Food Sovereignty: Women and Meliponiculture in Corozo community, Nicaragua

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Degree of Master of Science
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Abstract of Thesis

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Food sovereignty is the right to healthy food based on agroecological production, placing those who produce, distribute, and consume food at the center of food policies. In Nicaragua, peasant agriculture faces great challenges due to climate changes and policy making in the political sphere. Since ancient times, Nicaraguan women have been the protagonists in the story of achieving food sovereignty. NGOs and women's work in conservation of traditional seed, Indigenous customs and knowledge, along with their willingness to adapt new technologies and science-based agro-ecological methods suggest that autonomy can be obtained in ways that lead to food sovereignty. In this study, I include a case study that shows that Meliponiculture has the potential to contribute to family farming production, crop diversification and the rescue of native bees, a practice that returns women to community heritage protection.

Keywords: Food sovereignty, knowledge, agroecology, practices, politics, Nicaragua, climate change, diversification, Meliponiculture, bees, traditional, gardeners, seeds, conservation, pollination, community, indigenous

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List of Abbreviations

FAO Food and Agriculture Organisation of the United Nations

FSLN Frente Sandinista de Liberacion National (Sandinista Front for National Liberation

GDP Gross Domestic Product

MZ Manzana (Most used measure for land area)

NGO Non-governmental organisation

PCAC Programa Campesino a Campesino (Farmer to farmer programme

UNAG Union Nacional de Agricultores y Ganaderos (National Farmers' Union

UNAG Union Nacional de Agricultores y Ganaderos (National Union of Agricultural Producers and Ranchers)

USA United States of America

WTO World Trade Organisation

Glossary

Contra: Armed group backed and funded by the US in opposition to the Sandinista Government. They were involved in a civil war agains the Sandinista

Cordoba: The Nicaraguan National Currency

Don or Doña: Spanish equivalent of Mr and Mrs. Don and Doña are terms of high respect awarded to meritorious persons.

Ladino: A person of miexed racial ancestry:Spanish colonizers descendants mixed with indigenous people.

Machete Big instrument used for agricultural work

Manzana: Unit used in Nicaragua to measure land area. Manzana equivalent to 0.7 hectare
Mestizo: Person of mixed ancestry, generally of Spanish and Indigenous.

Tortilla: Flat bread made of maize

Milpa: The term means "maize field" but refers to a field planted not only with maize but with squash, beans, melons, sweet potatoes, Cassava, and other plants

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[1] "Administratively, Nicaragua is divided into 15 departments and two autonomous regions, with 153 municipalities. Geographically, it is divided into three regions: the plains in the Pacific, the mountains in the north and center, and the plains on the Caribbean Coast" (PRO Nicaragua, 2020).

1. Introduction

Nicaraguan peasant march in 1980s. "We are not birds who live in the air; we are not fish who live in the sea; We are Men who live off the land."

Picture 1. Nicaraguan peasant march in 1980s
Photo: Association of Rural Workers (ATC)

"For a comprehensive agrarian reform that prioritizes women, we have the right not to suffer from hunger and malnutrition."
Picture 2. Interest Group for Food security and food Sovereignty (GISSAN) protest in front of the National Assembly. March 08, 2007.
Photo: Eduardo Vallecillo

1.1 Political context: a brief history

The history of Nicaragua after the Spanish Colonial Period (1522-1820) is closely linked to political relations with the United States of America because of geographical proximity. In 1856, William Walker, U.S. physician, lawyer, journalist, and mercenary who wanted to start English speaking colonies in Mexico and Central America, usurped the presidency of Nicaragua in July 1856 and ruled until May 1, 1857 when he was forced out of office by Central American armies. William Walker began a pattern that would continue through the present of showing great interest in construction of an interoceanic canal. At the beginning of the 20th century, the United States invested mainly in river transport, mining, and export of bananas and wood. Years passed by marking history between coups d'état and the institution of a family dynasty started by Anastasio Somoza García. Anastasio Somoza and his sons constructed a dictatorship that would last 45 years in Nicaragua (1936-1979), with the support by the United States. Four decades of Somoza family dictatorship with its focus on very large-scale monocropping farming systems for export-oriented production perpetuated poverty and exacerbated extreme social, political, and economic inequalities in Nicaragua (Schiller, K et al 2020).

During the U.S. supported Somoza dictatorship, Nicaragua's economy was mainly agricultural. The rural population of Nicaragua was invested in generating 75.0% of the value of exports, which in 1951 reached 26.5 million dollars. In 1951, the World Bank carried out its first mission in the country. The World Bank believed that Nicaragua was ready for an economic awakening because of Nicaragua's vast territory and low population density. The investments by the World Bank in roads, agricultural machinery, and storage centers of

agricultural production were all assumed by the Somoza dynasty, accentuating the agro-export model for the next twenty years (Cruz, 2005).

Approaching the 1970s, the Nicaraguan economy changed negatively for the peasants, who were affected by the expropriation of their lands by landowners for the production of cotton and coffee, the expansion of the agricultural frontier, and unemployment. The 1972 earthquake ended up weakening the Somoza dynasty because of its complete failure to respond satisfactorily to the needs of the citizens devastated by natural disaster. The settlers began to show their dissatisfaction with the uneven distribution of wealth and the poverty that prevailed in society. The heirs of the Somoza dynasty were not open to changing the political model. By 1975 the political panorama was unfavorable for foreign and national investment and all these factors led to the national insurrection. The dictatorship ended in 1978 with the *Sandinista* revolutionary government (Feinberg, 2018). The *Sandinista* National Liberation Front (Spanish: *Frente Sandinista de Liberación Nacional,* FSLN) began implementing a massive literacy campaign, agrarian reform, and other social programs to rebuild the country starting in 1979 (Dore, 1992).

Change came quickly once the *Sandinistas* assumed power. During the first year of the *Sandinista* Revolution. 180 companies and more than 500 thousand hectares of land were confiscated by the FSLN, and the poles of social accumulation continued to shift throughout the eighties as properties were confiscated by the State, either to prevent their "decapitalization," or to guarantee "a more efficient administration." In less than one year, the State came to directly control banking to foreign trade, including food and oil exports and imports. The public sector's share of GDP went from 15.0% in 1978 to 41.0% in 1980 (Castillo et al, 1980). There was a climate of hope among many rural and urban people in the

1980s due, in part, to the literacy campaign but also to the sense of the people having won a multi-generational struggle against US-backed tyranny. However, both the revolutionary and neo-liberal governments saw no place for the small-scale farmer. The revolutionary policies in the 1980s did not benefit small farmers, first at all, because when decisions were made regarding agrarian reform, small farmers were excluded and kept unaware of the reality in which they were living. A second reason because the "*Sandinista* Revolution also promoted without hesitation the Green Revolution, which since the 50s has been present in Nicaraguan agriculture, especially in the cotton boom, but without an ecological vision"(Envio,1994). During this period of the Green Revolution, deforestation increased, transforming the rich land into a desert through deforestation, massive use of fertilizers, high levels of mechanization, and energy consumption to make room for cotton production to supply its textile industry. The peasant owners of the small but productive farms of that region were kicked off and forced to leave their land and establish themselves in other more productive land. Finally, small farmers were left behind was because the agrarian reform prioritized the development of state farms, which were represented by state-controlled business unions with interests in livestock, cotton, extensive pastures, sugar, rice, and sorghum, sugar cane and export cattle. During the neo-liberal era, the *Sandinistas* prioritized large-scale agro-export farms (Kaimowitz, 1986) and the life of small-scale farmers became even more precarious (Delgado, 2014). The history of the small-scale farmers is one of the continuous expropriation processes and usurpation of resources.

Agrarian Reform was created to put forth by the new "people's" government of Nicaragua. Its objective was to reduce poverty and hunger through the distribution of idle land to landless peasants, creation of cooperatives for farmers, and implementation of the state agricultural

enterprises. At this time, the National Union of Farmers and Ranchers (UNAG) or in Spanish Union Nacional de Agricultores y Ganaderos (UNAG) was also established in 1981 to support small rural farmers and producers, regardless of their politics. They intended to bring together all the small farmers and ranchers to work together and develop the agro-industrial projects proposed by the socialists. The above efforts did not work well because the Nicaraguan economy continued to be mainly agricultural and there was a little boom in the industrial sector, mainly due to the lack of investment in modernization. In addition, the food crisis exerted a lot of pressure on the government that prevented innovation or progress. Some agrarian reforms were accepted by a sector of the peasantry, but there was a peasant union that did not agree with the idea of centralizing agriculture. This group demanded rights to make decisions on their lands and their products. Peasants generally faced many difficulties in financing and commercializing their crops, causing black market dynamics and shortages. Here the government encountered confrontations that led to social upheaval once again, a situation that was exploited by opponents of *Sandinismo*. This development, along with other global circumstances, led to the presidential elections of the 1990s, but during this tumultuous time, the agricultural situation was exploited by the circle close to Daniel Ortega, Nicaragua's current president, to expropriate peasants from their lands. Expropriating peasants from their lands led to many legal conflicts over land ownership between large landowners and peasants, a problem which persists today (Zalkin, 1990).

The president-elect in 1990, Violeta Barrios de Chamorro, inherited all the conflicts generated in the transition: armed conflict, expropriations, and dominance of the market, in addition to fighting inflation that it inherited from the previous administration. During the entire neo-liberal period from 1990 to 2006, governmental policies focused on rebuilding the

national economy; transitioning from a populist and centralized policy to one of free trade, encouraging national and foreign investment, promoting freedom of price, and competition. However, the administration made decisions that profoundly affected the Nicaraguan peasantry (Zalkin, 1990). “In August 1990 the government granted the US company, Gold Neptune, a license to exploit the three most important gold mines in the North Caribbean, to Atlantic Timbres Corporation (ATMICO), 8 333 hectares and later another 55,000 of humid tropical forest for the exploitation of timber resources in the southern Caribbean. To this is added that the agreement did not establish compensation to Nicaragua for the granting of the right of exploitation” (El Nuevo Diario, 1990, p. 14).

The upheavals in 1990s in Nicaragua also included the needs of ex-combatants from the war, particularly in in the North with the Contra. The Contra were of peasant origin but also U.S.-backed and funded right-wing rebel groups active from 1979 to the early 1990s in opposition to the socialist Sandinista. 69% of the Contra expressed their intention to dedicate themselves to agricultural activities after the war (Greg *and Gilbert, 2010).* Seeds, supplies, animals and tools were distributed among the demobilized Contra who owned land. Non land owning Contra were left without resources, thus hindering any participation the movement into agriculture. Additional pressure on Contra peasant farmers included the fact that once the lands began to be cultivated after years of neglect, they did not produce enough or were not suitable. Added to these hardships was the drought that followed in the 1990s (Zalkin, 1990).

The rearmament was the result of an organizational process by a significant sector of former peasant-origin combatants who exerted pressure using arms to hand over the lands. During the first postwar years, a huge number of land claimants demonstrated the lack of government planning to serve this fundamental sector of society. Thus, given of the government’s ability

to deliver support in the traditional production areas of Nicaragua, they began promoting the movement of the agricultural frontier toward the sparsely populated Caribbean. As a result of the above, the agricultural areas of small producers expanded to the detriment of the environment. At the same time, by state initiative, a series of mining and infrastructure projects began to take shape, causing the emergence of new pro-environmental and anti-neoliberal social movements (Dore, 1992).

Although the microeconomy saw improvement during the neo-liberal ear in 2000, there were no positive trends for small farmers. Starting in 2000, a series of free trade agreements and small farmers rebelled because of the fact that the only beneficiaries were large landowners. In 2000, civil society organizations began to mobilize again Free Trade Agreements (FTA) and the Association Agreement with the European Union (ADAU). Throughout the country, actions got carried out to try to prevent the signing due to the damage free trade agreements would cause small growers. But the government signed, and the agreements were ratified with promises about improving conditions for small growers (Alvarenga-Lopez, 2014).

Twenty years later, small growers are still facing obstacles to growing crops in ways that allows them to rise from poverty. Rice, Beans, and Corn are some central agro-export products that Nicaragua produces. Since May 2020 the price of red beans has risen greatly, reaching 25 and even 30 cordobas in the markets of all large and small cities. To export basic grains abroad, there are collectors for the international market. One of them is the company AGRICORP, linked to the now millionaire Bayardo Arce Castaño, who is also an economic advisor to Daniel Ortega's government. The current government and these kinds of companies benefit from agreement reached by the Free Trade Agreement (FTA), even today. The continuing impact of the FTA on society is extensive. Those who profit take advantage

of what they once criticized. They are the new entrepreneurs who mobilize production while meanwhile, the population is denied any possibility of access to adequate food because they have no income from consistent employment.

With other scenarios like the one above, the transition from the neo-liberal period to the second term of Daniel Ortega Saavedra in 2007 arose. Baltodano (2014) details how the economy's trajectory went during this second period. In 2007, with the arrival of Ortega to the Presidency, a trend that was already becoming clear was manifested. The economic pragmatism shown by the FSLN in regards to privatizations and neoliberal policies becomes fully deployed (Envio,2014). Baltodano (2014) says, "A new phase begins then in which Ortega entered a rapprochement process with the other pillar of national power: the heads of big business grouped under the Superior Council of Private Enterprise (COSEP)." Ortega's symbiosis with the great national capital becomes a pattern in this new phase. I do not call that an alliance, it is a symbiosis because what defines the nature of the current regime is that its main mission is to strengthen and create conditions for the market economy, to strengthen big capital while distributing crumbs to the poor so that they may be calm. Ortega and his group are not with big capital for tactical convenience. They embrace big capital because now they are an important capitalist group and the government represents that community of interests that the new *Sandinista* oligarchy has today together with the traditional oligarchy and big international capital (Toussaint, 2018). According to Baltodano (2014), Ortega's entire government is able to enrich itself thanks to the communion of interests with the country's great capitals. Ortega is willing to ignore the human rights of the population, especially the peasants, who are kept marginalized and isolated from positive development policies; the government implements aid programs for rural areas, but it is not really in its

interest to implement measures that improve the family economy of the most disadvantage (Envio,2014).

However, there is evidence that during the *Sandinista* Goverment period, peasants have had access to credit and technical assistance in agricultural activities (Godek, 2014). From 2009-2019, Ortega has instituted a two-pronged plan for agricultural development: supporting big agribusiness growth, on one hand, and smallholder production on the other (Ripoll 2018). Women have also been visualized and taken into account in the government policies. In 2010, the Law of the Fund for the purchase of land with gender equality, Law 717, was created, aimed at giving rural women access to physical possession and legal ownership of land, improving their economic conditions, boosting gender equity, ensuring food security and fighting poverty in the country. However, the Government still has not allocated funds to rural women to use as credit to buy land (Silva, 2017).

In June of 2009, the Law of Food and Nutritional Sovereignty and Security was approved by the National Assembly recognizing food sovereignty. Thus, Nicaragua had become one of a handful of countries (mostly in Latin America) that had institutionalized food sovereignty in national policy (Godek, 2015). Through this law, the government implemented programs such as "Hambre Zero"(Zero Hunger) and Zero Usury with funds from the Bolivarian Alliance for the Peoples of America (ALBA), which aimed to promote peasant food production and improve their access to credit. Zero Usury program benefits rural women by granting them a credit with low interest rates for entrepreneurships. Hambre Zero, a health and nutrition program for mothers and children in poor regions, provides animals and supplies to very small-scale farmers, emphasizing women's credit. This program supports women by distributing support to women of families with limited access to land in

an effort to help them diversify their production, which in the past was limited to basic grains. Support has included cows, pigs, and chickens to improve, from a family production perspective, food consumption and potential economic help -scale female growers make a profit from the sales of small animals in local markets (Spalding 2011). It's clear that this law has had an impact on women's lives but the government has not accounted for the true participation of women in terms of their contribution to the gross domestic product. Women remain invisible in terms of acknowledgement of their work within the country's econmy as they develop agriculture and small enterprise in rural regions.

On the other hand, despite Law 693 on food and nutritional sovereignty, the government continues creating and implementing programs without significant involvement of agricultural producers in the formulation and execution of policies. Instead, the Government focuses on large landowners with intensive mono-cropping, animal production, or highly agri-chemical input dependent crops such as tobacco. These patterns are barriers to achieving food sovereignty in Nicaragua (Katharina et al 2020).

In 2011, the The *Sandinista* Goverment passed Law 765, the Agroecology and Organic, Production Law, followed in 2013 by the associated Technical Norms for Agroecological Production, which provide standards for agroecological production units. Law 765 is part of a host of legislation concerning broader social and environmental justice issues that has been passed by the National Assembly since 2007 (MAONIC, 2011).

The *Sandinista* Goverment's policies support agroecology, but also continue to regard the export-oriented production of high-value crops as a pillar of national economic development (Fréguin-Gresh 2017), and continued state subventions for fertilizers such as urea (Baca

Castellón 2018). Since 2013, the government has been flirting with a "middle path" of agroecology that allows the use of certain agrichemicals in agroecological farming, even though this is forbidden by Law 765. Therefore, policies from The Sanidinista government are contradictory and undermine ecological sustainability by, on one hand, promoting agroecology while on the other allowing the privatization of huge tracts of land for cattle ranching and extensive agriculture, tourism and mining (Schiller et al 2019). Currently, 31% of the region of Nicaragua is home to Indigenous and Afro-descendant communities. Although the state has given these groups legal rights to their lands, they continue to suffer recurrent invasion by settlers seeking to compel Indigenous communities to abandon their ancestral homes, in order take their lands and carry out activities such as illegal logging, monocultures, and cattle grazing (Envio, 2014). Additionally, Nicaragua struggles with poverty, political instability, human rights violations against Indigenous peoples, vulnerability to natural hazards, and lack of recognition of the role of rural women in agriculture activities.

1.2 Ongoing pressures for lives of Nicaraguan women

For centuries, rural women in Nicaragua have been responsible for domestic chores, care and feeding of families, gathering wood for cooking, cultivation, and commercialization of household gardens. It's also true that women consistently carry burdens of reproduction and community building responsibilities all while occupying the often-invisible daily domestic realm (Vivas 2009).

Even though rural women have been the driving force in creating community and home for centuriesrural women's economic participation is installed in the social imagination as a support role for men, which is why they are not considered protagonists of development.The

non-recognition of the organizations, and the State and its institutions (macro-level), regarding the role of productive work carried out by women, has been a determining factor in the invisibility of women producers in the statistics and, therefore, in training services, technical assistance and capital to produce. A study carried out by World Food Programme (2019) shows that the main items produced by women are mainly beans, fruits, and vegetables, which, together with corn and sorghum, from patio production, form a central part of the peasant economy, ensuring family consumption and, when possible, the sale of surpluses to the local market.

Another major obstacle to women's comprehensive development is the burden placed on them with domestic and reproductive work, both in physical and mental terms. Although it's rare for women in rural regions to leave the home to engage in income producing activities, when they do, this movement is rarely accompanied by distribution between men and women of reproductive or domestic tasks. In this way, women have continued to take care of children, the sick and the elderly, and domestic charges while entering the labor market, thus becoming double workers.

One of the most critical problems of women's invisibility in productive family work is that they provide work, products, and economic resources, but do not receive the benefits of their work in terms of payment, nor are they beneficiaries of the services they provide. The government agricultural sector assumes that women of the family do not participate in agricultural activities. Contrary to the stereotypical social belief, women are taking a leading role in practically all the activities of the productive processes, contributing a significant investment of time and work, while being responsible for reproductive work and participating

in organizational structures locally. The types of work in which women perform are key to the quality of products and production processes.

Regarding ownership of productive resources, inequality in land tenure and access is one of the most important gaps in rural areas and one of the main barriers to rural women's empowerment and economic autonomy, with structural roots, cultural and historical. Data from IV Cenagro (INIDE, 2011) indicate that women own only 13% of the total area of agricultural land. Most of the women have a land area of less than two manzanas (1.4 he) (Flores, S et al. 2018).

1.3 Climate and agroecological conditions

Pressures for women come from all sides in Nicaragua. Rural Nicaraguan women, who live in marginalized economic situations on land that is often prone to flooding and drought, are some of the first in communities to respond to and adapt to the unpredictable effects of climate change. Nicaragua is vulnerable to recurrent natural disasters, ranking sixth on the Long Term Climate Risk Index (Germanwatch, 2018). Connected to problems of climate change, the people of Corozo also face ecological risks resulting from soil erosion, damaged soil fertility and severe cycles of drought and flooding. Climate change in Nicaragua is also bringing intense, sudden rain. This, in combination with eroded soil conditions, leads to flooding that destroys livelihoods and drives food insecurity and displacement. Hurricanes, flooding and landslides are recurrent in Nicaragua and have a devastating socio-economic impact (INETER, 2018). Climate variability has significantly affected the production of corn and beans, which is the main driver of the economy for small farmers. The crop loss is increasing migration, both internal and external (Via Campesina 2018).

The Corozo community where I will focus my research, has experienced significant changes over the past twenty years due to the impacts of climate change, droughts, hurricanes, floods, extinction of species, deforestation, extinction of native trees and plants, and changes in pollinator density. The inhabitants of El Corozo usually say, "Every year we do not know what disaster we are going to face. We do not know if we will have good harvests or not." People in the northern region frequently experience food crises and must pull their children from school to cut coffee or leave the area altogether, emigrating. Twenty years ago, Corozo's Calico River flowed steadily, but now the previously tree-lined banks are bare for long stretches, and water in the dry season becomes sluggish. Also, people in the community share stories about the reduction in biodiversity over recent years. In conversations with community members, it's clear that the idea of conservation, reforestation and movement away from industrial agriculture is becoming popular support ideas of conservation, reforestation, and movement away from industrial agriculture.

The role of many non-profit organizations has been to provide "accompaniment" as small growers find ways to address dynamics of poverty through seeking innovative ways to face phenomena of market exploitation. In addition, nonprofits have had to anticipate climate change, machismo, and changes agricultural practices. Looking for ways to support and accompany women as they prove that their value is not only in the kitchen but also in contributing to the family economy through participating in the field and in small enterprise projects is central to mitigating patterns of oppression. It is for this reason that the work of small farmers organizations and nonprofits becomes a process of mitigating and adapting to the tumultuous social and climate pressures in rural regions.

Nonprofit Organizations, such as the women-centered, farmer-centered, Artists for Soup, and Programa Campesino a Campesino (a farmer to farmer organization or PCaC in Spanish) of the National Union of Farmers and Ranchers (UNAG), encourage small-scale growers to increase diversification of crops and local consumption. When small farmers' bean or corn harvests fail, they can fall back on vegetables or fruits that result from cultivating greater diversity and soil resilience on plots of land. These NGOS and small-farmer organizations also emphasize the need to reduce dependence on commercial inputs, and they promote use of ecologically -sustainable practices to improve local soil quality with biointensive methods, composting, collection and transformation of green manure, and cultivation of nitrogen-producing legumes, rather than using expensive fertilizers.

1.4 Aims and Objectives of the Research

This research lays groundwork for a Meliponiculture beekeeping project in an Indigenous community in the north of Nicaragua. Melipona bees are non-stinging bees kept for their medicinal value. At the center of this research is the question of whether integrating Meliponiculture to existing agriculture systems helps sustain and promote farm production, crop diversification and other agroecological principles. To provide a context and create a working foundation , this research explores previous research on Meliponas beekeeping programs in Latin America. The aim is to figure out whether the integration of Meliponas in biointensive farming practices led by women in an Indigenous community in the north of Nicaragua has potential as part of a multi-faceted community building program. This case study will engage a subset of the Indigenous women gardeners in Corozo, Nicaragua, who have interest in and the necessary conditions for setting up beehives on their land. Interviewing women to learn about their perceptions of work load, family health, nutritional and economic challenges, and perceived agency in the family and community, will provide

the basis for understanding challenges facing rural, Indigenous women who pursue bee-projects as part of their agroecological practice.

In this research I will examine if beekeeping encourages ecological awareness and supports biodiversity. I will also present the importance of bees for food sovereignty by exploring the connection between diversification of crops and the health/success of gardens that adapt bee-keeping. In addition, I will examine how beekeeping has potential to provide honey and a variety of beehive products.

Thus, the research questions and aim I wish to answer in this master research are:

- By accessing current knowledge and practice around biointensive gardening in Corozo Nicaragua, is it possible to deduce whether Indigenous women's current practices mesh with agroecology and food soveriegnty principles?
- How do Indigenous women's practices in Corozo mesh with food sovereignty principles, and what opportunities and barriers do women face?
- How could the introduction of native honey beekeeping projects help enhance the achievement of agroecological principles and food sovereignty?

Aims:

- To assess current knowledge and practices surrounding agroecology and food sovereignty in Corozo, Nicaragua.
- To contribute to peasant family farms' increase of production and diversification of crops.
- To evaluate potential for NGO Meliponiculture projects and help lay the groundwork for them.
- To explore possible contributions Meliponiculture projects could bring to family farm production and diversification of crops.

1.5 Outline

Chapter One: I explain the political and agricultural context of Nicaragua related with the neoliberal era and post neoliberal era and the national legislation in Nicaragua through the *Sandinista* government and challenges, opportunities rural women face.

Chapter Two: I give a critique of the importance of small family farming in rural Nicaragua,and explore integration of paradigms of food sovereignty and agroecology into

the communities of small farmers. In addition, I consider barriers to implementation and rise of food sovereignty, and practices surrounding agroecology. I examine how research has been mainly conducted by International Non Profit Organizations and Small farmers Organizations. Finally, I introduce some research on beekeeping with stingless bees in the context of the above themes.

Chapter Three: I use a theoretical framework that depends on principles of feminism, agroecology and food sovereignty to analyze the data from interviews presented in Chapter 5. I position myself as an partipant observer because of my own Indigenous background and connection to this community from childhood.

Chapter Four: Methodology; I present my case study and aspects related with the research community such as, location, ethnicity, economy, among others. I also present my research methods, data, ethics and limitations.

Chapter Five: I present the Results and Discussion by answering the research questions 1 related with the current knowledge and practices surrounding agroecology and food sovereignty in Corozo, Nicaragua and how institutions who work in this area help to achieve principles and practices of agroecology

Chapter Six: I present the Results and Discussion by answering the research question 2. I describe the perceptions work and the problems confronting them in this region of Nicaragua. In Chapter Seven: I present the Results and Discussion by answering the research question 3. I describe the perception, practices, and knowledge women and small farmers organizations shared with me about Nicaragua's Meliponiculture projects and I analyze Meliponiculture patterns and practices within Agroecology's principles and food sovereignty

paradigms and consider how Meliponiculture would enhance life for women biointensive gardeners in El Corozo.

In conclusion I summarize my research finding, highlight main contribution of my research.

2 Literature Review

Picture 3: Producer preparing corn seeds to save for feeding and next harvest

(Photo: Nidia Arauz, El Corozo, 30-05-2019)

2.1 Smallholder family farming, and the agricultural problems

Productive families in Nicaragua earn their livelihood from family agriculture. Smallholder family farming is a model in Nicaraguan agriculture that contributes decisively to food sovereignty. One of the salient features of smallholder farmer systems is their high degree of plant diversity in the agroecologically efficient agricultural systems (Chang 1977). The strategy of planting several species and varieties of crops stabilizes yields over the long term, promotes diet diversity and maximizes returns, even with low levels of technology and limited resources (Perfecto et al. 2009). The role of smallholder family farming is doubly commendable, not only because it guarantees food sovereignty, but also because it has preserved soils, water and biodiversity to guarantee its survival. Even under marginal conditions, agricultural family farming contributes significantly to the national agriculture. This produces items that are vital to the daily food supply of the Nicaraguan population, supplying over 60% of beans, 50% of maize, 40% of pork and 30% of domestic production of meat and milk, roots and tubers, vegetables and cacao (Huete-Perez et al 2017). This type of agriculture has the highest number of farms in the smallest area of land, yet industrial agriculture occupies most of the land in Nicaragua (Lenteren, J et al 2019,). According to the National Agricultural Census (CENAGRO, 2011), "the total area for agriculture is 8.6 million (1 manzana = 0.72 acres). Seventy-five percent of the land is in the hands of farms with an area of over 50 manzanas, while farms with another 100 manzanas occupy 56% of the land. Farms ranging from 0.1 to 20 manzanas barely account for 11% of Nicaragua's arable land. This last segment contains the type of family agriculture that supplies important foodstuffs to the Nicaraguan population." (Huete-Perez et al 2017, Pag. 428)

As I explain in the introduction, small scale farmers have been affected by not having an agrarian reform that protects traditional methods of Indigenous agriculture and the small growers who practice this and feed the Nicaraguan population. At the beginning of the 1970s, prioritizing increased agricultural production for export, an outward conventional production model, did not reduce poverty in local rural areas. The interests of those in power was not to supply the domestic market but rather to project themselves to the global market, endangering food security and sovereignty. The application of conventional technologies prompted the loss of local or traditional knowledge of Indigenous growers.

Even after the 2009 progress with the National Assembly passing of Law 693 on food and nutritional sovereignty, there were increasingly profound challenges growing in relation to climate change and the governments continuing difficulty in producing conditions necessary to foster sustainable practices. First Nicaragua is party to the Central American-Dominican Republic Free Trade Agreement (CAFTA-DR), a free trade agreement with the U.S. that is tied to CAFTA-DR. CAFTA-DR increase economic dependence on the success of large companies. CAFTA-DR compliance means limiting the resource rights of local communities, which contradicts the food sovereignty approach (Rosset, P. 2013). Under these circumstances, small farmers are left with few constitutional protections against development projects that invade their communities to deplete local resources through monocultures, mining, and land exploitations—affecting the water resources conservation, biodiversity, generating hunger and destroying families' capacity to maintain their livelihood and food diversity.

From these political, environmental, and social crises, diverse social movements arose, among them, *La Via Campesina*, formed by a group of farmers' representatives – women and men – from Africa, Asia, Europe, and the Americas founded *La Via Campesina* in 1993, Belgium to give a voice to small-scale farmers, rural women, peasants, Indigenous people, and agricultural workers to Defending Food Sovereignty, Struggle for Land and Agrarian Reforms, Promoting Agroecology and Defending Local Seeds, Promoting Peasant Rights and Struggle Against Criminalization of Peasants, among others (Via Campesina,1993).

2.2 Food sovereignty approach

La Via Campesina introduced the concept of food sovereignty at the World Food Summit, which took place in 1996 in Rome and was organized by the United Nation's Food and Agriculture Organization. *La Via Campesina* describes food sovereignty as follows:

> "The right of each nation to maintain and develop its own capacity to produce its basic foods respecting cultural and productive diversity. We have the right to produce our own food in our own territory." (*Via Campesina*, 1996)

The concept of food sovereignty put forth by *La Via Campesina* is anti-colonial in its critique of foreign domination under international trade rules of the World Trade Organization, WTO. It also critiques neoliberal credit conditions imposed by the World Bank and the International Monetary. Food sovereignty is therefore about focusing primarily on food producers, then on consumers (Via Campesina, 1996). *La Via Campesina* supports the peasant lifestyle and the rural communities that have been largely pushed out of recent trade and development paradigms.

Years later, in the *Via Campesina* Declaration of 2001, titled "Our World Is Not for Sale," the food sovereignty concept was increasingly incorporated into peasant movement as

> "The right of peoples to define their own agriculture and food policies, to protect and regulate domestic agricultural production and trade in order to achieve sustainable

> development objectives, to determine the extent to which they want to be self-reliant, and to restrict the dumping of products in their markets. Food sovereignty does not negate trade, but rather it promotes the formulation of trade policies and practices that serve the rights of peoples to safe, healthy, and ecologically sustainable production." (Via Campesina 2002)

According to Desmarais (2008) this concept introduced food sovereignty as the goal of the movement to effect change in the countryside, improve the livelihoods of people of the land, enhance local food production for local consumption and open democratic spaces and empower "people of the land" with a greater role and position in decision-making on issues affecting their daily lives. *La Via Campesina* focused on the small farmers' rights to produce food, which are often depressed by many national and international agriculture trade policies and regulations. Also, food sovereignty recognizes women as agents and actors and not merely consumers in the food system. Women build resilient agricultural systems based on agroecological farming practices that improve food production and are also in harmony with nature. "Women are forging new alliances with other farmers, peasants, and progressive researchers to rethink the ways of farming that do not harm the environment and Mother Earth." (Mpofu, 2018).

2.3 Agroecology as a fundamental pillar of food sovereignty

In 2015, during the International Forum for Agroecology hosted by *Via Campesina* in Mali*; La Via Campesina* confirmed the adoption of Agroecology as a fundamental pillar of food sovereignty and recognize agroecology as the only relevant, viable and ethically acceptable way to achieve food sovereignty (*La Via Campesina*, 2015). *La Via Campesina* also identified the agroecology as the heritage of rural and ancestral peoples, with a strong relationship with nature, with a gender approach aimed to satisfy the needs of local and national markets with high diversification.

> " As a science, agroecology is compatible with the struggle and vision of rural movements because it does not question peasant rationale but rather builds upon it, it does not attempt to radically modify local farming systems, instead optimizes their design and uses local resources and skills. Also, agroecology is socially activating as it requires community participation and horizontal methods of knowledge exchange to work." (Altieri and Toledo 2011, Altieri et al 2011, pag 6). Hence, "Agroecology provides the production strategies and methodologies and needs strong social movement to organize and spread the technologies and pressure governments to provide access to markets, credit and agroecological extension and research." (Altieri, 2015. Pag 38).

La Via Campesina sees peasant small scale-based agriculture as the model for food sovereignty because el small scale farmer "producing on a small-scale and using inputs produced on-farm, expanding soil fertility and promoting biodiversity." (*Via Campesina*, 2010 cited by Ripol 2015, pag. 18). According to Altieri (2015) "Small farmers play important roles as custodians of agricultural biodiversity , repositories of indigenous knowledge, producers of food, innovators and experimenters. Much of the agricultural biodiversity has been maintained through cultural tradition, which include community seed banks and community harvesting encouraging exchange of many varieties". "Agroecology produce more food on less land, using less energy and less water while enhancing the natural base, providing ecological services and lowering outputs of green house gases." (Altieri,2015, pag 38).

"In many areas of the developing world, traditional farmers have developed and/or inherited complex farming systems, adapted to the local conditions that have helped them to sustainably manage harsh environments and to meet their subsistence needs, without depending on mechanization, chemical fertilizers, pesticides, or other technologies of modern agricultural science" (Toledo et al. 1985). In Cuba, small farmers using agroecological methods obtain yields per hectare sufficient to feed about 15 people per year with energy efficiencies of no less than 10:1. Recent research shows that many small farmers

cope with and even prepare for climate change, minimizing crop failure through increased use of drought tolerant local varieties, water harvesting, mixed cropping, agroforestry, soil conservation practices, and a series of other traditional techniques (Altieri and Koohafkan 2008).

In October of 1998, Hurricane Mitch was the most damaging meteorological event to occur in the Central American region. Damages affected poor semi-subsistence rural farmers, commercial agriculture, urban dwellers and basic infrastructure (Christoplos, Ian et al 2010). Many families whose livelihoods depended on agriculture faced starvation. Mitch's torrential rains destroyed natural vegetation and standing crops ready to be harvested. Tons of topsoil was washed down from hillsides into rivers. Damage caused secondary crises of unemployment, labor migration, and worsened levels of social services, public health and poverty (Grunewald François et al 2000). Nicaragua lost around 5 percent of its Gross Domestic Product (GDP), with agriculture especially affected, and there was inestimable damage to forests and natural resources (ECLAC 1999).

After Hurricane Mitch, environmentalists evaluated the disaster in relation to agricultural and forestry practices. Holt and Giménez (2000) evaluated the agricultural performance, after extreme climatic events, such as Hurricane Mitch, in Central America; It was shown that farmers with diversification practices (cover crops, intercropping, and agroforestry) suffered less damage than their neighbors with monocultures. After the hurricane, the diversified parcels had 20-40% more topsoil, higher humidity, less erosion, and lower economic losses than their conventional neighbors. In conclusion, resilience to extreme climatic events is closely linked with biodiversity on farms, which constitutes one of the principles of agroecological practices. Research as early as the 1980s highlights the increase in production

using agroecological alternatives and three decades later, this research continues to consider this lens for considering production in comparison with conventional agriculture.

Various studies since the eighties highlight the increase in production, using agroecological alternatives, and their comparison with conventional agriculture, together with the care of the environment. Among them are polycultures, integration of crops and animals, as well as agroforestry systems. Several agroecological projects are also reflected, corresponding to the nineties, demonstrating that the combination of traditional crops and animals can increase productivity, improve biological relationships, and use natural and human resources effectively. Agroecological strategies have a favorable impact on production and biodiversity.

Seed management through community fairs and banks is discussed by Altieri and Nicholls (2012). Their work in Mexico, Guatemala, Nicaragua, Peru, Bolivia, Ecuador, and Brazil, focuses on the rescue of varieties of traditional or local crops (Creole seeds). To cite an example, in Nicaragua, the *Semillas de Identidad* project, which links more than 35,000 families on 14,000 hectares, has recovered and conserved 129 local varieties of corn and 144 of beans.

Other relevant research focuses on agroecological practices in gender relations; the investigation was in settlements of the Agrarian Reform in Brazil (Arias and Wesz ,2012).The case studies demonstrate the change in hierarchical structures in gender relations, a product of polyculture, multifunctionality, exchange with specialists, participation in networks, fairs, exchanges of experiences, and productive groups. In addition, the scholars show how supported agroecological practice run by women tend to democratize spaces and power. In conclusion, the dialogue of knowledge between genders opens.

Also, between the participatory methodologies, Altieri and Nicholls. (2012), highlight the importance of the *Campesino a Campesino* Movement (CAC) to promote agroecology in Latin America's rural territories. Through this movement, soil conservation practices were introduced on slopes in Honduras, which tripled or quadrupled their yields from 400 kg to 1,200-1,600 kilos per hectare, benefiting 1,200 families who participated in the program. Herbicides were eliminated. Together with this effort, there is human capacity formation through field schools and demonstrations on farms, supported by commercialization practices and public policies. Once again, the importance of human capital is concluded to develop agroecology and participatory processes, which must be closely articulated.

Casimiro (2013) documented the importance of family participation, who demonstrated that agroecology at the family level is possible; describe twenty years on a farm in Cienfuegos, Cuba, and the family's agroecological decision. It is an agricultural cooperative, with 53.7 hectares, where agroecological procedures have been incorporated, producing diversified food for human and animal consumption, along with forest maintenance. The authors conclude that family agroecology is a useful practice, and through its principles of recycling, saving energy, it generates savings for the family. In addition, because family agroecology uses renewable sources of energy, and increases productivity of lands, it decreases migration from the field to the city.

Smallholder farmers in India possessing on average 2 ha of land each, make up about 78% of the country's farmers while owning only 33% of the land, but responsible for 41% of national grain production. Their contribution to both household food security and to farm outputs is thus disproportionately high (Via Campesina 2010).

Despite all the positive impacts, evidence of the impact that agroecological practices are having, which can be seen reflected in these studies mentioned, there is still a lot of work to be done; mainly, I have found that in Nicaragua, processes related to the implementation of policies of food sovereignty and agroecology need to be documented. According to Altieri and Toledo; "Of key importance will be the direct involvement of farmers and scientists in the formulation of the research agenda and their active participation in the process of technological innovation and dissemination through Campesino a Campesino models where researchers and extension workers can play a major facilitating role. " (Altieri and Toledo 2011, pag 12). On a larger scale, a revision of the current agrarian reform will be necessary in order to promote agroecology at the national level and ensure that best practices become common practice.

3 Theoretical framework

3.1 Agroecology

The bases of agroecological practices in Nicaragua emerged in the peasantry in the 1980's in the context of the Sandinista Revolution's triumph and response to economic, ecological and social failure with earlier agricultural models. Agroecological practices arose in tension with the 1960s and 70's agro-industrial models of production for cotton and other monoculture export crops. The 1990's promoters of agroecology differentiated themselves from the dynamic surrounding organic agriculture that arose in a time of liberalization and post-conflict reconstruction of the agricultural sector. Agroecology emerged in socio-economic sectors with greater resources and agro-industrial technologies at a time when large-scale growers were looking for new alternatives to market items in new niches of a competitive and very volatile world market. It wasn't until one decade later, after Hurricane Mitch (1998)

that agroecology's hidden growth began to be apparent. During this post-Mitch period, agroecology started being treated as a "miracle solution" for building producers' resilience to environmental pressures. Despite the fact of Nicaragua being a country with public policies, they do not have a rectilinear trajectory. But concepts of agroecology and organic agriculture began to be institutionalized after 2007, and the two ideologies merged with the countries' political agenda.

Agroecology is the implementation of the science of ecology to agricultural systems. It seekscarbonintensive methods that develop and maintain soil fertility without external inputs like synthetic fertilizers, herbicides and pesticides. In addition, agroecology tries to develop necessary interactions among species to promote biodiversity and a sustainable ecological structure.For example an ecological farm that surrounded by a forest will receive many services from the forest, such as beneficial insects, pollinators and enhance soil organic matter. On the contrary , for example, a cotton plantation as usual in Nicaragua, where only cotton plants are present in monocultive, and requires constant external energy subsidies, such as pesticides, fossil fuel intensive machinery and synthetic fertilizers.

According to Altieri (1997), increasing numbers of scientists recognize that the reductionist approach to agriculture has produced great damage to society and the environment and this has made necessary the conceptual framework and language around "ecology," leading to the evolution of agroecological thinking. The press for alternatives to practices that damage the environment has allowed agroecology to emerge from traditional knowledge in the context of science. "As a discipline that integrates ecological concepts to the management of anthropogenic ecosystems, agroecology is a good starting point to promote innovative development processes in rural landscapes" (Méndez and Gliessman, 2002, p. 1).

When Altieri (2015) mention that agroecology is a science, a movement, and a practice based on combining scientific and traditional knowledge (Figure 1, it's possible to think of science as the bridge that allows restoration of the ecosystem and development of socio-economic aspects. Biological processes are enhanced by applying agroecological principles into the agriculture practices; these principles and practices can be share via farmer to farmers exchanges. Altieri see agroecology as a pillar in the food sovereignty framework, one that stabilizes land, water, seeds and other productive resource for small farmers and landless people , while also offering economic opportunities.

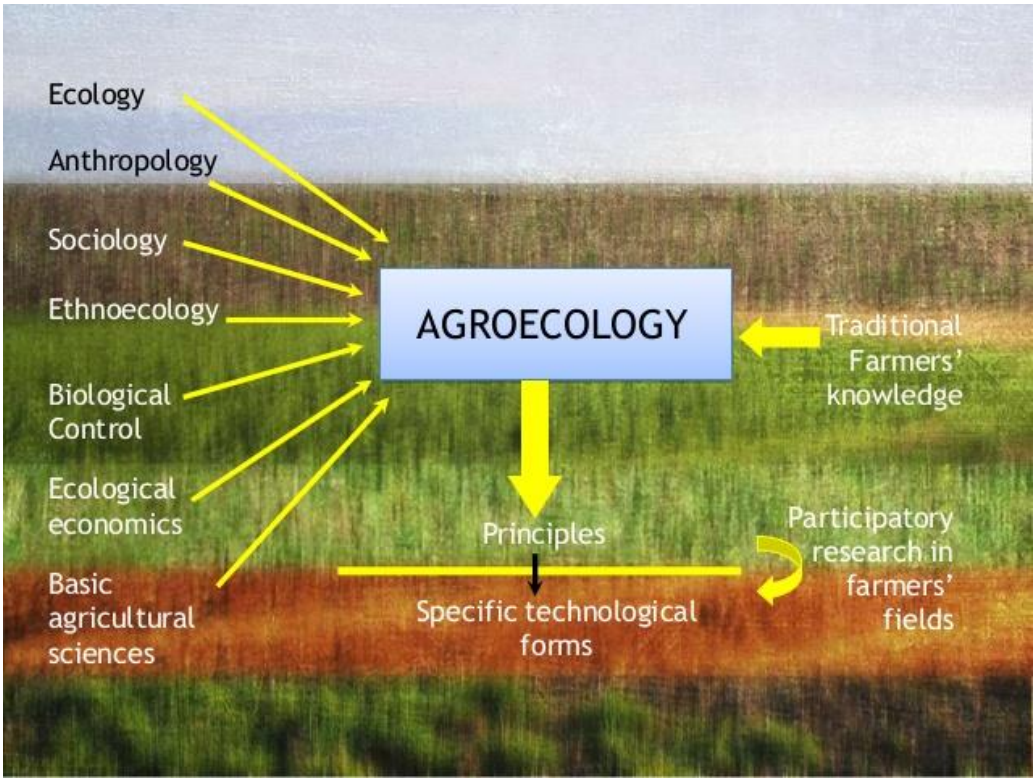


Figure 1- Agroecology combines elements of traditional farmers' knowledge with elements of modern ecological, social and agronomic science, creating a dialogue of wisdoms from which principles for designing and managing biodiverse and resilient farms are derived Ecology. (Altieri, 2016).

3.1.1 The Principles of Agroecology

According to Altieri (2015), "Agroecological principles take technological forms or practices in order to be applied." For example, the principle of diversification in a space combined with beans, corn, cassava or other crops, the technology in this sense would be polycultures or milpa. Implementing these practices promotes processes that are fundamental for an agroecosystem to function, such as nutrient cycling, pest regulation, and allelopathy for weed control. Altieri also argument that appropriate technologies should be based on Indigenous knowledge and rationale; be economically viable, accessible, and based on local resources; be environmentally sound, and socially, culturally, and gender-sensitive.

As a science, Agroecology is based on a series of principles, such as:

1. Enhance the recycling of biomass, with a view to optimizing organic matter decomposition and nutrient cycling over time.

2. Strengthen the “immune system” of agricultural systems through enhancement of functional biodiversity – natural enemies, antagonists, etc., by creating appropriate habitats.

3. Provide the most favorable soil conditions for plant growth, particularly by managing organic matter and by enhancing soil biological activity.

4. Minimize losses of energy, water, nutrients and genetic resources by enhancing conservation and regeneration of soil and water resources and agrobiodiversity.

5. Diversify species and genetic resources in the agroecosystem over time and space at the field and landscape level.

6. Enhance beneficial biological interactions and synergies among the components of agrobiodiversity, thereby promoting key ecological processes and services.

3.2 Principles of Food Sovereignty

Food sovereignty is about the right to healthy harvests, the right to food that is culturally-appropriate, and the right of each country or people to define their own food policies without intervention from outside. Food sovereignty is also the right to produce with fair prices for consumers and producers. There is an emphasis on access to national and local markets for small-scale producers; produce is exported only after requirement at local and national levels are met. (Altieri, 2015)

In the Nyeleni World Forum on Food Sovereignty in 2007 allowed participants to agree on six principles or pillars of Food Sovereignty (Mulvany, 2007):

1. Focuses on Food for People: Food sovereignty stresses the right to sufficient, healthy and culturally-appropriate food for all individuals, peoples and communities, including those who are hungry or living under occupation, in conflict zones and marginalized. Food sovereignty rejects the proposition that food is just another commodity for international agribusiness.

2. Values Food Providers: Food sovereignty values and supports the contributions, and respects the rights of women, men, peasants and small-scale family farmers, pastoralists, artisanal fishers, forest dwellers, Indigenous peoples, agricultural and fisheries workers, including migrants who cultivate, grow, harvest and process food; and rejects those policies, actions and programs that undervalue them, threaten their livelihoods and eliminate them.

3. Localizes Food Systems: Food sovereignty brings food providers and consumers together in common cause; puts providers and consumers at the center of decision-making on food issues; protects food providers from the dumping of food and food aid in local markets; protects consumers from poor quality and unhealthy food, inappropriate food aid and food tainted with genetically modified organisms; and resists governance structures, agreements and practices that depend on and promote unsustainable and inequitable international trade and give power to remote and unaccountable corporations.

4. Makes Decisions Locally: Food sovereignty seeks control over and access to territory, land, grazing, water, seeds, livestock and fish populations for local food providers. These resources ought to be used and shared in socially and environmentally sustainable ways which conserve diversity. Food sovereignty recognizes that local territories often cross geopolitical borders and advances the right of local

communities to inhabit and use their territories; it promotes positive interaction between food providers in different regions and territories and from different sectors to resolve internal conflicts or conflicts with local and national authorities; and rejects the privatization of natural resources through laws, commercial contracts and intellectual property rights regimes.

5. Builds Knowledge and Skills: Food sovereignty builds on the skills and local knowledge of food providers and their local organizations that conserve, develop and manage localized food production and harvesting systems, developing appropriate research systems to support this and passing on this wisdom to future generations. Food sovereignty rejects technologies that undermine, threaten or contaminate these, e.g. genetic engineering

6. Works with Nature: Food sovereignty uses the contributions of nature in diverse, low external input agroecological production and harvesting methods that maximize the contribution of ecosystems and improve resilience and adaptation, especially in the face of climate change. Food sovereignty seeks to heal the planet so that the planet may heal us; and, rejects methods that harm beneficial ecosystem functions, that depend on energy intensive monocultures and livestock factories, destructive fishing practices and other industrialized production methods, which damage the environment and contribute to global warming.

3.3 Meliponiculture as a tool of agroecology

Within the framework of the rescue of indigenous heritage, this thesis also includes a case study analysis to include a new technology within the framework of crop diversification. Taking agroecology into account, meliponiculture could have an impact on the recovery of agroecosystems, the rescue of Indigenous cultures using honey as a medicinal product, and the conservation of native plants and native trees of the community.

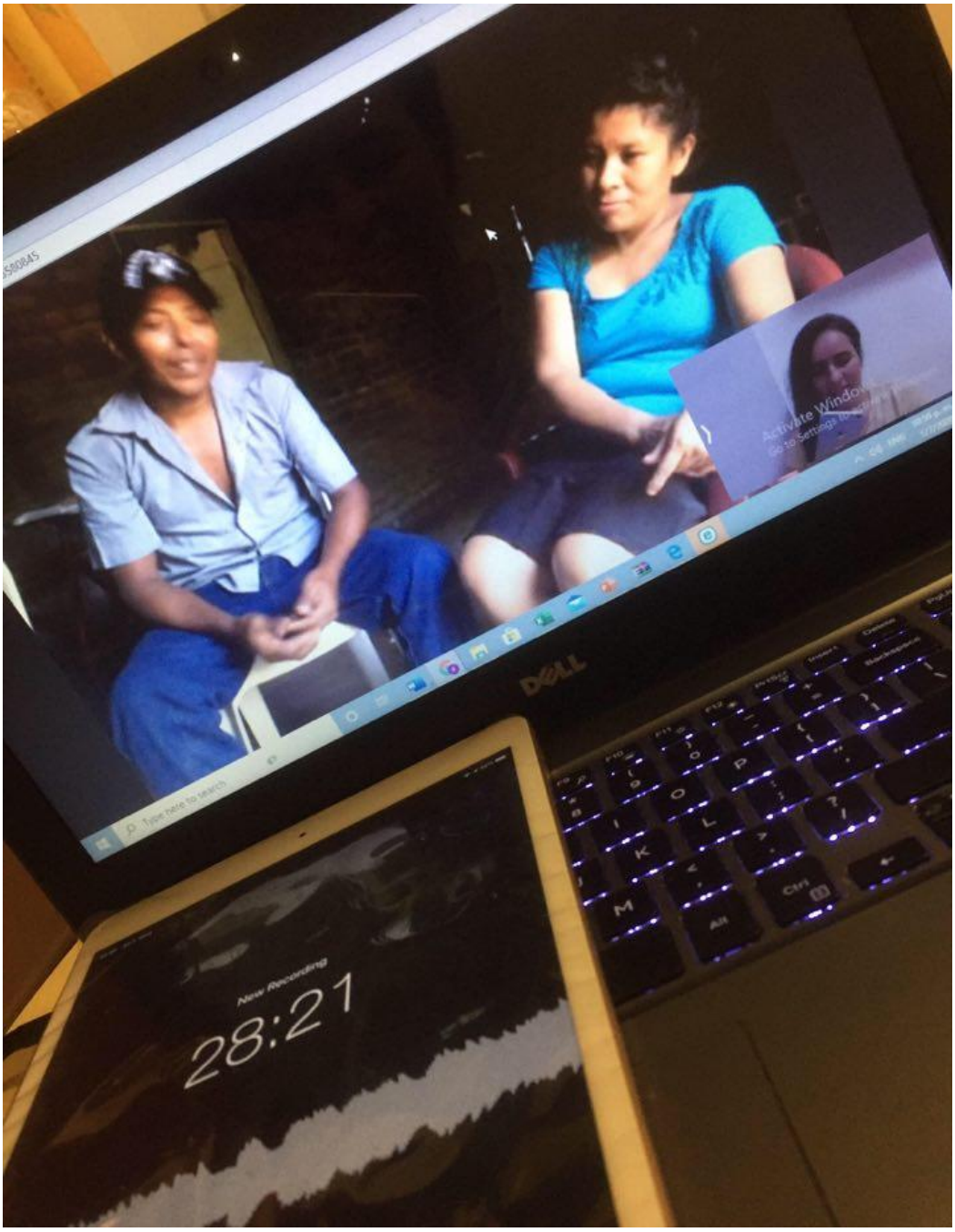
Meliponiculture refers to the breeding and management of native stingless bees and receives this name because this type of bees is taxonomically classified within the Meliponinae tribe, being subdivided into the tribe: Meliponini and Trigonini (Rosales, 2013), which corresponds to one of the many groups of bees native to America. The practice of Meliponiculture represents great opportunities for producer families in the rural sector, allowing them better expectations in their production units. From the point of view of food and nutrition security,

Meliponiculture would contribute to improving family income, diversifying production through increase pollination, and become an excellent source of energy, nutritional and medicinal support in family diets. The breeding of native bees is one of the livestock activities that does not carry any negative environmental impact.

In the same way, Meliponiculture is linked to agroecology and food sovereignty since it can be combined with agroforestry systems (SAF) by inserting beehives and trees in an integrated way in the management of orchards or crops, favoring organic production and environmental protection. Wolff (2012) explains that the integration of bees in agroforestry systems emerges as a good strategy for the sustainability of family agriculture and an extraordinary area of action for small farmers; the raising of bees contributes to the preservation of natural resources and the environment, in any case, its integration in agroforestry systems is very advantageous in agricultural farms.

Stingless bees or meliponids have recently been determined to play a crucial role in the pollination of wild plants and agricultural crops in tropical regions. According to Kerr et al. (2001), these insects pollinate more than 38% of all plant species in the Amazon region, this being a definitive detail for the conservation of the forest or its disappearance. Our Amazon contains almost 80% of the world's plant species, many still unknown in their potential benefits for humans or the ecosystem; without its specific bees, the forest is without its reproductive element of resilience and biodiversity.

4 Methodology



Picture 4. Author interviewing husband and wife, small growers in the community of Corozo, Nicaragua.

(Photo: Nidia Arauz, 07/07/2020)

4.1 Study Area

My thesis uses qualitative research, a subjective and systematic approach that highlights and explains daily life experiences and further gives them proper meaning (Burns and Grove, 2009). This exploratory case study involves a group of women gardeners, small farmers, and organizations who work to promote agroecology in El Corozo, Nicaragua, an Indigenous community located in Matagalpa in the municipality of San Dionisio, the northern part of Nicaragua. I am member of this community. Therefore my observation as a woman and a community member informs assumptions I make as I interpret the specific approaches to work by small farmers, the patterns of integration of women in agriculture, and finally, the perceptions of locals regarding changing roles of women in the community. My role as a participant observer also emerges during remotely recorded open-ended interviews and during "on site" observation in households of small growers.

4.1.1 Location

The case study took place in El Corozo, Nicaragua, one of the 15 communities of the municipality of San Dionisio, a small community deep in the mountain range of the Matagalpa Highlands in the Centre-North of Nicaragua. According to the Municipality of San Dionisio-*Alcaldía San Dionisio* (2018), the Corozo community consists of 190 households, around 1000 inhabitants. This small community still has its original name, El Corozo. It is 129 kilometers away from Managua, Nicaragua's capital, and 35 km away from Matagalpa Department, the second largest region of the country in population size, the fourth in area. Its geographical coordinates are 12° 47' 0" North, 85° 52' 0" West and altitudes between 494 and 1814 m.a.s.l. (Google Earth Pro, 2020). See Map 1. "General Map of Nicaragua and localization of study area."

4.1.2 Climate

The climate is semi-arid with precipitation levels ranging from 1384 to 1686 mm/a from May to October. The temperature ranges from 21 to 29°C all year round. In April, the maximum temperature of 29ºC and January, minimum temperatures of 21ºC. There is a three-month dry season between December to April. The hottest period extends between March and April (Don Pablo, Centro Humboldt representative, key informant).

4.1.3 Ethnicity

El Corozo community was a settlement of Indians. According to locals in Corozo, it's understood that Indians always liked to live near rivers. The Cálico River crosses the territory from north to south and receives the Susulí river. Just slightly more than two decades ago, both rivers were very mighty, and a forest was inhabited by many species that have now been lost. There are no public records of the Indigenous history of Corozo, only oral histories provided by elderly members of the Indigenous community. The Indigenous cemetery provides the only concrete record register in the community. In recent history, an astrologer came to the community and registered 12 graves. In the river, there are footprints in the stones of figures, and some of the agricultural plots cultivated by current residents have traditional "dead barriers" used by ancestors as part of the milpa farming and other Indigenous agricultural activity (Don Treminio, 88 years old, 2020.,key informant).

Map 1: General Map of Nicaragua[2] and localization of study area.

The municipality of San Dionisio, ♂ marked with a circle on the map, is in the north of Nicaragua in the department of Matagalpa.

(Source: U.S. Central Intelligence Agency , Political map of Nicaragua, 1997)

[2] "Administratively, Nicaragua is divided into 15 departments and two autonomous regions, with 153 municipalities. Geographically, it is divided into three regions: the plains in the Pacific, the mountains in the north and center, and the plains on the Caribbean Coast" (PRO Nicaragua, 2020).

Corozo's first inhabitants were the Matagalpa Indians, influenced by the culture of Los Chontales or Chontales through the commercial exchange. When Spain invaded these regions, many Matagalpan Indians were expelled from their own lands. Spanish men with last name Arauz spread throughout Nicaragua's northern region and mixed with Indigenous women; the Spaniards spawned children. As a result of this, the Ladinos emerged. Currently, many of Corozo's inhabitants do not consider themselves Indigenous; they identify themselves as peasants or *mestizos* (people of mixed European and Indian ancestry) and calling a person from the Corozo community "an Indian" is considered offensive, the term suggesting ignorance or backwardness.

Currently, in Corozo, "2% of the land is in the hands of large non-Indigenous producers (more than 50 hectares); 19% in the hands of medium-sized Matagalpa-born producers (from 11 to 49 hectares) and "76% in the hands of Matagalpan poor farmers" (between 0.25 and 10 hectares) (Eggs 2007).

4.1.4 Relief and soil characteristics

A study carried out by the International Center for Tropical Agriculture (CIAT) in 2001 in three communities of San Dionisio, including El Corozo community, mentions that the relief is formed mostly by undulating or broken terrain and that 86% of the soils to municipal level are superficial soils (types vertisol), which present rocks on the surface. Also, local soil are Andisols, Alfisols, Inceptisols, Entisols, and Mollisols (Pfister, 2003).

4.1.5 Economy

Family income in Corozo depends primarily on production of basic grains such as corn, beans, and sorghum. These crops are used for family consumption and surplus is sold in the nearby city of Matagalpa or in the San Dionisio Municipality. Family sales of basic grains

constitute San Dionisio's primary agricultural market, and this dynamic is the primary factor in driving the municipality's development and growth.

Basic grains are grown during two harvest seasons : *Primera*, the rainy sowing season lasting from May until July, and *Postrera*, at the end of the rainy season from August until October. During the dry season, February-April, some families plant crops using small-scale irrigation systems. Often Corozo experiences a shortage of food in June and July because families have consumed all existing stores of corn, beans, sorghum. In order to ensure a crop for the following season, all save seed needs to be sowed during the first harvest. According to the interviews carried out with the gardeners, this situation with food shortage is due to the fact of families having small plots and not enough room for growing food. In addition, interviewers suggest that food shortage comes about because of poor planning in making arrangements to store food for the whole year. During this period, many families migrate to coffee farms in Nicaragua's north region. Women may also find employment in coffee farms or in El Corozo as maids. Sometimes families must separate and send a member of the family to Matagalpa or Managua or even to the United States in order to try to have a better income.

Picture 5: Dry and winter season in Corozo.

(Photo: Artists for Soup, 15-04-2019/20-08-2020)

In the last three years (2018-2020), the economy and nutritional health of has improved because of a non-profit organization, Artists for Soup, implementing a program of biointensive gardens in the community. This program prioritizes rural families who have small plots and supports them in the diversification of their properties. Artists for Soup also supports women's groups in developing small enterprises.

The biointensive cultivation method implemented by Artists for Soup in El Corozo is an organic farming method, developed in 1970 by the North American John Jeavons through Ecology Action Organization and introduced in Nicaragua in 2009 (SIMAS, 2018.) This method promotes a set of agroecological production practices, technologies, and principles of healthy and diversified food in small spaces providing a solution to family nutrition, food security, and sovereignty in the face of significant climate change problems (ADAR, 2016), mainly in communities such as Corozo located within the dry corridor (central-northern region of Nicaragua).

According to ADAR, the Association for Regional Development of Agroecology (2016), and Artists for Soup, the biointensive method encourages soil conservation and preservation of native seeds and focuses on eight principles:

Picture 6: Eight Principles of Biointensive Gardening.

(Photos: Artists for Soup, 2019-2020)

Since 2018 until now, women from El Corozo have been applying these principles in their small plots, supporting and learning from each other. In addition to developing skills around biointensive method for individual families' nutrition gardens, the community support resulting from bringing women together leads to improved food supply in the larger community. There are around 65 bio-intensive gardens, including churches and local schools

(Artists for Soup, 2020). Chapter 5 will address the agroecology principles applied by six women who have developed successful nutrition gardens and are in the early stages of developing beekeeping enterprises as a sample to analyze this research thesis.

4.1.6 Transportation

There is no public transportation in Corozo. To reach the Corozo community, people take the bus from Managua to the city of Matagalpa. In order to travel to Corozo from Matagalpa, people take the road that leads to San Ramon, in the direction of San Dionisio municipality. There are buses from Matagalpa that leave regularly. The bus takes approximately one hour and 20 minutes from Matagalpa, picking up people and cargo along the way. The bus does not pass through the el Corozo community but stops at the entrance of the community. From that bus stop, people walk around 40 minutes or more to get to their houses, depending on how far they live. In order to reach home, many families must climb many steep hills surrounding the community and cross the Calico and Susulí rivers that cross the community from north to south. All the community inhabitants know each other, so it is customary to meet the neighbors and say hello on the way while travelling on foot to the destination.

4.2 Research strategies

During 2019, months before starting my master's degree at CEU, I was hired for a consultancy to conduct interviews with women by the nonprofit organization, Artists for Soup, a group that promotes the work of agroecology as an instrument to achieve food sovereignty. Artists for Soup's programs work with women and focus on biointensive nutrition garden training, reforestation, fuel-efficient cook stove initiatives, small enterprise development, seed saving and among others. The consultancy consisted of conducting 68 interviews with Artists for Soup's participating small growers, all women, in the Corozo community before opening a program to implement clean cook stove project to reduce

deforestation and the impact of indoor air pollution caused by open stoves. My direct collaborators in conducting these interviews were the director of programs, Elioena, and the executive director of AfS, Judith. I immediately moved into the Indigenous region in the Corozo community to do this interview work for six months. This is a familiar community because I was born and grew up here until the age of 14, when I moved to the capital Managua to live with relatives and pursue school, university and later, work with two different environmentally-focused nonprofits, IBIS Denmark and Oxfam. The interviews I conducted and the small growers I came to know while working with Artists for Soup motivated me to do the Master in Environmental Sciences and Policy (MESP) and later, pursue my thesis on women in agriculture in this region.

Picture 7: Conducting interviews with Artists for Soup's participating small growers from El Corozo

(Photo: Artists for Soup, 2019)

Through my thesis research, I want to contribute to the Corozo community, highlighting the work women and their families are doing in the Corozo, and the challenges and opportunities women and their families face. Also, I hope this research will contribute to the body of writing available to various organizations promoting agroecology, Indigenous rights, and gender equality in Nicaragua. My experiences as a lifelong member of this community, my

field work in 2019, and my interactions with collaborating nonprofits who work with agriculture gave me insight and a larger context as I analyzed data collected in 2020 appearing in the following methodology section. In the methodology section, I also discuss the limitations and challenges of this research.

The thesis focuses on current agricultural principles used by small growers in Nicaragua, focusing on opportunities and challenges as perceived primarily by women. Through semi-structured interviews and document analysis, I want to understand perceptions Nicaraguan small growers, NGO directors, and farmer organizations have about food sovereignty by focusing on their perceived challenges and solutions. The thesis explores current struggles emerging from governmental policies through the lens of critiques from directors of NGO's working to address, adapt and mitigate these policies in local contexts. One of the central agricultural activities of interest in this thesis is meliponiculture, a type of beekeeping practiced in many Indigenous communities in Mexico and Central America.

Through semi-structured interviews and content analysis of documents, I analyzed the challenges and opportunities that women in rural areas face. I listened to their perceptions/observations on the nutritional and economic benefits and difficulties of small scale growing and heard stories about gender-specific changes/challenges experiences in their community and their work in the agriculture. Although women are the focus in this thesis, I also listened to the perception of some men in the Corozo community in order to hear some male perceptions of how Nicaraguan policy impacts their lives, gender dynamics in the community, and their families' economy.

4.2.1 Semi-structured interviews and content analysis

The principal source of data in this research comes from interviews as they provide valuable insights (Yin, 2003). My thesis benefits from the perspective, knowledge and experience

shared by different organizations responding to questions about my topic of interest in this research. Finally, I consider author/participant observation and asset. My experience in the field with small growers goes back as far as 2014 with my work from 2012-2017, with an International NGO, IBIS Denmark, in the North Caribbean Coast Autonomous Region (RACCN), and the South Caribbean Coast Autonomous Region (RACCS), and then more recently with Artists for Soup, in my home in the Indigenous region in Corozo, Nicaragua.

The interviews were semi-structured with a range of open-ended questions that evolved and sometimes changed during the course of my research. My follow up questions were often responsive to answers provided by participants, which allowed conversations to go into more depth and remain responsive to the interests of participants. The purpose of the questions was to start a candid conversation about the participants' opinions, perceptions, and stories around concerns central to my thesis. This format allowed me to collect a realistic and unguarded interview that was useful for interpretation on the issues surrounding my research topic.

I decided to create three categories representing non-profit organizations, small farmers organization, and gardeners that I reached out by email and WhatsApp to coordinate the interviews conducted by Skype and WhatsApp. I did sixteen interviews, including six bio-intensive gardeners, small growers benefitting from the meliponiculture project in the process of being implemented by Artists for Soup in Corozo, three influential small farmers organizations with ongoing projects in the El Corozo Community and four external farms that works with Meliponicultura projects in the Pacific region of Nicaragua. Their ages ranged between 26 and 80 years old. Among the interviewees, ten were women and five were

men. (See Appendix 2 “List of interviewees” shows the classification of the interviews by age and gender).

The interviews were recorded using a digital voice recorder and were later transcribed from Spanish to English. The research does not include physical observations for reasons I will explain in the "limitations of the research." However, through videos, photographs, interviews, and my own experience living in El Corozo, I was able to identify the agroecological practices implemented by women in their plots and their contribution to agroecological principles.

Open coding can be defined as “the analytical process through which concepts are identified and their properties and dimensions are discovered in data” (Strauss and Corbin 1998, 101). In order to analyze data, I developed a method of coding without using Nvivo. This decision to code data myself resulted from adaptations I had to make due to constraints of Covid-19 “stay at home orders” and logistical difficulties in finding large numbers of small growers with access to phones and internet. The interview transcripts and research notes were analyzed in depth by looking at the text at hand. Analyzing interviewees’ language by concept also allowed me to find reoccurring themes while coding interviews and some of these themes included “acquiring knowledge,” “increasing numbers of pollinators in gardens,” “developing diversity,” “building soil fertility,” “pest management,” “seed saving,” cultivating compatibility in an among families,” “water management, and “local production-consumption.” I then came up with categories within which these concepts and themes could fit to answer the three main research questions. There could have been a large number of categories drawn out from each interview. However, I tried to focus on common themes and concepts that seemed to be repeated across the interviews.

4.2.2 Document analysis

Hence, document analysis was used for two main purposes. I studied around three existing sources, such as laws approved by the Nicaragua government related to seeds, agroecology and food sovereignty. I analyzed the data I collected through interviews I found support for interpreting the data through using existing studies related to my research topics conducted by International and Nicaraguan researchers from NGOs and Universities. The studies I used covered topics including: biointensive gardening, gender, beekeeping, and meliponiculture projects, agroecology, and food sovereignty These documents helped me understand Nicaragua's agriculture's current paradigms. They helped me understand how data collected interviews mesh with my research purposes, especially with regards to my interest in the lives of Indigenous women. The second purpose of relying on outside documents was to supplement the narrative that was coming together from the interviews themselves. I informed research participants that their opinions and perspectives would appear in my thesis anonymized.

4.3 Ethical

I did not change the name of the community where my case study took place, nor the municipalities or cities I mention in this research. During interviews, I requested permission from participants to use their name or organization for the purposes of my research and writing and all agreed. However, I decided not to use participant names. I chose most of the pseudonyms among common names in the north region in Nicaragua. This anonymization was necessary to protect their lives, and I do not want to put people in danger.

4.3.1 Consent

At the beginning of each interview, I explained my research objectives. I asked my research participants' consent to use their opinions, and I asked for permission to record the interviews,

life stories, and words in my research. I recorded these moments in which they gave me their approval. I received permission from organizations and individual participants to use the photos that are included in my research.

4.4 Limitations

The original idea of the thesis was to simultaneously start and study a Meliponiculture project in the El Corozo, Nicaraguan community with a group of women currently involved in small scale agricultural projects. Because of Covid-19, the project could not be implemented as planned. Travel to training sites had to end in February of 2020 and focus had to shift away from seeking outside expertise on meliponiculture because of Covid 19 toward finding safer existing community models of beekeeping. Many of the women benefitting from this project had already had the first two trainings when this project started. The project was scheduled to start in October when flowering, according to experts I spoke with, is at its peak, I was able to carry out interviews on Meliponicultural with rural indigenous women participating in small agricultural projects without any problems. I also collected the information I needed on existing Melponas projects by speaking with several directors of NGOS in Nicaragua and reviewing documents on case studies in Latin America.

Other limitations emerged from the lack of access to related studies of meliponiculture in Nicaragua. I found many studies related to bees and beekeeping practices, but I did not find documents based on the impact that bees have on crops and how this contributes to food sovereignty. In the Corozo community, NGOs working have no impact studies of the projects they implement related to agriculture or bee studies, so my thesis will be the only study in this community.

5 Results and Discussion

(Photo: Juliana, 27-08-2020)

Polyculture farm

Picture 8: Polyculture farming with more than one species growing at a time (Zea mays, corn, beans).

Biointensive garden

Picture 9: Biointensive garden with deep excavation and companion planting of cabbage, carrots, broccoli, spinach, cauliflower, passion fruit, Passiflora edulis, and granadilla, Passiflora ligularis Juss.

Introduction

I start by answering the research question 1. How do Indigenous women's current practices mesh with agroecology principles? Here I begin to examine the brief history of the regions' transition to agroecology, focusing specifically on women's integration in this transition. I describe current knowledge and practices surrounding agroecology in Corozo and explore how institutions who work in this area help to achieve principles and practices of agroecology. Areas of focus in this section include animal integration, water harvesting, crop diversification and rotation, maintenance and expansion of local genetic diversity, development of composting and organic inputs, and more.

In addition, I answer research question 2. How do indigenous women's practices in Corozo mesh with food sovereignty principles and what opportunities and barriers do they face? I examine the way agroecological management and soil fertility enhancement allows small farmers to stop depending on external chemical inputs. I also explore the ways women have opportunities to be "drivers of change" in cultivating food sovereignty through sharing knowledge and influencing community behavior. Through producing food on their small hectares and training others on how to do this, women are in the position to shift the community toward greater autonomy and sustainable agricultural practices. Finally, I analyze the barriers women face in society and the shortcomings of current government policies.

5.1 A brief historical review: Traditional peasant agricultures in El Corozo

Don Treminio, a smallholder farmer and an 88 year old "historian" of El Corozo, explains that many years ago, the land was more fertile than it is now. From a small parcel, people used to harvest a large amount of basic grain-corn and beans production without using agrochemicals.

> "With two manzanas of land, I used to get 80 quintals of corn. Crops were very healthy without agrochemicals. Our soil was fertile because our fertilizer for the plot was ash; when we saw that the land no longer gave more crops, we cut down the trees. We burned that plot so that the ash would restore health to the soil, and we let it rest for a long time, and we used another parcel that we had to continue sowing until it no longer gave more, we returned to the first plot when it was already recovered and so on. Years later, we change our technique for the milpa method, and we saw that it was better because the family increased. We needed land to cultivate with our children, and the new generation came with a different mentality. I want to mention that the traditional method of sowing was the plow for farmers who had their oxen and ease of acquiring the plow." (Interview with Don Treminio, El Corozo, 07/07/2020)

Don Treminio also mentioned that they did not know about agrochemicals until 1950.

> "We did not know what fungicides are until in 1950, a Sandinista Cooperative called Plan Invierno (English: Winter Plan) came to the community and offered us a credit plan that consisted of giving us seeds, and fertilizer to apply to corn and the beans and in exchange, we paid with quintals of beans or corn, from the same harvest. We were mistrustful initially, but this organization came to the Corozo to train us; it was the first time we knew about the fertilizer and used it in our crops. Plan Invierno was the first to introduce fertilizer to the Corozo. To cancel our debt, this organization sent Credomer to put a price on our basic grains. We delivered certain quintals of beans to Plan Invierno, depending on the price to cancel the debt, and the rest was sold in San Dionisio or Matagalpa. We decided to organize with them because we saw that the harvest was yielding, and we had enough profit left." (Interview with Don Treminio, El Corozo, 07/07/2020)

The slash-and-burn method is not a current practice in Corozo. Milpa cultivation, the traditional method used for centuries in Mesoamerica combining maize, beans and squash, continues to be a method that small farmers use. Milpa cultivation is consistent with methods of agroecological farming. These traditional cultivation practices allow farmers to have the empirical knowledge of working without agrochemicals, a key factor for NGOs, government, and peasant organizations to take in account to generate synergies "through the co-creation process by combining traditional, Indigenous, practical and local knowledge of producers with global scientific knowledge" (FAO, 2018).

The movement toward agroecology has been a difficult and long process. The data provided by Don Treminio on the use of pesticides coincide with the arrival of The Green Revolution in Nicaragua in the 1950s (Envio,1994), which I briefly mentioned in the literature review. Even today, agribusiness companies continue to promote monoculture farming, an approach that depends heavily on pesticides and chemical fertilizers. Because the country lacks ecological regulation mechanisms, the entire ecosystem in Nicaragua's rural communities is harmed by this persisting pattern.

Agribusiness greatly influenced the changes in agricultural methods in the smallholders' farmers from El Corozo. For the last seven decades, biodiversity has been decreasing in Corozo and deforestation has been rampant. Transformation to monoculture in the region has increased dependence on external inputs, pesticides and chemical fertilizers. Further, what these companies have left behind is debt, enrichment of large-scale farmers, credit cooperatives, soil erosion, poverty, and lack of preparations to face natural disasters.

Several studies have been carried out and show that monoculture is not sustainable (Gliessman, 2018). A research conducted in 24 departments in Nicaragua, Honduras, and Guatemala after Hurricane Mitch found that “sustainable plots had 20–40 percent more topsoil, greater soil moisture, and less erosion and experienced lower economic losses than their conventional monoculture farms” (Holt-Gimenez 2000).

Based on the information above, in the next sections, I introduce agroecology's transition after Hurricane Mitch and the role that women played in this process through small farmers' organizations' accompaniment.

5.2 Presence of Organization in Corozo

This short introduction examines various small farmer organizations working in El Corozo, with a focus on their specific work emphasis as it relates to conservation, food sovereignty, and the lives of women.

The descriptions of the following organizations present in the El Corozo community emerge from questions I asked interviewees who work with these and from interviews conducted with many directors and leaders in organizations. The data in this section is descriptive and limited to examples pertaining to the eleven organizations in the community that include state and development institution.

Of the organizations that I describe below, I decided to interview organizations that have a greater presence in promoting agroecology and food sovereignty in the El Corozo Community. I interviewed Farmers to Farmer Program (UNAG-PCAP) because it has been working in the community for many years since 1994, and Artists for Soup Organization, which has been collaborating with the El Corozo for three years and has been committed to highlighting women's work in agriculture activities. I also interview Centro Humboldt representative in Corozo to know aspect related with climate change. The data I provide from the other organizations is information that I gather through interviews with the gardeners and key informants.

The structures of representation of the government for the 190 households in El Corozo are the *Secretarias Políticas* (Political Secretaries), which are elected by the Corozo Community. By mandate of the Vice President of Nicaragua, Rosario Murillo, the representatives in the communities must be women. These two women act as intermediaries between the state and

El Corozo, helping Corozo families transmit concerns they have to the San Dionisio major. These women also follow up on projects carried out in the community

La Comunidad Indigena (The Indigenous Community of Matagalpa) is one official organization that helps manage issues pertaining to land. La Comunidad Indigena works throughout the Matagalpa Department, including the region of El Corozo. The land region categorized as Corozo is property of *La Comunidad Indígena de Matagalpa*. Corozo's land is Indigenous, and local families who have ownership papers are leasing it from *La Comunidad Indígena de Matagalpa*. This cooperative is responsible for granting title deeds and legal rights to the lands of Corozo inhabitants. In addition, the cooperative supervises land use and measures the lands to defend people in cases of conflict over property lines. The cooperative also plays the role of protecting and preserving Indigenous customs and traditions. One of the problems the cooperative articulates is that small farmers have to pay a small amount of yearly tax (in Spanish *canon*). This debt can be settled, sold or inherited freely, yet the transfer has to be carried out through *La Comunidad Indígena de Matagalpa*. However, most small farmers do not pay this tax, so they do not have the right to sell their properties, unless they pay all the leases that have been in arrears for years. Some residents of the community have expressed disappointment with *La Comunidad Indígena de Matagalpa* because they have not helped them resolves problems created through land conflict and unresolved debts.

In recent years, external farmers have come to Corozo to buy land. Often non-Indigenous external farmers exploit the land by burning and destroying fauna for livestock activities. The purchase of land by people from outside the community has had consequences that have led to wells drying and chemicals being used, a practice which impacts water quality. In addition

to well drying up, water sources coming from the mountains have also dried up, affecting mainly women and their families who depend on that water for consumption, irrigation, hygiene and household chores. Those affected have filed complaints with the authorities and *La Comunidad Indígena de Matagalpa*, but the community and representative from a *Comunidad Indígena de Matagalpa* have been unable to solve this issue. In other cases, those affected prefer to remain silent because they fear reprisals. An anonymous informant also commented that to arrange land titles, small growers have to pay large fees. In order to change the dynamic with non-Indigenous outsiders mistreating land, this informant suggested that the issuance of land titles must be offered free of charge because it is *La Comunidad Indígena de Matagalpa's* responsibility to sustain the communities' natural resources and Indigenous practices.

La Casa Comunal (In English: The Communal House) is made up of a Board of Directors that can be reelected when the El Corozo community deems it necessary or when a member of this board cannot continue to perform their functions. Two men and one woman head the Board of Directors. They are in charge of watching over the community's problems related to drinking water. In collaboration with the community in monthly meetings, the Board of Directors creates proposals to mitigate and improve the communities' water problems. The Board of Directors also records the new beneficiaries of drinking water, collects money for the water service house by house monthly, makes deposits to the bank of the payments received, and leads reforestation projects at the water source, among other tasks. While working for an organization in Corozo in 2019, I attended meetings at La Casa Comunal. I observed that women and young people were active participants, and I observed that there was a great deal of participation from women and young people. I noticed that women were

invited to participate in having a role on the Board of Directors. However, women expressed that they cannot take the position because they were afraid to walk with money alone; someone could steal it. Others expressed that they did not have time because they had to take care of their children or check with their husbands first. However, I could see that women contribute creative ideas for proposals on improvements in the community and issues of protection and conservation of water sources.

Unión de Campesinos Organizados de la Cuenca San Dionisio (UCOSD) is one of the agricultural cooperatives founded in 1987 that supports male and female peasants in their quest to gain access to their land. In El Corozo, there are still peasant families who do not own their property because they cannot pay the cost of a plot. Many families rent land from to their neighbors to be able to harvest and sustain supplies of food. The UCOSD, in this sense, implements a program that they call "lease with a purchase option." Families have the right to buy it through a lease with the power to purchase for fifteen years with joint tenancy or under Usufruct. This means that the UCOSD gives the right to enjoy the property with the obligation to preserve the property and improve it. A person can have the land for life; she can gift it to her family but not sell it or divide it without the consent of the UCOSD. This organization also promotes and supports the participation of women. Through training in agricultural production techniques, it encourages the use of new technologies that families can acquire through credit, such as irrigation systems, tunnels, and silos.

In 2019 I interviewed a biointensive gardener supported by UCOSD. She is under "lease with a purchase option." I was very impressed by the milpa agricultural an ancient practice where small Indigenous growers create nutritionally and environmentally beneficial gardens by planting corn together with varieties of squash and bean, melon, tomatoes, chilis, sweet

potato, jícama, amaranth, and more. This biointensive gardener had a milpa garden surrounding her house and had incorporated her biointensive garden within this existing practice. Her sector does not have access to potable water. The well her family uses for drinking water and domestic chores remains far from the house. However, a small farmers' organization supports her with materials to harvest rainwater, but this system did not work due to the lack of training and assistance from the organization that helped her. (The type of material to collect rainwater was not adequate or appropriate for the conditions of this area). The failed water system had not been a barrier to continue cultivating and harvesting her plot and feeding her four children and her husband. She told me that her land was not hers but that if she decided to pass it along to others, it should only be to UCOSD, and they will pay an extra amount for the improvements.

Proyecto de Desarrollo de San Dionisio (PRODESSA)- San Dionisio Development Project, is a Nicaraguan NGO that has a strong presence in Corozo promoting gender equality, as well as access to loans for agricultural materials and entrepreneurships. PRODESSA functions as a facilitator of project management; which means they work as intermediaries between state organizations, non-governmental organizations, and the community. With the support of this organization, women from Corozo achieved projects for community improvements, such as the community bridge across the river, w potable water access, sanitation, and small business training and support, a pantheon in the community, medical assistance, among other projects in the agriculture sector.

Organización Para el Desarrollo Económico y Social Para el Área Urbana y Rural- ODESAR/Organization for Economical and Social Development for Urban and Rural Areas (ODESAR), is a nonprofit civil association that works with a focus on nutritional food

security taken as a transversal axes: gender, environment and citizen participation. Together with Programa Campesino a Campesino/Farmers to Farmer Program (UNAG-PCAP), a small farmer organization promotes agroecology and food sovereignty by preserving natural resources such as soil conservation, agroforestry, seed banks, autonomy, gender equality, the rescue of ancestral knowledge and value. Both emphasize the use of land to produce food and sell the surplus to buy products that are not produced on their farms. Also, small farmers from Corozo can have access to loans to purchase agriculture materials and apply for support to develop small enterprises led by women. In Corozo, they have representatives led by young people, both men, and women. These representatives are responsible for holding community meetings where central issues related to agriculture are presented and addressed.

Centro Humboldt is a Nicaraguan non-profit organization dedicated to promoting territorial development through the sustainable management of the environment and natural resources. In Corozo, their work focuses on climate adaptation, mitigation, and risk prevention for planting crops. They have a representative in El Corozo who is in charge of measuring the temperature, preventing risks from harvesting, and the amount of rain that falls in the area, using technology provided by *Centro Humboldt.*

Artists for Soup, Inc. an international nonprofit organization, has a strong presence in Corozo promoting gender equality and gender justice. Artists for Soup is the most recent organization to come to Corozo. In 2017, Artists for Soup started work with school, church and family nutrition gardens and women's art collectives. They have been in the Matagalpa region for three years now and are expanding and connecting with agroecology programs at Nicaraguan Universities. Their projects promote agroecology and food security/sovereignty through biointensive gardens. The connections between environmental health and human health are

central to the work of the organization and present in their focus on preserving natural resources and improving conditions of the soil. They promote community seed-saving and fund reforestation efforts using native species as a way to animate community conversations about conservation. In addition, through rainwater harvesting, and reduction of dependence on external, synthetic inputs, the organization looks for ways to shift families in the community toward sustainable models of cultivation in the community.

Artists for Soup uses innovation and clean, sustainable technology such as fuel-efficient cook stoves with participating biointensive gardeners in the community to protect biodiversity, reduce deforestation and smoke inhalation in the home. An additional reason Artists for Soup promotes the fuel-efficient cook stoves is that this method of cooking reduced the number of hours women spend preparing food for the family; the heat in Nicaraguan-made fuel-efficient stoves is easier to control and requires less oversight than traditional methods of cooking on open fires. Finding ways to support women as they adapt clean sustainable technologies helps them pursue potentially creative or income-producing activities and is connected to Artists for Soup's mission of gender justice.

5.3 Impact of Hurricane Mitch in Corozo

Hurricane Mitch impacted Corozo families in 1998, leaving it in extreme poverty. The two rivers crossing the community, the Calico River and the Susuli River, overflowed and destroyed the properties and plots adjacent to these rivers; several native trees were lost that, for many years, gave life and great landscape to the community. The landslides washed away the topsoil, damaged the crops, and left small farmers with few options to cultivate it. Women and children were the most vulnerable in that they, more than the men of the community, did not have access to medicine and medical care or any ability to leave the region. Due to the

fact that the community was cut off by landslides, people lost access to food and clean water. Hurricane Mitch created a situation where families had to come together to support each other and provide shelter and share what little food was available with those most unprotected. After the hurricane, aid arrived, managed by the municipal mayor of San Dionisio to support the harmed families; however, there was poor handling of Donations. Few families from Corozo were able to access it. Even though Hurricane Mitch created a dire and urgent situation, it created the impetus for small farmer organizations and community leaders to retake control of agricultural practices through seeking more resilient methods of agroecology. In addition, this crisis situation opened up an opportunity for women to begin to have a voice in the community's debates and decision-making on food production issues. Over time, the community began to recognize women's contributions and strengths when facing this type of disaster (observation from my own experience in the community).

During Hurricane Mitch in 1998, government organizations, cooperatives and small farmers NGOs that promote agroecology methods began to arrive to Corozo, among them were agricultural technicians from Union de Campesinos Organizados de San Dionisio -UCOSD (Union of Organized Peasants of San Dionisio), Organización para el Desarrollo Económico y Social para el Área Urbana y Rural-ODESAR (Organization for Economic and Social Development for Urban and Rural Areas) and Programa Campesino a Campesino-PCAC (Farmer to Farmer Program). These groups came to Corozo with the idea of providing solutions to peasants in the face of the emergency. The groups were confronting the disappointment of many peasants experiencing losses in their crops due to land degradation, lack of financing to buy fertilizers. Lack of adequate means for the storage of grain production on their farms was common. People only had sacks or bags, which were easily

attacked by insects and rodents, which caused high storage losses. Many small growers lacked access to clean water. Most of the inhabitants did not have their own property deeds because it was expensive to pay for the legal process to arrange this. Finally, as climate and land conditions continued to shift, new pests emerged that peasants did not know how to control, among other problems.

In order to know how the problems mentioned before were addressed, I had an interview with Don Cirilo, a representative from the UNAG-PCAP Organization. UNAG-PCAP has been working for many years in Corozo. Cirilo said that smallholders, in partnership with small farmers organizations, started promoting and implementing agroecological solutions by using local resources, encouraging farmers to diversify their plots, a strategy to conserve biodiversity, and providing technical support in the implementation of agroecological practices such as polyculture, agroforestry, soil conservation, among others.

According with Don Cirilo, the transition to agroecology has not been an easy job. UNAG-PCAP has been working in communities for more than ten years, and he mentions that at first, the farmers did not adapt to the idea of diversification and reorganization of their plots. This situation required many workshop and training. With practice, farmers have seen the benefits resulting from improved soil quality, microclimates, and better yields in their crops.

One central challenge is that Nicaraguan culture in rural areas is very difficult to change. “Sometimes we have meetings in a municipality, and around us, we have 30 companies offering chemical products at low prices," says Don Cirilo. He also mentioned that change to traditional and sustainable models to agroecology; farmer need more widespread awareness. "Even among the farmers, sometimes they are discouraged because they are working with the approach of no chemical inputs, but others are not."

Don Cirilo describes the methodology used to build awareness and reduce the use of chemicals in agriculture. UNAG-PCAP keeps a registration chart that they fill out for each producer; they also provide small growers with trees to reforest and help them organize their plot/farm. Many of these producers start with a crop, and little by little they diversify the crops. At the end of the year they can see the progress and benefits of producing several plants at the same time and changing crops according to the season.

This methodology has been necessary because an annual operating plan helps farmers to set goals for the short term and long term. At the same time, UNAG-PCAP does a long-term study for each organized producer/farmer, proposing activities to be carried out with a current map and a future map to assess each producer's work. The idea is that in 5 years, the farms will be self-sustaining.

UNAG-PCAP also organizes workshops to raise awareness among the general population, said one representative from UNAG-PCAP. This representative went on to describe how, in addition to workshops, through local radio, they promotes a campaign of "No To Cutting Down Trees, No Burning and No To The Use Of Chemical Products." (Representative from UNAG-PCAP, 2020).

One other strategy used by UNAG-PAP to help small farmers adapt agroecological methods is to create a movement of seed banks in the region. The aim of the seedbank movement is to allow small growers to have easy access to seeds for sowing, to promote native seeds, and to stay away from transgenic seeds. UNAG-PCAP also collaborates with foundations, cooperatives, and NGOs to increase their impact around this focus on seed available. Also, UNAG-PCAP creates cooperatives, which operate as small businesses where communities

can promote local food consumption and seek the integration of women in agriculture in order to promote access to credit with a low-interest rate.

However, UNAG PCAP argues that the transition has been an gradual adaptation process. The success can be found in "accompaniment" that happens when UNAG PCAP carries ideas out to the peasants and helps them take advantage of available resources and traditions such as adapting natural fertilizers, using native seeds, pursuing agroforestry and silvopastoral practices of integrating trees in order to allow grazing of domesticated animals in a mutually beneficial way.

Consistent with UNAG-PCAP's focus on the importance of access and inclusivity is their work in Corozo with including women in decision-making. According UNAG-PCAP, a rural women's roles in an agriculture project is critical because women are traditionally the ones responsible for family health; they are very aware of the benefits of acquiring a chemical-free crop for the health of self and family. Also, women have thoughts of saving money and economizing in various ways, which motivates the movement away from the purchase of chemical supplies. UNAG-PCAP's focus on including women has had positive outcomes for the community, according to Don Cirilo.

> "Ten years ago, it was challenging to integrate women because men were the ones who decided in all the fieldwork, and women did not participate in anything. However, now the woman is the one who negotiates and leads many projects. Before gathering a group of women was a challenge. Now women organize and support each other. Today you can see how they come from their communities to the municipality of San Dionisio to sell at fairs and are fundamental contributors to the family economy," (Interview with Don Cirilo, San Dionisio, 07-07-2020).

The emergence of local fairs selling local produce is a development that opens additional opportunities for women. In addition, fairs promote local consumption, facilitates direct sales from the producer without intermediaries, allows the exchange of knowledge between

women and consumers, and develops women's leadership potential and broadens their experience as women become exposed to work other women carry out in their communities. The women from El Corozo Community are now often recognized for their work in agriculture in events organized by the local mayor's offices and small farmers organizations. Women are central to most events organized by small famer organizations that promote the work done primarily by woman.

One way to understand the way women's roles have been central to the transition to agroecology in El Corozo, is through storytelling. What follows are some illustrations focusing on specific women in the community who have been instrumental in this process.

5.4 Women at the beginning of agroecology transition: Opportunities and challenges

When UNAG-PCAP started working in Corozo Community, Don Cirilo said that Doña Liseth and Doña Cristina were women in the Corozo community who decided to be part of the agroecology movement, both participating in the workshops organized by UNAG-PCAP. Doña Cirilo described how the women helped with the meetings, made plans with the UNAG-PCAP technicians, and provided strategic ideas for their community. Some people from their community made comments about women participating saying, "They have nothing to do. That is man's work." (Don Norlin, phrase 30/06/2020)

I talked by phone with Doña Liseth to find out what her experience was as a woman in this transition to agroecology. Unfortunately, I was unable to communicate with Doña Cristina to hear her observation on the gender-related experiences of this transition.

Doña Liseth described what UNAG-PCAP offered in the way of a new approach to small growing practices.

> "we had several meetings and training with these organizations that came to Corozo, and they proposed that we stop burning our plots since we killed all the organisms in charge of disintegrating organic materials, we also burned the flower of the earth, weakening the fertility of the soil, something that we did not know, those terms of people who study are difficult to understand, but they explained us in detail, they also explained to us that we should try another method of sowing that is not plowing the land since we were eroding the soil and when the rain fell it washed the land, so the proposal was to do it "pura coba" [3] besides that it comes out cheap because not everyone in the community has oxen and a plow. They proposed to train us on our land to make living barriers, dead barriers, levees and contour lines. They also helped us identify the type of land in our plots, which we did not know. They also told us to continue implementing the milpa method." (Interview with Doña Liseth , 58 years old, an agroecological activist from El Corozo, 10/07/2020)

Doña Liseth said that she and Doña Cristina received a lot of criticism for going to the meetings with the organizations in the community. She and Doña Cristina were the only women who attended the community meetings. The church members criticized her because they said "Liseth does not have time to go to church because of going to those meetings." She also received comments/ gossip from people in the community who said things such as: "that job is not for women," "they are wasting time," among others. But Doña Liseth says she was never paid attention to those words and always spoke up in the meetings before the eyes of all the men in that meeting. She proposed ideas because she knew the community very well and understood some of the specific problems small growers were experiencing with agriculture.

Even though Doña Liseth was critiqued for her outspokenness in the transition to agroecology, she was also viewed as a community leader, which became evident during Hurricane Mitch when many of the most desperate members of the community lost their homes in floods and mud slides and found shelter at the small farm of Doña Liseth . The important thing for her was that "her thoughts were heard," she says.

[3] Pura coba: use just one material- purely mattock/hoe

Doña Liseth went on to explain that during Hurricane Mitch, she lost all her harvest and had an enormous debt with the credit cooperatives because she had used that money to buy fertilizers for agriculture. Since they lost the crop, she had no money to pay the debt, nor did she have money to feed her five children. However, the cooperatives established a longer term than what was stipulated to have the chance to collect the money to be able to pay. Meanwhile, she began to sell *nacatamales*[4] with her little daughters and snacks for the meeting participants and lunch for the technicians of the organizations that came to do the community meetings to have the income to feed their children and buy school supplies buying food for her family. She continued to attend the meetings since the land was not producing as before. She wanted to hear solutions since they offered something different without having to invest a lot of money. Doña Liseth made her plot available for the technicians to use as a demonstration farm to carry out the tests and she also offered a space in her house for the technicians from these organizations to hold community meetings. Partnering with organizations allowed her to be present at all the meetings while simultaneously continuing to motivate other women who were in the same situation to join, train and incorporate new practices. Over time, the women of the community began to come to her house. Women start giving their opinions in the meetings. Doña Liseth said, "One of the hard things is getting women to talk." Eventually, some women assumed important roles in the community, roles that were previously unavailable due to the restrictions of machismo of men in the community and the church. In the times before agroecology came to Corozo, a woman had no role in community meetings or in leading Christian worship or preaching.

[4] *Nacatamale*,a traditional dish made over a fire with corn meal, coating pork, peppers, onions and other fillings and wrapped in plantain leaves,

Only men were allowed to do these activities while women participated by attending, cleaning, and listening. Doña Liseth says:

> "Now, women have strong leadership in the church; we are the president as ladies, we preach, and we are the most creative. We lead worship and propose good ideas for the church. Additionally, we have a treasurer of potable water, a female director at Colegio Margarita Arauz (local school), young women who are training to be nurses, community women leaders assigned by NGOs to organize meetings, and lead projects. Some women have also managed their household finances; this aspect continues to be a challenge in the community."

The women who manage their household finance tend to be those who have family gardens, their own small businesses as such as bakeries, vegetables or fruits sales from their garden surplus, sewing commission, orchards and seedling development and sales, pulperia (grocery store work) , cheese production from small livestock holdings (my own observation during 2019).

Barriers to women having autonomy and control of family finance continue to limit families in many ways. Doña Juliana, Director of Programs for Artists for Soup, mentions that lack of family planning and sexual education in Corozo leads to women having many children, a pattern that isolates women and prevents them from integrating into female-led projects. However, PRODESSA and other organizations have anticipated these issues, making discussion about reproductive health and sexuality central in their programs. Thanks to new concerted efforts to address women's health, it has been possible for women not only to plan their families with more agency but also to carry out Pap test screenings, a new benefit for women. In the past, women rarely received adequate exams or screening because their husbands would not allow male doctors to see their wives' bodies, and women felt ashamed as well. Now, in the Corozo community, a womens' medical brigade arrives once a month to provide support and screening for women.

Through my years of living in the Corozo community, I have observed all the way females systematically become marginalized from before birth. Pregnant women learn quickly that a man's attitude about her carrying a son was much more appreciative than if she carried a daughter. I've also observed that in Corozo, women were often considered physically weak and incapable of the same tasks as men. However, this situation has been changing in the community, but is has been a challenging job for NGO's to raise awareness and educate men of the new generation to see women as equal and worthy of respect. NGOs and other community-based organizations also have had a struggle trying to create paths to education for females in the community. Some parents still do not allow daughters to study because they believe that daughters will inevitably find boyfriends which makes investing in female education a waste of time and money. Parents prefer their daughters to stay at home, helping the mother with the household chores. The idea in some families continues to be that a daughter should practice household skills, contribute to the family with her labor, and find a good hardworking husband.

In 2019, when I led reforestation and river clean-up programs for Artists for Soup, I focused on recruiting female and male youth to support this work but also invited the women who lead biointensive gardening initiatives in the community to join us. We knew when we designed the program that we would be working against a machismo system when trying to include women in a work that benefitted from asking women to leave their houses for part of a day. However, women decided to join this program, perhaps partly because of the growing awareness of the importance of this kind of conservation work cultivated through local organizations. It was like a revolution of women because it was the first time the community had seen women together in groups of fifteen planting trees, picking up garbage, and

speaking to people on the roads about the importance of not throwing garbage or spilling agrochemicals in the rivers. Women who go to the river for water to complete household chore, or collect water for their gardens, understood the words of these women working in reforestation. Of course, there was a lot of gossip from the community men and women criticizing the work these female gardeners did. Comments that were common included opinions about women who have "nothing to do in their homes." Some people also objected to the fact that husbands did not give their authority for women to be out of the house like this and a decent woman would know better than leave her home to do this work.

According to Artists for Soup Programs Director, the objective of these kinds of programs is to protest against the system that for years has been in the community. Shining a light on new ways of acting can lead to positive change. This change has been reflected in every action women take. Reforestation is related to the work of agroecology and food sovereignty. Having fruit and native trees throughout the community provides the conservation and rescue of pollinator populations, reduced due to unsustainable agricultural practices; it also allows for feeding of people, protection of bees and other pollinators, and conservation native seeds of both fruit trees and native forests. In this way, women contribute to recovering biodiversity; having a more diverse agroecosystem tends to prevent invasive species explosions and increases stability and resilience against environmental or climatic disturbances and changes (Altieri and Nicholls, 2013).

Women in El Corozo do much more than plant trees and keep the house. Their list of daily work includes hauling water, cooking for hours each day, gathering firewood and sometimes engaging in work that produces a bit of extra income such as sewing, baking bread or crafting dolls. During the last three years in Corozo, agroecology has been promoted by a group of

more than 65 women participating in a biointensive garden program alongside their families, and ten female scholarship students each year from the locally-based Margarita Arauz public school. In addition, two female volunteer agroecology students from the National Autonomous University of Nicaragua complete internships in Corozo participate as part of their academic plan with the Support from Artists For Soup Organization. In Corozo, in small scale family farms, women play a key role in all stages of food production. One group of 65 women has been working in their gardens for more than three years. All of them are full of testimonies about how this experience with biointensive gardening has changed the way they eat, understand the environment, organize family finance, and spend their time working. The women also speak of the influence they have achieved in their community and their families due to newly-found respect that comes from recognition of their contributions to the family health and finances. For this study, I selected six gardeners who participate with Artists for Soup and interviewed and transcribed their observations about their experiences as growers. I selected these women due to the fact that they will be the beneficiaries of the meliponiculture project on their diversified plots.

In the next section, I describe the keys concept surrounding agroecology and food sovereignty articulated by interviewees. Interviews focus on current agroecology practices utilized in this women-led program in Corozo.

5.5 Key concepts raised by interviewees related to agroecology and food sovereignty

a) Defining agroecology

While doing research for my thesis, I considered it essential to ask interviewees the question of what "food sovereignty" and "agroecology" means to them. By asking this I hoped to

learn about their perceptions of these concepts and evaluate whether agroecological approaches and philosophies are evident in their answers.

The Executive Director of Artists for Soup defined agroecology as a balancing act. Like art, there's a need for innovation while also staying in conversation with tradition, in this case, traditional Indigenous knowledge. The Executive Director said the most valuable training comes from the dynamic of creating opportunities that encourage small farmers to use personal experience to propose ideas for benefitting their community. She suggested rescue of Indigenous practice is tied to using local resources and local knowledge.

> "Twenty years ago, much of the forest in Corozo was cut down, reducing flora and fauna diversity, and water availability. Artists for Soup hopes to provide support in recovering some of this lost biodiversity through environmentally-sustainable food growing, reforestation, and green education. People in the community share stories about the reduction in biodiversity over recent years and they tend to support ideas of conservation, reforestation and movement away from chemicals and pesticides. They speak about the way water shortages and droughts are more prevalent now. I think people understand agroecology from their own experience of change." (Interview with Doña Judith, 07-07-2020).

Consistent with these views on the importance of utilizing local experience, a representative from UNAG-PCAP agrees with Artists for Soup that agroecology is formed through the practice and experimentation of the community itself, with an organizations' support.

> "Agroecology is a science; for its implementation, it requires an intense work of peasant experimentation and the entities' support. The peasants are the experimenters in the planting of plots. It means horizontal participation and communication; we must learn and teach each other. Agroecology is the preservation of natural resources such as soil, water, seed, in addition to promotion of principles of conservation, increased crop fertility and biodiversity through pollination, reforestation, livestock management, companion planting, reforestation, gender inclusion, among others." (Interview with Don Treminio, UNAG-PCAP 10-07-2020).

For the gardeners in El Corozo, agroecology is often defined as sowing only organic, and planting a variety of vegetables, fruits and basic grains, (Interview with six gardeners). Many of the gardeners I spoke with defined the concept according to their current practices. Even

though large organic farms can also be developed using commercialized forms of monoculture, small scale farmers tend to use agroecological principles that contrast this by diversifying and rotating crops with a focus on soil improvement and local consumption.

b) Defining food sovereignty

UNAG PCAP focuses its definition on agroecological principles and mentions that food sovereignty describes providing food for a longer time and without starvation and shortages. It also guarantees peasant families' permanent feeding through diversification, focusing on agroecology and promoting the advancement of food sovereignty in Nicaragua. (Interview with Don Treminio, UNAG-PCAP 10-07-2020). Instead, Artists for Soup defines food sovereignty focusing on historical background and empowerment of small farmers;

> "A movement of small farmers who pursued food sovereignty has the potential to heal some of the erosions and imbalances created by industrial agriculture, war, and white supremacy/colonialism, and autocratic governing." (Interview with Doña Judith, 07-07-2020)

On the other hand, gardeners define food sovereignty more aligned with their rights;

> "Harvest our food, have the right to our seeds and live on what we produce." (Interview with six gardeners).

According to the information collected, I understood agroecology as a fundamental pillar of food sovereignty. Agroecology allows self- empowerment by small farmers, giving them decision-making powers, and establishing synergies by exchanging traditional and scientific knowledge by providing local development technologies. Agroecology is also a tool used by small farmers' movements to speak out against social injustice and fight against transnational companies, threatening the peasant economy and biodiversity. On the other hand, food sovereignty is achieved through political conquest, defending the right to access

land, producing one's own food, the right to seeds, better agrarian reforms, among others of a political context.

Agroecology brings together ideas about a more environmentally and socially sensitive approach to agriculture. It not only focuses on production but also on the ecological sustainability of the production system. This implies a number of characteristics about society and production that reach well beyond the limits of farms (Altieri 1999). Gliessman (2002) defines this approach as "the application of ecological concepts and principles for the design and management of sustainable agroecosystems."

The concepts and principles of agroecology are reflected in the work led by six women, which I will describe in the next section, according with the "Table 1. Agroecological practices described by gardeners from Corozo" that I included it in chapter 4 "Methodology."

5.6 Agroecological principles on the ground

The following table describes some of the agroecological practices led by gardeners that mesh with the Agroecological principles.

Table 1. Agroecological practices described by gardeners from Corozo.

Identified Practice	Each number refers to an agroecological principle listed in Table 2					
	1	2	3	4	5	6
Compost application	x		x			
Mulching	x		x	x		
Crop rotation	x		x	x	x	
Use microbial/botanical pesticides		x				
Use of insectary flowers		x			x	x
Living barriers, dead barriers		x	x		x	x
Intercropping/ Polyculture / Milpa	x	x	x	x	x	x
Animal Integration	x		x	x	x	x
Water conservation (Rainwater harvesting in tanks, basins, grounds)				x		

(Source: Adapted from Altieri MA and Nicholls CI, 2004)

Table 2: "Agroecological principles for the design of biodiverse, energy efficient, resource-conserving and resilient farming systems." (Altieri MA and Nicholls CI, 2004)

1	Enhance the recycling of biomass, with a view to optimizing organic matter decomposition and nutrient cycling over time
2	Strengthen the "immune system" of agricultural systems through enhancement of functional biodiversity – natural enemies, antagonists, etc., by creating appropriate habitat
3	Provide the most favorable soil conditions for plant growth, particularly by managing organic matter and by enhancing soil biological activity
4	Minimize losses of energy, water, nutrients and genetic resources by enhancing conservation and regeneration of soil and water resources and agrobiodiversity
5	Diversify species and genetic resources in the agroecosystem over time and space at the field and landscape level
6	Enhance beneficial biological interactions and synergies among the components of agrobiodiversity, thereby promoting key ecological processes and services

(Source: Adapted from Altieri MA and Nicholls CI, 2004)

5.6.1 Compost application and Mulch

The gardeners expressed that during the dry season, they use the residues from their harvest to spread across the top of the soil in the garden; in this way, organic material helps them to conserve water, protect roots of plants, inhibit weed growth, and retain moisture in the soil. Other gardeners express that they do not only apply residues from the harvest to their gardens but the exercise this practice with their basic grain production. When they cut the weeds, they leave the residues drenched with water in order to improve the next harvests' soil.

The continuous addition of crop residues, compost, and the use of cover crops or green manures reduce erosion and provide nutrients to the soil and enhance biological control of pests, increase the soil organic matter content, which also increases the water storage capacity of the soil. Research has shown that an increase in organic matter from 0.5 to 3.0% doubles the amount of available water (Magdoff and van Es. 2000).

Gardeners make their organic fertilizer of grass, dried leaves, and greens of corn (Zea Mays) or beans (Phaseolus Vulgaris) mixed with cow manure, black soil. For example, the abonera

(compost) rich in bacteria contains 45% of dry material and 55% of green material, of which 25% is legume or bean compost, and the other 35% is weeds or other crops. They also have cover crops such as green manures and Canavalia (Ensiformis) to provide Nitrogen, Potassium, and Carbon to the soil. Having good organic matter in the soil increases moisture absorption; Like Doña Lucrecia, a who studied biointensive method with Doña Juliana, described the new way she now fertilizes her family garden:

> "I clean the garden, cut the weeds or crop residues, and put it in my compost bin. In the same way, we do this in the other plots. We usually leave the residues of the crops scattered over the plot. In past years, we used to burn all the residues; now, we are aware that it is better to leave it to feed the soil for the next harvest." (Interview with Doña Lucrecia, El Corozo, 03-07-2020).

Additionally, gardeners who work in livestock use the land of the farmyard where they have the cow manure to apply to the garden and plot.

5.6.2 Living barriers, dead barriers, and windbreak

Common soil conservation practices promoted by small farmers' organizations in El Corozo include development of living barriers, dead barriers, contour lines (apparatus A , used when there are sloping plots), windbreaks, ditches, dikes, crops of coverage, and applications of compost. In addition, small farmer organizations promote the importance of avoiding “slash and burn” method as a way to clear lands. Soil conservation strategies are promoted with goals of sequestering carbon, increasing organic matter, increasing soil fertility, and maximizing moisture retention. In addition, these strategies can improve rooting conditions through avoiding soil erosion and runoff. However, still too few families in the community apply these practices (A gardener, key informant).

Soil conservation is often taught through trainings that focus on the biointensive cultivation method, an approach that focuses on the concept of “growing back the soil,” or in other

words, cultivating the microbial sponge and "good" fungus. Cultivating the microbial sponge and a developing the fertility of soil protect crops from pests. With the biointensive method of cultivation, one of the requirements is to learn to return nutrients to the soil through the elaboration and use of compost (biointensive fertilizers). By filling the soil with life to resist pests, small growers no longer require synthetic fertilizers or pesticides.

Picture 10: Soil conservation practices promoted by small farmers' organizations in El Corozo.

4. (Photo: Juana, El Corozo, 28-08-2020/06-09-2020)

Contour barriers (live, dead): "Living and dead barriers" describe an ancient Indigenous land practice implemented in the Corozo community and in other rural regions in Central America. There are still dead barriers practiced by the Indigenous people that prevail as examples; many organizations have supported the maintenance of this practice which is used to reduce erosion and stop landslides due to rain.

UNAG-PCAP has also promoted living barriers. Two of my interviewees have this system on their land.

Living barriers are used where the land lacks contour. These barriers are used to both enrich the soil and produce food for humans and animals. The small growers I spoke with have different kinds of living barriers: three gardeners use the barriers for pigeon peas (used in making bread) and grass (to feed cattle). The other gardeners grow Zacate Valeriana, which serves as living barriers and, at the same time, is a medicinal plant.

Windbreak: Corozo families widely use this system. They use it so that the wind does not damage the crops. In addition, windbreaks help with controlling pests. Windbreaks are trees in a row, and they also help women to get firewood. Research results on the effects of these practices indicate reductions in 80% in soil loss due to erosion (Sampaio et al. 1995, Galindo et al. 2005, cited by Altieri 2017) and increases from 25 to 150% in soil organic matter levels (Perez-Marin et al. 2006, Menezes et al. 2002, Sampaio and Salcedo 1997, Tiessen et al. 2003, cited by Altieri 2017).

5.6.3 Polycultures

All the gardeners expressed that they work with crop associations milpa or polycultures: corn, beans, sorghum, cassava fruits trees. The association of crops has also been effective in improving soil cover and conditions. Polycultures have also been shown to play an indispensable role in the control of pests and diseases (Hernandez et al. 1998; Serrano 1998).

5.6.4 Microbial/botanical pesticides and use of insectary flowers

Interviewees mention the success they have had with the pest management, weed control, and soil development through techniques that involve crop rotation. In addition to rotating plants, interviewees also spoke about the importance planting “San Diego,” a medicinal plant that repels pests. Women also must remove whitefly by hand during heavy periods of rain.

According to Doña Juliana, the agroecologists who directs the programs run by Artists for Soup, women also learn methods of pest control through “companion planting.” For example, the most common pairings are root crops such as carrot, radish, beet, other leafy plants such as cauliflower, lettuce, broccoli, in association with scent-producing plants such as parsley, celery, garlic, onion, basil, rue, coriander.

Medicinal plants, due to their smell, serve as a repellent and Canavalia works as fertilizer. Around the garden, women create a system of living barriers that are yucca and other associated plants. They also say that they maintain beneficial insects and that their plants serve as food for pollinators that visit the garden.

> "In the end, the garden is like a small forest where an agroecosystem is created, and many microorganisms work, insects that are very good for the soil. Living barriers made of trees also work to keep chemicals out of the plot."(Interview with Doña Juliana, 26-06-2020)

5.6.5 Crop rotation

In biointensive gardens, women do not plant the same crop twice in the same bed or family member in the same area during the year. During the year, women have training sessions to help them put plants that are compatible with others. For example, exchanging crops classified as strong nutrient extractors to crops classified as donors, which host bacteria that form nodules in the roots where nitrogen is fixed and culminate with plants that are light consumers of soil nutrients (Interview with Doña Juliana, 10-07-2020)

5.6.6 Water conservation (Rainwater harvesting in tanks, basins, grounds)

Gardeners practice rainwater harvesting. Two women have water collection basins, rain collection tanks, ground water, and drinking water access. The other women have the river close to their house, but it tends to run dry or get sluggish and muddy during the summer

seasons. These women mentioned that they would like to improve their irrigation system because it takes time to transport water, bucket by bucket, in order to keep their garden alive.

5.6.7 Diversity

My interviewees in this section all own their own property. Five gardeners report that they got their property with savings purchased from working on coffee farms outside the community, and through the sale of bean and corn. Only one participant responded that her property was acquired through inheritance from her father-in-law. The size of the plots of my interviewees is between 2.11 to 15.50 hectares.

Local food production & consumption: According to the interviews with directors of Artists for Soup, photos, and videos, the women participating and represented this section have a great biodiversity on their plots. They have a range of approximately between 20 to 60 species, including crop species fruits, basic grains, medicinal plants, flowers. They also have integration of livestock and poultry on these plots. The Artists for Soup demonstration garden provides an example of the range of what is possible to grow in the region on a less than 15.50 hectares of land. The garden beds in this garden produce many types of pollinators important to bees, as well as vegetables new to the region such as bok choy and spinach. Staple crops such as cabbage, onions, carrots, celery, lettuce, cucumber, broccoli, cauliflower grow well here, as do many species of medicinal plants. Fruits at this demonstration garden include Indigenous lemon, orange, mango, avocado and passion fruit.

The Artists for Soup demonstration garden is used for family consumption, cooking workshops, and some surplus sale. Other women, small growers in this group, use their garden production mainly for family and animal consumption. All Artists for Soup gardens are fenced in, although land outside the fenced in areas often provides space for a small

orchards or livestock. Three gardeners said they sell the production surplus locally (mainly those who have between 5 to 12 hectares). Sometimes they produce a surplus of vegetables, and they sell these in the nearby community, Corozo church, neighbors or San Dionisio municipality. Frequently they share food each other; “we share with the neighbors or relatives in exchange for another fruit or vegetable that they have."

Basic grains (beans, corn and sorghum) are sold to merchants who come to Corozo, or sometimes women travel to Matagalpa to sell their produce for a better price. The other women with less than 5 hectares said that they do not sell their basic grains because they have such a small plot and do not produce surplus.

Also, UNAG-PCAP created cooperatives, which operate as small businesses, where communities can promote local food consumption and seek the integration of women in agriculture in order to promote access to credit with a low-interest rate.

Gardeners responded that the only foods and supplies they get externally are rice, oil, sugar, and sometimes cheese, and medicine. All women use natural medicines from their garden created from the herbs they have.

They also mentioned that they do not depend on external materials to make their garden, everything is made locally and with the support of Artists for Soup. In the same way, they do not depend on external labor to work in their parcels. The whole family collaborates. Only Doña Nidia still depends on external labor because she has the largest plot, and the land needs maintenance.

Integrated farming systems in which the small-scale farmer produces grains, fruits, vegetables, fodder, and animal products simultaneously out-produce yield per unit of single

crops such as corn (monocultures) on large-scale farms." (Gliessman 1998). Research carried in Mexico shows that a "1.73 ha plot of corn monoculture produces as much food as a hectare planted with a mixture of corn, squash, and beans." (Altieri, M et al 2011).

According to five gardeners <1.50 ha, they claim to have enough food to feed their families even during food shortages in the community in June and July. They save food for that period, but one of the gardeners > 1.50 ha, lacks basic foods such as corn and beans, so her husband works on other farms to buy food, as do many other people in the community.

5.6.8 Conserving traditional seeds

Gardeners save seed from their harvest to avoid buying transgenic seeds. They talked about how transgenic seeds had recently arrived, and the sellers of this seed deceived the peasant, saying that this seed is native. The commercialization of transgenic seeds in Nicaragua unacknowledged. Those who do it act illegally since the distribution or use of transgenic seeds, mainly of basic grains such as beans and corn, is prohibited by the Nicaraguan authorities. However, people are free to grow vegetables with transgenic seeds. This is why Artists for Soup promotes native or open-pollinated vegetable seeds to preserve native seeds.

Gardeners mentioned they learned traditional strategies to collect seeds since their parents and grandparents taught them to save the best sources from the beans and corn crops in order to regenerate the garden/basic grains in the next season. Part of the Artists for Soup program includes the conservation and collection of garden seed and native seeds trees. All the women collect the seeds of their crops and conserve native trees' seed for the nursery they all manage. Through the Artists for Soup, interviewees learned to share the seeds they collect from their gardens and plot (natives trees). They believe the way they can contribute to the community is thorough sharing seeds so people can plant their food.

UNAG-PCAP created a movement of seed banks with the aim that producers have access to seeds for sowing, conserving native seeds, and staying away from the transgenic seeds. In Corozo, there is a seed bank managed by one of the gardeners interviewed with her family. Seed banks help families when they run out of seed for their crops, both for themselves and for someone in the community.

People in El Corozo are maintaining traditional varieties as part of their culture. For example, in the church, every harvest, they celebrate a year more of harvest, and people can sing and be grateful to God for their crop and thankful when they have a great winter to harvest. Doña Judith, Executive Director from Artists for Soup, says: "We see seed-saving as work that is part of promoting agroecology because of its being consistent with past Indigenous practices and connected to goals of increasing fertility and biodiversity in the region

> "The use and preservation of local seeds and crop varieties suited to local climates and associated with traditional peasant knowledge, on the contrary, give potential to empower women as the tradition keepers of seeds and the transitional knowledge between their care and resilience and the nutritional health and resilience of families and communities." (Wijeratna 2018)

For the past three years in Corozo, women have been contributing to the conservation of native seeds. Every year women and their families join projects aimed at reforestation native trees and conservation of seeds from their gardens. Some gardeners claim they did not collect vegetable seeds until training with the Artists for Soup training.

Family and community organized seed banks increase the possibility of success with food sovereignty by decentralizing seed sources and giving women and families the right to decide what to plant, produce and consume.

Nicaragua is the only Central American country where the use of transgenic seeds is prohibited. However, there is a risk that the government will privatize local genetic resources and affect the food sovereignty of thousands of peasant families and the country.

6 Case Case study: Women and Meliponiculture in El Corozo community, Nicaragua

Picture: Soncuan negro (scaptotrigona subopscoripenis) collecting pollen from onions flowers in biointensive gardens

(Photo: Artists for Soup, El Corozo, 12-03-2019)

Introduction

Within the strategies set out for 2020-2021, Artists for Soup (AFS) outlined an Apiculture and Meliponiculture project in the El Corozo Community. The goal of the project is to promote agroecology and food sovereignty in El Corozo and surrounding communities. The project's hopes to spotlight the beneficial role native bees play when combined with cultivating crops, medicinal plants, nutrition producing trees and sometimes timber in and around biointensive family gardens. Combining Meliponiculture and biointensive gardening and related agricultural or agroforestry activity has the potential to optimize the rescue of traditional Indigenous native bee production practices both for environmental conservation and income producing purposes. This project in Corozo and surrounding communities would market honey locally and also use it for family consumption.

According to Artists for Soup Executive Director, keeping local bees (Melipona beecheii) is a new activity for AFS. Meliponiculture is a type of beekeeping that focuses on non-stinging bees that can live compatibly with people. AFS's main motivation for exploring Meliponiculture is that some small biointensive family garden growers who collaborate with Artists for Soup have the land conditions and interest to make Meliponiculture successful. In addition, the Executive Director talked about the ways their organizations tries to diversify plant species and pollinators on the small plots while simultaneously looking for activities that might increase nutritional potential and income for families:

> "Our attraction to Meliponiculture is connected to the fact of this bee's value as a pollinator that creates medicinal honey, its compatibility with family life (it's not dangerous for children), and they fact of this bee thriving on organic gardens and orchard, which families cultivate in this region. Corozo, Nicaragua, where we work, is an Indigenous region, and traditionally, in earlier times, this type of bee was raised. We expect to use a local honey producer to teach our participants how to move forward with our bee project." (Interview with Doña Luz, 04-07-2020)

A group of AFS gardeners and spouses began training with Sweet Progress, a nonprofit that works with honey production and marketing in Nicaragua, but because of Covid 19, the AFS group could not travel to the site for training after March. At this point, about ten people are involved in AFS's pilot project to implement the bee project starting in October of 2020. In this case study, I selected six female gardeners to interview, on the advice of Artists for Soup's Program Director, and I present my work in this chapter.

In this chapter, I will answer the **research question 3. How could the introduction of native honey Beekeeping projects help enhance the achievement of agroecological principles and food sovereignty?** Here I describe the perception, practices,and knowledge women and small farmers organizations shared with me about Nicaragua's Meliponiculture projects. In order to establish a context for understandstanding Meliponiculture in Nicaragua, I use studies on Meliponiculture from other parts of Latin America. I also use information collected through interviews with nonprofit civil associations such as; Nicaraguan Association of Solar Women (FUPROSOMUNIC), Association for an Integral Community (ADIC), Association for Community Agricultural Diversification and Development (ADDAC and *Micelio Centro Ecosalud* (MCE), a group that works with the small farmers to promote agroecology, Beekeeping and Meliponiculture in Nicaragua.

Finally, I analyze Meliponiculture patterns and practices within Agroecology's principles and food sovereignty paradigms and consider how Meliponiculture would enhance life for women biointensive gardeners in El Corozo. My two main objectives for this case study are:

1. To evaluate potential for NGO Meliponiculture projects and help lay the groundwork for them.

2. To explore possible contributions Meliponiculture projects could bring to family farm production and diversification of crops.

6.1 Brief Context: The Stingless Bee (Melipona beecheii) and stinging bees (Apis mellifera)

In Mesoamerica,a term used to describe Mexico and Central America before the 16th-century Spanish conquest, the stingless bees has a long history of being highly valued in tropical Indigenous communities. Stingless Beekeeping (meliponiculture) reached the level of technical skills and productivity attained by the Maya in Mesoamerica with the stingless bee *Melipona beechei*, which gave rise to divine representations of significant influence on spiritual and religious life, which included forms, customs, rituals, and beliefs (Quezada, 2019).

In Nicaragua, the harvest of honey from *"jicote"* (Melipona beecheii) is a practice existing since pre-Columbian times when our Indigenous ancestors collected honey they found in the forests. Honey was harvested from swarms in the woods and from local-style hives kept close to the house or in the garden. The honey produced by *"jicote"* bees was highly respected for its medicinal properties for Indigenous women who know of its uses to heal wounds and purify the blood after giving birth by combining native honey with herbal tea. European honeybees were introduced into the Pacific coastal region in the 14th century by German settlers who wanted to increase coffee production by improving pollination. In the 1960s, the national agricultural program developed Beekeeping, and in 1980, the Canadian government collaborated in development with the NGO CARE (Gilles Fert, 2003). In 1984, the arrival of the first swarms of Africanized honeybees radically changed Beekeeping methods and work habits. These African bees affected the Meliponiculture methods of small farmers from

Corozo. Don Toño, a 63 years old beekeeper in Corozo with experience with stingless bees, described the changes to local populations when the Africanized bees arrived:

> "Thirty years ago, I managed my hives with local bees, yellow African *"jicote"* , a small local native bee. A very hardworking bee. From two boxes, I used to harvest 20 liters of honey. However, an invasion powerful African bees came to Corozo. They were very angry and killed all the bees in my hives, and they also ate the honey."(Interview with Don Toño, El Corozo, 03-07-2020)

The yellow African *"jicote"* bee, according to Don Toño, became extinct over time, first, due to the arrival of African bees and second, due to the use of chemicals used in agriculture. However, other species of Meliponas have remained in El Corozo, such as the *"jicote" bravo Italiano* (Local Spanish Corozo name) know in Nicaragua as *"jicote" canelo* (melipona costarricensis). This is one of the oldest bees in the El Corozo community, and it's resilient and a very productive in making honey. Among other species are also the *Guatemansito* (local Spanish Corozo name), *Tamagas mancito* (cephalotrigona zexmeniae), *Soncuan chele* (scaptotrigona pectoralis), and *Mariolitas* (tetragonisca angustula). The honey from these bees has been used as a medicine to improve production through pollination. According to Don Toño, when it comes to selling the honey produced by these types a bees, the honey brings a higher price than the honey of African bees. Other species of bees have appeared, but Don Toño does not consider them to be as valuable as the Meliponas. These bees are the *zonteco;* they attack the Italian *"jicote" bravo* bee. Other intruder bees, called *El bocón* and *Zangano,* appear in summer; they are not good at producing honey, and they eat honey from Meliponas bees. Because of the challenges of raising bees in a climate with so many competing species of bees, Don Toño believes it's very helpful when people can join the training with organizations dedicated to the management and breeding of bees to learn how to handle these difficult situations. Currently, Don Toño has eight boxes of *Mariolitas* (tetragonisca angustula), *Tamagas mancito* (cephalotrigona zexmeniae), and *Soncuan negro*

(scaptotrigona subopscoripenis). His honey production is used for self-consumption, and to sell locally in El Corozo.

The honey that is most marketed in Nicaragua is honey that comes from stinging bees (Apis mellífera); the practice of raising this honey is known as Apiculture or Beekeeping. 80% percent of the Nicaraguan honey from stinging bees is produced primarily for export to markets in Germany, Italy, United States of America and Taiwan. The north-central region of Nicaragua is one of the leading honey producers (La Prensa, 2019). The Meliponas honey harvest (Melipona beecheii) has a smaller market because Nicaraguan producers tend to prefer Apis bees since their reproduction is very fast and productive compared to the slow growth of native stingless bees (Arce et al, 2010). Additionally, honey from Melipona stingless bees has not been commercialized because few people know of this honey in urban regions. However, few small farmers in Nicaragua are dedicated to Beekeeping stinging bees because of the expense and land requirement. Families need to have a large enough plot to install the hives. Hives must also be far from their house for safety reasons. Caring for bee-hives and processing honey from hives requires equipment, training and time.

In the next section I will explain the management of melipona bees and Apis bees as described by the ADIC and FUPROSOMUNIC interviewees who works specifically in Indigenous communities in Nicaragua and projects with Meliponiculture and Beekeeping programs led by women.

6.2 Differences between management of Stingless Bee (Melipona beecheii) and stinging bees (Apis mellifera)

Two central characteristics of Meliponas is that they work long hours and they are very selective and sensitive in what they need to survive. Doña Clarisa from FUPROSOMUNIC,

57 years old, explained that both Meliponas and Apis bees start work very early, between 5:30 to 6:00 am. The bees explore every flower of fruit and vegetable, and all the trees. Meliponas like small flowers, and gardens with tomatoes, sweet pepper, onions flowers, and medicinal plants, are ideal flora for them. They need sufficient flowering, and they cannot survive with insecticide-contaminated environments Meliponas are recommended for many types of organic gardens because pollinate thoroughly. The optimal condition for them is to find a place that is not too shade-filled or too sunny, with a balance of darkness and light. It is critical that there be enough light to avoid fungi. Also, due to their small size, it is recommended to put them in a place that the wind does not affect them. It is necessary to take into account the direction of the wind, although it is worth noting that the bees themselves create the door to the hive in a way that consistently avoids the wind.

Apis bees have some characteristics that set them apart from the Meliponas. During the winter when there is a lot of rain or wind, the Apis bees prefer to stay in the hives to be fed. In an emergency, women can feed bees with the Apis or Meliponas' honey diluted water and the smell of flower nectar. According to Doña Karen from ADIC, 48 years old, this method it is not recommended because bees become addicted to sugar / sweet, and then lose their ability to extract nectar from the flowers. Doña Clarisa from FUPROSOMUNIC, 57 years old, said that Apis bees can be feed on their own honey combined with water or a mixture of brown sugar. She feeds each hive one liter to prevent them from leaving. This feeding period is done between September and November. However, it can also be done every fortnight. Doña Clarisa from FUPROSOMUNIC, 57 years old, also mentioned that Apis bees like proteins, such as meat or eggs. She sometimes feeds them with a sweet, egg-based cake.

Women must be careful because these bees, when they are starving, leave the hives and even eat dead animals.

In many ways, raising Apis bees is more difficult and costly than raising Meliponas. Doña Clarisa from FUPROSOMUNIC, 57 years old, expressed that the Apis beehive boxes should be located far from the house because the hives are sensitive to electric lights and human noises, like the machete, an important and frequently-used tool for farmers to chop weeds, organic matter for compost, kindling for fires, and more. Also, the sting of Africanized bees is dangerous for people with allergies. In highly populated communities, it is not convenient to have Africanized bees. Women must be prepared before visiting the hive. Women should have a bee suit and bee smoker that protects the body and prevents bees from getting close to the woman's skin.

In contrast to the Apis bees, Meliponas can be kept close to a house. Doña Karen from ADIC, 48 years old, said that the good thing about these types of stingless Melipona bees is that women can have them outside the patio and gardens, and close to the family. Keeping stingless bees does not require expensive equipment. According to Doña Karen from ADIC, 48 years old, it requires a lot of "dedication and love".

Likewise, both Apis and Meliponas contribute to the Nicaraguan economy because several small businesses are dedicated to marketing honey and making use of the derivatives of bees. Both types of bees are important in agriculture as they help improve fertility of plant and increase crop yields. These bees are essential in the dynamics of tropical ecosystems; they fulfill several functions and provide information on the quality of habitat; signaling shifts in community health as a kind of barometer of well-being. Most flowering plants in nature need to be pollinated to produce fruits and seeds. The bees also have a favorable environmental

impact since they reforest degraded regions and favor preserving plant species through pollination (Roubik, 1989; Michener,2000).

In Chapter 5 and in the description above**,** biontensive gardens have the adequate condition to install Meliponas hives their gardens. All the women's gardens are close to their homes and most of them have small plots for vegetables, timber, and nutrition-producing trees. Both Apis and Melipona beehives can be incorporated by women into existing organic agricultural practices and both approaches are likely to produce economic, environmental, and human health benefits. Meliponiculture, even more than Beekeeping Apis, has the potential to increase species diversity and fertility in the region where women live because of the fact that this type of bees requires organic, chemical free environments. Finally, Beekeeping with stingless bees amplifies messages about the interconnectedness of ecosystems and serves as a catalyst to promote sustainability in rural areas. In the next section I describe the perceptions and concepts that women have about pollinators.

6.3 Gardeners' perceptions and knowledge on pollinators

During interviews, I was interested in learning how much the gardeners in Corozo and surrounding communities already knew about bees. I asked gardeners if they could identify "pollinators" in their gardens or around their plots outside the gardens. The gardeners expressed that they frequently have visits from pollinators in their garden, among which they mentioned the hummingbird, ladybug, butterflies, and bees. Doña Cristina, 57 years old, says that bees are part of her family and work, day and night, pollinating crops. The bees are in every place on their plot, in the corn, the beans, and all kinds of vegetables they have because everything they produce is organic. According to the Food and Agriculture Organization of the United Nation (2018); "more than 75 percent of the world's food crops depend, to some

extent, on pollination. Accordingly, pollinators, like bees, butterflies, birds, moths, beetles, and even bats, help plants reproduce."

Pollination is the process through which pollen is transferred from the stamen (male flower organ) to the stigma (female flower organ). In this way, the germination and fertilization of the flower's ovules occur, which gives rise to the production of seeds and fruits. Therefore, through pollination, we will have more productivity, and the existence of native species is guaranteed when producing seeds. Pollination is a vital service within ecosystems, highly dependent on the symbiosis between species, that is, the relationship between plants and pollinators. This link is established through the collection of nectar (as a source of carbohydrates) and pollen from flowers (as a protein), which bees make to feed and survive (Interview with Don Erick, ADAC, Matagalpa, 07-07-2020).

Native stingless bees have been dramatically affected by environmental deterioration resulting from loss of vegetation providing nectar and pollen. Increased use of chemical pesticides also damage and eradicate bee populations. Meliponas are very sensitive and can die from exposure to contaminated flowers. For Meliponas to carry out pollination work and thrive in a region, communities must stop using chemical products, which may turn out to be challenging in Corozo since some farmers do use chemicals (my own perceptions).

Thus, I will highlight in the next section the Meliponiculture within agroecological principles.

6.4 Meliponiculture within agroecological principles

According to Gliessman, (2012) “Agroecology must integrate science, technology, practice, and movements for social change.” Incorporating Meliponiculture into biointensive gardens can benefit from using technology to collect and share Indigenous knowledge. Ideally the Meliponiculture intervention will be accessible, adapted to community members' subsistence needs, and based on local resources to promote diversification and boost autonomy. Sharing data on and best practices using photographs and illustration allow information to travel across communities of gardeners. Collection of important climate and pest information and dissemination across communities and organizations benefits from integrating technology. “Agroecological principles take technological forms or practices in order to be applied." In this sense, implementing the Meliponicultura project would help to enhance the achievement of agroecological principles as follows (Altieri et al, 2015, Gliessman, 1998):

1. Enhance recycling of biomass and optimizing nutrient availability and balancing nutrient flow.
2. Strengthen the “immune system” of agricultural systems through enhancement of functional biodiversity—natural enemies, antagonists, etc., by creating appropriate habitats.
3. Provide the most favorable soil conditions for plant growth, particularly by managing organic matter and by enhancing soil biological activity.
4. Minimize losses of energy, water, nutrients and genetic resources by enhancing conservation and regeneration of soil and water resources and agrobiodiversity.
5. Diversify species and genetic resources in the agroecosystem over time and space at the field and landscape level.
6. Enhance beneficial biological interactions and synergies among the components of agrobiodiversity, thereby promoting key ecological processes and services.

1. **Enhancement recycling:** this is essential for crop stability and high production, and in the case of gardens where Meliponas are to be established, use of organic compost to avoid chemicals. Recycling nutrients avoids past traditions of slash and burn method, a practice that was used to clear large plots of ground quickly. The Program Director of

Artists for Soup trains and models more sustainable methods of recycling nutrients which she describes: "I clean the garden, I cut the weeds or crop residues and put them in my compost bin." Through nutrient recycling, a process of breaking down organic matter and allowing microbes to work, she promotes a sustainable process. In addition, when biointensive gardeners leave the crop residues in the plot, little by little, the soil's fertility is recovered and natural resistance to pests increases. The Program Director of AFS also discussed how biointensive gardeners learn how make use of soil from the corral where they have the cow manure. This enriched soil can be used for building compost and applying in the garden. Gardeners who use manure and *lombrihumus*, an organic agent liquid used to accelerate decomposition with compost, are in a better position to break their dependence on external inputs of chemical fertilizer and pesticide.

2. **Diversify species and genetic resources in the agroecosystem over time:** this is critical because through pollination, biointensive gardeners and beekeepers have the potential to optimize production of seeds and fertility of forests, orchards and vegetable gardens. A healthy and dynamic ecosystem allows for greater success with regeneration and resilience in times of climate instability. Bees are one of the central organisms that can help El Corozo succeed in bringing back some of the following species of trees lost during Hurricane Mitch: *Guapinol* (Hymenaea courbaril), *Llama del bosque* (Spathodea campanulate), *Madrono* (Arbutus unedo L.), *Malinche* (Malinalli Tenépatl), *Marango* (Moringa oleifera), *Nogal* (Juglans regia), *Pino ocote* (Pinus oocarpa Schiede*), Pintadillo* (Caesalpinia eriostachys Benth), *Roble sabanero* (Tabebuia rosea), *Sardinillo* (Tecoma stans L.Juss), *Tamarindo* (Tamarindus indica L), *Teca* (Tectona grandis), *Tempate* (Jatropha Curcas L.), *Cedro Real* (Cedrela odorata), *Coyote* (Platymiscium pleiostachyum), *Ceiba* (Ceiba pentandra), *Chilamate* (Ficus sp.), *Guaba* (Inga

spectabilis), and *Guanacaste* (Enterolobium cyclocarpum), (Gauthier, 2019).

3. **Provides the most favorable soil conditions for plant growth and Minimize losses of energy, water, nutrients and genetic resources:** this is important because bees help guarantee pollination, a central factor in producing biomass for improvement in the quality and stability of soil. Without pollinators, the community cannot feed itself. In Corozo, bees would be beneficial not only to biointensive gardens and orchards but also to increasing health and fertility of existing native forest. Forests and gardens produce biomass. In Corozo, it's clear that native forests are directly linked to water availability, particularly in the dry season. In addition to helping to create the conditions that increase availablility of organic matter, bees increase a greater awareness of environmental protection and interdependence in a community that lives directly off the land, as people do in Corozo.
4. **Enhancement beneficial biological interactions and synergies among the components, and functional biodiversity:** this is important for the women of Corozo because of the small size of plots and the need for high levels of productivity near houses. Imported models of monoculture requires agrochemicals and reduces the possibility of self-determined food production. Women working with biointensive gardens and bees increase productivity of their own and neighbors' agricultural systems if they adopt practices that use rotation planting and species conservation. For example, in Corozo, it's important not to cut the yellow veneer, the laurel and red strawberry tree when trying to increase the number of pollinators in an area. Maintaining a dynamic and biodiverse plot of land isn't something that Nicaraguan policy makers will promote but many NGOs who have contact with women in El Corozo region recognize its importance. The importance of optimizing interactions of species by small growers is a priority for the

women of Corozo during this time of climate change.

Meliponiculture is very compatible with agroecology because by working with Meliponas bees in biointensive gardens, women would be intentionally diversifying the garden's production. Artists for Soup would also promote the interaction between bees, gardens, orchards, and native forests, generating benefits for the agroecosystem that supports the health of the community. Over time, as the bee project expanded and pollinator increased in the region, small growers would obtain higher levels of productivity, In addition, its assumed that forests would also stabilize or increase, native tree species returning to areas that have suffered from deforestation.

The emphasis on the relationship between pollination by bees and productivity in gardens was central in many of the interviews I conducted. A woman representing ADIC provided a small illustration of another aspect of the importance of training beekeepers to plan gardens strategically, using principles of agroecology as their guide: A coffee producer contacted ADIC to ask that they help provide him with bees. The women from ADIC helped him get started with the bees thorough advising him on making his farm a place that could sustain bees. ADIC said the most important part of the bee keeping training was in helping the farmer adapt best practices on all the non-bee related aspects of his farm. For example, most importantly, he had to be taught how to avoid using chemical products on coffee plants because the Meliponas bees do not pollinate a flower that been exposed to chemicals. Over time, the farmer came to realize that the more bees there are in his plot, the higher his production of coffee (Interview with Lorena, ADIC, Matagalpa 20-07-2020).

Gardeners can produce much healthy food for their community, and Meliponicuture is a new agroecology tool in El Corozo, increasing production's stability through diversification and contributing to national food sovereignty. In the next section, I will describe how this project achieves food sovereignty principles.

6.5 Meliponiculture within food sovereignty

After carrying out the analysis on Meliponas bees' contribution in agroecological practices, I realize that they are the primary pollinators in conjunction with others agents to help biointensive gardeners diversify their plots, guaranteeing food not only for El Corozo families but also for their animals and other agents that move within the ecosystem. Due to climate change, water scarcity in Corozo, deforestation, and other sustainability issues, the work of pollination done by bees is central to supporting women's lives both directly and indirectly. As women diversify their plots and buy in to community projects that seek ways of building back the ecosystem through reforestation, a more resilient environment for food production and seed regeneration starts to emerge, moving Corozo toward greater food sovereignty. Thus, Meliponicultura project contribute to the six principles or pillars of Food Sovereignty (Mulvany (2007), which are:

1. **Focuses on Food for People**:

Biointensive gardeners I interviewed in El Corozo have great enthusiasm to work with Meliponas. Many of the gardeners have already started preparing their plots to develop conditions that allow them to install beehives in their gardens. Interviewees described the changes they have made to their plots which make them ideal for bees. For example, some of the gardeners have planted fruit and timber trees provided by Artists for Soup and the reforestation project. They have trees including mango, mamey, pineapple, orange, avocado,

nance, *mamon* (Melicoccus bijugatus), lemon, mandarin, grapefruit, guava, banana, coconut, and achiote. In addition, gardeners plant pumpkin and granadilla vine, both flowering and attractive to bees. Gardeners speak of the importance of not cutting *chapa* amarilla (little yellow flower) that many people in the community consider to be weeds. They also plant medicinal plants in the garden, all pollinators. Gardeners in this group tend to have many flowers around their house and the garden. Wolff (2012) explains that the integration of bees in agroforestry systems emerges as a good strategy for the sustainability of family agriculture and a great area of action for small farmers; raising bees contributes to preserving natural resources and the environment. In any case, its integration in agroforestry systems is very advantageous in agricultural farms.

Wolff (2012) also mentions that integrated Meliponiculture in gardens fosters mutual benefits, both to increase the quantity or quality of fruits, propagation of native forest species and the more abundant the blooms. The closer the hives are to gardens, the greater will be the productivity when raising bees. Hence, meliponas bees are sustainable, given that these bees are adapted to the tropics (weather) and the type of forests that surround the El Corozo community and native plants from the area. Gardeners mentioned some of the varieties they produce in their gardens such beans, corn, cacao, cucumber, celery, parsley, garlic, carrot, cabbage, onion, cabbage, chiltoma, coriander, spearmint, oregano, sweet potato, and pipian (little seed of squash), bell peppers, and cucumber. They have always cultivated cassava, taro, sorghum, quequisque, bananas, and plantain to diversify their plots. Just two gardeners have coffee plantations, and other gardeners planted 250 plants of guava to add a variety. Some of the biointensive gardeners are planning to make some changes to expand their gardens and add a wider variety of crops. Meliponas bees, therefore, guarantee the right to

sufficient, healthy, and culturally appropriate food through pollination, obtaining fresh fruits, different flavors, sizes, and aromas to feed Corozo's families.

Bees, like women, have the capacity to work in a community and restore ecosystem health is given conditions that are livable and just. Also, through this Meliponiculture project both Artists for Soup and the planters work strategically to promotes the national agroecology policy of Nicaragua Law No. 765 Law for the Promotion of Agroecological or Organic Production, and Nicaragua's Law 693, the Law of Food and Nutritional Sovereignty and Security.

2. Values Food Providers:

Bees are selective about where they will live; they cannot thrive if undervalued, poisoned, or harassed, just as is true with women. According to 48 years old, Doña Karen from ADIC, Meliponas bees cannot access any food that does not come from a flowers and they reject flowers that contain chemical products. However, there are nutrition shortage dates for Meliponas bees (May-October), but the bees are intelligent, and they know how to save food for these times of shortage in their hives. Meliponas have a particular nest designed to store food. Doña Clarisa from FUPROSOMUNIC, 57 years old, also shared her experience working with Meliponas and said that during this period of flower shortages, they do not feed the bees because these bees always have food reserves. Meliponas are very selective and very clean in their diet. Meliponas require and demand the right conditions.

I believe that bees are very similar to the small farmers; they protest against the system that wants to impose a type of food that they consider is not suitable for their health, environment, and population. They keep food for the time of scarcity, which coincides with the customs presented by the El Corozo community's inhabitants, who save food for a certain period. Bees

are also communal; they share their food, provide medicine, and create a healthy environment for all living beings.

The stingless bee project encourages the planting of medicinal plants and trees. *Guásimo* (Guazuma ulmifolia) and *Jiiñocuabo* (Bursera simaruba) have known health- benefits and traditional uses. Using these plants, women produce tea to sell in the cooperative. Cultivating medicinal plants and trees has two functions; flowering medicinal plants feed the bees and the trees produce leaves that are used for human consumption through the tea. The products have benefited women since they get sick less frequently from the flu because the syrup they produce is anti-flu and anti-inflammatory, and honey is also a food supplement with known medicinal benefits for their families (Interview with Doña Karen from ADIC, 48 years old, Matagalpa, 03-07-2020).

The meliponas show us that they are aligned with traditional Indigenous agricultural practices, adapted to living in their habitat with native plants that are their main foods. Therefore, they are part of the indigenous knowledge that should be taken into account as a national policy that recognizes the roles they play in the food system and the importance of its conservation. Our local bees continue working, acting protecting the mother earth restoring the community ecosystem by sending us a great message and teaching us with their actions how to cultivate without pesticides. Unfortunately, there are no government funds that invest in the conservation and rescue of native bees, scientific studies, or incentives for farmers who manage Meliponas bees.

3. Localizes Food Systems:

Meliponiculture also encourages encounters between small farmers and consumers. ADAC, FUPROSOMUNIC, and ADIC are organizations that train women in the technical management and breeding of meliponas bees with agroecological practices and to create products derived from bees such as soaps, creams based on coconut, shampoo, infusions, lotions, and a variety of other products from wax produced by bees. They have cooperatives with health licenses where women can sell their products. Women can also sell in fairs, local businesses, but mainly it seeks to have a balance avoiding the exploitation of bees and focusing on local consumption. The products are also sold in pulperias (local stores) and at peasant fairs. For example, FUPROSOMUNIC has a straw ranch made on the Highway side, and women can sell honey, dehydrated products such as ginger powder, hibiscus tea, coffee, turmeric powder, plants, flowers, and fruits. Also, FUPROSOMUNIC has an agreement with a local restaurant near the demonstration garden called Mi Viejo Ranchito (My Little Old Ranch). This restaurant gives FUPROSOMUNIC space to sell their products. Therefore, conomically, there's the potential the families can increase their earnings from selling the honey and producing commodities such as soap and lotion from its derivatives (Interview with David from *Micelio Centro Ecosalud*, 28-07-2020).

On the other hand, in El Corozo, the biointensive gardeners use their production for self-consumption and local distribution in pulperias (local grocery stores), churches, neighbors, and family members. The food distribution system are based on food exchange (barter system). They provide vegetables in exchange for another food product. For example, in exchange for buying sugar, rice, oil, or soap, they pay the local grocery stores with corn,

beans, vegetables, fruits, chickens, or eggs. In this way, this group of women avoids giving money to multinationals or consuming external products contaminated by chemical products.

Don Toño, 63 years old, husband of one of the gardeners who work with Artists for Soup in bio-intensive gardens is the only meliponas bee producer with eight hives in his home as part of agroecological practices. He uses it for self-consumption and sells it as a medicinal product in the community. The inhabitants of Corozo buy his honey because they trust that it is an organic product and natural medicine.

Through implementation of this *Meliponicultura* program in conjunction with the biointensive gardening, Artists for Soup adds an important ally, I believe, to work that promotes agroecology and food sovereignty. Artists for Soup gives decision-making roles to gardeners on how to implement work in their homes as they tirelessly promote biointensive gardening, seed saving, and now, rescue of native bees as a community heritage project. Artists for Soup influences participants in this work to acquire healthy, fresh, and nutritious food and to share knowledge with women and families who seek to learn biointensive method.

4. Makes Decisions Locally:

Through Apiculture and Meliponiculture, women find leadership roles in their communities. Doña Clarisa from FUPROSOMUNIC, 57 years old, explains how women often recognize and the value of bees because their work is similar to the work women do in their lives. Doña Clarisa goes on to describe how bees create leadership, hierarchy, support each other, work in an organized way, defend their territory, and protect each other from predators. As meliponas build their own nest, they themselves are able to create their queen. The meliponas reproduce themselves and choose their queen. They select the best egg they

have and decide to take care of it and protect it because they know that the queen is there.

Some of El Corozo gardeners I interviewed described family situations where the sharing of tasks reminded me of bees in terms of an organized way of daily work with the mother, "queen," being in charge of key decisions. For example, Justina, 44 years old, says that she makes the garden decisions and directs the division of labor within her family. She was in charge of teaching her family about garden management. Her husband and sons support her with digging, putting up fence, collecting compost materials. Her daughters support Justina with planting, maintenance, and seed collection. The irrigation of the garden is shared. Justina makes certain that everyone cooperates and rotates activities.

Artists for Soup and other small farmers' organizations have the capacity to promote leadership and encourage women to exchange knowledge and empower others in their community through implementing biointensive gardening/Meliponiculture programs. For example, one of the gardeners says that when other women in the community see her garden, they feel motivated and join to create their own gardens with gardeners help because producing food from home generates savings, improves health, and allows them to distract themselves from everyday problems.

Over the past three years, I've witnessed how many Corozo women are modelling leadership roles by creating different small businesses that they create while simultaneously cultivating and controlling food production from their home garden. One important aspect of the Meliponiculture project's introduction is that it intersects with the local faith in natural medicine and builds interest in this in the community. Through the increase in medicinal

plants, honey, and products derived from honey, the community and family become self-sustaining and not depend on external products such as soaps and medicines.

One surprising aspect of beekeeping for women, according to interviewees at ADIC and FUPROSOMUNIC, is that melipona bees support women's need for non-violent households. Bees avoid intra-family conflict and if family members know this, they may work harder to try to maintain the kind of peace that supports women's leadership and work. According with Doña Karen from ADIC, 48 years old, from ADIC, the Meliponas need harmony in the human family. If there are many conflicts in the family, the bees do not reproduce. When the family supports the project, including the husband, there is a higher probability of bee retention and success in generating a healthy bee population. If a woman is taking care of the bees and the families does not support her, laughing at her because suggesting she is wasting time, she is not likely to succeed even if she has two hives. Women who live in conflictual and non-supportive households tend to have trouble making progress with the bee project because of not having the necessary environment for the bees. Doña Clarisa from FUPROSOMUNIC, 57 years old, from FUPROSOMUNIC also said that it is essential that women or anyone who is dedicated to the Meliponas bees must have an excellent love for bees because if the bees sense the caretakers are in a bad mood or a family in constant conflict, the bees will absorb all that energy, will have aggressive behavior, and will always be on the defensive.

Although families have important roles in making a bee project succeed, it's also very important for NGOs to provide technical support, evaluation, and continued focus on applying agroecological principles if larger goals of gender justice, food sovereignty, and

community development are to advance.

5. Builds Knowledge and Skills:

Meliponiculture is one more tool within agroecology to promote food sovereignty and it allows gardeners to participate in technological innovation. In this training process between Artists for Soup, associated organizations, and gardeners will create a knowledge exchange. Artists for Soup and other NGOs and local Corozo gardeners benefit from studying the behavior of bees in bio-intensive gardens. Their role becomes collecting information and setting a precedent for future generations in the preservation of native bees.

According to Doña Karen, 48 years old, ADIC strives to a network of support for small growers using polyculture, not only to generate economic income but also to promote and enhance the conservation of the biodiversity of plants and bees in various regions. During ADIC's project with Meliponas, the organization has needed support from experts because, in Nicaragua, there are few studies on Meliponas. She also says, "Our idea is also to be able to organize ourselves across Indigenous communities and to be able to make alliances in order to study our natives bees." From my perspective, state policies and budgets should invest in research and create budgets to promote existing laws on agroecology, seeds, bees, gender, and food sovereignty and not just leave the work to Non-Governmental Organizations.

During this study, I came to appreciate the wealth of knowledge elders and grandparents contribute to the community's current agroecological practices with the support of small farmers' organizations. However, there are no studies on the community's native bees, nor are there projects focused on meliponiculture issues. Therefore, this project is essential in the community and to begin to carry out studies of the different types of native bees and

pollinator that still exist in El Corozo because it all too common to hear of local inhabitants in El Corozo region say that native trees, wild animals, aquatic animals are becoming extinct. Still, there is no research supporting evidence despite the number of small farmer organizations that have collaborated in the community for many years.

6. Works with Nature:

In El Corozo region, it's clear that agro-industrial approaches to farming reduce the health of bee populations. According to Don Toño, 63 years old, the loss of biodiversity and the adaptation of agrochemicals make bees sick and reduce their populations. Still, thanks to their resistance to becoming eradicated, they survive and reproduce. Bees are known to look for new places where the environment is less polluted. When they find these places, they keep working. The hope and plan in Corozo is that a well-executed Meliponiculture program could serve as a catalyst and motivator for a community to restore the ecosystem over time.

Beekeeping generates many economic benefits. Farmers do not invest in chemicals because the bee helps to create a healthy environment for their production. Bees also contribute to diversifying agriculture in the community. Perhaps equally important, according to Doña Karen from ADIC, 48 years old, is the fact that women are motivated to generate additional income for their home and contribute to their community.

AFS believes the bee project has the capacity to raise community awareness about local ecosystems as biointensive garden participants work with bees in ways that increase productivity in regional crops. Along these same lines, Doña Karen from ADIC, 48 years old, told of an experience of the discoveries small growers sometimes make while working

with bees in the community. She believes small farmers' love for bees because of bees' positive impact on agriculture could have indirect benefits of influencing neighbors to diversify and adapt non-chemical approaches to agriculture. Her story is of a small farmer improving his coffee crop through keeping bees:

ADIC met a coffee producer in Tuma La Dalia Municipality who produces organic coffee. This farmer began to rescue native bees because many bees came to his coffee plantation, perhaps attracted to it because he does not apply chemicals. According to Doña Karen this farmer was excited to learn how bees contribute to the diversification and vitality of his farm. He can see that his coffee now has a better quality and this year, he was able to harvest honey twice because the coffee flourished much more, producing a rich habitat for the bees.

According to Doña Karen, stingless bees provide a great environmental service. When bees are looking for food, they build a life in forests. As bees carry pollen from plant to plant, the forest regenerates, and in this way, bees to conserve the ecosystems in which they exist. However, in recent years in Nicaragua, beekeepers and Meliponiculture producers have to contend with deforestation, the expansion livestock operations, and eroding agricultural practices. In addition, climate change has caused drought and winds, which are the main enemies of bees (Calero, Mabel, 2019). Additionally, Meliponas suffer the damage produced by people who do not have knowledge about the breeding of native bees and only desire the product of the honey. Not knowing how to care for the bees can result in destroying entire colonies (Interview with Doña Tono, ADIC. Matagalpa, Nicaragua, 06-07-2020). In the next section I will describe the perceptions with the Meliponiculture projects and how this project meshes with the agroecology principles.

7 Conclusion

According to the agroecology practices described in the results of this thesis research, both Artists for Soup and gardeners are putting food sovereignty into action, since agroecology is a tool to achieve food sovereignty. These women are providing nutritious, healthy, and culturally appropriate food for their families and community. Through their practices, Indigenous women in Corozo have implemented a sustainable system that uses agroecology to build a culture of resistance and autonomy that responds to periods of crisis faced by the community due to threats from climate change.

Women play important roles as custodians of agricultural biodiversity, recovering Indigenous knowledge through preservations of natives seeds. The development of community seed banks encourages the exchange of many varieties. The agroecological method allows women to produce more food on a small plot of land using locally available resources. The gardeners with small plots demonstrate that they can apply principles of agroecology and depend minimally on external inputs. Women interviewed say that most of their food comes from crops they raise and a small percentage comes from purchases of external food such as rice, sugar and oil. Women also claim that they spend less time cultivating because of new methods of soil management and intercropping. Natural pesticides, green manures, compost and other agroecologically-based changes result in fewer weeds and pests. Seed-banks allow for sharing of seed in ways that leads to greater biodiversity in the region. Biodiversity may be the key issue that stands out among those interviewed; their main interest in diversifying plots to feed their families is linked to the desire for security during times of community crisis. In this way, this group of Indigenous women promote food sovereignty, simultaneously creating a precedent or model in El Corozo that demonstrates how work of women is fundamental to the economy of the family and the

development of the community. They are also creating resilient plots to confront climate change phenomena of drought and flooding. Finally, by deciding to cultivate using agroecological methods, women resist the unsustainable methods offered by agrochemical companies in Nicaragua and achieve greater independence in growing their own food.

Small farmer organization have and will play essential roles in achieving greater participation using agroecological methods through accompaniment, trainings, and support adopting sustainable technologies. Small farmer organizations in El Corozo highlight the fact that bio-diversifying plots will be central not only to families' self-sufficiency and nutritional health but also to communities in times of crisis. Therefore, implementing agroecological practices becomes a delicate political activity promoted by the NGOs in order to address gaps that the state does not assume. In collaboration with small farmers, NGOs have the opportunity to achieve food sovereignty and at times support policies that favor agroecology and food sovereignty .

Despite the fact that Nicaragua distinguishes itself as one of Latin America and the Caribbean's most active regions in terms of promoting agroecological practices and gender equality, there are still many challenges NGO's and the Nicaraguan Government must face in order to make positive advances and achieve food sovereignty. It's important for the Government to allocate a budget to supports laws created in ways that promote research of agroecological interventions, and propagation of local agroecology through small farmer access to resources and training. This kind of shift would underscore work that is being done currently by NGOs.

On the other hand, it is necessary for all small farmer organizations and government organization working in the El Corozo Community 1) to organize and create a joint strategy

for carrying out research and integrating the knowledge of farmers and consumers. This kind of collaboration would lead to development of a plan that mitigates damages caused by agro-industrial companies currently interfering in the development of food sovereignty. 2) Highlight role of women in agriculture through continuing to reset norms around work outside the home and inclusion on community decision-making. 3) Analyze strategies for access to credit by small farmer organizations and cooperatives in cases where these specific groups promote the purchase of agrochemicals. Promote the entrepreneurial approach while simultaneously maintaining a balance through minimized mineralization or other unsustainable strategies in favor of small farmers sovereignty and community autonomy. 4) Create awareness campaigns in churches, schools, community meetings on agroecological approaches, with a focus on promoting local consumption. 5) Use success stories of small farmers, like the five examples of self-sustaining women in Corozo, to highlight benefits of agroecology in an "exchange of experience" program with other organizations and communities. 6)Finally, provide incentives for small growers to adopt resource-conserving technologies and implementation of agroecological methods.

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Appendices

Appendix1.Summarizing table presenting the research questions, research aim, and a nalytical levels

Table 3
.Summarizing table presenting the research questions, research aim, and analytical le vels

Main research q uestions	Research Aims	Analytical level (s)
How do indigenous women's current practices mesh with agroecology principles?	To assess current knowledge and pr actices surrounding agroecology an d food sovereignty in Corozo, Nicaragua	Rural; Rural community National: (food sovereignty and Agroecology policies) Regional; To observe the knowledge translating practices by NGOs Local: To understand how people from Corozo interpret the knowledge
How do indigenous women's practices in Corozo mesh with food sovereignty needs, and what opportunities and barriers do women face?	To engage rural women gardeners in Corozo, Nicaragua to learn about their perceptions work and the problems confronting them in this region of Nicaragua.	Rural; Corozo Community (From perceptions, knowledge, stories) National; (Particular policies related with Gender)

How could the introduction of native honey beekeeping projects help enhance the achievement of agroecological principles and food sovereignty?	To evaluate potential for NGO Meliponiculture project and help lay the groundwork for them. To contribute to peasant family farms' increase of production and diversification of crops.	Regional; Experiences from beekeeping experts (NGO, research, content analysis and so on) Rural; Recommendations according data analisis

(Source; Adapted from *Gonda*, N. 2016)

Appendix 2. List of interviewees

Table.4 List of interviewees in Corozo community

NO.	Name / Pseudonym	Community	Date of the Interview (2020)	Gender (F/M)	Age
1	Luisa	Corozo, García sector	01-07-2020	F	41
2	Miriam	Corozo, Central Sector	03-07-2020	F	44
3	Cristina	Corozo, Central Sector	03-07-2020	F	60
4	Martina	Corozo, La chaquira Sector	08-07-2020	F	61
5	Justina	Corozo, Central Sector	08-07-2020	F	38
6	Liseth	Corozo, Central Sector	10-07-2020	F	58

Table.5 List of interviewees with non profits organizations and small farmers organizations

NO.	Pseudonym for community inhabitats/responsability for members and workers of institutions	Organization	Location	Date of the interview	Gender	Age
1	Karen-Head of Community Development	Association for an Integral Community (ADIC). (Nicaraguan non-	Matagalpa	19-06-2020	F	38

		profit organization)				
2	Cirilo - Responsible for a Youth Project	Farmer to Farmer program (UNAG-PCAP)-Small farmers Organization	San Dionisio, Matagalpa	30-06-2020	M	46
3	Clarisa-Executive Director	Nicaraguan Association of Solar Women FUPROSOMUNIC (Nonprofit Organization)	Masaya, Nicaragua	02-07-2020	F	57
4	Luz-Executive Director Programs Director	Artists for Soup (Nonprofit organization)	New York and Corozo Nicaragua	04-07-2020	F	58
5	Erick-Melipona and Apis project manager	Association for Community Agricultural Diversification and Development (ADDAC). (non-profit civil association)	Matagalpa	07-07-2020	M	26
6	Juan-Farmer Manager.	Organic Farm, Micelio Centro Ecosalud. anonymous society	Carazo	20-07-2020	M	27
7	Pablo-Centro Humboldt representative	Centro Humboldt Representative	Corozo	20-07-2020	M	60
8	Treminio	"historian" of El Corozo	Corozo Community	07-07-2020	M	80

Appendix. 3 Size of the plots-Gardeners

N.	Gardener	Size of the plots (He)		Peoples in their families	Varieties of plans (Approximately), according the interviews, depend of the seasons.	Animal integration
1	Luisa	1.50		3	20 variety of crops, including fruits, vegetables, medicinal plants, flowers, and basic grains.	chickens/laying h ens (gallus gallinaceus)
2	Miriam	2.11		4	24 variety of crops, including fruits, vegetables, medicinal plants, and basic grains.	chickens/laying h ens. (gallus gallinaceus) pigs (Sus scrofa-domesticus) turkeys (meleagris gallopavo) ducks (anas platyrhynchos) Livestock/Cows-Bos taurus
3	Cristina	4.93		4	30 variety of crops, including fruits, vegetables, medicinal plants, flowers, and basic grains.	chickens/laying h ens. (gallus gallinaceus) pigs (Sus scrofa-domesticus) Livestock/Cows-Bos taurus
4	Martina	5.63		4	38 variety of crops, including fruits, vegetables, medicinal plants, flowers, and basic grains.	chickens/laying h ens. (gallus gallinaceus) pigs (Sus scrofa-domesticus) Livestock/Cows-Bos taurus
5	Justina	10.56		4	42 variety of crops, including fruits, vegetables, medicinal plants, flowers, and basic grains.	chickens/laying h ens. (gallus gallinaceus) pigs (Sus scrofa-domesticus) turkeys (meleagris gallopavo) Livestock/Cows-Bos Taurus, horse (Equus caballus)

6	Liseth	12.67		6	65 variety of crops, including fruits, vegetables, medicinal plants, flowers, and basic grains.	chickens/laying h ens. (gallus gallinaceus) pigs (Sus scrofa-domesticus) Livestock/Cows-Bos Taurus horse (Equus caballus)