Entre Los Mayas Lacandones de Nahá. ECOSUR.

Cook, Suzanne. 2016. The Forest of the Lacandon Maya: An Ethnobotanical Guide. Springer.

Cortés, L.E.U.C., L.C. Barrera, M. Fernández-Aliphat, and R. Méndez-Mariaca. 2013. "Manejo de Los Agroecosistemas En La Comunidad Lacandona de Nahá, Chiapas." Etnobiología 11 (3): 34–44.

Diemont, Stewart AW. 2006. "Ecosystem Management and Restoration as Practiced by the Indigenous Lacandon Maya of Chiapas, Mexico." Doctoral, The Ohio State University.

Diemont, Stewart AW, and Jay F. Martin. 2009. "Lacandon Maya Ecosystem Management: Sustainable Design for Subsistence and Environmental Restoration." Ecological Applications 19 (1): 254–266.

Diemont, Stewart AW, Jay F. Martin, and Samuel I. Levy-Tacher. 2006. "Emergy Evaluation of Lacandon Maya Indigenous Swidden Agroforestry in Chiapas, Mexico." Agroforestry Systems 66 (1): 23–42.

Diemont, Stewart AW, Jay F. Martin, Samuel I. Levy-Tacher, Ronald B. Nigh, Pedro Ramirez Lopez, and J. Duncan Golicher. 2006. "Lacandon Maya Forest Management: Restoration of Soil Fertility Using Native Tree Species." Ecological Engineering 28 (3): 205–212.

Durán-Fernández, Alejandro, Juan Rogelio Aguirre-Rivera, José García-Pérez, Samuel Levy-Tacher, and José Arturo De Nova-Vazquez. 2016. "Inventario florístico de la comunidad lacandona de Nahá, Chiapas, México." Botanical Sciences 94 (1): 157. https://doi.org/10.17129/botsci.248.

Falkowski, Tomasz B., Adolfo Chankin, and Stewart AW Diemont. 2020. "Successional Changes in Vegetation and Litter Structure in Traditional Lacandon Maya Agroforests." Agroecology and Sustainable Food Systems 44 (6): 747–767.

Falkowski, T.B., Vázquez-Pérez, J.R., Chankin, A., Campos-Beltrán, A.Y., Rangel-Salazar, J.L., Cohen, J.B. and Diemont, S.A.W., 2020. Assessing avian diversity and community composition along a successional gradient in traditional Lacandon Maya agroforests. Biotropica.

Falkowski, Tomasz B., Adolfo Chankin, Stewart AW Diemont, and Robert W. Pedian. 2019. “More than Just Corn and Calories: A Comprehensive Assessment of the Yield and Nutritional Content of a Traditional Lacandon Maya Milpa.” Food Security 11 (2): 389–404.

Falkowski, Tomasz B., Stewart AW Diemont, Adolfo Chankin, and David Douterlungne. 2016. “Lacandon Maya Traditional Ecological Knowledge and Rainforest Restoration: Soil Fertility beneath Six Agroforestry System Trees.” Ecological Engineering 92: 210–217.

Fujiyoshi, Phillip T., Stephen R. Gliessman, and Jean H. Langenheim. 2007. “Factors in the Suppression of Weeds by Squash Interplanted in Corn.” Weed Biology and Management 7 (2): 105–114.

Hansen, Matthew C., Peter V. Potapov, Rebecca Moore, Matt Hancher, Svetlana A. Turubanova, Alexandra Tyukavina, David Thau, S. V. Stehman, Scott J. Goetz, and Thomas R. Loveland. 2013. “High-Resolution Global Maps of 21st-Century Forest Cover Change.” Science 342 (6160): 850–853.

Hillebrand, Helmut. 2004. “On the Generality of the Latitudinal Diversity Gradient.” The American Naturalist 163 (2): 192–211.

Howard, Patricia. 2003. “Women and the Plant World. An Exploration.” In Economic Botany. Vol. 58. https://doi.org/10.1663/0013-0001(2004)058[0486:DFABRE]2.0.CO;2.

———. 2006. “Gender Bias in Ethnobotany: Propositions and Evidence of a Distorted Science and Promises of a Brighter Future.” In Proceedings of the International Society of Ethnobiology 9th International Congress and Society for Economic Botany 45th Annual Meeting.

Howard, Patricia L. 2010. “Culture and Agrobiodiversity: Understanding the Links.” Nature and Culture: Rebuilding Lost Connections, 163–184.

Isakson, S. Ryan. 2009. “No Hay Ganancia En La Milpa : The Agrarian Question, Food Sovereignty, and the on-Farm Conservation of Agrobiodiversity in the Guatemalan Highlands.” The Journal of Peasant Studies 36 (4): 725–59. https://doi.org/10.1080/03066150903353876.

Kimmerer, Robin. 2011. “Restoration and Reciprocity: The Contributions of Traditional Ecological Knowledge.” In Human Dimensions of Ecological Restoration, 257–276. Springer.

Kuhnlein, Harriet V. 2020. “Foreword.” In Indigenous Food Systems: Concepts, Cases, and Conversations, vi–vii. Canadian Scholars.

Larios, Carolina, Alejandro Casas, Mariana Vallejo, Ana Isabel Moreno-Calles, and José Blancas. 2013. “Plant Management and Biodiversity Conservation in Náhuatl Homegardens of the Tehuacán Valley, Mexico.” Journal of Ethnobiology and Ethnomedicine 9 (1): 74.

Levy Tacher, Samuel Israel, J. Rogelio Aguirre Rivera, María Magdalena Martínez Romero, and Alejandro Durán Fernández. 2002. “Caracterización Del Uso Tradicional de La Flora Espontánea En La Comunidad Lacandona de Lacanhá, Chiapas, México.” Interciencia 27 (10).

Martin, Jay F., Stewart AW Diemont, Erick Powell, Michele Stanton, and Samuel Levy-Tacher. 2006. “Emergy Evaluation of the Performance and Sustainability of Three Agricultural Systems with Different Scales and Management.” Agriculture, Ecosystems & Environment 115 (1–4): 128–140.

McGee, R. Jon, and Belisa Gonzaléz. 1999. “Economics, Women, and Work in the Lacandon Jungle.” Frontiers: A Journal of Women Studies 20 (2): 175–189.

Momsen, Janet Henshall. 2004. Gender and Development.

———. 2007. “Gender and Biodiversity: A New Approach to Linking Environment and Development.” Geography Compass 1 (2): 149–162.

Nabhan, Gary Paul, DeJa Walker, and Alberto Mellado Moreno. 2010a. “Biocultural and Ecogastronomic Restoration: The Renewing America’s Food Traditions Alliance.” Ecological Restoration 28 (3): 266–279.

———. 2010b. “Biocultural and Ecogastronomic Restoration: The Renewing America’s Food Traditions Alliance.” Ecological Restoration 28 (3): 266–279.

Nations, James D., and Ronald B. Nigh. 1980. “The Evolutionary Potential of Lacandon Maya Sustained-Yield Tropical Forest Agriculture.” Journal of Anthropological Research 36 (1): 1–30.

Nations, James, and Valenzuela, Chan K’in Jose. 2017. Lacandon Maya: The Language and Environment.

Nigh, R., and Stewart AW Diemont. 2013. “The Maya Milpa: Fire and the Legacy of Living Soil - Google Académico.” https://scholar.google.com/scholar_lookup?title=The%20Maya%20milpa%3A%20fire%20and%20the%20legacy%20of%20living%20soil&author=R.%20Nigh&publication_year=2013&pages=E45-E54.

Padmanabhan, Martina. 2011. “Women and Men as Conservers, Users and Managers of Agrobiodiversity: A Feminist Social–Ecological Approach.” The Journal of Socio-Economics 40 (6): 968–976.

Perfecto, Ivette, and John Vandermeer. 2008. “Biodiversity Conservation in Tropical Agroecosystems.”

Quisumbing, Agnes R., Ruth Meinzen-Dick, Terri L. Raney, André Croppenstedt, Julia A. Behrman, and Amber Peterman, eds. 2014. Gender in Agriculture. Dordrecht: Springer Netherlands.

Rangel-Landa, Selene, Alejandro Casas, Erandi Rivera-Lozoya, Ignacio Torres-García, and Mariana Vallejo-Ramos. 2016. “Ixcatec Ethnoecology: Plant Management and Biocultural Heritage in Oaxaca, Mexico.” Journal of Ethnobiology and Ethnomedicine 12 (1): 1–83. https://doi.org/10.1186/s13002-016-0101-3.

Rendón, Javier, Alejandro Casas, Ana Moreno Calles, Ignacio Torres-García, and Eduardo Frapolli. 2020. “Traditional Agroforestry Systems and Conservation of Native Plant Diversity of Seasonally Dry Tropical Forests.” Sustainability 12 (June): 1–27. https://doi.org/10.3390/su12114600.

Skarbø, Kristine. 2014. “The Cooked Is the Kept: Factors Shaping the Maintenance of Agro-Biodiversity in the Andes.” Human Ecology 42 (5): 711–26. https://doi.org/10.1007/s10745-014-9685-1.

Suárez Gutiérrez, Gloria Mariel, Eduardo Bello Baltazar, Rosa Elba Hernández Cruz, and Allan Rhodes. 2016. “Ecoturismo y El Trabajo Invisibilizado de Las Mujeres En La Selva Lacandona, Chiapas, México.” El Periplo Sustentable, no. 31.

Timmermann, Cristian, and Georges F. Félix. 2015. “Agroecology as a Vehicle for Contributive Justice.” Agriculture and Human Values 32 (3): 523–538.

Toledo, V.M., and Narciso Barrera-Bassols. 2008. La Memoria Biocultural: La Importancia Ecológica de Las Sabidurías Tradicionales. Vol. 3. Icaria editorial. https://books.google.com.mx/books?hl=es&lr=&id=5LAJ8kp0BjUC&oi=fnd&pg=PA11&dq=la+memoria+biocultural+la+importancia+ecol%C3%B3gica+&ots=Fr8wVMM7Wp&sig=9N3Q1VXOPQ2r8DC9u32CGp0xac0.

Zhang, Wei, Taylor H. Ricketts, Claire Kremen, Karen Carney, and Scott M. Swinton. 2007. “Ecosystem Services and Dis-Services to Agriculture.” Ecological Economics 64 (2): 253–260.

CHAPTER 4

Conclusions, Limitations and Recommendations

4.1 Conclusions

This work aimed at understanding how women are shaping the diet and landscape in Lacanja Chansayab, Mexico. There is a historical and global pattern of omitting information regarding women and domestic work and there is a need to fill the gender gap to correctly understand the current context.

To answer the research question, one of the main objectives was to understand the relationship Lacandon Maya women have with food. Throughout the interviews, several themes came out and I chose the four most salient. The first relationship I chose between women and food is one of empowerment. This might seem contradictory in the first instance since cooking and the kitchen are mandatory activities for women. However, throughout the interviews I was able to discover that social recognition and power as a product of cooking, particularly cooking traditional food since women are the carriers of that tradition. Also, it is through cooking for tourists that many women have been able to be economically independent.

The second important relationship women have with food is one of memory and nostalgia, food, brings back moments and people which is important for the women in Lacanja. Food is a way to remember those that are no longer here but are still loved. The third relationship I found is that food is a way in which women are establishing a relationship with non-human beings. Women are producing their food, or a part of their food and this forces them to care for and tend to other non-human beings, many of them report that it is a source of happiness and wellbeing. The last relationship that I discussed that Lacandon women have with food is one of discrimination. The ability to eat certain food reflects social status. In the case of Lacanja, there is the idea that eating traditional food reflects poverty and backwardness, so many women that still daily eat traditional food have received hurtful comments from others.

Once I had a better understanding of the relationship Lacandon women have with the food, I wanted to understand how food has changed with time. I learned that processed foods are slowly been more eaten and even preferred over traditional food and it is not only a pattern in Lacanja Chansayab, but it is a national trend in Mexico.

As part of the interviews, many women mentioned that efforts should be placed to promote traditional food, they provided three main ideas, promoting the production of the traditional agroforestry systems and the transmission of the knowledge and abilities to cook traditional food, as well as offering traditional food to tourists, a practice that is currently not common in the community. Given all the benefits that traditional food could provide to the community, I claim that traditional food could potentially trigger biocultural restoration in Lacanja Chansayab.

I then wanted to understand in more detail how women are producers and conservers of agrobiodiversity, and thus shapers of the landscape of Lacanja. For this, I did plant community samplings of three different stages of the agroforestry system and compared them with plots managed by men. This work is the first time a Lacandon house patio has been surveyed through plant community sampling, and it showed a huge amount of edible, medicinal, and ornamental plants.

I was able to determine that plots of *kor*, *pak che kor*, and patio managed by women have no statistical differences in terms of diversity and richness of ethnotaxons with those managed by men. I however found differences in terms of ethnotaxons composition in the system of *kor* (in Spanish *milpa*). This difference in ethnotaxon composition is a result of differences in management. Women have disservice plants unevenly distributed in the *kor* because they plant less *Cucurbita argyrosperma*, a local squash, which is an inhibitor of disservice plants. As a tradeoff for this decision, women have more individuals of maize than men in their *kor*.

My speculation for the difference in management is that women have less access to the job market than men. This leaves them with few other options of income. Consequently, women will have the time to

remove disservice plants with more detail than men, so they do not plant *Cucurbita argyrosperma* to reduce this effort. Moreover, *Cucurbita argyrosperma* is a crop that is particularly physically demanding as each squash can weight up to 5 kg and its seed is collected in sacks than can weight 50 kg. Finally, those sacks need to be sold in the city, which is another impediment for women as they do not speak Spanish fluently and they are less accustomed to traveling to the city.

I was able to find exceptional diversity of plants and uses in plots managed by women, comparable to those that have been reported before in previous studies on plots managed by men in Lacanja. My results indicate that women are as capable as men in producing a diverse and productive agroforestry system. However, women are more vulnerable than men because the whole food system depends on them, they need to do all the work in the fields and all the domestic work. Additionally, women that harvest their agroforestry system are usually older, as women only have access to land tenure once they become widow, so this makes them more vulnerable to disease and getting hurt while doing the strenuous work of a farmer.

This work is an important contribution to understanding the complexity of the relationship between the Lacandon Maya and their environment. By adding a gender perspective, I was able to give voice to the women in the community, which prior had not been included in the research. Women in the community are fundamental because they are not only reproducing the agroforestry systems but also, they are the carriers of the knowledge and necessary skills to transform all the agrobiodiversity into a diverse meal.

4.2 Limitations and Future Research

The work in Chapter 2 work was mostly based on the food conversations completed with ten Lacandon women, resulting in the collection of recipes, and with the overall participant observation of the three-month fieldwork. The number of conversations represents less than 6% of the population of women. I intended to concentrate on developing a relationship with women, instead of increasing the number of conversations. Therefore, formal conversations were completed during the last two weeks of fieldwork. I had many unrecorded conversations with women before finally doing recorded interviews. I think this

strategy was fruitful because it allowed me to develop a relationship and to determine the most important topics to be later further studied in more detail.

Fieldwork was completed from June to August, which are the months with the highest arrival of tourists, so it was hard for women that work in restaurants to find the time and energy to participate in the conversations with audio recording. If possible, I recommend working off the tourist season as well; this would be important to include women that work in the tourist sector. Tourist season over the summer is also a time of the year when women who cultivate their food are very busy working in the land. This can become an opportunity to help them, but otherwise, they tend to be less busy after the harvest.

The present work documents part of the relationship some women in Lacanja have with food. I am not providing an exhaustive list of their relationship. I am sure that there are many other aspects of this relationship that are also important. In this work I focused a lot on the relationship women have with edible plants, however, women also develop special relationships with other living beings like animals and fungi. This could be an area of further study, where special concentration is given to the relationship to other than plant edibles.

There is also a very interesting link between food and medicine in Lacanja. During certain maladies, people recommend you often consume certain traditional food, which will improve your health. It would be interesting to understand how do Lacandon people relate to those medicinal products and compare them to their relationship with allopathic medicine.

I recognize that there are women in the community that expressed their dislike for cooking; they had no interest in participating in the project and they prefer to buy processed food because it takes them out of the kitchen faster. Cooking and overseeing domestic activities are not a chosen work by women, but rather an imposed one. Many people in the community even consider this a women's duty and not even a proper work. I acknowledge that some women might dislike cooking and respect their personal decision. Consequently, this makes my work biased towards the positive aspects of the relationship between food

and women. I decided to go ahead, despite the bias, because it was my objective to understand the relationship between women and food, and women keener to participate did so because they enjoy cooking. It would be important to voice the negative opinions women have with cooking and understand this relationship in a deeper way.

Themes touched in this thesis are very complex and it is not my intention to study them in detail, rather, my objective is to provide a general platform to hopefully initiate further in-depth study. It would be interesting to study in more detail each of the four themes proposed. I think it would be important to study how government programs like Progresa or Payment for Ecosystem Services increase or decrease women's empowerment, food sovereignty, and resilience of households.

Further research, especially in Naha and Metzabok, and with a larger sample size to continue studying the relationship of Lacandon women with food, particularly the negative aspects of this relationship. Other important studies would be to research in more detail the socioeconomic factors affecting the consumption of traditional food to understand drivers of the shift in diet. Also to study how cultural and structural violence against women limits their access to basic rights, adequate food and nutrition, and other opportunities for self-development as well as suggestions and actions on how to overcome this gender imbalance (see Bellows and Jenderedjian 2015).

Another important future research area could be to study in more detail the link between agrobiodiversity and culinary diversity, I think it would be especially interesting to document it in a year-long project understanding how this changes among the seasons to identify is there are periods among that year that tend to be more scarce than others.

Finally, it is important to recognize that every researcher arrives in a foreign place with preconceived notions of gender and other social relators that bias the results. As much as I worked hard to avoid any predisposition during my fieldwork and analysis of results, I recognize that any mistakes are my responsibility.

Women and men have different ways of relating to Nature, as I describe in Chapter 3, that are not necessarily reflected in ecological measurements like richness and diversity and are still important. For instance, it could be interesting to understand how the women's and men's understanding of the ecosystem services that the traditional agroforestry system offers, differs. Because even though they are producing similar plots in terms of richness and diversity, maybe they understand the products and the complexity of the system in different ways.

According to the concept theory of intersectionality, gender is one of many sociocultural aspects that can shape people's relationship to land and other beings, there are other stratifies that can impact such as land tenure, number of households, education. For this chapter, I describe women's and men's traditional division of gender in the community. I recognize that not all people identify as men or women and some do not fit into the binary gender framework.

An important methodological limitation was that all the naming of the ethnotaxons was exclusively done by a male expert. On the one hand, this promotes the homogenization of the naming of the plants, but on the other hand, this could prevent us from learning gender-specific knowledge. It would be interesting for future research to understand the heterogeneity of traditional knowledge, by comparing the recognition of ethnotaxons and their uses between women and men. This could be done by triangulating information to make sure both genders call the same species the same name and annotate any differences.

The diversity of varieties within the agroforestry system was not included in the listing of ethnotaxons. During fieldwork, not all ethnotaxons were fruiting or showing the phenological characteristics necessary to be able to distinguish between varieties of the same ethnotaxons. Given this limitation, I am underestimating the richness of ethnotaxons within the plots. Previous literature has recognized women as drivers of a diversity of varieties as they require a variety of culinary diversity (Skarbø 2014). Making a study in terms of productivity could lead to understanding better diversity and richness at the level of varieties. It would be important to note the particular use each product will have and how it varies among

the seasons. For instance, I observed in the field that *Cucurbita argyrosperma* is used in many ways along with its cultivation, where at the beginning flowers at eaten, then the fresh vegetable, then the leaves, and finally the seeds of the mature pumpkin. This shows how the diversity of even one particular variety of ethnotaxon can be huge.

I had a low number of women participants in the study. This reflects also the fact that the number of women managing their land ownership is low. A plausible explanation is that women generally only have access to land tenure after they are widowed. It is also the case that older women did not have access to school and thus few of them speak Spanish, so as an outsider it can be a bit more complicated to establish contact with them, especially without an interpreter. I was not able to record any young women producing their agroforestry system and understanding this would be important. Is it because they do not have access to land tenure? Or is it that they need cash to satisfy their needs and their children´s needs?

Finally, this study is a picture of the diversity and richness found in plots of women and men; it would be interesting to study in a longer period and understand if ecological measurements or management changes across the seasons between women and men.

4.3 References

Bellows, Anne C, and Anna Jenderedjian. 2015. "Violence and Women's Participation in the Right to Adequate Food and Nutrition." In *Gender, Nutrition, and the Human Right to Adequate Food: Toward an Inclusive Framework*, edited by Anne C Bellows, S.S. Valente, Stefanie Lemke, and Núñez Burbano de Lara, M.D., 108–61. London & New York: NY Routledge.

Skarbø, Kristine. 2014. "The Cooked Is the Kept: Factors Shaping the Maintenance of Agro-Biodiversity in the Andes." *Human Ecology* 42 (5): 711–26. https://doi.org/10.1007/s10745-014-9685-1.

Appendix 1: Guide for interviews

Guideline for personal presentation

Mi nombre es Lucía Pérez Volkow, soy de la Ciudad de México, soy estudiante y me interesa mucho estudiar la comida que se come en Lacanjá, desde cómo se cultiva hasta cómo se prepara. Para esto estoy haciendo pláticas del tema para juntar la perspectiva de diferentes personas en el pueblo. La información será publicada en un libro que voy a escribir, que llamamos tesis. Me gustaría que esto fuera una plática, donde usted me haga preguntas y comentarios. Para guiar esta plática, yo tengo una serie de preguntas preparadas. Si usted no quiere contestar algo que le pregunte está en su derecho. Usted puede terminar esta conversación en cualquier momento. Su participación no va a estar relacionada con su nombre y quiera pedir su autorización para grabar la plática. Las preguntas las dividí en varias secciones, en la primera quisiera aprender un poco sobre usted y si usted siembra milpa, después quisiera platicar acerca de la comida tradicional y cómo ha cambiado con el tiempo.

Mention: Date, who is present, time, place of conversation

First section (demographic)

1. ¿Cuál es su nombre?
2. ¿Qué edad tiene?
3. ¿De dónde es originaria?
4. ¿Cuántos años lleva viviendo en Lacanjá?
5. ¿Hasta que grado pudo estudiar?
6. ¿Está casada o juntada?
7. ¿Su esposo vive?
8. ¿Cuántos hijos tiene?
9. ¿Le ayudan sus hijos en su trabajo?

Second section (special for measured milpa)

1. ¿De qué tamaño es su milpa?
2. ¿Qué tipo de tierra tiene su milpa?
3. ¿Cuántos años tiene su milpa?
4. ¿Cuándo la quemó por última vez?
5. ¿Qué tipo de acahual era antes de quemarla?
6. ¿Quién es el dueño de la milpa?
7. ¿Contrata a alguien para que le ayude?
8. ¿Qué tipo de maíz siembra?
9. ¿Cuándo sembró este año?
10. ¿Llega a utilizar algún químico para ayudarle a su milpa?

Third section

1. ¿Conoce la comida tradicional?
2. ¿Cuál es la comida tradicional para usted?
3. ¿Qué tiene de especial la comida tradicional para usted?
4. ¿Sabe cocinar la comida tradicional?
5. ¿Quién le enseño a cocinar la comida tradicional?
6. ¿Cuáles son las recetas tradicionales que más le gustan?
7. ¿En qué tiempo del año se come?
8. ¿Cuáles son los días festivos más importantes en Lacanjá y qué se come en ellos?
9. ¿Le cuesta conseguir los ingredientes para cocinar comida tradicional?
10. ¿Le cuesta conseguir los ingredientes para cocinar comida de la tienda?
11. ¿Normalmente de dónde viene el maíz que usa para sus tortillas?
12. ¿Qué tan seguido come de ese maíz?
13. ¿Normalmente de qué frijoles come?
14. ¿Qué tan seguido come esos frijoles?
15. ¿Qué alimentos consume de su milpa, patio, selva, acahual, tienda?
16. ¿Hay algún programa de gobierno que le ayude a obtener alimentos?
17. ¿Usted prefiere la comida tradicional o la de la tienda y por qué?
18. ¿Por qué cree que alguien prefiere la otra comida?
19. ¿Cómo ha cambiado con el tiempo la comida que se come en Lacanjá?
20. ¿Por qué no se vende comida tradicional en las tiendas en Lacanjá?
21. ¿A los turistas les gusta la comida tradicional?
22. ¿Qué pasaría si se deja de comer la comida tradicional?
23. ¿Qué pueden hacer las mujeres para evitar que se pierda la comida tradicional?
24. ¿Qué pueden hacer los hombres para evitar que se pierda la comida tradicional?
25. ¿Hay algo más que me quiera contar alrededor del tema de comida en Lacanjá?
26. ¿Quisiera hacerme una pregunta?

Appendix 2: Examples of R scripts of final results

Diversity and Richness GLM Analysis Example

Authors: Lucía Pérez Volkow and Tomasz Bartosz Falkowski

```
#Research Question:

### Is richness and diversity different for F and M?

###This is the script for milpa 10m2, GLM


library(tidyr)

library(vegan)

library(fitdistrplus)

library(MASS)

library(npsurv)

library(lsei)

library(lme4)

library(ggplot2)

library(Matrix)

library(AER)


##Tyding the data to obtain richness and diversity (shannon and
simpson)

raw<-read.csv("m10.csv")

site<-paste(raw$gender,raw$owner)

m10<-data.frame(site,raw[1:227, 3:4])

m10spread<- spread(m10, maya, num, fill = 0)

m10<-m10spread[1:10,2:105]

m10rh <-data.frame(m10spread[1:10,1],diversity(m10,index =
"shannon"),specnumber(m10),diversity(m10,index = "simpson"))

M10<-separate(m10rh, col = 1, into = c("Gender","num"), sep = " ")

names(M10)[2]<-"Owner"
```

```
names(M10)[3]<-"H"
names(M10)[4]<-"Richness"
names(M10)[5]<-"D"
M10$Owner <- as.factor(M10$Owner)
M10$Gender <- as.factor(M10$Gender)
View(M10)

#Data

#Richness
FR<-mean(M10$Richness[1:5])
SDFR<-sd(M10$Richness[1:5])
MR<-mean(M10$Richness[6:10])
SDMR<-sd(M10$Richness[6:10])

table(FR, SDFR, MR, SDMR)

#H
FH<-mean(M10$H[1:5])
SDFH<-sd(M10$H[1:5])
MH<-mean(M10$H[6:10])
SDMH<-sd(M10$H[6:10])

table(FH, SDFH, MH, SDMH)

#D
FD<-mean(M10$D[1:5])
SDFD<-sd(M10$D[1:5])
MD<-mean(M10$D[6:10])
SDMD<-sd(M10$D[6:10])
```

```
table(FD, SDFD, MD, SDMD)



#######################################################
### GLM for RICHNESS

#negative binomial
summary(glm(Richness ~ Gender, data=M10,family=poisson))
17.199/8 #p=0.098; Dispersion=2.15, try quasipoisson
summary(glm(Richness ~ Gender, data=M10,family=quasipoisson))
17.199/8 #p=2.93; Dispersion=2.15, try negative binomial
M10nB<-glm.nb(Richness ~ Gender, data=M10)
summary(M10nB) # p=0.205; Dispersion=1.284

########################################
### GLM for H

#gaussian
M10gH <- glm(H~Gender,data=M10)
summary(M10gH) # p=0.828  #RD/df=0.1239487
plot(M10gH) #QQplot seems slightly non-normal, so try gamma, which has
no assumption of normality of residuals
summary(glm(H~Gender,data=M10,family=Gamma)) #p=0.828
0.274/8 #Dispersion =0.034

########################################
### GLM for D

#gaussian
M10gD <- glm(D~Gender,data=M10)
```

```
summary(M10gD) # p=0.602
plot(M10gD) #QQPlot looks great, so stay with Gaussian distribution
#RD/df= 0.01130788
```

Ethnotaxon Composition Example Script

Authors: Lucía Pérez Volkow and Tomasz Bartosz Falkowski

```
#Research Question:
# Is species composition different in F and M?
##This is the script for milpa 10m2

library(tidyr)
library(vegan)
library(fitdistrplus)
library(MASS)
library(npsurv)
library(lsei)
library(lme4)
library(ggplot2)
library(Matrix)

raw<-read.csv("m1.csv")

##Tyding the data
site<-paste(raw$gender,raw$quad)
M1<-data.frame(site,raw[1:517, 3:4])
names(M1)[3]<-"specnm"
mspread<- spread(M1, maya,specnm, fill = 0)
m1<-separate(mspread, col = 1, into = c("Gender","num"), sep = " ")
m1.1<-separate(m1, col = 2, into = c("Owner","num"), sep = "(?<=[A-Za-
z])(?=[0-9])")
m1.1$num <- NULL
```

```
m1.1$Owner <- as.factor(m1.1$Owner)

m1.1$Gender <- as.factor(m1.1$Gender)

m1a<-aggregate(m1.1[1:100,3:ncol(m1.1)], by=list(Owner=m1.1$Owner,
Gender=m1.1$Gender),FUN=sum)

m1group<-data.frame(m1a[1:10,1:2])


###Creating data frame of species

m1s<-(m1a[,3:ncol(m1a)])


############# Analysis #############

### tabasco

tabasco(sqrt(m1s))


#nMDS with sqrt and bray

m1nM <- metaMDS (vegdist (sqrt (m1s), method = "bray", binary =
FALSE), k = 2)

str(m1nM) # 0.0653


###Shepard plot###

stressplot(m1nM,main="Milpa 10m2 nMDS")


##Plotting data

#extract NMDS scores (x and y coordinates)

data.scores = as.data.frame(scores(m1nM))


#add columns with the groups of m1 group to data frame

data.scores$Gender = m1group$Gender

data.scores$Owner = m1group$Owner

head(data.scores)


##Plot
```

```
grp.M <- data.scores[data.scores$Gender == "M",
][chull(data.scores[data.scores$Gender ==


"M", c("NMDS1", "NMDS2")]), ]

grp.F <- data.scores[data.scores$Gender == "F",
][chull(data.scores[data.scores$Gender ==


"F", c("NMDS1", "NMDS2")]), ]

hull.data <- rbind(grp.M, grp.F)

ggplot(data.scores, aes(x=NMDS1, y=NMDS2, shape=Gender, col=Gender)) +

  geom_point() +


geom_polygon(data=hull.data,aes(x=NMDS1,y=NMDS2,fill=Gender,group=Gend
er),alpha=0.30) +

  theme_bw() +

  labs(title = "Milpa 10m2 nMDS")


#permANOVA only works if groups have the same "multivariate spread" so
we need to test this using Marti

#Anderson's betadisper()


BDWis<- anova(betadisper(vegdist(sqrt(m1s), method =
"bray"),m1a$Gender))

#p=0.7262, p>0.05, so the multivariate spread is homogeneous


#Adonis with sqrt

adonis_location = adonis(sqrt(m1s) ~ Gender, m1a)

adonis_location ###Pr(>F) = 0.065
```

Appendix 3: Excerpt from Lacandon Maya Recipe Book

Chigua Flower Soup

Author	Rosa Gonzales
Preparation time	One hour
Ingredients	Pumpkin flower (chigua variety), young chiguas, lemon, salt, onion and garlic
Origin of ingredients	*Milpa*, patio.
Months of consumption	June
Description	A soup with chigua flower which can be eaten with tortillas.
Curiosities	It is only during a brief period of the year that this soup can be eaten and flowers need to be gathered early in the morning.

Preparation

Image	Description
	You need to go to the *milpa* to gather the chigua flowers and young chiguas. Flowers need to be gathered early in the morning. If you pick up chiguas that are not young enough, the shell will be too tough to be eaten. Chiguas grow up to 5 kilos, so it is only during the first months that they can be eaten like this.
	The inferior part of the flower (the green part) needs to be removed. You only eat the petals and the central portion.

	Once the flowers are separated, you need to properly clean every petal, many times you can find insects inside. Also make sure that you properly clean the chiguas, as they tend to have soil.
	Cut the chigua into big pieces.
	Boil the flowers and the young chigua.
	Once it starts boiling, add salt, onion, and garlic.

	Allow it to boil for a few minutes.
	You can add a bit of lemon and chili and eat it with tortillas.

Appendix 4: List of Lacandon Maya Ethnotaxons

Spanish Name	Mayan Name	Latin Binomial	General Use					
ciruela	abor	*Spondias sp.*	EDI	-	-	-	-	-
té limón	ak	*Cymbopogon citratus*	MED	-	-	-	-	-
frijol de vara	ak i bú	*Phaseolus vulgaris*	EDI	-	-	-	-	-
-	ak' j'uun	*Poulsemia armata*	EDI	FIB	-	-	-	-
pasto	ak' suuk'	*Cyperuse ligularis*	DIS	-	-	-	-	-
frijol de abono	akí kajbé	*Mucuna pruriens*	ECO	-	-	-	-	-
-	aki kante	UNK	UNK	-	-	-	-	-
-	akin téj	UNK	EDI	MED	-	-	-	-
mala mujer	ak'isá	UNK	DIS	-	-	-	-	-
chapai	aktej	*Astrocaryum mexicanum*	EDI	-	-	-	-	-
almendra	almendra	*Terminalia catappa*	EDI	-	-	-	-	-
anís	ánis	*Pimpinella anisum*	EDI	JEW	-	-	-	-
anona	anona	*Morinda citrifolia*	MED	-	-	-	-	-
arroz frijol	aus b'ú	*Vigna umbellata*	EDI	-	-	-	-	-
-	ax a'ak	UNK	EDI	-	-	-	-	-
-	axi ché	UNK	DIS	-	-	-	-	-
-	ba max'	*Diospyros digyna, Pseudolmedia oxiphyllaria*	EDI	-	-	-	-	-
-	baché	*Lonchocarpus longistylus, Lonchocarpus punctatus*	EDI	-	-	-	-	-
-	bajom	*Cordia alliodora*	CON	-	-	-	-	-
flor de mayo	bak nicté	*Plumeria spp.*	ORN	-	-	-	-	-
inga	bakram bitz	*Inga sp.*	EDI	-	-	-	-	-
-	barum té	*Theobroma bicolor*	EDI	-	-	-	-	-
-	birám surí	*Dioscorea bulbifera*	EDI	MED	-	-	-	-
inga, vaina	bitz	*Inga vera, I. pavoniana*	EDI	-	-	-	-	-
palma shate	bo í	*Chamaedorea oblongata*	ORN	-	-	-	-	-
-	box bú	*Vigna unguiculata*	EDI	-	-	-	-	-
plátano guinea	box patam	*Musa spp.*	EDI	-	-	-	-	-
vainilla	buk ruchí, buruch	*Lonopsis utricularioides*	EDI	-	-	-	-	-
-	burí kax	*Canavalia villosa*	EDI	JEW	-	-	-	-

carambola	carambola	*Averrhoa carambola*	EDI	-	-	-	-	-
chaya	chai	*Cnidoscolus multilobus*	EDI	-	-	-	-	-
nochebuena	chäk che	*Euphorbia pulcherrima*	ORN	-	-	-	-	-
camote rojo	chak is	*Ipomoea spp.*	EDI	-	-	-	-	-
majuagua roja	chak jaror	*Heliocarpus donnelli-smithi, Heliocarpus appendiculatus*	CON	FIB	HAN	HUN	-	-
cacao rojo	chak käkä	*Theobroma cacao*	EDI	-	-	-	-	-
chilim colorado	chak koyó	*Persea schiedeana*	EDI	-	-	-	-	-
belén	chak kuku	*Impatiens sp.*	ORN	-	-	-	-	-
melón rojo	chak mello	*Sicana odorifera*	EDI	-	-	-	-	-
-	chak mi che	UNK	FIR	TUT	-	-	-	-
palo guacamaya	chak mó	UNK	HAN	-	-	-	-	-
tripa de mono	chak mo ak', chak apa ak	UNK	JEW	-	-	-	-	-
-	chak mukó	UNK	ECO	ORN	-	-	-	-
limón criollo	chak murix	*Citrus sp.*	EDI	-	-	-	-	-
maíz rojo	chak nar	*Zea mays*	EDI	FIR	FOR	MED	STO	TUT
papaya roja	chak put	*Carica spp.*	EDI	-	-	-	-	-
palo mulato, palo indio	chak rá	*Bursera simaruba*	LIV	MED	-	-	-	-
tulipán	chak top che	*Hibiscus rosa-sinensis*	LIV	ORN	TOO	-	-	-
-	chak top che iká	UNK	DIS	-	-	-	-	-
cebolla roja	chak tza k'ek'én	*Allium spp.*	EDI	-	-	-	-	-
-	chak u baker	UNK	DIS	-	-	-	-	-
-	chamak waj	UNK	EDI	-	-	-	-	-
-	chankäp, kärá	*Canna indica*	DIS	JEW	-	-	-	-
yerbamora	cháuk, cha yúk	*Solanum nigrenscens*	EDI	-	-	-	-	-
-	chechém	*Metopium brownei*	ECO	FIR	FIS	-	-	-
-	chei suuk	UNK	UNK	-	-	-	-	-
nancy	chi	*Byrsonima crassifolia*	EDI	-	-	-	-	-
jícama	chi kan	*Pachyrhizus erosus*	EDI	-	-	-	-	-
chícharo	chícharo	*Pisum sativum*	EDI	-	-	-	-	-

tepejilote	ch'iip	*Chamaedorea alternans, Chamaedoerea tepejilote*	EDI	-	-	-	-	-
-	ch'iip turix	UNK	HUN	-	-	-	-	-
naranja	chiná, araxa	*Citrus x aurantium*	EDI	-	-	-	-	-
-	ch'ismosí robir	UNK	DIS	-	-	-	-	-
chililllo	chok	*Connarus lambertii, Rourea glabra*	HUN	-	-	-	-	-
-	chuchu bí	UNK	EDI	TOY	-	-	-	-
-	ch'uí	*Androlepis skinneri*	BIO	-	-	-	-	-
piña dulce	chújuk pa'ach	*Ananas comosus*	EDI	-	-	-	-	-
balsa	chúkun, chújam	*Ochroma puramidale*	ECO	-	-	-	-	-
-	chum ak	*Passiflora edulis*	EDI	-	-	-	-	-
amapola	ch'uté	*Pseudobombax ellipticum*	CON	FIS	REF	-	-	-
bambú	ch'uum jará	Bambusoideae	CON	ORN	-	-	-	-
citronela	citronela	*Pelargonium graveolens*	MED	-	-	-	-	-
corona de cristo	corona de cristo	*Euphorbia milii*	ORN	-	-	-	-	-
cuna de moisés	cuna de moisés	*Spathiphyllum sp.*	ORN	-	-	-	-	-
flor de margaritas	flor de margaritas	*Bellis sp.*	ORN	-	-	-	-	-
guaya	guayam	*Melicoccus bijugatus*	EDI	-	-	-	-	-
-	ibi kax	*Oxyrhynchus trinervium*	JEW	-	-	-	-	-
chile	ik	*Capscium annuum*	EDI	-	-	-	-	-
-	ikam	*Lycianthes heteroclita*	UNK	-	-	-	-	-
frijol ip, frijol gigante	ip	*Phaseolus sp.*	EDI	-	-	-	-	-
camote	is	*Ipomoea batatas*	EDI	-	-	-	-	-
-	isam robir	UNK	DIS	-	-	-	-	-
-	isi c'ho	UNK	DIS	-	-	-	-	-
-	ja ach kiish	UNK	BIO	-	-	-	-	-
mamey	ja as	*Pouteria sapota*	EDI	-	-	-	-	-
-	ja xap k'ak	UNK	FIR	-	-	-	-	-
-	jaach k'anche	UNK	CON	FIR	MED	-	-	-
-	jaach kix	UNK	DIS	-	-	-	-	-

plátano macho	jach patam	*Musa paradisiaca*	EDI	-	-	-	-	-
platanillo	jachor, jacham	UNK	EDI	-	-	-	-	-
-	jai iu tix	UNK	UNK	-	-	-	-	-
chayote de agua	jajach pix	*Sechium spp.*	EDI	-	-	-	-	-
jamaica	jamá	*Hibiscus sabdariffa*	EDI	-	-	-	-	-
majagua	jaror	*Heliocarpus donnelli-smithi, Heliocarpus appendiculatus*	CON	ECO	FIB	-	-	-
jaba	jas che	*Alseis yucatanensis*	EDI	-	-	-	-	-
-	jiit kix	UNK	DIS	-	-	-	-	-
-	jo bio	UNK	FIR	-	-	-	-	-
momo	jobé	*Piper auritum*	ECO	EDI	-	-	-	-
jobo	jujup, k'iina	*Spondias mombin*	ECO	EDI	MED	LIV	-	-
bugambilia, flor papelillo	junche	*Bougainvillea sp.*	ORN	-	-	-	-	-
-	jut ki	UNK	DIS	-	-	-	-	-
-	jutur xamuk	UNK	DIS	-	-	-	-	-
platanillo	jutur xir	UNK	ORN	-	-	-	-	-
momo agrio	k'a k'a jobé	UNK	MED	-	-	-	-	-
-	k'a ka robir	UNK	MED	-	-	-	-	-
yuca agria	k'a k'a tzin	*Manihot spp.*	EDI	-	-	-	-	-
-	k'aan suum	*Sinclairia deppeana, Sonchus oleraceu*s	BIO	ECO	-	-	-	-
-	kaat	*Parmenteria aculeata, Parmenteria edulis*	EDI	-	-	-	-	-
maíz chaparro	kaba nar	*Zea mays*	EDI	FIR	FOR	MED	STO	TUT
cacao	käkä	*Theobroma cacao*	EDI	-	-	-	-	-
papaya amarilla	k'am put	*Carica spp.*	EDI	-	-	-	-	-
maculis	k'an joi	Anacardiaceae	MED	-	-	-	-	-
coco amarillo	k'an kokó	*Cocos nucifera*	EDI	-	-	-	-	-
limón amarillo	k'an murix	*Citrus x limon*	EDI	-	-	-	-	-
-	kan tu xikin	UNK	DIS	-	-	-	-	-
colorín	k'ante	*Erythrina folkersii*	JEW	MED	-	-	-	-
pitaya	kap ayim, remó	UNK	EDI	-	-	-	-	-

castaña	kastan, nukuch ox	*Artocarpus altilis*	EDI	-	-	-	-	-
-	ke we	UNK	EDI	-	-	-	-	-
pata de vaca	k'ewém	*Chamaedorea ernesti-augustii*	ORN	-	-	-	-	-
-	ki bok, nukuch re sisikutz	*Clibadium arboreum*	CON	NER	-	-	-	-
hule	k'ik	*Castilla elastica*	HUN	RES	-	-	-	-
-	kikni barum	*Ardisia compress*	EDI	ORN	-	-	-	-
uña de gato	k'iri ak	UNK	MED	-	-	-	-	-
-	kitam murix	UNK	EDI	-	-	-	-	-
-	kix ukuch	UNK	MED	-	-	-	-	-
nopal	k'oj	*Opuntia spp.*	EDI	-	-	-	-	-
coco	kokó	*Cocos nucifera*	EDI	-	-	-	-	-
-	kokojche	UNK	EDI	-	-	-	-	-
guarumbo	ko'och	*Cecropia obtusifolia, Cecropia peltata*	ECO	NER	-	-	-	-
orquídea	ko'och batz	*Gongora unicolor*	ORN	-	-	-	-	-
-	ko'och kox	UNK	JEW	-	-	-	-	-
chilim	koyó	*Persea schiedeana*	EDI	-	-	-	-	-
cedro	k'u che	*Cedrela odorata*	CON	-	-	-	-	-
hormiguilo	kukunté	*Pterocarpus rohrii*	MUS	-	-	-	-	-
-	kukux	UNK	ECO	MED	-	-	-	-
palma	kum	*Crysophila stauracantha*	EDI	-	-	-	-	-
calabaza	k'um	*Cucurbita pepo*	EDI	-	-	-	-	-
kakate	k'un k'un che	*Oecopetalum mexicanum*	EDI	MED	-	-	-	-
-	k'ur ik ir	UNK	DIS	-	-	-	-	-
cilantro	kurentó	*Coriandrum sativum*	EDI	-	-	-	-	-
jobillo	kurinché	*Astronium graveolens*	HAN	-	-	-	-	-
tabaco	k'utz	*Nicotina tabacum*	NER	POI	STO	-	-	-
-	kutz si	UNK	DIS	-	-	-	-	-
-	kuur ak'	*Dioscorea bartletti*	EDI	-	-	-	-	-
-	k'uut	*Calathea macrosepala*	EDI	-	-	-	-	-
-	kux nok	*Bidens odarata*	DIS	-	-	-	-	-
-	kuxú che	UNK	DIS	ECO	-	-	-	-
achiote	kuxú, kuxúp	*Bixa orellana*	EDI	-	-	-	-	-
-	k'uyuch	UNK	EDI	-	-	-	-	-
lichi	lichi	*Litchi chinensis*	EDI	-	-	-	-	-

jícara	luch	*Crescentia alata*	TOO	-	-	-	-	-
macal	mäcär	*Xanthosoma robustum*	EDI	-	-	-	-	-
-	machich	*Lonchocarpus rugosus*	FIR	-	-	-	-	-
maguey	maguey	*Tradescantia spathacea*	MED	-	-	-	-	-
-	majá puk sik che	*Trophis mexicana, Trophis racemosa*	EDI	-	-	-	-	-
-	makai ch'om	UNK	DIS	-	-	-	-	-
mango	mä'ku	*Mangifera indica*	EDI	-	-	-	-	-
-	mak'urám	*Piper aduncum*	ECO	MED	TUT	-	-	-
plátano de masam	masam patam	*Musa spp.*	EDI	-	-	-	-	-
-	max ak'	UNK	BIO	FIS	MED	-	-	-
mandarina	mején china	*Citrus sp.*	EDI	-	-	-	-	-
mandarina cajero	mején china cajero, mejen araxa cajero	*Citrus sp.*	EDI	-	-	-	-	-
mandarina chica	mején china, mejen mandarina	*Citrus sp.*	EDI	-	-	-	-	-
-	mején kuutsi	UNK	DIS	-	-	-	-	-
limón	mején murix	*Citrus x limon*	EDI	-	-	-	-	-
papaya chica	mején put	*Carica spp.*	EDI	-	-	-	-	-
-	mején tu xikin	*Aristolochia foetida*	DIS	-	-	-	-	-
-	mején xamuk, mején shukun irum	UNK	DIS	-	-	-	-	-
-	mején yax mak'urám	UNK	ECO	-	-	-	-	-
-	mején yax mak'urám kax	*Piper sp.*	ECO	-	-	-	-	-
melón	melló	*Cucumis melo*	EDI	-	-	-	-	-
-	misip robir	UNK	TOO	-	-	-	-	-
ámbar de la selva	mooch	UNK	JEW	-	-	-	-	-
verdolaga	mumun bak	*Trianthema portulacastrum*	EDI	-	-	-	-	-

limón	murix	*Citrus x limon*	EDI	-	-	-	-	-
-	muxam che	*Alchomea latifolia*	ECO	-	-	-	-	-
-	nak ja' robir	UNK	DIS	-	-	-	-	-
-	nak jai chiip	*Chamaedoria cataractarum*	EDI	-	-	-	-	-
maíz	nar	*Zea mays*	EDI	FIR	FOR	MED	STO	TUT
-	ne sabin	UNK	DIS	-	-	-	-	-
-	nej k'ambur	*Anthurium schlechtendalii*	ORN	-	-	-	-	-
-	ni'j sur	UNK	ECO	JEW	-	-	-	-
-	nikté	*Clematis sp.*	EDI	MED	-	-	-	-
níspero	níspero	*Eriobotrya japonica*	EDI	-	-	-	-	-
-	nukuch joteré che	UNK	EDI	-	-	-	-	-
-	nukuch mochi ja'	UNK	JEW	-	-	-	-	-
-	nukuch pasak	*Costus spicatus*	EDI	MED	-	-	-	-
sidra	nukuch rima	*Citrus sp.*	EDI	-	-	-	-	-
mata blanca	nukuch ukanté	UNK	CON	ECO	FIB	-	-	-
-	nukuch xamuk, nukuch xukú	UNK	DIS	-	-	-	-	-
aguacate	on	*Persea americana*	EDI	-	-	-	-	-
-	on te	*Ocotea cernua, Licaria alata*	EDI	-	-	-	-	-
-	op	*Annona cherimoya*	EDI	-	-	-	-	-
-	op ch'urúm	*Guazuma ulmfolia*	EDI	-	-	-	-	-
-	op max, om max	*Annona sp.*	EDI	-	-	-	-	-
orégano	orégano	UNK	EDI	-	-	-	-	-
plátano oro	oro patam	*Musa sp.*	EDI	-	-	-	-	-
orquídea	orquídea	Orchidaceae	ORN	-	-	-	-	-
piña	pa'ach	*Ananas comosus*	EDI	-	-	-	-	-
tomate criollo	pak an xir	*Solanum lycopersicum*	EDI	-	-	-	-	-
piña agria	papa pa'ach	*Ananas comosus*	EDI	-	-	-	-	-
-	pasak	*Costus guanaiensis*	EDI	MED	-	-	-	-
plátano	patam	*Musa sp.*	EDI	-	-	-	-	-
pimienta	pesaj che'	*Pimenta diocia*	EDI	-	-	-	-	-
-	pet ak'	*Combretum fruticosum*	ECO	EDI	-	-	-	-

guanacaste	petzk'in	*Enterolobium cyclocarpum*	CON	ECO	JEW	-	-	-
chayote	pix	*Sechium spp.*	EDI	-	-	-	-	-
-	p'op'och murix	*Citrus jambhiri*	EDI	-	-	-	-	-
guanábana	pox, papá op	*Annona muricata*	EDI	-	-	-	-	-
tamarindo	poxá wech	*Dialium sp.*	EDI	-	-	-	-	-
capulín	pujám	*Mutingia calabura*	EDI	-	-	-	-	-
caoba	puná	*Swietenia macrophylla*	CON	ECO	MED	-	-	-
guayaba	pur, pichik	*Psidium guajava*	EDI	-	-	-	-	-
papaya	put	*Carica spp.*	EDI	-	-	-	-	-
papaya de pájaro	put i chich	*Carica spp.*	ECO	-	-	-	-	-
papaya silvestre	put i k'ax	*Carica spp.*	ECO	-	-	-	-	-
-	ra' is	UNK	MED	-	-	-	-	-
lima	rima	*Citrus sp.*	EDI	TOO	-	-	-	-
mimosa púdica, palo dormilón	robir k'uwena	UNK	MED	-	-	-	-	-
-	robir mostas	UNK	MED	-	-	-	-	-
-	robir nak j'a	UNK	DIS	-	-	-	-	-
-	sa sak che	*Eupatorium nubigenum*	ECO	EDI	-	-	-	-
-	sa sap ak	UNK	DIS	-	-	-	-	-
-	sa' sap robir, sak top robir	UNK	ECO	DIS	-	-	-	-
-	sa' sap suk	UNK	DIS	-	-	-	-	-
-	s'a s'i póm	UNK	MED	-	-	-	-	-
sábila	sábila	*Aloe vera*	MED	-	-	-	-	-
-	sai	UNK	UNK	-	-	-	-	-
-	saiya	UNK	DIS	-	-	-	-	-
-	sak ak	*Beilschmiedia anay*	EDI	MED	ORN	-	-	-
frijol blanco	sak bú	*Phaseolus spp.*	EDI	-	-	-	-	-
mata palo	sak copó	UNK	UNK	-	-	-	-	-
camote blanco	sak is	*Ipomoea batatas*	EDI	-	-	-	-	-
majauagua blanca	sak jaror	*Heliocarpus appendiculatus*	FIB	-	-	-	-	-

-	sak karap, nukuch karap	UNK	JEW	-	-	-	-	-
-	sak kik' nij barúm	UNK	ORN	-	-	-	-	-
maíz blanco duro	sak nar	*Zea mays*	EDI	FIR	FOR	MED	STO	TUT
-	sak onté	*Nectandra ambigens?, Licaria alata?*	EDI	-	-	-	-	-
-	sak opche	UNK	UNK	-	-	-	-	-
-	sak top robir	UNK	DIS	-	-	-	-	-
cebolla blanca	sak tza k'ek'én	*Allium sp.*	EDI	-	-	-	-	-
yuca blanca	sak tzin	*Manihot sp.*	EDI	-	-	-	-	-
-	sak woró	UNK	EDI	-	-	-	-	-
cabeza de mico	sakats'	*Licania platypus*	EDI	-	-	-	-	-
sandía	sañá	*Citrullus lanatus*	EDI	-	-	-	-	-
sandía de ratón	sañá ijchó	*Melothria pendula*	EDI	-	-	-	-	-
-	sayam, sayam sai	UNK	DIS	-	-	-	-	-
jenjibre	sensión	*Zingiber officinale*	EDI	MED	-	-	-	-
jaboncillo	si jom	*Sapindus saponaria*	MED	-	-	-	-	-
cacahuate	sikí tei ruum	*Arachis hypogaea*	EDI	-	-	-	-	-
chigua	sikir, chijim	*Curcurbita moschata*	EDI	-	-	-	-	-
-	sikité	*Jatropha curcas*	EDI	MED	-	-	-	-
-	s'it món	UNK	EDI	-	-	-	-	-
-	sits'	*Justicia sp.*	MED	TIN	-	-	-	-
canela	sor che	*Cinnamomum verum*	EDI	-	-	-	-	-
-	sotz che	UNK	ORN	-	-	-	-	-
-	sotz kin	UNK	JEW	-	-	-	-	-
-	sotz pix	*Sechium spp.*	EDI	-	-	-	-	-
-	sotz re che robir	UNK	ORN	-	-	-	-	-
sacate	su uk	Poaceae	UNK	-	-	-	-	-
-	súban, subín	*Acacia collinsii*	EDI	-	-	-	-	-
caña de azúcar	suca	*Saccharum officinarum*	EDI	-	-	-	-	-
girasol	suj	*Helianthus sp.*	EDI	-	-	-	-	-
-	sukí	UNK	EDI	MED	-	-	-	-
plátano tabasqueño	tabasqueño patam	*Musa spp.*	EDI	-	-	-	-	-
pino	taj te	*Pinus spp.*	FIR	ORN	-	-	-	-

limón injerto	tak bi murix	*Citrus x limon*	EDI	-	-	-	-	-
algodón	tamá	*Gossypium hirsutum*	FIB	-	-	-	-	-
corcho blanco	tao	*Belotia mexicana*	CON	ECO	TOO	-	-	-
-	te us	UNK	BIO	ORN	-	-	-	-
-	te usír	*Renealmia mexicana*	ORN	-	-	-	-	-
-	t'er bitz	*Inga nobilis, Inga pavoniana*	EDI	-	-	-	-	-
bola de caballo	tonsimín	*Tabernaemontana amygdalifolia*	RES	-	-	-	-	-
toronja	toronja	*Citrus paradisi*	EDI	-	-	-	-	-
-	ts'ak ba'ker	*Gouania lupuloides*	MED	-	-	-	-	-
perejil de monte	ts'ak kai	UNK	EDI	-	-	-	-	-
-	ts'ak k'an tabí	*Dorstenia contrajerva*	MED	-	-	-	-	-
yerbabuena	ts'akax	*Mentha citrata*	EDI	-	-	-	-	-
-	ts'ibaré ché	*Astronium graveolens*	LIV	ORN	-	-	-	-
-	ts'u tok, tap to	*Hampea nutricia*	FIB	-	-	-	-	-
-	tu xikín	*Ipomoea spp.*	MED	-	-	-	-	-
buche	tuch	*Thevetia ahouai*	EDI	MED	-	-	-	-
cebollín	tza k'ek'én	*Allium porrum*	EDI	-	-	-	-	-
-	tzak k'akir	*Stigmaphyllon dichotomum*	DIS	MED	-	-	-	-
-	tzak xe ji	UNK	MED	-	-	-	-	-
yuca	tzin	*Manihot esculenta*	EDI	-	-	-	-	-
jaimito	tzit yá	UNK	EDI	-	-	-	-	-
briofita?	tzosé ruum	UNK	BIO	-	-	-	-	-
hongo	tzukan ru um	Fungi	UNK	-	-	-	-	-
-	tzurá	UNK	ARO	ORN	-	-	-	-
uva silvestre	tzus	*Vitis tiliifolia*	EDI	-	-	-	-	-
zapote negro	uch	*Diospyros digyna*	EDI	-	-	-	-	-
mata blanca	ukanté, sak che	*Sapium lateriflorum*	ECO	HAN	HUN	-	-	-
-	ukuch	*Solanum schlechtendalianum*	EDI	MED	-	-	-	-
-	urim	*Ipomea sp.*	ORN	TOY	-	-	-	-
-	utsup kisim, yom kisim	UNK	ARO	-	-	-	-	-
-	wo' che'	*Casimiroa sp.*	EDI	-	-	-	-	-
-	xai	UNK	ORN	-	-	-	-	-
-	xamuk, xukú	UNK	DIS	-	-	-	-	-

guano	xan	*Sabal mauritiiformis, Sabal mexicana*	CON	-	-	-	-	-
-	xei xamuk, xei xukú	UNK	DIS	-	-	-	-	-
-	xinich	*Byrsonima crassifloia,Ardisia paschalis*	EDI	-	-	-	-	-
plantanillo	xir	UNK	EDI	-	-	-	-	-
-	xoté ikyum	*Cestrum racemosum*	EDI	-	-	-	-	-
chicle zapote, chico zapote	yá	*Manilkara zapota*	EDI	-	-	-	-	-
ceiba	ya'aj che	*Ceiba pentandra*	ORN	-	-	-	-	-
-	yax baché	*Lonchocarpus guatemalensis*	FIR	-	-	-	-	-
yuca gigante, yuca agria	yax che tzin	*Manihot esculenta*	EDI	-	-	-	-	-
nancy verde	yax ch'i	*Byrsonima crassifolia*	EDI	-	-	-	-	-
coco verde	yax kokó	*Cocos nucifera*	EDI	-	-	-	-	-
chilim verde	yax koyó	*Persea schiedeana*	EDI	-	-	-	-	-
-	yax mejen makurami kax	UNK	ECO	-	-	-	-	-
chayote verde	yax pix	*Sechium spp.*	EDI	-	-	-	-	-
-	yax xámuk	UNK	UNK	-	-	-	-	-
-	yoch che kap	*Bourreria oxyphylla*	EDI	-	-	-	-	-
-	yoch mo'	UNK	ECO	-	-	-	-	-
-	yoch simín	UNK	ECO	-	-	-	-	-
-	yoch susuy	*Clibadium arboreum*	ECO	-	-	-	-	-
-	yoch ts'unú	*Justicia aurea*	ECO	-	-	-	-	-
-	yoch urum	UNK	MED	ORN	-	-	-	-
-	yusup kisim, yom kisim	UNK	ARO	EDI	-	-	-	-
-	ziba kara	UNK	JEW	-	-	-	-	-

Key for uses

Use	Acronym	Description
aromatic	ARO	plants valued for their perfume for personal use or the surroundings
bioindicator	BIO	its pressence or phenologic event is used an as indicator for biotic, abiotic or cultural events
construction	CON	plants used for construction of infraestructure (walls, ceiling, etc.)
disservice	DIS	plants that are unwanted in the milpa because theyoutcompete other more desired plants
ecological	ECO	plants used to enhance soil properties (increase organic matter, increase seed bank, attract pollinators)
edible	EDI	any part of the plant is used to eat, prepare food or beverages, also plants that are used to wrap food
fiber	FIB	plants that provide fibers
firewood	FIR	plants used to generate fire
fishing	FIS	plants that aid in fishing
forage	FOR	plants that are use to feed domesticated animals
handicraft	HAN	plants used to create decorative objects
hunting	HUN	plants that aid in hunting
jewelry	JEW	plant used to make jewelry (necklace, bracelet, earings)
living fence	LIV	plants used to limit space
medicinal	MED	plants used to treat and/or cure, and/ or prevent human diseases
musical instrument	MUS	plants used to make musical instruments
nervous alterer	NER	plants that alter the human nervous system
ornamental	ORN	plant is recognized to have an aesthetic value
poison	POI	plants that are used to harm other plants, animals, fungi (insecticides, fungicides…)
reforestation	REF	plants used with the objective of reforestation
resin	RES	plants that their resin can be extracted
storage	STO	plants that help in the storage of seeds, other plants, things
tincture	TIN	plants used to create colors
tool	TOO	plants to elaborate practical objects
toy	TOY	plants used to elaborate toys
tutor	TUT	plants used as tutor, support or nurse to another plant of interest
unknown	UNK	not a known use

Lucía Pérez Volkow

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Master's student interested in research pertaining to biocultural restoration, socioecological systems, and agroecology.

Education

Master of Science, Environmental Science **Expected to Graduate: December 2020**
State University of New York College of Environmental Science and Forestry (ESF), Syracuse, NY *GPA: 4.00/4.00*

Thesis: Filling gender gaps: determining how traditional knowledge of Lacandon Maya women shape the landscape and the diet in Lacanja Chansayab, Mexico

Bachelor of Science, Biology **Graduated: June 2018**
Universidad Nacional Autónoma de México, Facultad de Ciencias, Mexico City, Mexico *GPA: 9.91/10*

Thesis: Socioeconomic factors that affect the efficiency in the production of charcoal in the Basin of Cuitzeo, Michoacan, Mexico

Exchange Program, Department of Anthropology & Biology **September 2015 – February 2016**
Universität Wien, Vienna, Austria

International Baccalaureate **August 2010 – May 2012**
Mahindra United World College of India, Pune, Maharashtra, India

Awards

Fulbright-García Robles **August 2018 – August 2020**
Research Grant from the Randolph G. Pack Institute **December 2019**
ESF Tropical Social Forestry Scholarship, ESF **December 2019**
Alumni Memorial Scholarship, ESF **April 2019**
Research Grant, ESF Career Fellowship Program, ESF **May 2019**
Latin America and the Caribbean Grant for Field Research Summer, Syracuse University **May 2019**
Graduate Student Association Research Grant, ESF **May 2019**

Research Experience

Master of Science Thesis Researcher **August 2018 – Present**
Graduate Program of Environmental Science, ESF

- Understand how women shape the landscape and diet in Lacanja Chansayab, Chiapas, Mexico
- Use mix effect models and non-metric multidimensional scaling to determine if plant communities differ in different stages of the traditional agroforestry systems managed by women and men
- Use RQDA (RStudio package) to analyze interviews using Grounded Theory
- Provide description of the food systems of Lacanja Chansayab

Undergraduate Biology Thesis **August 2014 – June 2018**
Institute of Research in Ecosystems and Sustainability (IIES-UNAM), Morelia, Mexico

- Described traditional charcoal management in the Cuitzeo Basin, Michoacan, Mexico

Generated typologies of producers according to their social characteristics using Principal Component Analysis and data from 42 interviews

- Determined if social heterogeneity helps explain traditional kiln efficiency and management practices
- Analyzed whether social heterogeneity and management practices generate different levels of consumption of biomass

Research Assistant in Mexican Center for Innovation in Energy (CEMIE-BIO) **May 2017 – June 2018**
Institute of Research in Ecosystems and Sustainability (IIES-UNAM), Morelia, Mexico

- Served as the Research Assistant for Sustainability and Public Policy in Biofuels, particularly charcoal
- Performed administration and logistics of fieldwork
- Developed and implemented online surveys

Research Assistant in the Laboratory of Mountain Ecosystems **March 2016 – April 2017**
Faculty of Science, UNAM, Mexico City, Mexico

- Determined socioenvironmental indicators, particularly Ethnobotanical damages due to megaprojects in Mexico
- Synthesized data and texts
- Documented a review of Ecosystem Services of Mexico City

Research Assistant on Sustainable Charcoal Indicators **January 2016 – June 2018**
Institute of Research in Ecosystems and Sustainability (IIES-UNAM), Morelia, Mexico

- Focused on project: "Search for key sustainability indicators in traditional Mexican systems of charcoal production" (PAPIIT-IA202216)
- Determined socioenvironmental indicators that indicate sustainable production of charcoal in Mexico
- Performed administration and logistics of fieldwork

Research Assistant in Monitoring Forests in Mexico City **April 2016 – May 2017**
Faculty of Science, UNAM, Mexico City, Mexico

- Focused on project: "Participative Monitoring of the reforestation and ecological quality of rivers in the Water Forest with emphasis in the Magdalena River Basin" (PAPIIT IT 201415)
- Assisted with community monitoring of reforestation and water quality in Magdalena River Basin
- Implemented and transcribed interviews in the community

Research Assistant in Synergies and Compensations in Charcoal Production **June 2014 – December 2015**
CIECO (current IIES), UNAM, Morelia, Mexico

- Focused on project: "Synergies and compensations between ecosystem services in forests where charcoal is produced"
- Measured efficiency of charcoal production in earth-mound kilns
- Conducted data collection and cleaning

Publications and Working Documents

- Pérez Volkow, L. 2018. Factores socioeconómicos que afectan la eficiencia de la producción de carbón vegetal en la cuenca de Cuitzeo, Michoacán, México. Bachelor's Thesis. Facultad de Ciencias, UNAM.

- Pischke, E.C., Volkow, L.P., & Fragoso-Medina, M. (2018). Practicing what we preach: Reflections on the pros and cons of transdisciplinary research in Erongarícuaro, Mexico. *Revista Vínculos*, *3*(1).

- Uribe, T. O., Mastrangelo, M., Torrez, D. V., Piaz, A., Gallego, F., Soler, M. F., … others. (2015). Estudios

- Uribe, T. O., Mastrangelo, M., Torrez, D. V., Piaz, A., Gallego, F., Soler, M. F., … others. (2015). Estudios transdisciplinarios en socio-ecosistemas: Reflexiones teóricas y su aplicación en contextos latinoamericanos. *Investigación Ambiental Ciencia y Política Pública*, *6*(2). Retrieved from http://www.revista.inecc.gob.mx/article/view/257

- Working document: *"Chan nikté visits her grandparents"* This is a children's book about all the things a little girl can learn from her Lacandon Maya grandparents regarding tending the jungle and cooking.

- Working document: *"From the jungle to the table"* This is a recipe book that collects traditional Lacandon Maya dishes. It has information from harvesting and collecting ingredients, to how to prepare them.

- Working document: From rainforest to table: Lacandon Maya women are critical to diverse landscapes and food in Lacanja Chansayab, Mexico. Research paper

- Working document: Lacandon Maya women and agroforestry systems in the rainforest of Chiapas, Mexico. Research paper

Relevant Workshops and Trainings

Workshop Participant, *Agroecology* **junio 2020**
Centro Latinoamericano de Investigaciones Agroecológicas, CELIA. Online course.
- "Agroecología y la reconstrucción de una agricultura post covid"

Workshop Participant, *Socio-Environmental Synthesis Course* **January 2020**
The National Socio-Environmental Synthesis Center (*SESYNC*), Annapolis, USA
- "Graduate Leaders in Socio-Environmental Synthesis"

Workshop Participant, *Ethnobotanical Research Workshop* **June 2014 – May 2017**
Botanical Garden, National Autonomous University of Mexico, Mexico
- "Use and Management of Natural Resources: An Ethnobotanical and Ethnoecological Approach"

Organizer and Participant, *Socioecological Systems Course* **November 2016**
IIES-UNAM & Inter-American Institute for Global Change Research, Morelia, Mexico
- "Conceptual Basis for the Management of Socioecological Systems"

Participant, *Interdisciplinary Course* **March 2014**
CIECO-UNAM (current IIES), Inter-American Institute for Global Change Research, Morelia, Mexico
- "Management of Socioecological Systems to Support Decision Making"

Poster and Oral Presentations

Poster Presenter **November 2017**
V International Congress of Ecosystem Services in the Neotropics, Oaxaca, Mexico
- "Social Dimensions in the Efficiency of Charcoal Kilns: The Case of Production Systems of Charcoal in Michoacan, Mexico"

Oral Presenter **July 2017**
VI Mexican Congress of Ecology, Leon, Mexico

Oral Presenter **July 2017**

Meeting of the Association of Tropical Biology and Conservation, Merida, Mexico

- "Socio-economics, Efficiency and Environmental Impact of Charcoal Producers in a Mexican Watershed"

Poster Presenter **April 2015**

V Mexican Congress of Ecology, San Luis Potosi, Mexico

- "The Effect of Social Factors in the Efficiency Rate of Earth Kilns for Producing Charcoal"

Skills

Computer: R (for quantitative and qualitative analysis), Microsoft Word, Excel, PowerPoint
Languages: English, Spanish

Volunteer Experience

Facilitator, United World College, NGO., Mexico City, Mexico **August 2012 – August 2018**
Interpreter/Translator, Workers Center of Center New York, USA **January 2020- Present**