Family Farm Households Practicing Community Economies:

Understanding socio-ecological resilience in Sancti Spiritus, Cuba

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Picture in the front page: Domes of Finca del Medio covered with *Hedera* - Author: Maria Borràs Escayola

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ABSTRACT

The livelihoods of 700 million people are dependent on socio-ecological systems via agriculture and fisheries (Cohen et al., 2016), which are being directly threatened by the rapidly changing environmental patterns affecting their socio-ecological resilience. In Cuba, to improve the socio-ecological resilience of family farms, as the fundamental support for the achievement of food sovereignty (Funes Monzote, 2008; Casimiro, 2016), they are transforming the agricultural model (Casimiro, 2016; Funes-Monzote, 2008) towards food systems less dependent on external inputs - oil, chemicals and expensive technologies. Building on the study of Casimiro (2016), based on the creation of indicators to assess family farm resilience, the purpose of this study is to explore what a Community Economies perspective enables us to better understand socio-ecological resilience, understood as the as the ability to persist over the long-term through buffering shocks and adapting to change (Darnhofer, 2016) and transforming. Socio-ecological resilience is the key concept of this thesis since it emphasizes the interdependency and interconnectedness of social and ecological dynamics (Darnhofer, Lamine, Strauss & Navarrete, 2016), both of which are essential to understand family farms, the unit of study of this research. Community Economies is the call for reframing the economy with the ambition to reflect a wider reality, an economy beyond capitalist practices, where other economies are also thriving (Gibson-Graham, Cameron & Hely, 2013, p.7); in which interdependence, communication and collective action are essential components. To read the socio-ecological resilience, three coordinates (needs, surplus and encounter) were used and identified together with the 24 participants, from six family farm households on the province of Sancti Spiritus, Cuba. The results from this thesis point out the importance of mixed methods research when studying socio-ecological resilience. Although the indicators are a very good method to provide an overview of the good practices and the missing ones, are not able to capture the differences between strategies, they miss the concrete examples such as the division of labour inside the family or the network that has with other farms, and they cannot capture the process of negotiation to adopt certain practices to meet the needs, which have a direct influence in the adaptability and transformability of the system, and thus the socio-ecological resilience. The reading of practices using community economies reemphasizes that resilience is not a 'thing' that can be seized, held or measured, it is not an attribute or property of a farm or a farmer. Rather, resilience is the emergent result of ever changing patterns of relations, relations that are material, social and cultural (Darnhofer, Lamine, Strauss & Navarrete, 2016). If we want to achieve sustainability, if we are to create resilient systems that can cope with change and adapt and transform (Darnhofer, 2016), we need to start building the capacity to see our interdependency among humans and between humans and non-human others, negotiate our relationships and the needs of ourselves and the others (human and non-human), to create a sense of care that can lead to other system representations.

1. INTRODUCTION

The well-being of 700 million people globally is dependent on socio–ecological systems via agriculture and fisheries (Cohen et al., 2016). The livelihoods of these people are being directly threatened by the rapidly changing environmental patterns. As climate change takes hold, it is likely that vulnerability of socio-ecological systems will increase, endangering the future of people working on agriculture and fisheries all around the globe. It is therefore urgent to approach challenges in a positive manner to be able to create space for other alternatives to flourish, and, as Bill Mollison (1988) expresses in the permaculture principles, being aware that the problem is the solution, in a sense that to envision a new alternative we should carefully study what created the actual problem. As the United Nations' 2030 Agenda on Sustainable Development Goals (SDGs) highlights, current sustainability challenges lie in the intricately intertwined socio–ecological systems: they are about equality and social justice as much as about biodiversity, ecosystems and the environment (Ravera et al., 2016) and they need to be addressed as an "indivisible whole" (Nilsson, Griggs & Visbeck, 2016, p.320).

We are living in a global crisis: economic, social and environmental. As exposed by the interview with Deo Sumaj (Secretary of the National Indigenous Peasant Movement in Argentina) *humanity is in crisis; we are experiencing climate change, hunger, energy crisis, unemployment, urban migration, pollution and degradation of natural resources. Many of these problems result from the exploitation of natural resources by capitalist agriculture (*Gianella 2013, pg. 18). In rural areas where social and ecological crises are faced, those crises are associated to the modernization processes from the Green Revolution (Casimiro, 2016). Those processes, such as the introduction of big machineries, the creation of pest resistant crops highly dependent on chemical inputs, the hybrid seeds and specialization of the productions, have transformed the traditional way of farming. Before the Green Revolution farmers cared for their land, nurtured the soil with practices of crop rotation and green manures, while trying to cover the needs of their families. The modernization led by the Green Revolution had a direct impact on the way of farming by disassociating the sociological context from the farming itself. Moreover, having the capital reproduction, merely the production of money, as primary objective (Casimiro, 2016) has dissociated farming from its socio-ecological context, generating socioeconomic inequalities, unsustainable processes and strong rural migration processes (Nicholls, Altieri & Vázquez, 2016; Casimiro, 2016). Specifically, in Cuba, the challenge lies on transforming the agricultural model (Casimiro, 2016; Funes-Monzote, 2008) towards food systems less dependent on external inputs (oil, chemicals and expensive technologies), along with improving the socio-ecological resilience of family farms, as the fundamental support for the achievement of food sovereignty (Funes Monzote, 2008; Casimiro, 2016). In Cuba, 65% of the food produced comes from family farming (Rosset, Machín, Roque & Ávila, 2011). But, an ever-increasing pattern of consumption of a certain type of foods, like cereals, the rising price and the availability of oil and the scarcity of land to cultivate, are some of the signs of the systemic crisis (Gonzalez de Molina, 2013) we are in, part of a failed development model.

Bookchin was convinced that *the very notion of the domination of nature by humans stems from the very real domination of human by human* (Bookchin 1982, pg. 1). Fortunately, there is room for change, to rebuild relations among humans and between humans and non-human others. There is hope for human possibility, to show that other relations, far from domination, are feasible and are there. To develop this idea of possibility further, it is important to talk about socio-ecological systems, that consider the interdependency among humans and non-human others and gives the

possibility to negotiate a better future, in the attempt to build resilience. So, to transform this crisis into something valuable for now and for the future generations, it is highly needed to come with interdisciplinary work and mind-sets (Fortuin et al., 2014). We can work with other specialists, exchange knowledge, but first there is a mind shift that needs to occur. It is necessary to start working with systems thinking (Mollison, B., 1988) to understand that we are not alone and our actions have consequences not only here in Europe but also in Cuba, all around the planet, because we live in a globalized world. The demand for interdisciplinary research in the environmental field is strongly increasing (Fortuin et al., 2014). Accordingly, in this thesis I will build specifically on the concept of socio-ecological resilience, which combines notions from ecology and sociology, and is a key component in the construction of a more sustainable and equal society. Following this line, and focussing on the patterns of production-consumption, which influence the socio-ecological resilience of family farms (Casimiro, 2016), using the theory of community economies can be an innovative methodological tool towards the creation of a future of possibility, where economy, ecology and society are interrelated and interdependent of each other (Gibson-Graham, 2006). A future where the negotiation of this interdependency is an option for enhancing the understanding and development of socio-ecological resilience.

Economy, as one of the drivers of change, plays a major role in determining the choices that farmers make. Farmers should ensure the future of the farm on short and long term, positioning economy as a crucial term when building socio-ecological resilience. For assessing this domain of resilience, I want to pay attention to diverse economies (Gibson-Graham, 2008). Economies that are not only the subject of capitalist imperatives, rather economies that value people over capital and the interdependencies between social, ecological and economic domains. Economies are explained not merely as market transactions and capital accumulation but also involve needs and ethics. Therefore, I will take the community economies framework as a guide for this thesis. The concept of community economies is a radical approach to transform society that understand economy as a space of decision making in which we negotiate our interdependence with other humans, other species, and our environment (Gibson-Graham, Cameron & Healy, 2013, p.103). With negotiations that are never ending and where constructing new realities becomes an ongoing project.
Several experts (Altieri, 2002; De Schutter, 2014) have suggested that the rescue of traditional management systems combined with the use of agroecological strategies may represent the only viable and solid route to increase productivity, sustainability and resilience of agricultural production (Nicholls, 2013). Agroecological strategies are essential but not sufficient to achieve sustainability (Nicholls & Altieri, 2012), therefore the community economies perspectives enable us to consider the environment as part of the socio-ecological system, which we appreciate and care, not just as a mere available resource. We need to appreciate, care for and repair -as much as we can- the ecological relationships that have supported all forms of live over thousands of years (Gibson-Graham, Hill & Law, 2016), which is a very important aspect of community economies.

This thesis was conducted on Cuba to continue the work made on the study of the socio-ecological resilience of family farms (Marquez Serrano & Funes-Monzote, 2013; Casimiro, 2016; Funes-Monzote, 2008). Basically, I took as a guide the PhD thesis of Leidy Casimiro (2016), who created the methodological tools to evaluate the socio-ecological resilience of family farms in Cuba, creating a set of indicators to come up with a practical tool to assess the transition of family farms in the adoption of agroecology as a strategy and philosophy (Casimiro, 2016).

1.1 Regional background – Cuba, agroecology and family farms

The Caribbean is considered one of the most vulnerable regions from the climatic point of view (Márquez Serrano & Funes Monzote, 2013) due to the increasingly frequent and intense passage of tropical cyclones that affect the economy and the ecology of the countries located in this geographic area (IAASTD 2009), and Cuba is not an exception. These events threaten the socio-ecological resilience of family farming, which represents more than 80% of agricultural exports, over 60% of food production and 70% of agricultural employment, according to information provided by the FAO Regional Representative for Latin America and the Caribbean (FAO, 2010).

Cuba has a total extension of 109.884 km2 from which 62267 km2 are agricultural land (ONEI, 2016a). The land in Cuba is all from the state but there are different forms of tenancy. Few months after the victory of the Revolution, in May of 1959, there was the first agrarian reform which gave land to the recently created sugar cooperatives, expropriated by the State from the big land owners. (Vuotto, 2016). At the beginning of the 60's the Cooperatives of Credit and Service (CCS) were created and, ten years later the Cooperatives of Agrarian Production (CPA). Those forms of organization and the laws that accompanied those changes, made possible the development of the cooperative movement, transforming the small individual peasant production into collective forms of production (Vuotto, 2016). The modifications of the law for land tenancy that happened in 2008 (59/2008) and 2012 (300/2012) gave the possibility to every person that wanted to get a piece of land, for a period of time (10 years) and start farming, according to the social object that appeared in the contract with the State (Gaceta Oficial, 2012).

There are four land tenancy forms in Cuba: UBPC, CPA, CCS and dispersed peasants. UBPCs (Basic Units of Cooperative Production) are constituted with workers from state enterprises, the lands that have been transferred to them as usufruct and the means of production purchased from the State. These UBPCs are producing various crops, citrus, fruit, coffee, tobacco and livestock. CPAs (Cooperatives of Agricultural Production) constitute a collective form of social property and are created from the decision of the peasants to unite their lands and other fundamental means of production. CCSs (Cooperative of Credits and Services) are primary collective organizations that allow the common use of irrigation, some facilities, services and other means, their equipment and in which the resulting production is still private. And dispersed peasants are those who do not belong to any form of cooperative organization (ONEI, 2016a). Is important to keep these forms of organization to better understand the development of the research and the discussion of the results and conclusion.

Since the beginning of the 1990s Cuba has been going through an intense agroecological transition. The dissolution of the USSR and the US blockage pushed towards a redesign of the socio-ecological system, due to the shortage of imports. Since then, there has been a transition from an industrial, monoculture and export-oriented agricultural model to an agroecological, diversified and food self-sufficient model (Casimiro, 2016; Funes-Monzote 2008), still in construction. The goal of agroecology goes far beyond the use of low-input technologies, to decrease dependency. The emphasis is on the design of complex agroecosystems that take advantage of socio-ecological interactions, and synergisms between biotic and abiotic components (Funes et al., 2002). The dissolution of the USSR and the US blockage, which was a catastrophe at first, turned out to be a gift, for Cuban farmers, to reinvent their practices. Cuba's political and economic isolation, in combination with the particular climate, in today's globalised

world demands constant adaptation by its inhabitants (Buchmann, 2009) and a strong network of organized people to support this adaptation.

Agroecology has played a key role in helping Cuba survive the crisis caused by the collapse of the socialist bloc in Europe and the tightening of the US trade embargo (Rosset, Machín, Roque, & Ávila, 2011). Agroecology emerged as an approach to better understand the ecology of traditional farming systems and respond to the mounting problems resulting from an increasingly globalized and industrialized agro-food system (Altieri & Toledo, 2011). There is this widespread false idea, that technological innovation alone, without important social and economic changes, will provide more sustainable agriculture (Gonzalez de Molina, 2013). But the practical dimension of agroecology needs from politics, and engagement from the community, a movement, as well as researchers, to achieve change in the actual food system (Gonzalez de Molina, 2013).

The agricultural models of big monoculture plantations dedicated to export prevailing in Cuba for almost 400 years, until the beginning of the 1990s have contributed significantly to the deterioration of the natural resource base that sustains agriculture (Funes-Monzote, 2009). Despite this, later developments (beginning of 1990s) in the Cuban agricultural sector were influenced by three fundamental drivers: diversification, decentralization, and the aim for national food self-sufficiency (Funes-Monzote, 2008). Since the early 1990s technological innovations have been introduced in all branches of agriculture and scientific institutions have tested environmentally sound technologies on a large scale.

Favourable conditions have been created during the last 25 years for the transition from an industrial, monoculture and export-oriented agricultural model to an agroecological, diversified and food self-sufficient model (Funes-Monzote et al., 2009; Funes- Monzote, 2009). Through the Movimiento Agroecológico de Campesino a Campesino (MACAC, Agroecological Movement from Peasant to Peasant) that the National Association of Small Farmers (ANAP) used to build a grassroots agroecology movement (Rosset, Machín, Roque & Ávila, 2011), numerous agroecological practices, to do more with less, like crop rotation, green manures, polycultures, agroforestry, crop-livestock integration (Funes et al., 2002), efficient use of renewable energy sources, among others, have been disseminated and adopted. Identified by farmers in the study of Márquez Serrando and Funes-Monzote (2013), the adoption of strategies such as biodiversity management, livestock-agriculture integration, conservation practices and increased soil fertility, strategic pruning of trees and crops, adequate forest cover, food conservation and social cohesion at the community level have served to resist, for example, the impact of strong hurricanes that have struck the Island (Márquez Serrano & Funes-Monzote, 2013). The MACAC is a great example of farmer's organization dedicated to build and share knowledge. An example of how collectively are making their practices more resilient. A practical example of building community economies and socio-ecological resilience to transform their communities.

Despite the benefits of MACAC and agroecology the socio-ecological resilience of family farms is still fragile. Family farms generate more than 65% of the food produced in Cuba (Rosset, Machín, Roque & Ávila, 2011). However, they are still struggling because of the persisting interest from governments and corporations in high external input systems with costly technological packages in order to achieve a supposed increase in food production and thus the decrease of its imports (Casimiro, 2016). This contradictory view keeps the agroecosystems dependent on external inputs and energy inefficient (Altieri & Funes-Monzote, 2012) while causing high environmental costs (Casimiro, 2016) and threatening the socio-ecological resilience. Moreover, the socioeconomic aspects of agricultural development (like land tenure and

economic diversity) have been insufficiently integrated into the development of new policies (Funes-Monzote, 2008), limiting the imaginary to create alternatives that are integrating ecological and social processes (Funes et al., 2002). Still, success of family farms is mainly read in terms of conventional economic benefits (e.g., yield/ha, input-output cost assessment, market competition). The questions raised by community economies scholars Gibson-Graham, Hill and Law (2016) are applicable to this Cuban context:

> "What of all the diverse human economic activities that cannot be capitalized and priced? What of the relations between human and environments that are not about 'servicing' but are about mutual care and stewardship? What about the developmental dynamics that are not driven by accumulation, the releasing of potential, creative restructuring and structural maintenance? Indeed, if it is the capitalist economic system (albeit in the form of a new 'regime of accumulation') that persists, how might radical transformation and a new development trajectory come about?" (p. 705)

Having a look at the socio-ecological resilience of family farm households with the framework of community economies is an opportunity to open the space for interdependency recognition and negotiation and construct a more sustainable and equal society.

1.2 Problem statement

As outlined by Altieri and Nicholls (2005), a key strategy towards building self-sufficient, resilient and sustainable food systems is to take into consideration the interrelatedness of agroecosystem components—ecological, social and economic (Simon & Pérez, 2010). Economy is a crucial component of any socio-ecological system and has not been the focus of attention when talking about resilience (Funes-Monzote, 2008; Plummer & Armitage, 2007). And when it has been studied, it has been through the lens of conventional economics (Casimiro, 2016; Márquez Serrano & Funes Monzote, 2013). For this reason, community economies will be the perspective I will take for this thesis to add a new perspective to the understanding of socio-ecological resilience of family farms. I will refer to community economies as the place of ethical negotiation to open space for other realities, a space of co-learning where we, humans, can start seeing the 'non-human sphere' in ethical terms (Gibson-Graham, Hill & Law, 2016) in the construction of socio-ecological resilience via adaptation and transformation.

There are several studies on the evaluation of socio-ecological systems in Cuba (Buchmann, 2009; Funes-Monzote et al., 2011; Altieri & Funes-Monzote, 2012; Casimiro, 2016), but most of them focus on the creation of indicators to support innovative (agroecological) strategies for farmers and policy makers. The evaluation through indicators is a useful tool to assess the farming system resilience, but they sometimes miss the social relations, historical conditions and identities embedded in the socio-ecological system of a farming family, which has much to say in the construction and transformation of the system and the development of socio-ecological resilience.

As Gisbson-Graham, Hill and Law (2016) express "there is a need for more experimental and ethically driven conceptions of economic dynamics and a less utilitarian view of economy–ecology interdependence" (p. 706). Since agroecological practices are highly context specific, it is important to understand the perceptions of Cuban family farms regarding their own socio-ecological resilience to transform their own realities and strengthen their socio-ecological resilience. The resilience of a socio-ecological system is determined not only by biotic or environmental factors but also by human strategies and economic conditions (Casimiro, 2016) and it is unclear how their strategies foster sustainable ecological livelihoods (Gibson-Graham &

Miller, 2015) and create spaces for negotiation in the framework of community economies. Using this framework will be suited because, from their own experience on the farm, will make explicit the interrelations and interdependencies among humans and between humans and non-human others, that are essential in the construction of the socio-ecological resilience.

1.3 Purpose of the study, research questions and relevance

To be sustainable, having a look at the agronomist practices needed, and just considering the environment is not enough (Nicholls, 2013). It is important that we observe people and nature, or economies and ecologies, as interdependent systems, that change, adapt and transform (Gibson-Graham, Hill & Law, 2016, p.704). We need to include social praxis, because humans are not different and separated systems but part of a complex whole. As Ethan Miller (2014) explains:

> (…) environment is what we breathe and what we eat, and since breathing and eating are acts of intimate ingestion -in which air and food enters us and touch us from the inside- the environment is inevitably located within our very bodies". (p.17)

From my point of view, we (mostly western world, minority world) are hyper-separated from nature. We lost the ability to be affected by the non-human world, thanks to our industrialized economy. But, there are other ways to relate among us and with the non-human world. To do so we need to go far beyond the fast and simple solution to one problem offered by, in this case, the actual agricultural model (i.e. pesticides to combat diseases and fertilizers to boost yields). Because we are not elements alienated and sterile but are part of a complex system that interacts constantly with many other spheres (like environment, other-humans, other-non-humans) at the same time. The distinction between those spheres is purely practical, mainly for research and descriptive purposes (Miller, 2014). Resilience studies are moving towards that direction, embracing the complex adaptation and transformation of socio-ecological systems to govern economy-ecology interdependence (Gibson-Graham, Hill & Law, 2016; Darnhofer, Lamine, Strauss & Navarrete, 2016). A key feature of socio-ecological resilience is the strategies of social organization (i.e. networks of solidarity, food exchange, etc.) used by the farmers to handle difficult circumstances (Nicholls, 2013; Márquez Serrano & Funes Monzote, 2013). For this reason, the main goal of my research is to understand what everyday practices family farmers do to improve socio-ecological resilience in Cuba to improve the scientific basis for a sustainable present and a better future, using community economies as a guide.

In doing so, this research aims to add another perspective, building on the study of Leidy Casimiro (2016), to the understanding of socio-ecological resilience, in the context of a case study in the region of Sancti Spiritus, Cuba, via a participatory process, to understand better family farms' ability to respond to change in the ecological, social, economic and political environment.

Due to the methods used for the research, the process will provide the researcher and the farmers with tools to identify the already existing elements that enable family farms to adapt to a changing socio-ecological world. The hypothesis for the research is that there is a positive association between community economies and the resilience of socio-ecological systems. That is, stronger community economies, where members of the community recognize and negotiate their interdependency with other humans and non-human others, achieve higher levels of resilience. The theory of community economies is based on six ethical coordinates that allow members to negotiate their interdependency. These coordinates are: needs, surplus, encounter, consumption, commons and investment. Since the time for the completion of the thesis is limited I decided to focus on the three first coordinates of community economies: needs, surplus and encounter,

positioning needs as the central coordinate from where to start negotiating the interdependency. The theory of community economies and the coordinates are explained further in the theoretical framework.

1.3.1 Research questions

To address the purpose of this thesis the following main research question (RQ) was formulated:

RQ: How do practices of community economies contribute to the understanding of the resilience of the socio-ecological system?

To answer the main question, the following sub-questions were formulated:
SRQ1: How do family farms perform resilience based on the socio-ecological indicators defined by Casimiro (2016)?

SRQ2: How do family farms perform resilience based on the community economies framework?

SRQ2.1: How do family farm household members negotiated decisions over what *needs* should be met to survive together well?

SRQ2.2: How is surplus from family farm households produced, appropriated and distributed to meet the identified needs?

SRQ2.3: How do family farm household members *encounter* human and non-human others in ways to support one others' needs?

1.3.2 Societal and scientific relevance

This thesis aims to contribute to broaden the space for the definition of the resilience concept in the context of socio-ecological systems. Resilience is studied by scholars from their own discipline (i.e. ecological resilience, social resilience, economic resilience) although books (Berkes, Folke & Colding, 1998; Biggs, Schlüter & Schoon, 2015) and scientific papers (Adger, 2000; Altieri, 2013; Darnhofer, Lamine, Strauss & Navarrete, 2016; Folke, 2006; Folke, Colding, Berkes, 2003; Gibson-Graham, Hill & Law, 2016; Márquez Serrano & Funes Monzote, 2013; Walker, Holling, Carpenter & Kinzig, 2004) have been written in the research for an interdisciplinary approach to overcome the sustainability challenge. The peculiarity of this study is the focus on family farm households' socio-ecological resilience in contemporary Cuba from a completely new lens, the one of community economies, in order to shed light on factors that have been neglected when assessing resilience.

Transdisciplinary research has proven its ability to generate knowledge and forms of collaboration that are crucial for solving complex societal problems, such as climate change, biodiversity loss, natural resource depletion, and others (Fortuin et al., 2014) The environment does not distinguish disciplines and neglect compartmental divisions set us by us, humans. Instead, the environment is also part of the social, and vice versa. Transdisciplinary research aims to integrate academic knowledge from various disciplines and non-academic knowledge in order to be better able to conduct research on real world problems and to create new knowledge and theories which can be used to improve the present state of affairs (Fortuin et al., 2014).

The thesis is structured in chapters. Following the Introdction (Chapter 1), the theoretical framework (Chapter 2), where the concepts and theories on which this research is based are explained. Then the methodology (Chapter 3) followed to answer the research questions is described. The results are structured in three different chapters. First, there is a detailed profile of each farm (Chapter 4) to situate the reader and give the scenario to understand better the other

two chapters. Following (Chapter 5) there is the presentation of the results of the socio-ecological indicators defined by Casimiro (2016) (Chapter 5), answering SRQ1. And third, the result of the socio-ecological indicators following the coordinates of community economies (Chapter 6), to answer SRQ2. The main research question (RQ) is answered in Chapter 7, integrating the results of chapters 5 and 6. And finally, Chapter 8, gives the conclusions and recommendations for future research.

2. THEORETICAL FRAMEWORK

This section provides an overview of theories and concepts on which this research is based. This study builds upon studies on socio-ecological resilience, family farming, community economies, and participation and local ecological knowledge. Being aware of the complexity of the topic this proposed research attempts to add another perspective in the understanding of the socio-ecological resilience of family farms in Cuba. By attending to their perceptions, this research wants to understand the everyday practices that family farmer members do, and how these practices support the improvement of their socio-ecological resilience.

The first sub-section explains how the concept of socio-ecological resilience is understood. The second sub-section focusses on the importance of family farming and household as a unit of analysis. The third sub-section describes an understanding of community economies, as the space to create diversity, which nurtures resilience. And, the last sub-section focuses on explaining why the participation of family farm members and the local ecological knowledge is important when doing research.

2.1 SOCIO-ECOLOGICAL RESILIENCE

As stated in the introduction, the demand for interdisciplinary research in the environmental field is strongly increasing (Fortuin et al., 2014), and asks researchers to engage in conversations with other research disciplines. Socio-ecological resilience is a good example of combining notions from ecology and sociology to understand systems, in this case, family farms.

Resilience, in this thesis, is understood as the ability to persist over the long-term through buffering shocks and adapting to change (Darnhofer, Lamine, Strauss & Navarrete, 2016) and transforming. The concept of socio-ecological resilience it emphasizes the interdependency and interconnectedness of social and ecological dynamics (Darnhofer, Lamine, Strauss & Navarrete, 2016), both of which are essential to understand family farms.

Socio-ecological resilience framework challenges approaches building on equilibrium, stability, predictability and efficiency (Darnhofer, Lamine, Strauss & Navarrete, 2016), which are at the heart of the modernisation of agriculture (Weis, 2010) and the actual economic system. Moreovoer, socio-ecological resilience thinking highlight dynamics across time, space and domains (Darnhofer, 2010) and emphasizes the need to adapt and change, rather than the ability to buffer shocks and return to 'normal' (Darnhofer, Lamine, Strauss & Navarrete, 2016), crucial in a world that is constantly changing. Resilience of socio-ecological systems, of which humans are also part of, is based on understanding those systems as complex, and future developments as unpredictable, thus emphasizing adaptive approaches to management (Darnhofer, 2010), not returning to normal but adapting and transforming. Resilience describe the present practices and characterize a system's ability to deal with change while considering the coming generations. In resilient socio-ecological systems, change and renewal may nurture novelty and innovation (Folke et al., 2002; Marschke & Berkes, 2006) contributing to strengthen inherent capacities of communities, ecosystems and individuals to deal with this unpredictable change, and to drive change in a manner that will lead to wide-spread and sustainable improvements to well-being (Cohen et al., 2016). Resilience describes the degree to which a socio-ecological system is capable of self-organization, learning and adaptation (Holling, 1973; Gunderson & Holling, 2002; Walker, Holling, Carpenter & Kinzig, 2004). Resilience is the combination of processes and practices embedded in a socio-ecological system, whose constituent parts are integrated and

interdependent (Adger, 2000) providing the system with adaptive and transformative capacities. Social resilience, defined as the ability of groups or communities to adapt to extreme causes of stress, whether social, political or environmental, must go hand in hand with ecological resilience (Nicholls, 2013; Adger, 2000). This is why, in this thesis, the concept examined is the socio-ecological resilience, and the other concepts and theories are standing on it.

2.2 Family farms and household member's perceptions

Family Farming (which includes all family-based agricultural activities) is a means of organizing agricultural, forestry, fisheries, pastoral and aquaculture production (IPC, 2014), managed by the family. Family farms are important for a variety of reasons. First, they are inextricably linked to food sovereignty and thus self-sufficiency. La Vía Campesina, the biggest international movement that coordinates peasants around the world in the defence of sustainable family farming systems, have proposed the definition for food sovereignty as:

> "The right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations. It defends the interests and inclusion of the next generation. It offers a strategy to resist and dismantle the current corporate trade and food regime, and directions for food, farming, pastoral and fisheries systems determined by local producers. Food sovereignty prioritizes local and national economies and markets and empowers peasant and family farmer-driven agriculture, artisanal—fishing, pastoralist-led grazing, and food production, distribution and consumption based on environmental, social and economic sustainability" (La Vía Campesina, 2007).

Second, family farming preserves traditional knowledge and varieties, adapted to the region while contributing to biodiversity and promoting the sustainable use of natural resources (FAO, 2014). And third, there is a great diversity of structures in family farming (IPC, 2014) which leads to a great variety of strategies. Family farms are prepared to adapt and transform. Resilience thinking emphasizes that to persist, farms need to change (Darnhofer, Lamine, Strauss & Navarrete, 2016). The family and the farm are linked, co-evolve and combine economic, environmental, social and cultural functions (IPC, 2014). Moreover, as Van der Ploeg (2013) summarizes perfectly, family farms are the link between past, present and future, creating a collective memory over time.

Figure 1. Ten qualities of family farm. source: Van der Ploeg (2013).

In Cuba, family farms are the most important form of farming with more than 150.000 families in rural areas (FAO, 2010) and provide more than 65% of the island food (Rosset, Machín, Roque & Ávila, 2011; ONEI, 2015a; Casimiro, 2016). It is important to focus on the household because we are studying family farms and is in the household where relations between family members are created and reproduced. *Oikos* means "household" or "habitat"and is the common etymological root for both ecology and economy (Gibosn-Graham, Hill and Law, 2016). *Oikonomia*, economy, is the "management" (*nomos*) of the household (*oikos*). *Oikologia*, ecology, is the "knowledge" (*logos*) of the household (*oikos*). In the household is where both, economy and ecology, interact and is the space where the interdependency between human, non-human and environment becomes clear.

2.3 COMMUNITY ECONOMIES

The community economies theory is a term first developed by J.K. Gibson Graham (2006) to portray the reality of existing diversity in current economies (Hicks, 2009). The logic of capital accumulation that feeds the actual global market (called Capitalism) is based on the exploitation and the usurpation of the surplus farmers generated. The problem, as exposed by Olivier De Schutter, is that "once food becomes a commodity that responds to the laws of supply and demand, it will serve only the needs of those who have the greatest purchasing power […] creating a paradox in which the luxury tastes of some parts of the world's population are satisfied whereas the basic needs of others are not recognized and cannot be satisfied" (Goris, 2014, p 41). A good portion of food produced has become commodity already, part of a capitalist economy that serves to the market, and not to the people. It might be difficult to escape from its hegemonic discourse,

that presents capitalism as the only present form of economy (Gibson-Graham, 1996), but there are alternatives and we just need to give them the space and the voice to become visible.

> "What if we were to see economic activities not in terms of a separate sphere of human activity, but instead as thoroughly social and ecological? What if we were to see economic sociality as a necessary condition of life itself? What if we were to see the economy as ecology—as a web of human ecological behaviours no longer bounded but fully integrated into a complex flow of ethical and energetic interdependencies?" (Gibson-Graham & Miller, 2015, pg. 2).

Gibson-Graham (2008) have sought to bring thinking into action around the economy by creating alternative discourses to help people perform new worlds. Community economies is the call for reframing the economy with the ambition to reflect a wider reality, an economy beyond capitalist practices, where other economies are also thriving (Gibson-Graham, Cameron & Hely, 2013, p.7); in which interdependence, communication and collective action are essential components. Gibson-Graham depart from the premise that *our economy is the outcome of the decisions we make and the actions we take* (Gibson-Graham, Cameron & Hely, 2013, p. xiii)

To go through the concept of community economies, I will draw on the example that Gibson-Graham, Cameron and Healy (2013) use in their book, *Take Back the Economy: An ethical guide for transforming our communities*. "Imagine that our economy is a community garden. The future of the garden is secured by the present practices, so the investment in giving back the nutrients to the soil as well as investment in the relationships between the people that makes the garden flourish" (Gibson-Graham, Cameron & Healy, 2013, p.164). We have the responsibility of maintaining the nutrients and the people. For a sustainable future accumulating a richer soil profile and a robust knowledge bank is crucial. However, this accumulation of knowledge and nutrients, promoted with agroecology, is often ignored in industrial agriculture. "This type of agriculture relies on chemical inputs to maintain soil fertility and gives no attention to the place-based knowledge that farmers build up over generations" (Gibson-Graham, Cameron & Healy, 2013, p.164). Soil is being depleted and the knowledge created and trespassed during generations lost. By contrast, agroecology offers an entirely different approach, one that fits much better with the concept of diversity, from which community economies is defined. In agroecology "compost is added to the soil and farmers increase their understanding of how to interact sustainably with plants, animals, insects, soil and water" (Gibson-Graham, Cameron & Healy, 2013, p.165). In this garden, a diverse economy, an economy that recognizes the interconnection between the elements and the ethical negotiation of the decisions over space and time, is fostered.

In community economies, six coordinates are used to disclose the interdependencies among humans and between humans and non-human others. Those six coordinates are based on 5 aspects of the economy: labour, enterprise, market, property and finance. Because it is about reframing, I will rephrase what is understood by each coordinate. When talking about labour, how to understand work, "in a community economy we take ethical action by acknowledging how our survival is connected with that of others" (Gibson-Graham, Cameron & Healy, 2013, p.39), and thus the **needs** are connected and negotiated with the needs of others (human and non-human). Considering enterprise, "in community economy we negotiate how to spread the benefit bestowed by **surplus** to the well-being of people and the planet" (Gibson-Graham, Cameron & Healy, 2013, p.73). Business is no longer about creating money but about sharing the **surplus** generated out of gifted resources and hands of the people. Surplus, understood as what is left after covering the

needs, the labour produced beyond what is needed. Related to transactions, "a community economy is a space of decision making in which we negotiate our interdependence with other humans, other species, and our environment. Never ending, ongoing project" (Gibson-Graham, Cameron & Healy, 2013, p.103). The transactions are not exclusively linked to a global market, but it is more about **encountering** others, here and there, and being aware of our **consumption**. Property is another key concern of community economies. "In a community economy, we share what sustains us with current and future generations" (Gibson-Graham, Cameron & Healy, 2013, p.148). Here a very important concept, **the commons**, is rescued to bring collective action to the heart of the question. And finally, talking about **finances**, "in a community economy we use investment more transparently to build a future for all" (Gibson-Graham, Cameron & Healy, 2013, p.177).

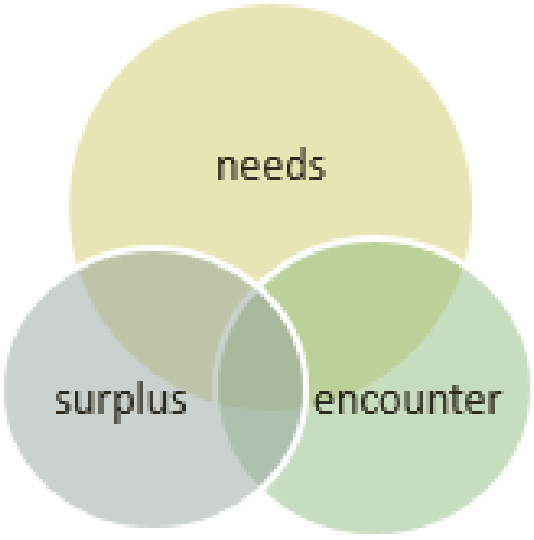

Figure 2. The three coordinates of Community Economies.

As mentioned before, I will only focus on three out of the six ethical coordinates because of time constraint. I chose to start with the first three because they are the starting point for the conversation about the interdependence among humans and between humans and non-human others that might enlarge our vision for other possibilities. Examining **needs**, as a practice of thinking what we really need to survive well, and in this context, also what is needed to adapt to changes and disturbances of the socio-ecological system. **Surplus** production and distribution, looking at it from a diverse economies framework, cannot be identified outside of a relationship with non-susrplus – what is necessary for survival, what are the needs (Gibson-Graham, Cameron & Healy, 2013, p.54). Keep in mind that what is "surplus" and what is necessary for "survival" are interdependent (Gibson-Graham, Cameron & Healy, 2013, p.73). So, if we want to construct new spaces of negotiation we need to understand what is the needs and the surplus (the generated wealth beyond the needs) and how this surplus is distributed to produce well-being for people and the planet (Gibson-Graham, Cameron & Healy, 2013, p.65). And last, but not the least, the **encounters** among humans and between humans and non-human others. How these encounters provide the basis for a well-being, not based on money or calculations of price. We rely on others close by to provide care for us, mainly at the first and last stages of life, but also throughout life (Gibson-Graham, Cameron & Healy, 2013, p.104) and how those relations of care influence the resilience of the socio-ecological system at the stake, the family farm.

This practice of reframing, in this case the economy, is an experimental approach, open to new ideas that is central to political and social transformation, therefore is an essential practice in

building socio-ecological resilience, which also aims to understand the complexity and diversity of the systems to promote adaptive and transformational approaches.

2.4 Participation and Local Ecological Knowledge

Since community economies is about negotiation of interdependency, participation, to create this conversation is crucial. Participation has the potential to promote adaptation in environmental governance through building up critical social relationships and learning in resource-based communities and locals (Shioya, Kluvánková-Oravská & Chobotová, 2011). This study is informed by a participatory approach, meaning that findings will be the results of a negotiation with participants, to create a process of learning with and by people involved (Chambers, 1994) and a comparison of their view with a more qualitative analysis of the farms.

Local ecological knowledge (LEK) constitutes a key analytical domain of socio-ecological systems research (Berkes, Folke & Colding, 1998; Folke, 2006). This knowledge is build when farmers observe and experiment with the environment (Milestad, Kummer & Vogl, 2010). There are distinctive ways in which LEK emerges. On the one hand, LEK might be useful to complement researcher's knowledge, in a more specific context, based on observation and experimentation (trial-error). On the other hand, it might happen to challenge the scientific approach that, sometimes, serves vested interests (Gadgil et al., 2003). Overall, Local Ecological Knowledge is crucial for the understanding of the specific socio-ecological resilience (Folke et al., 2003) in this case, of family farms.

An appreciation for farmer-generated knowledge challenges conventional approaches to agricultural research and related policymaking that privileges Western epistemologies of knowledge production (Méndez, Bacon & Cohen, 2013). Traditional knowledge and indigenous practices of resource management are the base of peasant agroecosystems resilience (Altieri, 2013). Soil conservation, genetic diversity maintenance, collection of water and use of multiple crops are some of the examples that can help in reducing the risk. Most of those practices are linked with the social network of farmers that exchanged during generations this agroecological knowledge, contributing to the collective ability to respond to variation, thus improving socioecological resilience (Altieri, 2013). The place where the knowledge is produced and the relations fostered or not during this production are crucial for the development of strategies that can work in the specific context, thus, the ability to see the relationship in which knowledge is produced becomes crucial.

Following, there is the graphical representation of the theoretical framework, to better portray the relationship among the three concepts/theories:

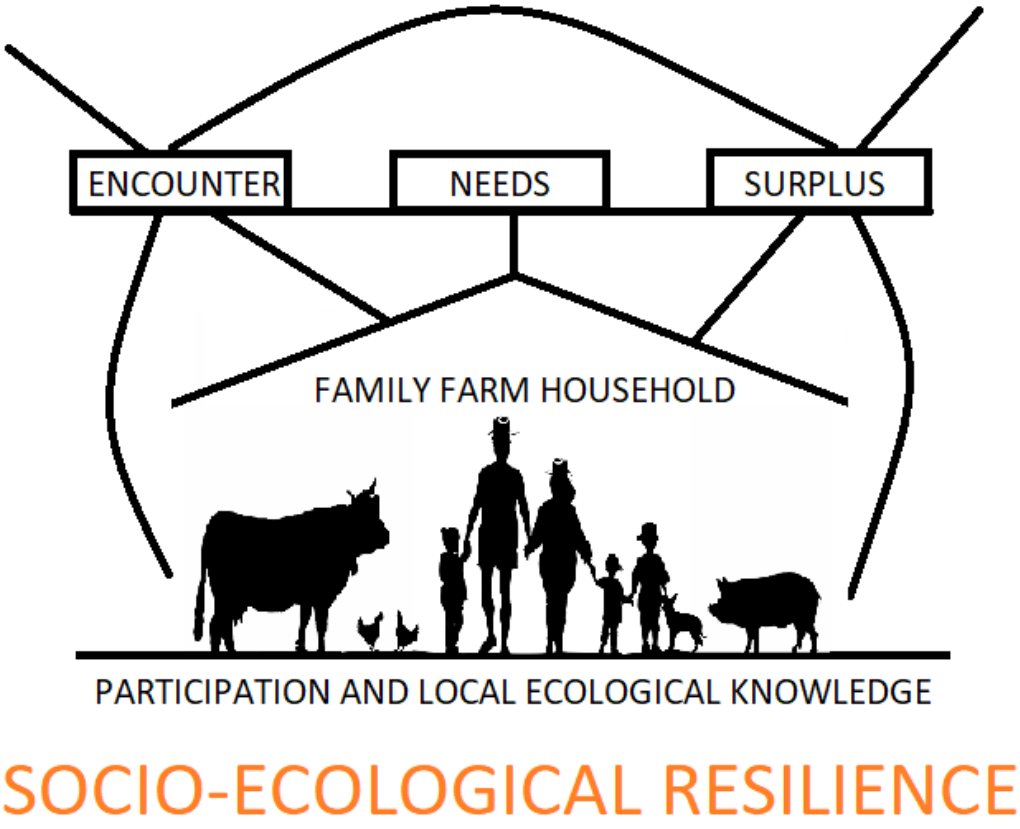

Figure 3. Conceptual framework built on the studies of Van der Ploeg (2013), Gibson-Graham, Cameron and Healy (2013), Chambers (1994), Folke (2016) and Darnhofer, Lamine, Strauss & Navarrete (2016).

This framework supports the reserach objective and helps answer the research questions because, it connects the theories of community economies with the institution of family farms and the process of participantion of the memebers of the family in the space of socio-ecological systems and their capacity to adapt and transform. By connecting the needs, the surplus and the encounters of family farmers, within and beyond the household, and the participation of the members socio-ecological resilience of family farmers can be better understood, and thus, anwer the main research question of the present thesis.

Having discussed the theoretical framework used to examine the data collected, I will now turn to Chapter 3 to discuss the methodology deployed to collect and analyse the data.

3. METHODOLOGY

This chapter outlines the setting, the selection criteria and participants, study design, methods of data collection and analysis, challenges and ethical concerns. This research took place in Sancti Spiritus province, Cuba, from February to June of 2017 and it was supported by the family farm of *Finca del Medio* (Taguasco, Cuba) and the *Estación Experimental de Pastos y Forrajes 'Indio Hatuey'* (EEPF-IH) in the field. Out of the necessity of feeding with better products the Cuban livestock after the revolution (EEPF-IH, 2015), the EEPF-IH was the first Estación Experimental founded in 1962 by the Revolutionary Government and currently is working on the following areas: 1) identification of multifunctional phylogenetic resources (i.e. medicinal plants); 2) nutrition, reproduction and animal health; 3) diversified agricultural production; residues treatment and bioenergy; 4) sustainable rural and local development; as well as 5) providing products and technology and scientific and technical support. This study uses a cross-sectional case study design. The main research methods will be observation, semi-structured interviews and farm diagnosis questionnaires. Quantitative secondary data and qualitative and quantitative primary data was integrated in the final analysis phase, to provide a meaningful picture of the socio-ecological resilience of family farms in the region of Sancti Spiritus, Cuba. In the following chapter, first, information on the setting of the research will be provided, as well as important elements of the agrarian policy of the island. Second, the selection criteria of the sample, followed by the study design and the data collection methods. And finally, the data analysis methods used to answer the research questions.

3.1 SETTING

The fieldwork took place in Sancti Spiritus province, Cuba. The name of Cuba derives from the Taino Indian designation for the island "coabana" meaning "great place" (Index Mundi, 2016). The island has a tropical climate. The warm temperatures of the Caribbean Sea and the fact that Cuba itself almost completely blocks access to the Gulf of Mexico, make Cuba prone to frequent hurricanes. The dry season lasts from November to April; the rainy season from May to October. The average temperature is 21 °C (70 °F) in January and 27 °C (81 °F) in July (Index Mundi, 2016). During the fieldwork, we passed from the dry to the rainy season, but no big rains appeared, what was a big concern for all the Cubans, farmers and non-farmers.

Figure 4. Map of Cuba. The yellow square indicates the specific area of the research, in the province of Sancti Spiritus. Source: GoogleMaps®

More specific, the study is carried in Sancti Spiritus Province. Situated in the middle of the island, between 21°32', 22°27' North latitude and 78°56', 80°07' West longitude. The region has a highly heterogeneous landscape: a big plain in the north, the mountain ranges of Bamburanao and Menses-Cueto and the mountains of Fomento and Guamuhaya, more in the center of the province. It has long rivers, especially Jatibonico del Norte, Higuanojo, Yayabo, Jatibonico del Sur y Zaza. In terms of soils, brown carbonated soils are prevalent, as well as typical ferralitic red soils and hydromorphic soils (ONEI, 2016a)

Figure 5. On the left, central part of Cuba with the area of the research marked with the yellow square. On the right, expanded map of the specific research area comprehending the municipalities of Cabaiguán, Taguasco and Sancti Spiritus (capital of the province).

Cuba has a population of 11.239.224, and Sancti Spiritus represents the 4,1% (466.359) of it with a medium (68,8 hab/km^2) population density (ONEI, 2016a).

3.2 Selection criteria and selected farm households

The research was done together with six agroecological family farms of the province of Sancti Spiritus. The reason six family farms were analysed is because of the researcher's contacts in Cuba, the possibilities discussed with the ANAP (*Asociación Nacional de Agricultores Pequeños*, National Association of Small Producers) who gave the permits to visit the farms, and because four out of six were included in Leidy study. Del Medio (IF1), the farm where I was hosted, is situated in Sancti Spiritus province, and Leidy is the oldest daughter of the family. She, has recently graduated from a PhD with her PhD Thesis, titled *the methodological basis to evaluate the socio-ecological resilience of family farms in Cuba* (Casimiro, 2016). Due to place proximity from where I was hosted and the available secondary data already collected by Casimiro in that region, six family farms were selected. Those farms are already part of BIOMAS-CUBA, a project from EEPF-IH that started in 2008 to explore sustainable alternatives for energy production, based on local resources, and provide technologies to reduce energy dependence. The overall goal of BIOMAS-CUBA is to reach energy sovereignty in agriculture, by producing, most of the energy consumed by the farm, on the farm. Moreover, participation is one of the transversal objectives of the project, what made the development of this research smoother because they were already used to be interviewed and give their opinions. In Table 1 there are the family farms included on the study. In the next chapter (Chapter 4) the profile of each farm is provided:

Table 1. The family farms included in this study and the programmed visits

Nº	Name	Cooperative (CCS)	Family name	Municipality	Visits
1	Del Medio	Rolando Reina	Casimiro Rodríguez	Taguasco	I lived here 3 months
2	Río de Agua Viva	10 de octubre	Solenzal García	Sancti Spíritus	February 13; March 18-19; April 17
3	San José	Bernardo Arias	Torres Gil	Sancti Spíritus	February 13;

					March 19-20; April 17-18
4	Flor del Cayo	Patria o Muerte	González López	Cabaigúan	March 2; March 20-21; April 19-20
5	El Ingenito	Julio Piñero	De la Concepción Pérez	Cabaigúan	March 2; March 21-22; April 20
6	Las Dos Rosas	Bermundo Paz	Rodríguez López	Cabaigúan	March 2; March 22-23; April 21-22

Six farms were part of this research and 24 interviews were performed to all the adults of the family living on the farm. There were 11 men and 13 women with an average age of 46 years old. The youngest household (26 years old) was Rio de Agua Viva, and the oldest household (41 years old) was Flor del Cayo. Considering also the kids and the direct family not living at the farm, the average goes down to 34 years old. This is a good sign, since it means there are children on the farm that may want to take over the *finca*. It is important to get acquainted with the names, to be able to follow the profiles, the indicators and the outcomes from the interviews. Following, there are two tables: one with the names of the family members present at each farm (Table 2) and another with more technical information about location, precipitation, temperature and soil properties (Table 3).

Table 2. Household composition of the farms with all the active members of the family living in the farm. The number of the case study and the number associated to each participant are useful to follow the discussion of the results in Chapter 6.

Case Study	*Finca*	Nº	Household composition	Age
1	Del Medio	1	Juan	61
		2	Montse	59
		3	Julio	35
		4	Laura	26
		5	Claudia	22
2	Rio de Agua Viva	6	Mireia	46
		7	Raul	53
		8	Yanina	28
		9	Sergio	31
3	San José	10	Pedro	70
		11	Elena	67

		12	Angel	37
		13	Raquel	28
		14	Lola	18
4	Flor del Cayo	15	Jacinta	50
		16	Nico	55
5	El Ingenito	17	Joaquin	80
		18	Ana	75
		19	Luisa	37
		20	Oliver	40
		21	Luis	40
		22	Yolanda	35
6	Las Dos Rosas	23	Marta	44
		24	Adrián	48

In Table 3 technical information of the six farms is provided. Geographical coordinates are extracted from Google Maps®. Precipitation and Temperatures are an average of each municipality (ONEI, 2015a, b, c and d). For finca Del Medio there is more specific data due to the previous work of Casimiro (2016a). Information from the soils is a combination of ONEI (2016b) and Casimiro (2016). There are some differences among the farms, but this is an estimate from the *Oficina Nacional de Estadística e Información* (National Statistics and Information Office) and the work from Casimiro (2016).

Table 3. Technical information of each farm.

Case Study	Finca	Geographical coordinates	Municipality	Precipitation*	Temperature (max-min)*	Soils*
1	Del Medio	22.01646, -79.30516	Taguasco	1292	30ºC-23ºC	Brown carbonated soils are prevalent, as well as typical ferritic red soils and hydromorphic soils. They are also characterized with some slope % and with medium to low organic matter content. They have good
2	Rio de Agua Viva	21.89882, -79.44691	Sancti Spiritus	1275	31ºC-21ºC	
3	San José	21.99677, -79.48247				
4	Flor del Cayo	22.06766, -79.56401	Cabaiguán	1332		
5	Ingenito	22.06647, -79.56275				

6	Las Dos Rosas	22.10374, -79.48957				superficial and internal drainage and they are usually affected by erosive processes. The relief, the compaction and the rocks are some of the limiting factors of the area.

3.3 STUDY DESIGN

A mixed method procedure suits the aim of this study because it combines the collection of qualitative (open-ended) and quantitative (close-ended) data in response to the research question. This method is suited to the research because each type of data collection method answers to one of the sub-research questions; quantitative method for SRQ1 and qualititve method for SRQ2, and the combination of the two answer to the main research question (RQ). The blending of data provides a stronger understanding of the situation that either by one method alone (Creswell, 2013). A multiple case study design, with six family farms as case, is adopted.
The main research instruments were observation, semi-structured interviews and quantitative primary and secondary data collected using the questionnaires for the farm diagnosis developed by Casimiro (2016). The primary qualitative data and the primary and secondary quantitative data were integrated in the final analysis phase, to have an idea on how the practices of community economies performed by the participants provided meaningful information to understand the resilience of socio-ecological systems, answering the main research question.

A combination of methods was the key element of this research. Observation and description for the first phase of getting to know each other and the farms (qualitative data); exploration and explication of the farms by using the semi-structured interviews (qualitative data) and the questionnaires (quantitative and qualitative data) on the second phase, and integration of the data in the third phase to answer the main research question.

3.4 DATA COLLECTION AND ANALYSIS METHODS

Academic research can facilitate the process of analysing socio-ecological resilience via development of participatory research methodologies to better stimulate farmer's own perception on a selected topic, in this research regarding socio-ecological resilience. To serve the above-mentioned scope, it is necessary to: a) get to know the farm through an informal walk through the *finca*[1]*;* b) to understand farmer's adaptive practices; c) to collect information from previous studies about the socio-ecological resilience of the farms (Casimiro, 2016); and d) to perform the interviews with all family members.

The research is pragmatically divided into three main research phases. The first phase, is mainly about observing and descripting, in both directions. For the researcher to get to know how the farm works and

[1] How Cubans refer to their farms.

for the families to get to know the researcher. The second phase is explorative and explanatory and the third phase comparative and conclusive.

Figure 6. Phases of the research

In each phase, specific methods have been used to collect data to answer the research questions mentioned in the first chapter. In the following table, there is an overview of each phase, the methodology followed, the results obtained to answer the sub-research questions and the main research question:

Table 4. Graphic summary of the stages of the reserach, the methodology and methods followed at each phase, the results obtained and the relation with the research question and the sub-research questions.

Phase	Focus	Methodology		Methods	Data results	Answer to
1	Observation and Description			Walks on the farms. Informal talks with the HH members. Living at the farm	Family farm profiles. Information about the farm, the family and the family farm dynamics	
2	Explorative and Explanative	MERS (Casimiro, 2016)	Secondary data collection	Meeting with Casimiro	Indicators of resilience of three farms	**SRQ1**
		Community Economies	Primary data collection	Farm diagnosis questionnaire Semi-structured interviews	Information on the farm for indicators	
3	Comparative and Conclusive	Data analysis		Excel templates provided by Casimiro for indicators	Indicators of resilience of three farms	**SRQ1**
				QDA mite for interview analysis	Needs, surplus and encounter	**SRQ2**
		Integration		Critical reading of the results	Broad understanding of socio-ecological resilience	**RQ**

3.4.1 Phase 1: Observing and descripting

The first phase was a logical step when starting a research. The aim of this phase is to place the researcher and the participants in a common ground, to get to know each other and create a space for trust and exchange of ideas. The methods were mainly walks through the farm with the members while talking about the farm. There is a main farm where I lived during the whole research period, and I was staying at the other farms two-three days in a row to get to know the dynamics as well.

3.4.2 Phase 2: Exploring and explaining

The second phase was meant to collect the data necessary to be able to answer the research questions. For this phase I used the MERS methodology (Casimiro, 2016, see Annex A for detailed information) and semi-structured interviews to all the family farm members of the household.

3.4.2.1 INDICATORS FOR SOCIO-ECOLOGICAL RESILIENCE EVALUATION – MERS (CASIMIRO, 2016)

To be able to evaluate the socio-ecological resilience of family farms and answer SRQ1 I used MERS (*Metodología para la Evaluación de la Resiliencia Socioecológica*, Methodology for the Evaluation of Socio-ecological Resilience) developed by Casimiro (2016) and explained in detail in the Appendix A.

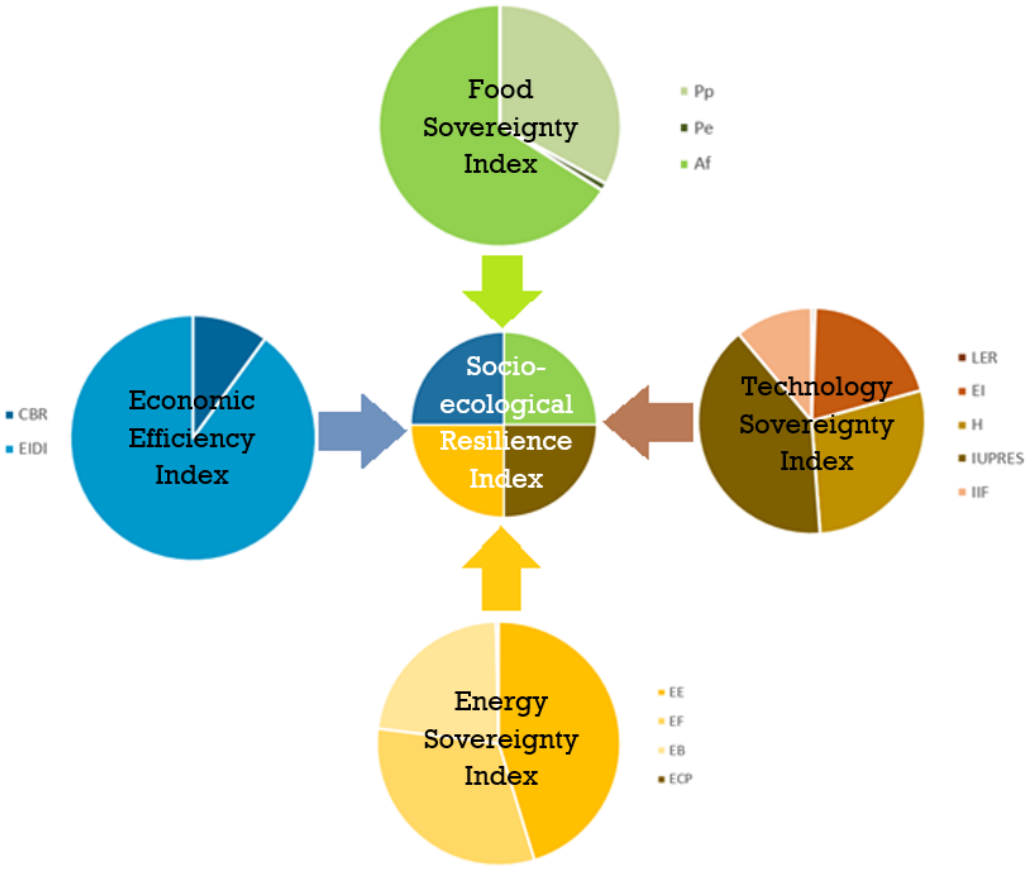

Figure 7. Socio-ecological Resilience Index (SRI). Each of the four indices contribute equally to the creation of SRI and each index is composed by indicators which have a relative weight (indicated with the pertinent colours of each circle)

To obtain the indicators for the six farms, two methods were used: collection of the indicators obtained previously by Casimiro (secondary data) and the farm diagnosis questionnaire provided by Casimiro to obtain the indictors of the farms that were not covered previously by Casimiro (primary data).

- **Step 1**: First I obtained the resilience indicators that were already collected by the completion of the PhD of Leidy and she taught me how to perform the questionnaires to obtain the necessary data for the creation of the indicators. She provided me with the farm diagnosis questionnaires (see Appendix B) and the excel templates to analyse the questionnaires and obtain the indicators.
- **Step 2**: Once I had the questionnaire I went to the farms where I asked all the necessary elements: farm area, water availability, energy sources of the system, composition and characterisitcs of the family and the workers, working hours of humans and anaimals, salaries, total year farm production, productive inputs (chemicals, food, energy, others), residue treatment, agroecological practices present in the system. The last part of the questionnaire was done by my, to determine the innovative intensity of the farm (part of the indicators for the creation of the Technology Sovereignty Index.
- **Step 3**: Once the questionnaire was done I entered the data on the excel template provided by Leidy, separating production and inputs, mainly. In each of the sheets there were all the productions (if not present I would add it), and then per element there was: Production (Kg) for the production and amount of input for the input sheet; Total income (CUP, the national currency of Cuba) for the production and Total expenditure (CUP) for the inputs; energetic equivalent (MJ/u) for both production and inputs; protein equivalent (Kg/u) for the production, the total energy (MJ) and the total protein (Kg). An example of the template can be found in the Appendix C. After entering all the data to the excel, I got the four indices: Food Sovereignty Index, Technology Sovereignty Index, Energy Sovereignty Index and Economic Efficiency Index, which combined gave me the Socio-ecological Resilience Index.
- **Step 4**: Check all the templates with Leidy for possible errors and discussion of the indicators with her. The questionnaire provides much more information than needed to come out with the indicators (numbers), but the information the participants share when doing the questionnaire is highly relevant for the meaningful interpretation of the indicators.

Using the MERS methodology and interpreting the results allowed me to answer SRQ1.

3.4.2.2 SEMI-STRUCTURED INTERVIEWS

The second method used was the semi-structured interviews.

- **Step 1**: Pilot interview with Juan Casimiro to check the functioning of the interview.
- **Step 2:** Interviews to all the family farm members (see Annex D).
- **Step 3**: Transcription of the interviews in Spanish.
- **Step 4**: Interview analysis using the QDA mite® program to code them (in English) and extract the information regarding needs, surplus and encounters.
- **Step 5**: Translation of the specific quotes from Spanish to English by myself to incorporate them in the analysis and give vivid examples.

In the results, when a participant is mentioned there is a code in brackets to relate it to the farm and the person. The code starts with IF (Interview Farm), the number of the farm and the number of the participant, that can be found on Table 2 (pg. 24).
An example follows: for Juan, from finca Del Medio the code will be: IF1_1.

The interviews and the later analysis allowed the researcher to answer SRQ2.

3.4.3 Phase 3: Comparing and concluding

The last phase of the research is the comparison of the results from the indicators and the interviews to see how the theory of community economies can add information on the evaluation of socio-ecological resilience of family farms, answering the main RQ.

3.5 CHALLENGES

Scientific integration seems to contradict the self-dynamics of scientific progress which can be regarded as a process of differentiation, specialisation and fragmentation. The specific aim of this reserach, to add another perspective, is challenging these dynamics of scientific progress and calling for a more integrative and divergent thinking, that support scientist and encourage them to make connections with other scientist. Scientists interested or involved in interdisciplinary and transdisciplinary research might therefore face structural barriers that hinder integration such as limited funding opportunities or restricted career opportunities (Fortuin et al., 2014). But it can also be exciting and inspiring, it can create novel, and unexpected achievements (Fortuin et al., 2014), and the encounter with other scientist, the conversations between disciplines and the recognition of the intrdependency, should be the base for scientific progress.

3.6 ETHICAL CONCERNS

After the first month, building trust with the families, oral consent was obtained from the respondents before taking the interviews. Before starting the with the interviews, the research purpose was presented during the previous visits and permission for recording the interviews was asked.

Participants' anonymity has been ensured. Details that could reveal identity were removed.

No other incentive was thought for the participants, even though there is the planning to return the results of the research in a smaller format and have a group discussion in the future.

The following chapters are the results of the research, that are divided in three. The first one will introduce the six farms and their characteristics. The second subchapter will be the result of primary and secondary data collection for the indicators. And the last subchapter, will be the one focusing on the interviews and the observations on-farm.

Figure 8. Picture of the houses present on the farm where the researcher lived during the field work in Sancti Spiritus, Cuba.

4. *FINCAS* – FARM PROFILES

In this chapter, there is a brief introduction of common elements that all fincas[2] of the research share, followed by a detailed profile of each farm. The profile is the result of the observation through the walks on the farms, the talks with the members and parts of the farm diagnosis questionnaire. This section serves the purpose to present, as much as possible, the characteristics of each farm to the reader, so results, discussion and conclusion are easier to follow and understand.

The six farms of the research share important features for its representation in the family farm sector in Cuba:

- All the farms are all part of the Cuban cooperative sector, specifically to CCS, and, as explained previously in the first chapter, this sector manages more than the 70% of the agricultural land in Cuba (ONEI, 2016b), so they are very important in the agricultural sector.
- They are all family farms, meaning that the family is living on the site and is the primary labour force (Van der Ploeg, 2013), even though some farms may hire outside workers. In Cuba, peasant family farms produce more than 65% of the country food (Rosset, Machín, Roque & Ávila, 2011; ONEI, 2015a), so they are the drivers for the country's food sovereignty.
- Due to the nature of Cuban land property, as explained on chapter one, all the farms in Cuba have a contract with the State. So, depending on the production and the animals a farm has, there is a production contract assigned to each farm, which is called the social object. Four farms out of six have tobacco as social object, with contract with the State, among other productions.
- More than 70% of the land in Cuba is degraded (the so called *tierra ociosa*), which means that is land not being used for agricultural purposes, nor livestock, nor forestry nor fruit production (unless it is on fallow period) or land that is covered with marabou, weeds or invasive plants giving very low yields (ONEI, 2016b). Moreover, most of the times, this degraded land is in scattered plots or with difficult access which makes it impossible for monoculture industrial agriculture to compete with family farming, considered to be one of the best ways in which this land can be restored (Casimiro, 2016). The farm sizes, ranging from 1ha to 14ha (small-medium), the diversification of the production and the crop and animal integration in the systems are some of the features that makes family farming the most viable option to recover those areas (Nicholls, 2011).
- The mean area in Cuban family farms is about 11,5ha, including the housing (Pérez, 2012; Casimiro, 2016). All the farms in this research are ranging from 3 to 13,42ha, with an average of 7,3ha, so most of the farms are around this number. There is only one farm that is bigger than the mean area, Las Dos Rosas (13,42ha). All the other farms have a smaller area. It is important to note that some farms, like Rio de Agua Viva, Flor del Cayo and Ingenito have additional farming area, outside the family farm, where they also produce.
- Most family farms in Cuba present a mix of traditional (i.e. intercropping and animal traction) and conventional (i.e. chemical application for the tobacco) practices (Casimiro, 2016) due to the different crops present in the farm. Tobacco needs a lot of fertilizers and labour, but there are different strategies to deal with it, depending on the farm and its organization. More will be explained on each farm profile.
- Family farming is practiced, in general, by peasants associated to the Cooperatives of Credit and Service (CCS). All the farms of this research are part of a CCS.

[2] *Finca* is the term for farm that I will use through the thesis.

In the following table, we have an overview of the six farms with the total area of the farm (ha), the animals present on the farm, the main crops cultivated, the family members living in the household, and the permanent and occasional workers. In bold there are the animals or crops that are part of the social object of the farm (the product which are sold to the cooperative), and the crops with * are the ones used to feed some of the animals. For example, in Del Medio, cows are the main animal, from which milk and meat is sold and sugarcane is one of the fodder for the animals, whereas in Rio de Agua Viva, apart from cows they also sell pigs, and they use Kingrass as fodder for the cows.

Figure 9. Pictures of the diffrent farms. Top left, image of a one of the biodigestors in finca 1; Top right Marta taking the feathers out of the chicken to prepare the dinner; Middle picture, overview of finca San Juan; Down left Adrián and his nephew cleaning the pig; Down right the two oxen of Flor del Cayo.

Table 5. Overview of the six farms: area, animals, crops and cultivated fodder, household members (in brackets, expressed the members that do not live in the farm but go there occasionally) and workers (permanent and occasional).

	Finca	Total Area (ha)	Animals	Main crops	Family members	Workers	
						Permanent	Occasional
1	Del Medio	10	**Cows** Pig Chickens Rabbits Turkey Horses Bees Dogs	Manioc Beans Potatoes Malanga Bananas Mangos Avocados Sugarcane* Others Home garden	5 adults 2 children	1	2
2	Rio de Agua Viva	3 (13)[3]	**Cows** **Pigs** Chickens Guinea fowls Goose Sheeps Goats Rabbits Guinea pigs Horses Bees Fish	Maize Beans Pumpkin Sweet potatoes Malanga Tomatoes Bananas Guayaba Mango Pineapple Kingrass* Others	4 adults 3 children	0	0

[3] Explained in the profile of this specific farm.

			Dog	Home garden			
3	San José	9	**Cows** **Pigs** Chickens Guinea fowls Goose Sheeps Rabbits Oxen Dogs	**Tobacco** Beans Pumpkin Sweet potatoes Malanga Tomatoes Bananas Guayaba Mango Pineapple Kingrass + kudzú* Others	5 adults 3 children	1	0 (5)
4	Flor del Cayo	9,63 (8)	**Cows** **Pigs** Chickens Horses Oxen Fish Dogs	**Tobacco** Maize **Beans** Manioc **Malanga** Tomatoes **Bananas** Guayaba Mango Sorghum* Others	2 adults (+2)	2	10
5	Ingenito	7,2 (32)	**Cows** **Pigs** Chickens	**Tobacco** **Tobacco seedling** Rice	6 adults 3 children	1	8

			Sheeps Horses	Maize **Beans** Manioc Malanga **Pumpkin** Onions Tomatoes Bananas Guayaba Mango **Papaya** Sucarcane* Others			
6	Las Dos Rosas	13,42[4]	Cows **Pigs** Chickens Horses Oxen Dogs	**Tobacco** **Beans** Manioc Malanga Sweet potatoes **Pumpkin** Onions Onions seedling Bananas Guayaba Mango Avocado Sucarcane* Others	2 adults (+2)	4	15

[4] 13,42ha is the local unit for *una caballería* (literally translated to 'one horse')

Up next the detailed profiles of the six farms are presented. From the six case studies there is one, Del Medio, which is more developed due to the time I spent on the farm. I lived there for three months so I have much more information than from the other farms, which I think it is important to keep in mind. The profiles follow the structure of: location of the farm, a bit of history of how did the family got there, the household composition and the permanent/occasional workers, the livelihoods of the family members, the water availability in the farm, the sources of energy used, the infrastructures present at the farm (installations, machines and perimeter), the treatment they give to the residuals, the agroecological practices present in the system and the appropriate technologies used, to increase the efficiency of the system.

Figure 10. map with the six different locations. 1. Del Medio, 2. rio de agua viva, 3. san josé, 4. flor del cayo, 5. ingenito and 6 las dos rosas. Scale: 1cm=2km

4.1 Del Medio

Location: The farm is situated in the municipality of Taguasco, in the province of Sancti Spiritus (see Figure 7, number 1), nearby Siguaney village, where they bring the milk every day and where Dario goes to school.

History: The *finca* Del Medio is a 10ha space of constant creativity and self-reflection. During the last 20 years they went through an agroecological transition. The family arrived at the land during the Special Period, in 1995 and at that time the land was mainly used for tobacco plantation and self-provisioning for the family. The land was once part of a bigger farm, *finca* Nueva, from the grandfather of José, who

started working it in 1942 with traditional techniques (Casimiro, 2016). In 1975 there was a shift adopting the technological packages and the chemical inputs suggested by the state to grow the tobacco and the other crops. Later, in 1994, *finca* Nueva was divided in two equal parts, for the father of Juan and his uncle. One of these parts (10ha) would become *finca* Del Medio, which nowadays is run by the family part of this research. The *finca* went through a transition from conventional practices, with mainly monoculture of tobacco which demands high input, towards a more holistic understanding of the farming system, using agroecology and permaculture as the guiding principles for the rural revolution they started, and start producing what they are doing now. From 1995 until now, 2017, they have been working to increase system efficiency and have more and more free time to also do other things they enjoy like writing, reading or painting.

Household composition and permanent/occasional workers: In the farm, they are 5 adults and 2 children. José Antonio (61) and Miledy (59) are the parents and creators of the farm project, together with their daughters (Leidy, 36 and Claudia, 23) and son (José Antonio jr. (35). Laura (the wife of José Antonio jr. 25) is also living in the farm and she is the main cook of the family. Dario (7) is the son of Leidy and Juan Alberto (5) is the son of Laura and Juan Antonio jr. They both are the young generation of the farm, the ones that possibly will continue working the land. Felipe (70) is a friend of the family who also works there during the weekdays and gives his wise advice due to his experience. Moreover, sometimes they hire a father and a son to help them with some punctual work, like doing some new fences or bringing logs from the dam, during the dry season.

Livelihoods: The whole family lives off the farm income. In *finca* Del Medio the contract is for milk, but they also sell the overproduction of other items like bananas or beans, once they covered the family (and friends') consumption. They also have an extra income from rural tourism. They been working on the construction of little houses where guests can spend a night and share with the family. Day visits are also a part of their project, so a big group can enjoy a day on the farm, share with the family and eat the home-grown food. Also, Leidy, the oldest daughter, she also works outside the farm as a researcher and brings whatever is needed when needed.

Water availability: In the farm area there is a dam, constructed by the family, and two wells, also build by themselves. In the dam, during the rainy season (April-November), usually there is a hydraulic ram working and pumping the water up. The two wells are connected with wind mills which make the function of pumping the water up. They worked very hard to have no problems with water, even during the dry period. There is a cistern, where the water from the dam gets collected for further utilization, as well as multiple collectors for the rainwater and the wells to use for the toilet or to water the plants. Next to the living area they also have a water reservoir that can keep around 40m3, from the rain or they can deviate water from the cistern, when this one is full. Moreover, they have a lot of contour lines with bananas, mangos and other fruit trees to reduce erosive drainage and keep the maximum amount of water in the system. Because the farm has an approximately 7% of slope, the dam, which is built at the lowest point of the *finca*, collects all the water that has passed by all the crops and trees, so there is no element disconnected, and no function provided by more than one element following the permaculture principles (Mollison, 1989).

Energy sources for the system: the main source of energy of the farm is the biodigestor, which approximately provides around 35% of the total energy, by the use of the biogas to cook and for the refrigeration of the fridges. The other important source of energy for the farm is the wind, which provides around 30% of the energy of the system. The 35% left is provided by the electrical energy (15%) that arrives to the farm, which most of the time is fall down, some fossil fuels (2%) for the motor, which the family uses sometimes to go to town, even though they go most of the times by horse (10%), another energy source for the transport. Moreover, they also have an efficient wooden stove (7%) which they

use to prepare food for animals and humans, to preserve food and boil water, among other functions. It is called efficient because, besides the several times that has been rebuilt to attain perfection, provides many functions at once (keeps the room warm, can dry fruits, boil water), using the same wood for many different functions. Lately they got, as a present, a solar oven (1%) which they used for cooking some vegetables. Due to the slow cooking properties of the solar oven food keeps the nutrients better than when boiled or fried.

Farm infrastructures: During the last years, they worked a lot on the construction of circular houses, for the main domestic area, that have several benefits: they are better resisting strong winds, the *Hedera* that grows on it isolates the room, so it is not too cold, nor too hot, and they have a great acoustic for a concert on the living room. There is the main dome, which is the one that was built first, that is the kitchen-living room, then, just in front and around the main dome there are two other domes and one small house, where most of the family lives, and also people that come visit stay. There is another small house, a bit separated from the rest where Laura, José and Juan-Alberto live. They are now working on two other domes. Because they like to experiment they are building one of the two domes with dry stones. Apart from the human houses there is also a small room where other elements for preparing food are present such as the wooden stove, the biogas oven, and the dryer shelves. It also serves as a repository, where they store the beans, the rice and other important and everyday products. There is also the old tobacco house, that at the moment they also use it as a repository, and planning to bring down and use the materials to build a new one, better isolated from the rats and the water. Last but not least there are the animal installations: the stable, where the cows spend the night, so the family can collect the manure for the biodigestor; the chicken house, where they can go to collect the eggs (even though they also have small straw nests everywhere); and the pig stable, where the pig is being fed and fattened with the leftovers of the family meals so after few months can be killed and preserved for the following months. Next to the dam there is a "jacuzzi" that works with the water force coming from the dam and provides a space of recreation for the family, to enjoy together.

Concerning machinery, there are few machines in the farm, most of the things are done manually, even though they are now thinking about buying a tractor, to humanize the labour, they have done most of the things by hand for several years. José Antonio, the father, created a ploughing machine with several functions (for more information about this see Appendix B). They have a "semi-automatic" washing machine but sometimes they also wash by hand, depending on the amount of clothes. They have a lot of old tools to fix the carriages or the oxen car as well as a lot of different mills (for the coffee, for the maize, for the coconut…).

The perimeter of the farm is a very important feature for the social sustainability of the farm and the promotion of healthy relationships with the nearby farmers. As José says, there is an essential principle: "…do not bother anybody or anything..." (Casimiro González, 2007), so if there are good fences, possibly live fences, with multipurpose trees or bushes, no animals will jump to the neighbouring fields, avoiding the conflict and keeping the animals where they belong. And it also works in the other way: no strangers can get in the farm area without being previously invited. In the farm, they have mainly *Bromelia pinguin L.* for the perimeter, as well as coconuts and other trees. The live fences are important for various reasons: first, they are alive, so they are part of the living system, providing food and shelter for other animals, like natural enemies, which will help with natural pest regulation. Second, they are

establishing the physical limits of the farm, avoiding animals to cross. Third, they also prevent soil erosion and enhance drainage and water retention due to the presence of roots in the soil. They also serve as wind breakers, protecting the crops and giving food to animals and humans. Moreover, they work as the alternative to conventional fencing (sticks and net), which sometimes is difficult to obtain due to shortage of products in the Cuban market (Casimiro, 2016).

Residues treatment: Most of the residues (i.e. crop parts that are not used for food, food leftover or grey water) are resources in Del Medio. Thanks to the endless motivation of the family in the project and the wish to make as much closed cycles as possible they have quite a good system in terms of recycling and turning waste into something valuable again. For the food leftover, there is not even a gram of waste. Everything you can't finish, the dogs will, or the pig, or the chickens. The water, as I explained above is also circularly re-used. From the toilets it goes, some to a pit, and some to the biodigestor. If there is soap, for example the one from the shower, it cannot go to the biodigestor, because it would kill the microorganisms, but the one from the toilet does. The biodigestor is a residue machine converter. The manure from animals and the faeces from humans go in and biogas and biofertilizers come out, decreasing at the same time the amount of nitrogen going to the atmosphere and the smell on the air, so contributing to the well-being of the family. The yield residues most of the time stay at the field so carbon and nitrogen are given back to the system. The glass bottles are used and reused for the preservation of fruits and sauces, the paper burnt in the wooden stove and the plastic is the only residue existing, that is thrown in the village.

Agroecological practices present in the system: they have a whole agroecological mindset, and they combine it with the permaculture principles, which makes this farm a very special place. From a knowledge point of view, they are already practicing agroecology in their management. They do crop rotation and intercropping (for example malanga, manioc and maize), they have the whole farm surrounded by trees that perform more than one function (windbreaker, shelter for insects and small animals, nesting for birds, fencing the area and provide food for animals and humans), they use the slope in their favour by the use of contour lines that help the soil retain more water and reduce erosion, and the position of the dam at the end of the slope ensures that most of the water stays in the system, they have an integrated residual management. They make vermiculture with the manure from the cows and the effluents of the biodigestor which then use for the home garden and the other fields.

Appropriate technologies: Use of biodigestor, windmill, hydraulic ram, efficient wood stove, dehydration of foods for flour and preservation and solar oven.

4.2 Rio de Agua Viva

Location: The farm is situated in La Sierrita, a neighbourhood of Sancti Spiritus city (see Figure 7, number 2).

History: The *finca* Rio de Agua Viva is a young farm of 3ha, which is much lower from the Cuban average of 11,5ha. They arrived at this farm 10 years ago, with a contract to work the land, at first moment with pig production. Raul, the father of the family, was already working in a plot of land before, but the family was not living there, and that made things difficult in terms of time management and protection of the farm, because he got stolen few times. After five years of living all together in this area they connected with the ANAP (the National Association of Small Producers) which introduced them to the agroecological movement present in Cuba and they started to follow courses and workshops that capacitated them to make a transition to a more integrated way of farming, mainly moved for a wish to

eat without poison. From 2014 until now, they have been working to integrate the animals with the other elements of the farm and also to have a place where to feel comfortable to live in.

Household composition and permanent/occasional workers: In the farm, they are 4 adults and 3 children. Mireia (46) and Raul (53) are the creators of the farming system, together with their daughters (Yanina, 28; Ruth, 12; and Debora, 9). Sergio (the husband of Yanina, 31) and Yanina also work in the farm, but they live in another house, in the same farm area, where they live together with his son, Josuá (7 months). They do not have permanent or occasional workers, even though sometimes a friend comes to gives them a hand, and the brother of Raul lives next door, with whom they share activities, such as taking care of the bees, and take care of each other.

Livelihoods: The whole family lives off the farm income. In this *finca* the contract is for pigs and cows (meat and milk), and they also sell the overproduction of other animals like sheep, goat, and eggs as well. They also have an extra income from the church, where Yanina and Sergio are pastors, but this income stays with them. Sergio also works sometimes weighing pigs with his scale.

Water availability: Even though the farm is called Rio de Agua Viva (Live Water River) there is no river on it. Instead there is a well which did not dry during this last three years of intense drought in Cuba. From the well, with the help of a windmill, they fill in an elevated cistern, where they can store up to 7000L. With the cistern, they can water the fields and have water in the house by using the force of gravity.

Energy sources for the system: the main source of energy of the farm is also the biodigestor, which approximately provides around 40% of the total energy, by the use of the biogas to cook. They have the biggest biodigestor of the farms of this study, with the capacity of 43m3. The second most important source of energy for the farm is the wind, which provides around 35% of the energy of the system and it is used to pump the water from the well to the cistern. The 25% left is provided by the electrical energy (15%) used for the ventilators, the fridge and the television, and by the daily use of the horse (10%), to go anywhere. They do not have any need of fossil fuels for any of their activities. Moreover, they are working on the construction of an efficient oven. They also use the energy of the sun to dry fruits and preserve them for later.

Farm infrastructures: There are two houses in the farm area, the first built, where Raul, Mireia, Debora and Ruth live and another one, built later, to have more privacy for Yanina, Sergio and Josuá. There are few installations for the animals: several stables for the cows, the pigs, the sheep and the goats; a shelter for the rabbits and the guinea pigs, where they have the vermiculture; and a pond for the fish. Next to the house they are now building a small kitchen and a big table so they can also welcome visitors and offer a pleasant environment to enjoy together. Next to that they have a big cupboard where they store all the sauces and canned food that they have conserved. Moreover, they also used to have a "covered garden", which now is on standby, but ongoing project. In the cow stable they built a very big pot to cook the cow heads to make the food for the pigs. Just next to the house there is also a small park for the daughters and the grandson, with a handmade swing and a slide, where they

can play. The fish pond, when is very hot, is used to swim. Additionally, they also have access to the shooting range that is next to the farm, which they use to let the cows graze.
They have almost no machines, just the pipes that use to water the fields, and the big pot to cook the cow heads. Apart from that they don't have any more machine. They also have mills to process food and to make food for the fish.
The perimeter of the farm is still young, like the farm, so it possible to see that they are working on a live fence along the entrance with fruit and fodder trees like coconuts, mangos and moringa. Still, most of the perimeter of the farm is defined by conventional fencing, with sticks and nets.

Residues treatment: In this *finca*, most of the residues are resources. They are really engaged with the projects of ANAP, PIAL and BIOMASS, so they try to incorporate all the new practices they get from talking with other peasants and from the participation in workshops. They have the vermiculture under the rabbit and the guinea pig so their faeces go directly there. The organic leftover is turned over into compost, to improve the soil. They also have a biodigestor, enough to cover their needs and for five other families when necessary. They use the residues from the sugarcane to feed the animals, as well as the residues from the slaughterhouse (the cow heads and other parts for the pigs). They also have a quite closed cycle for the water. From the well it goes to the pipe, which continues to the pipe and this one gives water to the house and to the pond. From the house, the wastewater goes to a pit. And the water of the pond is first used by humans and fish, and at a last stage it can be used to water the fields. The residues of the harvest also stay at the field. Because of the conservation techniques, they also reuse the glass bottles and other containers. Again, plastic is one of the residues that cannot be properly recycled, so it is thrown in town.

Agroecological practices present in the system: Because of their participation with all these projects they are very active in the creation of an integrated system. They do crop rotation and intercropping (beans and maize). There are live fences with *Jatropha curcas*, *Bursera simaruba* or *Moringa oleífera*, among others, which perform several functions: from fodder for the animals (*Jatropha*) to medicine for animals and humans (*Bursera* and *Moringa*). They also have a lot of fruit trees growing like coconuts, mangos, guava, tamarind, plums and bananas. They also make vermiculture with the manure from the cows, the rabbits, the guinea pigs and the effluents of the biodigestor. They also make compost and grow plants that are good as green manures such as *Azadirachta indica or Leucaena leucocephala.* Furthermore, they also use efficient microorganisms, produced by themselves, to fertilize the land and protect the plants.

Appropriate technologies: Use of biodigestor, windmill, cow heads cooking pot, dehydration of foods for flour and preservation.

4.3 SAN JOSÉ

Location: The farm is situated in the outside area of Sancti Spiritus, between tobacco fields and nearby La Aurora village (see map, number 3).

History: San José is a *finca* that has been kept by three generations already and continuing with fourth and probably fifth. The grandparents of Pedro, the father of the family, started the farm in 1890, more than a century ago, so it is a very mature system of 10ha, very close to the Cuban average, that has been cultivated and domesticated over a long period of time, a characteristic that you can observe just by looking at the forest standing behind the house, full of wise old trees.

Household composition and permanent/occasional workers: In the farm, at the moment, they are 5 adults and 2 children. Pedro (70) and Elena (67) are the parents of Arley (41) and Angel (37). Arley is now in

a mission in South-Africa, and has a child, Alejandro (9 months), with Lola (19), who also lives at the house. The mother of Lola is at the house most of the times, to help her daughter with her grandson, but she has her own house few meters away from the farm. Angel also has her partner, Raquel (28), living at home with him, with the daughter of her, Ángely (3). The household composition changes during the weekends and school holidays because then Rosi (7), the other daughter of Arley, and Kevin (14), the other son of Angel, are also there. They do not have permanent workers, but when the tobacco needs to be harvested they work together with the neighbours.

Livelihoods: The whole family lives off the farm income. In this *finca* the contract is for tobacco, mainly. They also have contract for pigs, and some milk. As all the other farms, they also sell the overproduction of other animals like sheep, eggs, beans and mangos. Now they also have another income from the work of Arley in South-Africa, which also allow them to get materials and other stuff from the exterior market.

Water availability: In the farm there is a well, that pumps the water by the help of a turbine, for the house. With another turbine, they also pump water out from the river, to water the fields.

Energy sources for the system: they have a biodigestor, but at the moment is not fully working because the pork decreased, there is not much manure to add, so they do not use it so much (20%). For cooking they also use the wood stove (20%) that Elena used all her life until the arrival of the biogas. Another important source is electrical energy (25%), coming from the state, used for the ventilators, the fridge and the television. Fossil fuels are essential in this system, for the use of the turbines, the tractor and the motorbike (35%).

Farm infrastructures: There is a house where all the family lives. Next to the house there is the shelter for the rabbits and some mills and machines for the harvest of different crops. A bit further away there is the tobacco house, a very typical landscape element of the region. There are also installations for the animals: a stable for the pigs and a fenced area for the sheep. Behind the house, where the forest starts they have an amphitheatre, to provide the space for workshops, meetings and celebrations.
They have a tractor, and some electrical devices like mills and other devices to choose the rice. They also have pipes to water the fields from the river.
Most of the farm perimeter is made with live fences, with *Trichanthera gigantea* and *Morus*, providing several functions, such as protecting the area, fodder for the animals and windbreaker. There are parts of the farm that are defined by the combination of sticks and nets.

Residues treatment: Because of their mature nature, most of the residues are reincorporated in the system. First, the residues from the harvest always stay at the field (but the ones from the tobacco, that works different). Second, the organic waste is given to the pigs and the dogs. And third, there is the forest, a whole ecosystem that cycles all the residues, fixing carbon and creating a broad food soil web among the roots of the trees so more residues can be absorbed and better utilized.

Agroecological practices present in the system: In this *finca* they do crop rotation and intercropping, also for the fodder of the animals among Kingrass (*Pennisetum purpureum x typhoides*, a grass) and *Pueraria javanica* (popularly known as Kudzú, a leguminous). There are live fences as explained just

above. They also have a lot of fruit trees growing like coconuts, mangos, guava, tamarind, plums, bananas, among others. In the forest, they also have a beautiful shaded coffee plantation, for self-consumption. They also prepare efficient microorganisms, produced by themselves, to fertilize the land and protect the plants.

Appropriate technologies: Use of biodigestor.

4.4 FLOR DEL CAYO

Location: The farm is situated next to the road that goes from Cabaiguán to Santa Lucía, in the municipality of Cabaiguán (see map, number 4).

History: Flor del Cayo is also a 10ha of land, near Cuban average, farmed through generations, from the great-grandparents of Nico, the father of the family. It has been highly exploited, so the land did not rest much during the past decades. The area of the farm used to be bigger but the grandparents of Nico split it up, and one part was for his grandparents, for his father and finally his.

Household composition and permanent/occasional workers: In the farm they are 2 adults, Jacinta (50) and Nico (55), most of the time. They have three children: Lester (27), who studies and lives in Habana, and Luiver (23) and Laura (23) who are also studying and spend the weekends at home. Sometimes the parents of Jacinta also spend time at the farm, since they are old and need somebody to take care of them. They have two permanent workers during the whole year. Armando (68), who worked already with the father of Nico and works along with him from the milking to the tobacco fields. And Chipy (47), who takes care of another piece of land that Nico is also managing. They both live at their own place. During the tobacco harvest and processing they also have several occasional workers (5-6).

Livelihoods: The family lives off the farm income. In this *finca* the contract is for tobacco, pigs and cows (meat and milk). Lately they changed the land use from horticulture to livestock to let the land rest a bit. They have been thinking about it for very long and this year, with the heavy drought, they took the decision, so they need less water. They also sell the overproduction of beans, malanga and bananas. They also have a tree nursery, which also brings income to the farm. Furthermore, Nico is also managing the piece of land of the neighbour that gives them money and also food. Jacinta used to be a mathematics teacher, but she stopped when they moved to the *finca*, to work at the farm along with Nico.

Water availability: There are two wells, which provide more than 60% of the water for the system, and there is one more on the way. Water is a scarce resource in Cuba, and is getting more and more difficult with the continuous years of drought. That is why they are looking for new spots for a well. The wells provide the water for the pigs, the house and the fields. There are also two small dams that are mainly of use for the animals and the fields (40%).

Energy sources for the system: the main source of energy of the farm is electrical energy (55%). The second and very important source, the biodigestor, which approximately provides around 25% of the total energy, by the use of the biogas to cook. The next source are the fossil fuels (15%) for the car. Last, but not least, the daily use of the horse (5%), to go bring the milk to the milk tank and to go close by, because for the long distances they have the car.

Farm infrastructures: There is the house where the family lives. Next to the house there is a "secondary" kitchen that is used when there is a lot of people, working or visits. In front of the house there is a small store house, where they keep the beans, the rice and other harvests. Next to that there are two pig stables, with a lot of pigs, around 70 pigs. Behind the stables there is the biodigestor, so the faeces can go directly there by gravity. In front of the stable there is another storage house for the fodder. There is also a tobacco house, an open stable for the cows and a structure that serves as a feeder for the cows. All the infrastructures for the cows are being adapted in the last year because of the recent land use change.

They have few machines. The one to process the sorghum and the sugar cane for the animals. Sometimes they use the tractor to work the land, but it is not of property. It is collectively owned by the cooperative.

The perimeter of the farm is covered with *Acanthocereus tetragonus*, a cactus, and *Gliricida sepium* trees (widely used for their allelopathic properties) Inside the farm, to divide the space, most of the fences are made in a conventional way.

Residues treatment: The residues of the harvest, like the beans, is kept on the ground to incorporate back into the soil. The faeces from the pigs is going directly to the biodigestor. The biogas is used for cooking and the effluents to fertilize the land. The water from the house goes to a pit behind the house.

Agroecological practices present in the system: They crop rotation and intercropping (sugarcane, sunflowers and *Morus*). They have trees all around that work as windbreakers and also provide food and fodder. They also use the efficient microorganisms (EM) and the biodigestor effluents.

Appropriate technologies: Use of biodigestor.

4.5 INGENITO

Location: The farm is situated just in front of Flor del Cayo, in the same road from Cabaiguán to Santa Lucía, and it is also from the municipality of Cabaiguán (see map, number 5).

History: This is another *finca*, of 7ha, almost half of the Cuban area, but they also manage other pieces of land. The main area (of 7ha) which surrounds the house has been under the same family for years. It was from the grandparents of Joaquin. The land is also very tired of tobacco and its conventional practices. Apart from this piece of land, where the family lives and have several crops, they also have other plots. They have one where they have cows of 13,42ha. Another one where they keep the cows that are not milking also of 13,42ha. For the tobacco, this year, they had to ask to the CPA (Cooperative of Agricultural Production) for 2ha of land, because tobacco needs 4 years of fallow and they had not enough land. And they also work another 3ha piece of land for tobacco nursery, for the State. [so this is rather a bigger farm compared to the previous 4 farms mentioned]

Household composition and permanent/occasional workers: In the farm, they are 6 adults and 3 children. Ana (75) and Joaquin (80) are the parents of Luisa (37) and Luis (40). Luisa and her husband, Oliver (40), have two children, Elisabeth (5) and Alejandro (3). And Luis and his wife, Yolanda (35), have a son, José-Luis (11). They live altogether under the same roof. They have three permanent workers, who live at their own house: one that takes care of the cows, one that work along with Luis and Oliver, and

one that takes care of the tobacco nursery. As usual for the tobacco farms, when is time for the harvest they need occasional workers (6-7).

Livelihoods: The whole family lives off the farm income. In this *finca* the contract is for tobacco and the tobacco nursery, the cows (meat and milk), and they also sell the overproduction of beans, pumpkins, onions and papayas. Yolanda works as teacher assistant in the school of the cooperative next to the farm, and this income stays for her, José-Luis and Luis, since they are trying to build a new house next to the farm so everybody can have more space. Luisa and Oliver used to work outside the farm and now it is already two years that they decided to work completely off the farm and with the family.

Water availability: Next to the farm there is a small river passing by, from which they take more than 40% of the water they need, but a lot of erosion of the fields made the small river full of land and now they have to work to take it out. They also have two small dams for the animals which contribute to an approximately 30% of the water and then a well, to provision the house, which makes the other 30% of water.

Energy sources for the system: one of the main sources of energy of the farm is the biodigestor, which approximately provides around 40% of the total energy, by the use of the biogas to cook and the effluents for the land. The other main source of energy is the electrical energy (40%) for the light, the turbines to pump de water and the devices at home. Then there are also the fossil fuels, which account for a 10% of the total energy demand, mainly coming from the motor, and the 10% missing is covered by the horse, which apart from the motor is the most used transportation method.

Farm infrastructures: There is one house where all the family lives. And there is one under construction, so Yolanda, Luis and José-Luis can move there. In front of the house there is the sheep stable, where they stay during night, because during the day they stay at a fenced area outside. Next to the sheep stable there is the pigs stable, where few pigs live. They also have a big tobacco house and a shelter where to save machines and other devices.
They have almost no machines, just some turbines to pump the water and the pipes that use to water the fields.
The perimeter of the farm that is next to the road it also with *Acanthocereus tetragonus*, the cactus, but most of the perimeter of the farm is defined by conventional fencing, with sticks and nets.

Residues treatment: The leftover of the papaya and the manioc is kept on the field. The beans leftovers is given to the sheep as fodder. It is not high quality but in times of drought is a good source of nitrogen and filling substance. The effluents of the biodigestor go to the fruit trees, mainly. The water from the house goes to a pit, and the faeces from the cows stay in the place that are placed.

Agroecological practices present in the system: Because they have so many different fields it is difficult to design and manage it in a way that everything can be integrated. They do manage the residuals and use efficient microorganisms, produced by themselves in a workshop that was made in the farm, to fertilize the land and protect the plants.

Appropriate technologies: Use of biodigestor

4.6 LAS DOS ROSAS

Location: The farm is situated in La Campana, a cooperative area on the other side of the highway, also from the municipality of Cabaiguán (see map, number 6).

History: This *finca* is not one held by generations. Adrián got the *one caballería* (13,42ha) of land 10 years ago, but they moved with the family only 7 years ago, and just by watching it is possible to see that a lot of work has been invested in this farm. Adrián was working before with pigs in rented stables, until he could get land by the last land reform that allowed the request of land.

Household composition and permanent/occasional workers: In the farm, living, they are 3 adults: Marta (44) and Adrián (48), with their youngest daughter Rosmery (17). Their other daughter, Roxane (23), is living in Cabaiguán with her husband and her son Alex (2), who also spends some time in the farm whenever she can bring him. The nephews of Adrián work at the farm as permanent workers. One works with the pigs mainly and the other one work along with Adrián, managing the farm, more in general. Also, because they are tobacco farm, during the high peak of harvest they can have up to 14 workers working with the tobacco, and there is also a woman working along with Marta in the kitchen to prepare the lunch for all those workers.

Livelihoods: The whole family lives off the farm income. In this *finca* the contract is for tobacco mainly, and pigs. As all the other farms, they also sell the overproduction of other crops like bananas, avocados, mangoes, tomatoes and onions. They also have an extra income from a deal that Adrián has with the front neighbour to take care of the land while he does not have the animals there and plant it beans.

Water availability: They have a river from where they get almost half of the water they need for the fields and for the animals and they have also got a well on the farm, to provide the house with water. This year, because of the drought, a neighbour had to help them to pump water out from the river, due to the accumulation of soil on the bed of the river, that stops the water from moving and then is more difficult to extract.

Energy sources for the system: the main source of energy of the farm is also the biodigestor, which approximately provides around 40% of the total energy, by the use of the biogas to cook. The second most important source of energy for the farm is the electrical energy (40%) used for the ventilators, the fridge, the television and the turbines. They also use fossil fuels (20%) for the bulldozers that help clean the river as well as for the tractors when needed, and for the motor, which they almost use every day.

Farm infrastructures: There is the house where Adrián, Marta and Rosmary live. Part of the house is only one-year old, they started with the project of enlarging two years ago. Behind the house there is the pig stable and a small garden of medicinal plants, from which Marta is an expert. Next to the stable there is the biodigestor to collect all the faeces. In this farm, we find two tobacco houses, because he used to have tobacco covered, that is much more demanding in terms of collection and preservation.

They have almost no machines, just the pipes that use to water the fields and the tractor that they ask to the cooperative when they need it. Apart from that they don't have any more machine.

The perimeter of the farm is still young. They are working on a live fence along the entrance with fruit trees like mangoes and avocados. And, next to the road they are also planting the cactus, *Acanthocereus tetragonus*. Still, most of the perimeter of the farm is defined by conventional fencing, with sticks and nets.

Residues treatment: They use the biodigestor for the faeces of the pigs and the effluents of the biodigestor goes to the fields. Not much residual treatment is done.

Agroecological practices present in the system: They do crop rotation and intercropping (sweet potatoes and onions). They also have a lot of fruit trees growing like mangos, guavas, tamarind, plums and bananas and they also use efficient microorganisms, produced by themselves, to fertilize the land and protect the plants.

Appropriate technologies: Use of biodigestor.

In this chapter, the farm profiles were explained in detail to prepare the ground for the following two chapters. The comming chapter (Chapter five) is the result of the farm diagnosis questionnaire and the secondary data collection from Leidy Casimiro, giving, as a result, the socio-ecological resilience indicator for each farm based on the clusters of indicators of food sovereignty, technology sovereignty, energy sovereignty and economic efficiency. This chapter is answering sub-research question 1 (SRQ1). Finally, the last chapter of the results (Chapter six) is the result from the interviews analysis following the lens of community economies to answer sub-research question 2 (SRQ2)

5. RESILIENCE BASED ON THE SOCIO-ECOLOGICAL INDICATORS OBTAINED USING MERS

The purpose of this chapter is to answer SRQ1 *"How do family farms perform resilience based on the socio-ecological indicators defined by Casimiro (2016)?"* analysis the data obtained from the six farms. The indicators for each farm will be discussed linking it with the profile to explain the performance of the indicators, and why resilience is higher in some farms and lower in others. The process followed to obtain the indicators is already explained in the methodology section (see Chapter 3) and additional material can be found in the appendices.

This section is based on the PhD thesis by Leidy Casimiro, the oldest daughter of *finca* Del Medio (IF1) and one of the supervisors of the present thesis. I followed her methodology to come up with the indicators for each of the six households and have an overview of the socio-ecological resilience index of each of the six family farms.

In the following section, I first go through each index (FSI, TSI, ESI and EEI) to explain the performance of them and relate it to the profile to give significance to the numbers. Second, I give an overview of all the farms with the four indices and the final socio-ecological resilience indicator (SRI) of the six farms, to have a broad view of the farms and the relation between them. The first index examined is the Food Sovereignty Index (FSI).

5.1 FOOD SOVEREIGNTY INDEX (FSI)

This index, composed by three indicators (Pp, Pe and Af), explore the actual capacity of a farm to self-provision themselves with the elements present at the farm at the moment of the diagnosis. Food Sovereignty has to do with "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (adapted from La Vía Campesina, 2007). Following the proposed indicators, food sovereignty is determined by the amount of people that can be fed from animal or vegetal protein/energy per hectare/year (Pp and Pe) and by the food provisioned on-farm in relation to the total food needs of the family (Af), so the capacity of food self-provision.

To come up with the Food Sovereignty Index the following indicators were obtained:

- **Pp**: Amount of people fed from animal or vegetal protein source per hectare in one year.
- **Pe**: Amount of people fed from animal or vegetal energy source per hectare in one year.
- **Af**: Percentage of the food that feeds the family produced on-farm.

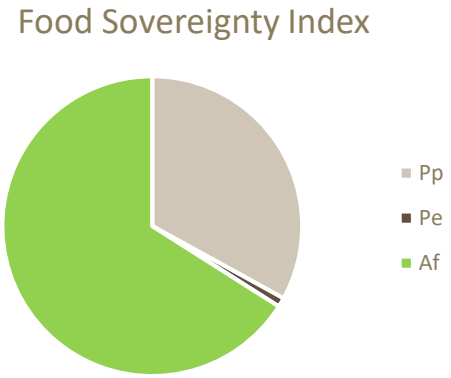

Figure 11. Graphical contribution of each indicator on the creation of FSI.

The table below shows the values for each indicator and the last column on the left provides with the FSI, result of the indicators combination (with their specific weights, for more information see Appendix A, p. 98).

Table 6. Indicators for the creation of the Food Sovereignty Index. Next to each indicator there is, between brackets, the relative weight they have in the composition of the FSI. The sum of all the weights is 1.

Finca	Pp (0,33)	Pe (0,01)	Af (0,66)	FSI
1	8	6,11	98%	**0,99**
2	56,7	15,93	95%	**0,86**
3	14	8	95%	**1**
4	10,7	6,5	82%	**0,99**
5	7,94	5,2	92%	**0,99**
6	19,3	12,3	70%	**0,87**

The numbers of the indicators alone do not give us much information, for this reason it is important to link them with each farm and explore them carefully.

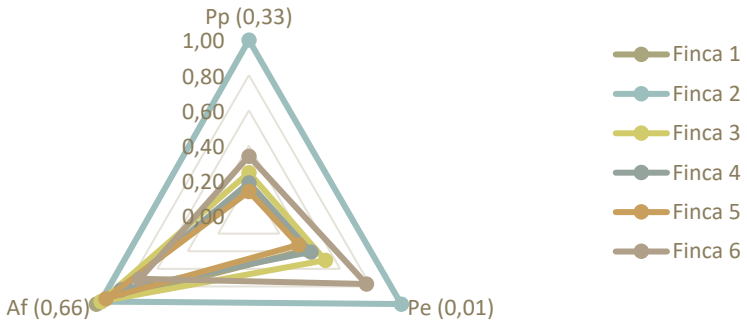

Figure 12. Graphical representation of the indicators for Food Sovereignty and the relative performance of each farm.

The indicator that has more weight in the final calculation for FSI is the Af (0,66%). This makes a lot of sense, even though the other two (Pp and Pe) can have very high values, due to the fact that a farm has a very big extension of land, thus can feed a lot of people per hectare per year, could be that the production is not meant to feed the family but to sell it to the cooperative. Actually, the farm that has the highest score on Pp (Amount of people fed from animal or vegetal protein source per hectare in one year), finca 2, has the lowest score on FSI. This is because in finca 2, the land they have is mainly dedicated to kingrass, a grass very high in protein content, which is meant for animal feed. The farms that have Pp and Pe with numbers close to the number of family members (fincas 1, 3, 4 and 5) are the ones with scores of 1 (finca 3) or really close (0,99, fincas 1, 4 and 5).

We can observe that Pe does not have much influence in the determination of the SRI, since the relative weight of this indicator is really low (only 0,01). Fincas 4 and 6 have a bit more of dependency from the exterior regarding food provision, they have the two lowest scores (82% and 70%, respectively).

Overall, all the farms have a very high score in the food sovereignty index. There is no farm lower than 85%, meaning that they have control over their diets and the products that conform them.

5.2 Technology Sovereignty Index (TSI)

The Technology Sovereignty Index (TSI), the result of the combination of five indicators (LER, EI, H, IUPRES and IIF), explains the degree to which the farm has the capability and the freedom to select, generate or acquire, and apply (Grant, 1983) technology needed for the correct functioning of the farm. Technology, in the thesis (Casimiro, 2016) is understood as a set of methods, skills, techniques, knowledge and processes used for the farm production to accomplish their own strategy. Technology sovereignty thus is related to technological self-sufficiency, because the index contemplates the possession of technology, the ability to generate it, and the innovative potential to come up with new solutions. Following the proposed indicators, technology sovereignty is determined by: the diversity of production (crop or animal) considering intercropping and/or rotation(H); the number of hectares that would be needed to grow in monoculture what is grown in one hectare of policulture (LER); the amount of external inputs used for the production (IE); the potential use of renewable energy sources using the appropriate technologies (i.e. the biodigestor, the windmills or the hydraulic ram) (IUPRES); and the innovative capacity and execution of the farm (IIF). This last indicator, due to its new nature on the thesis of Casimiro (2016), is explained more in detail in the appendices (Appendix A, Table 17, pg. 104). The other indicators were gathered from previous scientific papers studying also socio-ecological resilience. More references can be found on the Appendix A.

For the creation of Technology Sovereignty Index the following indicators were obtained:

- **LER**: Land Equivalent Ratio. Number of hectares needed to seed in monoculture and obtain the same yield obtained in a hectare of polyculture.
- **EI**: Percentage of external inputs used for production. Level of inputs not generated or used on-farm that are used on the productive system (%)
- **H**: Diversity of production using Shannon index. Value the diversity of the production, considering association and/or rotation. Includes the total production of each element (crop or animal) and the total production.
- **IUPRES**: Index of the Usable Potential of Renewable Energy Sources associated with the appropriate technology. Usable potential of the renewable energy sources associated with the appropriate technology, considering the utilizable potential on-farm (%).
- **IIF**: Innovative Intensity of the Farm. Level of execution of the innovative activities that exist on the farm for the agroecological management and design. (%)

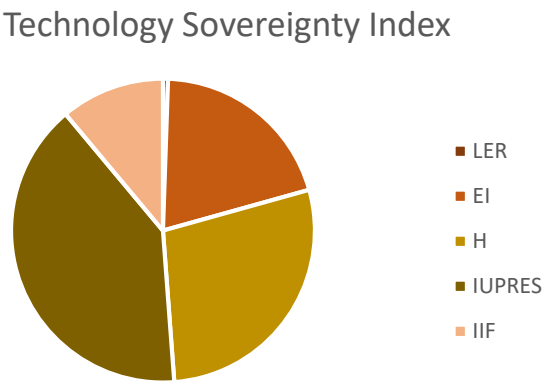

Figure 13. Graphical contribution of each indicator on the creation of TSI.

Table 7. Indicators for the creation of the Technology Sovereignty Index. Below each indicator there is, between brackets, the relative weight they have in the composition of the TSI. The sum of all the weights is 1.

Finca	LER (0,0054)	IE (0,2013)	H (0,2814)	IUPRES (0,4011)	IIF (0,1108)	TSI
1	2,74	10%	2,15	83,61%	95,44%	**1**
2	1,48	88%	2,14	10,15%	82,6%	**0,52**
3	1,5	45%	2,1	15%	84,5%	**0,6**
4	0,9	86%	2,2	8,9%	71,8%	**0,49**
5	1,2	89%	1,9	2,18%	55,6%	**0,41**
6	1,6	70%	1,7	15%	67,4%	**0,42**

In this index, the indicator that has more weight, almost half of the total contribution, is the IUPRES, the capacity and the actual use of appropriate technology to use renewable energy sources. We can see a direct correlation between IUPRES and TSI.

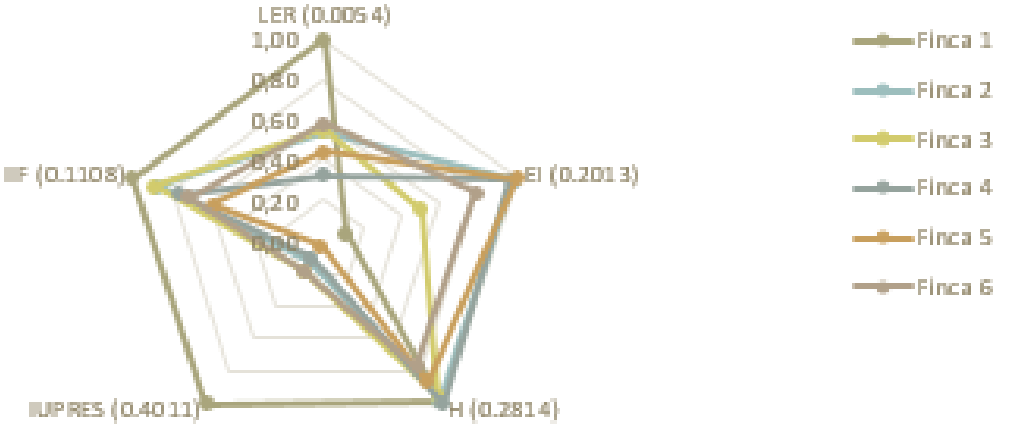

Figure 14. Graphical representation of the indicators for Technology Sovereignty and the relative performance of each farm.

Finca 1, which has the highest score on IUPRES has also the maximum score of TSI, this is because in finca 1 they have the appropriate technologies to have almost all the energy coming from renewable energy sources. They have biodigestor, windmills, hydraulic ram, efficient wooden stove, room for dehydration of foods and a solar oven, which give them the potential to obtain most of the energy from renewable energy sources. Fincas 4 and 5 have a very low score on that specific indicator, because in both of the farms they only have the biodigestor as appropriate technology, and in finca 5 they do not even use it because it was broken, which explains the extremely low number for this indicator. Furthermore, it is important to note that is not only about the appropriate technology, because IUPRES also contemplates the system energy demand. So, if there are a lot of technologies but the system's demands are very high, it will also score low. This can be shown if compared with Finca 6 and 3. These fincas (6 and 3) have only the biodigestor as technology, like 4 and 5, but their energy demand is lower.

Now, if we look at finca 6, even though have the same value than finca 3 in the IUPRES (15%), the TSI of finca 6 is much lower. This can be explained looking at the two other indicators contributing the most in the creation of TSI (after the IUPRES): EI (0,2013) and H (0,2814). The lower EI, the better, because this indicator is determining the percentage of external inputs used for production. This is confirmed by finca 1, which has the lowest EI and has the highest TSI. When we look at EI is important to consider the social object of the farms. Of course, the farms that have tobacco as social object will have higher score on this indicator. However, this is not the case for finca 2, which has no tobacco and

have almost the highest score in EI. This is because they have a lot of pigs and cows, and they import almost all the animal feed. So, coming back at the comparison between finca 6 and 3: both of them have a IUPRES of 15%, but finca 3 has a much better TSI than finca 6 (0,6 and 0,42 respectively). This is explained, because of the external input dependency (EI) that scores higher in finca 6 (70% in comparison with 45% of finca 3), and the diversity index (H), which has a lower value in finca 6 (1,7 in comparison to 2,1 of finca 3).

The indicator of the Land Equivalent Ratio (LER), has almost no contribution in the creation of TSI, since it has a very low relative weight (0,0054).

Having a look at the two fincas (5 and 6) with the lowest TSI (0,41 and 0,42 respectively) some conclusions can be drawn. Even though finca 6 has much better IUPRES in comparison with finca 5 (15% compared to 2,18%) because it has a lower system energy demand, but then, despite this lower demand, the dependency from external inputs is not that low, relatively, comparing IE and IUPRES. This is the reason why those two farms are the ones with the lowest scores of TSI.

5.3 Energy Sovereignty Index (ESI)

This index, composed by four indicators (EE, EF, EB and ECP), examine the capacity of exploitation of the Renewable Energy Sources (RES) with the appropriate technologies contextualized to its socio-ecological system. In the case of energy sovereignty, the most important elements are the energy efficiency and the percentage of energy used from the interior of the farm (Casimiro, 2016).

For the creation of Energy Sovereignty Index the following indicators were obtained:

- **EE**: Energetic efficiency. Relation between the total Mega joules (MJ) produced on the farm (from food production, using RES with appropriate technology, labour force, animal jobs or fertilizer production) and the ones imported to the system.
- **EF**: Percentage of energy used from the farm (human, animal, Renewable Energy Sources - RES). Energy used on farm from the farm own resources. (%)
- **EB**: Energetic balance. It considers the volume of production and its energetic content, and the energetic cost that was necessary to produce that food energy with external inputs
- **ECP**: Energetic cost of the protein production. Total energetic cost that was necessary to produce the food protein with external inputs.

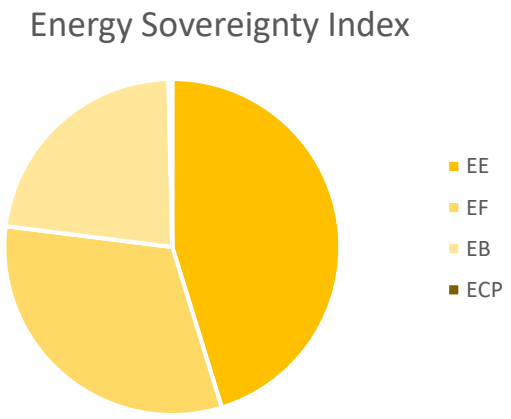

Figure 15. Graphical contribution of each indicator on the creation of ESI.

Table 8. Indicators for the creation of the Energy Sovereignty Index. Below each indicator there is, between brackets, the relative weight they have in the composition of the ESI. The sum of all the weights is 1.

Finca	EE (0,4524)	EF (0,3174)	EB (0,2265)	ECP (0,0037)	ESI
1	17,26	84,94%	10,86	0,58	**1**
2	0,2	11,48%	0,09	506,98	**0,38**
3	1,3	20,8%	1,02	95,7	**0,34**
4	0,5	13,72%	0,4	269,3	**0,2**
5	0,4	11,16%	0,3	338	**0,2**
6	0,7	5,1%	0,7	161,4	**0,2**

For the creation of the ESI, the most important elements, is the energetic efficiency (the relation with the total MJ produced on the farm and imported to the system) which contributes to almost half of the ESI, and the energy used on farm from the farm own resources (EF), which contributes with a 0,32% to the construction of the ESI.

Having said that, again, the finca that scores the best is finca 1. This is due to the low energy demands and the high energy production on the farm. The main source of energy of finca 1 is the biodigestor (providing 35% of the total energy), and the other important source of energy for the farm is the wind (around 30% of the energy). Only 15% of the energy of the system comes from the exterior, as clearly seen with EF (84,94%). In the profile, there are the detailed numbers, but in general, finca 1 has worked a lot to be energy sovereign with the construction of the efficient wood stove, the minimum use of fossil fuels and the lately incorporated solar oven.

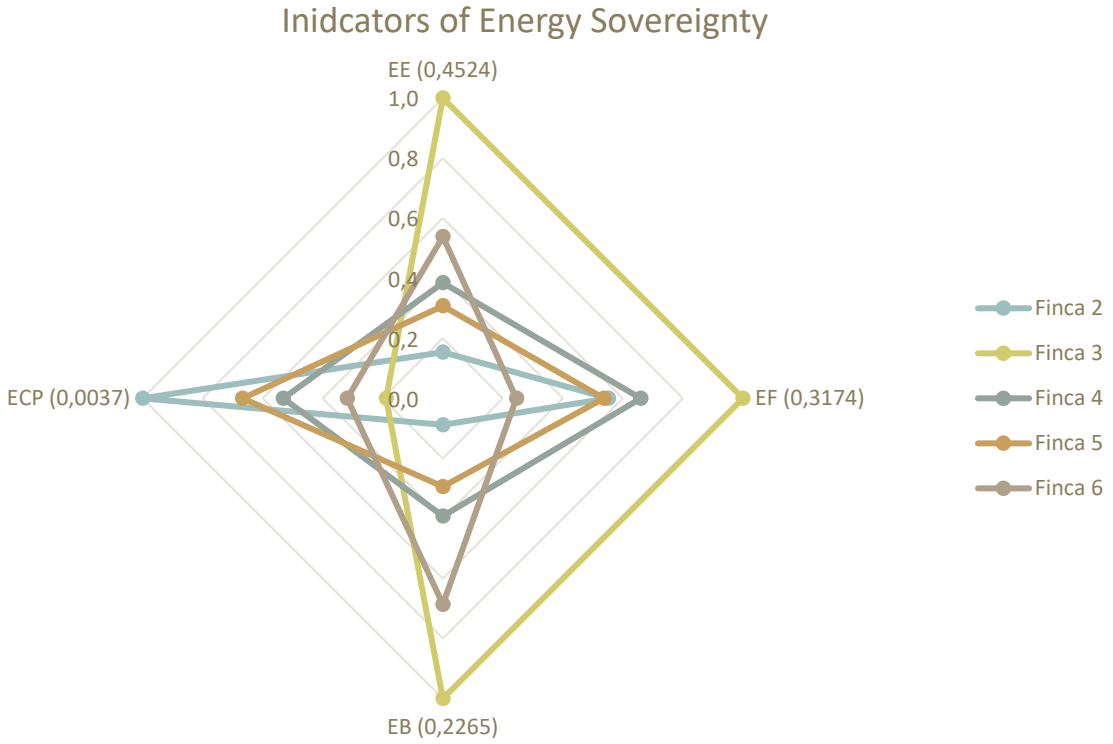

Figure 16. Graphical representation of the indicators for Energy Sovereignty and the relative performance of each farm. In this representation Finca 1 was not added because of the big difference with the other farms.

Fincas 2 and 3 have the second-best score on energy sovereignty but still there is a lot to be improved, mainly with the energetic efficiency in finca 2 and with the external dependency (EF and ECP) in finca 3. Finca 2 has the lowest EE of all the farms because, as said before, they have too many

pigs which demand a lot of energy inputs for the feed, which is also detectable looking at the ECP. ECP counts for the energetic cost of the protein production. Because ECP has not much contribution to the ESI creation, in Finca 3 the reason of a low ESI is the percentage of energy used on farm that come from the farm. Despite not having a very high system energy demand, as explored in the previous section, they still need to work to make the farm more self-provisioning in terms of energy.

Then, there is a curious fact that fincas 4, 5 and 6 have the same very low value of the ESI (0,2). This can be explained by the fact that the three of them have tobacco as social object, which makes it difficult in terms of external dependency, because they need to import a lot of products (i.e. fertilizers, and seedlings) to ensure the harvest of the tobacco. Related to that there is also the fact that EF (the energy used on the farm from the farm own resources) is calculated dividing the energy coming from the farm by the total energy demand. In this energy demand, there is also the count of people that work as permanent or occasional workers, which makes this indicator decrease.

5.4 Economic Efficiency Index (EEI)

The last index for the creation of the Socio-ecological Resilience Index is the Economic Efficiency Index (EEI), composed by two indicators (CBR and EIDI). This index is mainly taking into account the dependency on external inputs by considering the investment on those in relation to the total investment. If it is true that following agroecological practices can be more expensive at the beginning, on the long term it pays off, because this dependency decreases tremendously, while increasing soil fertility and thus farm productivity.

For the creation of Economic Efficiency Index the following indicators were obtained:

- **CBR**: Cost-Benefit Relation. Relation that indicates the cost per weight.
- **EIDI**: External Input Dependency Index. Relation among the inversion on external inputs related with the total inversion (including endogenous resources).

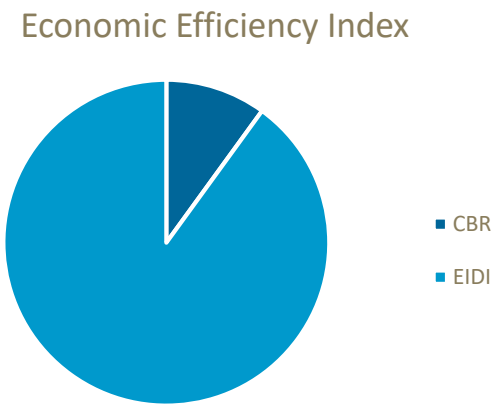

Figure 17. Graphical contribution of each indicator on the creation of EEI.

Table 9. Indicators for the creation of the Economic Efficiency Index (EEI). Next to each indicator there is, between brackets, the relative weight they have in the composition of the EEI. The sum of all the weights is 1.

Finca	CBR (0,1)	EIDI (0,9)	EEI
1	0,34	1,81	**1**
2	0,98	38,4	**0,74**
3	0,4	57,7	**0,62**
4	1,2	70,8	**0,38**
5	1,08	51,3	**0,56**
6	0,37	86,3	**0,26**

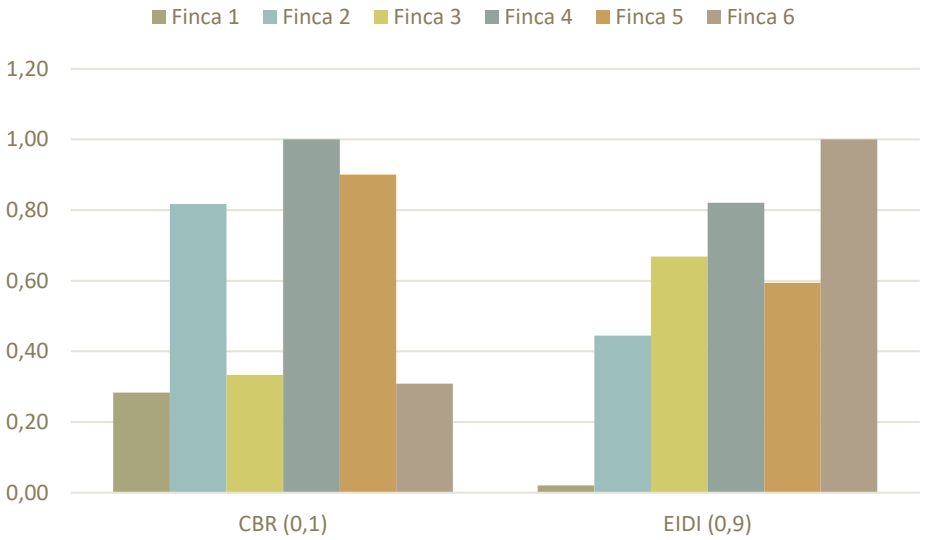

Figure 18. Graphical representation of the indicators for Economic Efficiency and the relative performance of each farm.

A good economic efficiency index is that based on obtaining economic gains based on minimal reliance on external inputs, high energy efficiency and use of endogenous resources, and low production costs (Casimiro, 2016). Based on that, focusing mainly on the EIDI, because is the one with almost all the contribution to the creation to the EEI, we can conclude that the higher the dependency on external inputs, the lower the economic efficiency. Because of a bad use of endogenous resources, or because the strategy of the farm is not well stated, too much energy and money is lost on the external dependency, decreasing the efficiency. It might be that some farms earn a lot at the end of the year, but they also had to invest a lot, and most of this inversion came from the exterior, decreasing the capacity of adaptation, due to the tight connection with the markets, the cooperative or the State.

5.5 Socioecological Resilience Index (SRI)

This index, which is the main outcome of the diagnosis of the farms, is composed by the above explained index (FSI, TSI, ESI and EEI). This index allows for a characterization of the fincas, to explain where they are in the transition towards a more resilient state, by changing towards agroecological practices. On the long term and through periodic applications of the farm diagnosis is possible to show progress and the dynamics of the agroecological transition to support this process of evolutions from the past experiences and the future projections (Casimiro, 2016). This index is the summary of all the stories explained using the Food Sovereignty Index, Technology Sovereignty Index, Energy Sovereignty Index and Economic Efficiency Index, to give a clear number from where to start improving the system. An

overview of all the indicators and the respective indices for the six farms can be found in Appendix E (pg. 120).

All the indices (FSI, TSI, ESI and EEI) have the same relative weight (0,25) in the creation of the Socio-ecological Resilience Index

In the following table and figure, there is an overview of all the indices for the six farms and the final socioecological resilience index.

Table 10. Collection of the 4 indices (FSI, TSI, ESI and EEI) to create the Socio-ecological Resilience Index for each farm. Here, the relative weight of each index is equal (0,25).

Finca	FSI	TSI	ESI	EEI	SRI
1	0,99	1	1	1	**0.99**
2	0,86	0,52	0,52	0,74	**0,66**
3	1	0,6	0,34	0,62	**0,64**
4	0,99	0,49	0,2	0,38	**0,51**
5	0,99	0,41	0,2	0,56	**0,54**
6	0,87	0,42	0,2	0,26	**0,44**

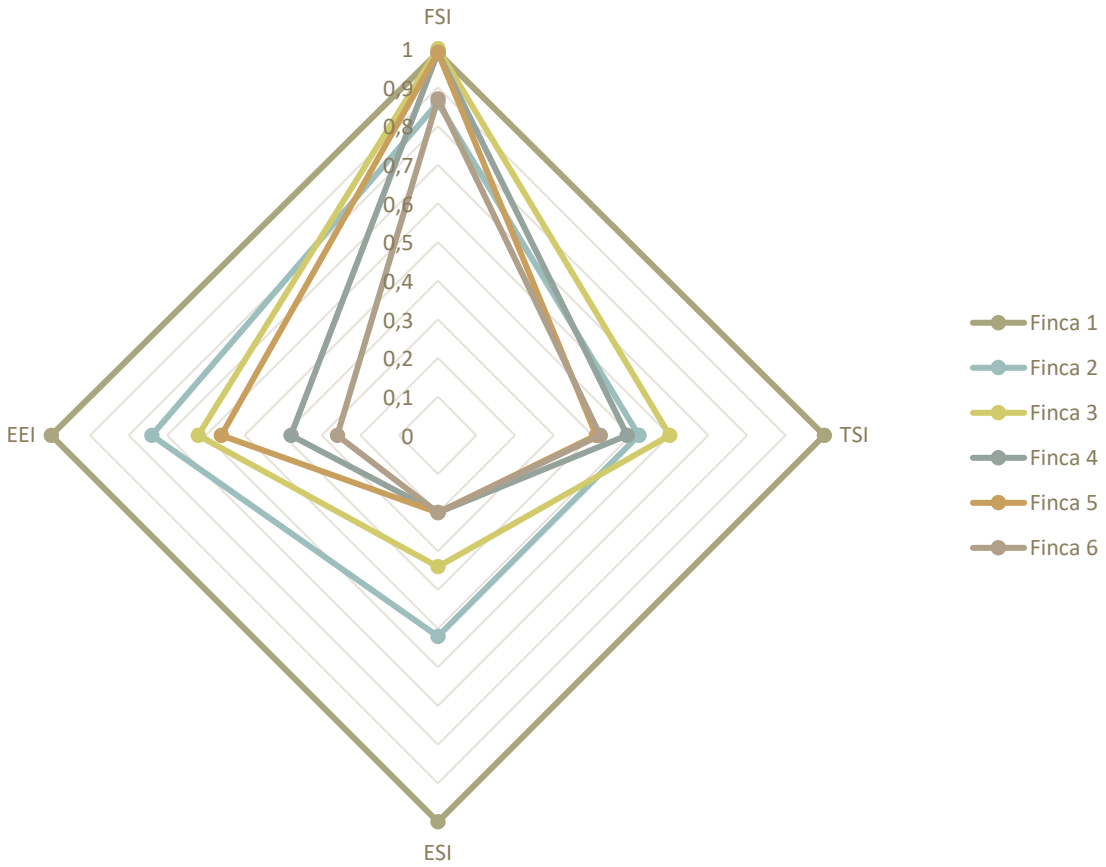

Figure 19. Graphical representation of the four indices (FSI, TSI, ESI, EEI) obtained by each farm.

Once the indicators for each farm were calculated and summed to determine the Socio-ecological Resilience Index (SRI) of each farm, then the resilient stage of the system was determined using the next scale (Casimiro, 2016) (Table 11). Del Medio is a highly resilient farm, almot showing a SRI of 1. It is followed by Rio de Agua Viva and San Juan, which are resilient, and then Ingenito, Flor del Cayo

and Las Dos Rosas are medium in resilience. Las Dos Rosas is almost on the limit between medium and low resilience, so strategies neew to be adapted to tranform the system towards a more resilient one.

Table 11. Determination of the resilient stage of the farm following the scale. For example, if the SRI is 45 it will have a scale of 3 meaning that has a medium resilience.

Scale to determine the resilient stage of the system	Resilient stage of the system	
	Value (%)	Stage
1	0-20	No resilient
2	21-40	Low resilience
3	41-60	Medium resilience
4	61-80	Resilient
5	81-100	Highly resilient

Figure 20. Graphical representation of the socio-ecological resilience index. SRI represented in absolute values on a scale from 0 to 100. Limits for each category are: no resilient (0-20), low resilient (21-40), medium resilient (41-60), resilient (61-80) and highly resilient (81-100). Each code is one farm: IF1 – Del Medio, IF2 – Rio de Agua Viva, IF3 – San José, IF4 – Flor del Cayo, IF5 – Ingenito and IF6 Las Dos Rosas.

This methodology, created by Casimiro (2016), is a new analytic and methodological tool that allows, from the evaluation of the several indicators and index proposed, determine the socioecological resilience of a family farm (Casimiro, 2016). Its application allows on the short term to determine how resilient a socioecological system is in the context of family farms at a specific moment in time. It allows also to identify critical points on the design and management of the system, establish strategic plans to improve each of the indicators and optimize future scenarios. The last table show the result of the integration of the four indices to obtain the SRI. Reading the table and the graphical representation we can say that finca 1 is highly resilient, almost 100%. That fincas 2 and 3 are resilient, and fincas 4, 5 and 6 have a medium resilience. This has been explained through the profiles and the indicators, following the individual characteristics of each of the farms.

Being highly resilient, adapted from Casimiro (2016), means, in relation with the indices:

- **Food Sovereignty Index**: having an agricultural production sufficient to feed more than seven or ten people per hectare per year in protein and energy respectively
- **Technology Sovereignty Index**: having functional diversity of crop and animal species; having less than 20% of external inputs used for production and being able to, through agroecological management, innovation and adoption of appropriate technologies, use of RES, so the system is supplied with energy in more than 75%.
- **Energy Sovereignty Index**: maximizing energy efficiency with the use of RES and having an external energy use of less than 30%.

- **Economic Efficiency Index**: Having low production costs and an investment in external inputs that represents less than 20% of the total investment.

Overall, to move towards more resilient family farms the most important step according to the socio-ecological indicators, is to cut the external dependency as much as possible, and rely on the resources of the farm. Lower the energy demand of the system, and make an efficient use of it, while, being efficient on the work, so there is no energy lost. Adopt an agroecological management, focused on diversity, recycling, and closing cycles on the farm. Have the necessary technology depending on the potential of the farm as well as create groups of consumers that can support the local farmers, so it decreases the supply chain, decreasing intermediary costs and increasing product quality. Also important is to have a high variety of food production and organic fertilizers, on farm. Of course, not everything is responsibility of the farmers. There is the need to implement public policies focused on the agro-ecological family farm through regulatory frameworks, programs, differentiated policy instruments, in addition to the existence or creation of structures and the accompaniment of institutions for technical assistance and research (Casimiro, 2016), if this way of farming must continue.

The collection of the indicators was a first step in answering the first sub-research question (SRQ1) in order to compare it with the results obtained from the community economies analysis and be able to answer the main research question. In the following chapter, I will discuss the results from the interviews and answer the second sub-research question.

6. RESILIENCE UNDERSTOOD FROM A PERSPECTIVE OF COMMUNITY ECONOMIES

In this last chapter of the results the second sub-research question is explored to answer the three sub questions regarding 1) the **needs** and the negotiations around them; 2) the production and distribution of **surplus**; and 3) the **encounters** among humans and human and non-human others of the family farm household members, from a community economies perspective. The objective of this chapter is to answer sub-research question 2 (SRQ2): *How do family farms perform resilience based on the community economies framework?* SRQ2 is divided in three sub-questions (SRQ 2.1, SRQ2.2 and SRQ2.3), one per coordinate. I first discuss what the needs are and how do family farm households negotiate decisions over those needs. Second, I explain how is surplus from family farm households produced, appropriated and distributed to meet the identified needs. And last, I examine how family farm household members encounter human and non-human others in a way to meet the identified needs. Since surplus and encounter are responding and having a conversation with the needs, the first needs section is larger than the other two. At the end of this section there is a wrap up of all the sub-research questions, in order to answer sub-research question 2.

6.1 NEEDS

To answer the first question of the second sub-research question (SRQ2.1) *"How do family farm household members negotiated decisions over what needs should be met to survive together well?"* is important to characterise, first, *what needs are considered by the household members* (6.1.1). From the interviews analysis, seven needs were encountered as most important by the members to ensure their well-being. Those needs are grouped into seven categories: comfort needs, energy needs, health needs, affective needs, relational needs, financial needs and political needs. Following those seven needs there are other seven features necessary to adapt to changes and be able to transform (6.1.2), contingent to the main needs, and finally there is the exploration on how negotiation over those needs is performed (6.1.3).

6.1.1 Main needs

Following, there are the seven categories explained and illustrated by the participants:

<u>Comfort needs</u>

Comfort related needs are identified by most of the participants, meaning that they need to have the proper space and facilities to work and live at the farm. The creation of a space of comfort to enjoy the place where they live and work was considered a must. This topic came out explicitly in half of the farms of the research (Del Medio, Rio de Agua Viva and Las Dos Rosas). Most identified needs are: the importance of feeling comfortable at home and the place they work, that there are spaces thought for everybody to work in a comfortable way but also spaces to relax, to play and to converse with friends and visitors; to create a space where the whole family, from the oldest to the youngest, can enjoy working and having a rest. As Yanina (IF2_8) illustrate "We created a space of comfort, where not everything is meant to be for work, but a space where we can enjoy once we are done working. Also, a space for the girls [her sisters] to enjoy their free time with their swing, their merry-go-round, as you can see".

Here I divided the spaces, the house and the farm, and their respective needs, as explained by the participants:

- To have good conditions on the house:

Having a house that provide enough space to answer the needs of all the members so that there is space for everybody. Yolanda (IF5_22) said "we need to hurry and finish the house, we are too many living under the same roof and this can create problems in the coexistence". A proper kitchen with enough

space to cook for a large amount of people, especially on farms with permanent and/or occasional workers; a proper place where to clean the clothes: “Some commodities are missing. A proper place to wash the clothes and finish the rooms for when many visits come so I do not have to run around changing all the bed sheets, and so on.” (Laura, IF1_4).

- To have good conditions for farming:

Working on water storage and management, like making more wells for the water availability and have bulldozers available to clean the rivers for improving the water storage in them: “We have to be prepared and we have to clean a little the dams and glens that are practically collapsed because before we arrived at the farm nobody took care of them” (Adrián, IF6_24). The mechanization of the labour, to make it more human, so less hours need to be spent on the field: “One way to humanize things a bit is buying a tractor. With which we will be able to load much more land and thus humanize the work for us. Making work smoother and at the same time you can bring more quantity” (Juan jr, IF1_3); to fence the farm area to keep the livestock and to limit the space not to invade the neighbours; to have enough food for the animals; to be able to enlarge the farm in terms of land or animals, if necessary.

Energy needs

Those needs relate to the source and use of the energy at the farm, a major concern for all the farms.

- To be more sustainable in terms of energy consumption and sources. All the farms of this research are part of the BIOMAS project, which provided the biodigestor and workshops for a better energy use. The biodigestor decreased the energy demand of the system considerably, by recycling the residues of the animals for biogas production: “Before we did not have the biodigestor, we now have a biodigestor, from which we benefit greatly. Firstly, for the economic part that we saved, that is, expenses of using an electric cooker. Now we use a gas cooker. We also benefit from the organic part: we use waste, the final product of the biodigestor for crops, for organic matter, and are products that we did not really have beforehand, and are things that are always beneficial” (Sergio, IF2_9).
- Some farms (Del Medio, IF1 and Rio de Agua Viva, IF2) use the energy from the sun, the wind and the faeces so that, someday, they can have all the energy needed produced on-farm, and become independent from external inputs: “Be sustainable in the electric energy. Because there are the wells for the water, the biogas [from the biodigestor] to cook, but there is no alternative for the electric energy to light the house. If we would have a source of energy for the house, then when a change [i.e. a cyclone] could come and we would not be much affected by it” (Raul, IF2_7).

Health needs

This category discloses the necessity of a healthy environment, free of chemicals, with good food, as well as having the necessary products for the correct hygiene. Moreover, it also accounts for the psychological health:

- Having good and healthy food: “We have acquired our own way of eating, which has to do with a healthy diet: minimal consumption of sweet and minimal consumption of fat” (Juan, IF1_1), free of chemicals, a direction that all farms should follow in order to sustain their good health: “We could raise only pigs and look for everything else outside. But we knew that if we did, we would not get anything healthy. Because what people give you outside is not as healthy as what we do here” (Mireia, IF2_6);
- Having the cleaning products necessary for the personal hygiene: “personal hygiene. That, for me, comes first. Is not it? Detergent, toothpaste, bath soap, laundry soap, all those things are very necessary” (Ana, IF5_18);

- There are also references to mental health, to never lose the desire for making what they like: "the desire, the illusion of being a peasant, feel at ease, and fight and work a lot because in the field you have to work a lot" (Ana, IF5_18).

Affective needs

Those are concerning the need of being together with the family: "to be united, that the family is united is very necessary" (Marta, IF6_23), to work together and share the space and time together, to have harmony in the family, for most of them is a must: "for me it is essential" (Oliver, IF5_20).

- The need of having the family together in the productive system becomes essential for all the participants, because it holds the farming memory as well as creates the synergies for the labour division and cooperation among the members of the family: "We form a team. We live here but it is also the place of self-employment, where we all work together, the whole family and knowing that all you are doing is to improve the system and our own life. Share the good times, the bad ones too, but always with their support" (Claudia, IF1_5). Having people working in one same direction makes work easier because the interest is shared and then the responsibility will be also shared and will be less of a burden for one person alone.
- For some participants, a crucial need is being close to the beloved ones "I need my husband to come! That is the first need I have" (Lola, IF3_14); and having the partner or the children close by: "The only thing I need to live is my daughter. If she is with me, and she is well and comfortable I will be ok" (Raquel, IF3_13).
- Respect and love are two main pillars for family harmony, as pointed out several times: "The fundamental thing in the family is that there is unity, that there is respect, and that there is love. When there is family unity, love and respect, the thing works, and then changes are possible" (Nico, IF4_16);
- Being together and united is also highlighted by most of the participants: "And family, family comes first. To have harmony and to be united with the family is the first thing, because if not, when that is missing, there is a very big imbalance" (Yanina, IF2_8). Being toghether and united enable each other. Probably, if not living together the sense of unity would be experienced less, and viceversa, having strong unity in the family allows a better co-existance.

Relational needs

The relational needs reveal the importance of the relationships, being in contact with other farmers, in the creation of a network of mutual support and knowledge sharing, and also to relate with society, to feel embraced by a bigger group of people sharing interests:

- The participants found important as a need to be in contact with other farmers: "we go to the workshops organized by Biomás, and by PIAL. There, we share with other peasants, we exchange agroecological practices and that is great to grow mentally and have more alternatives" (Marta, IF6_23).
- Also, to have a network to work together and exchange experiences: "We do the exchange, which I believe is one of the fundamental things, because it gives us the possibility to nourish ourselves and satisfy our needs because we exchange seeds, machines, knowledge, which is the most fundamental thing" (Pedro, IF3_10).
- In relation with the human contact, more concrete, to the broader society Juan (IF1_1) says "We need to have many families doing this activity, to feel as part of a group with the same opinions,

with the same desire. That, for me, would be something I need to feel completed. Find people with whom you can meet, and you can share your worries and successes".

Financial needs

Those needs are concerning the money and the strategies to manage the money:

- To have money to buy things when needed "Because I always want to buy a new cooking pot, a queen pot, a washing machine..." (Jacinta, IF4_15); like things for the house or nice clothes for special occasions "Money to buy nice clothes or useful things for the house. Clothes are the essential thing for one, but also to have things for the house. To have more commodities" (Elena, IF3_11).
- Also related to the money Luisa (IF5_19) says "I moved back to the farm because the money I gained with my job was not enough. They began to reduce, to give us less things, less incentives, and the salary did not reach for the basics. I don't buy many clothes but the children do need them, and I could not afford it. Now here in community is better, because together we have a better income". What she meant is that when she was living alone with her husband they had difficulties in terms of money, and now that they live all together at the farm, where everything is shared, there are more expenses, but they are collectively covered.

Political needs

Last, those are the needs referring to the agrarian policies and changes in laws necessary to make the family farm a viable option for people who already practice farming and those would like to start.

- It refers to the effort the State should invest in making this way of farming grow: "There is a lack of an agrarian policy that places this form of life in the centre, which truly dignifies it, supports it, recognizes it, awards it, institutionalize itself as an option, as a variant of the best. A policy that promotes this sustainable life on the land without the use of chemicals and with the family on the site as main characteristics." (Juan, IF1_1)

Summing up

Those seven categories are the needs identified by the participant household members. Sometimes we see that those needs interrelate with each other i.e. the comfort needs are related with the health needs since a clean house will chase away diseases or the relational needs also related with the emotional health. Those needs expose the interdependencies present within the family farm household members: creating comfortable spaces, preparing good and healthy food, being close to the family and sharing the expenses collectively, as well as the interdependencies present beyond the households, such as having relation with other people outside the family which can open the perspectives, or scaling to a macro level, having an agrarian policy that promotes this type of farming, where the family is living on the system. Those needs are the core element from where the other two coordinates (surplus and encounter) develop. In the next section, there is the description of the features necessary to adapt to change, crucial for this thesis, since it connects with resilience.

6.1.2 Necessary features to adapt to change

Apart from the needs found important by the participants, during the interviews there was a question also regarding the *necessary features to adapt to changes*, due to the changing climate and political patterns, existing in Cuba, and worldwide. Those features have a direct relation with the main needs explained just above. Having in mind possible changes that may occur (or that already occurred) they identified the following elements:1) have an open mind with allows to be more plastic and adapt; 2) have a good system management and design; 3) live on the farm with the family; 4) study, collect and

share information; 5) have enough freedom to be able to implement the necessary changes; 6) Educate the young generations and 7) have a good network of family and friends. In each title of the element there are the main needs to which each feature relates to, explained further at the end of each category. Showing up next there is the description of each of these elements:

Have an open mind – comfort, energy, health, affective and relational needs

The openness of mind is important to be able to recognize when, what and how is needed. Following this line, it is important to have an open mind to accept different types of knowledge and the need to make a personal change, a change of consciousness if one wants a change in the physical world, first it needs to occur in one's mind.

- To be able to adapt to change it is important to nurture the capacity to be open to those changes and to be able to tackle problems from different perspectives. As Sergio (IF2_9) said "if we want to face change we have to be willing to change ourselves first. If you want to face changes, you must be willing to change. If you want to do something different, as somebody said, you have to start doing things differently". It might be that one day a problem is solved in one way and the other day in another.
- Also, to focus on the solutions rather than on the problem. For example, in *finca* Del Medio (IF1) during this year's dry period they had almost no water on the dam but instead of complaining about that they took the opportunity to get some land from the bottom of dam (which is very rich in minerals) to add it to the garden, and, at the same time, put the cows to graze the new seedlings at the bottom of the dam.
- Related with the open mind there is the characteristic to have the ability to see opportunities around, focusing on the solutions. For example, in Rio de Agua Viva (IF2) they can support so many cows because they found almost 14ha where the cows can graze and walk. This is part of the military forces, and in exchange to take care of the place, they can put the cows there, otherwise with the three ha of land they have would be impossible to sustain so many cows.
- The importance of having an open mind is also to recognize when it is necessary to make a change. Like Nico and Jacinta (IF4) that decided to change from vegetable production to livestock due to water shortage: "We needed a change. We did not have that amount of water for so many productions, so Nico chose to change to livestock. It had been a long time since we wanted to change to livestock. This land has never rested, for many generations had been under vegetable production and tobacco plantation. Then we always said, we should change to let the lands rest, but years were passing and no changes happened, until this year. From the shortage of water Nico said: this is the chance! Let's do it right now. And we all made it" (Jacinta, IF4_15).
- Having an open mind can also allow to break with traditions. Juan (IF1_1) put it from a practical side "There are traditions and things that, really, cannot continue. For their cost, for their work, for what costs to nature and for profit either. We must develop a philosophy of practice, of reality, of the specific context, of enjoying ourselves as human beings, of doing human work, of dreaming that, even if it is very difficult, this will change. And it has to change, even if it is on a small scale". Also, Pedro (IF3_10) pointed out how important it is to adapt to the current situation: "we have to change the way we work, the way to introduce new technologies, adapt them to our form, that is to say that scientific advances are not opposed to traditional knowledge, but we adapt it to the environment".

Those aspects, to focus on solutions and break with traditions, to be able to recognize when a change is necessary or when there is an opportunity, are related with the previous categories of needs. They relate to comfort in the sense that if change is possible, improvements will be more easily attainable; to energy needs because being able to break with traditions may enhance innovations i.e. regarding energy use; they also connect with the emotional health, in the sense that if the focus is on the solution our mind will

be stimulated in a positive manner, which will directly affect the mood; to the affective needs because an open mind allows for greater empathy, which will improve the respect and love among the members and finally, to the relational needs because an open mind will create more room for pro-actively seek other perspectives, thus increasing interdependencies among other farmers.

Have good system design and management – comfort, energy, health and financial needs

- To work with intelligence to be able to overcome the problems that may arise, as Angel (IF3_12) said "work with intelligence, not be coarse, and face the problems that might come". Work with the head, and make things in a proper way so they last long, as Juan (IF1_1) mentioned ¨we have windmills that have been running for 12 years, they never had to be repaired; the hydraulic ram that also has 12 years and the same, stoves, biodigestors that already have several years and that are practically eternal. That they are things which cost us a lot, we thought thoroughly, we spend a lot of work, but it is for ever". They need more labour in the beginning, one needs to invest more hours, but in the long term it pays off.
- Another important element is to be ready for whatever it can come, and develop the ability to foresee short term and long-term events, so that you can work towards that. For example, with good management of the food for the animals and the space you have. Prepare yourself for the winter making hay during summer and store it like Raul (IF2_7) said "During the rainy season I want to put the cows grazing there, in the area of the kingrass[5]. If I have a lot of food to the paddocks I move the cattle there, and I cut the kingrass to make hay, and when the dry season comes I don't have to work so hard", which relates directly with the comfort needs of the farm.
- Also, related to the design there is the need to create a system that can work in multiple ways. For example, in finca Del Medio (IF1) they have several options to use: the wind mills, the biodigestor, the ram, the dam. When one day there is no wind, with the water from the dam and the ram they can provide the water necessary for the house, so the fact that there is no wind won't be a problem. Claudia (IF1_5) explained this point very clearly saying that the key of the management is ¨not to look at the problem, but always seek the solution. If the reservoir is not full of water, it will be the moment to take soil out from the bottom and bring it to the garden. It is also the time that good grass comes out for the cattle to graze and so on... that each element has several functions, as one of the permaculture principles¨.
- A good management also implies having enough water. For Cuban farms, water is a critical point. To adapt to changes, specially to the drought that stroke the island the last years, it is important to know how to manage it: "we need to come with ideas, to see how to store more water capacity and how to use it more efficiently" (Oliver, IF5_20). In *finca* Del Medio (IF1), they tried to collect as much water as possible: "based on that we have worked a lot doing wells, dams, making retaining walls so that when it rains the water stays and infiltrates to the mantle and so the springs are more fertile. And so, while it is not erosive for the land, that there is no drag, that the nutrients of the soil don't leach, and in case that some water is still running away, this will be collected in the dikes of the rice, where it is flooded to plant rice. And then, in the final stage, there is the reservoir, which retain all the water left" (Juan jr, IF1_3). Again, we can see one function supported by many elements, and many elements supporting one function, as a guiding principle, which directly relates to the energy needs by increasing efficiency of the system.
- Knowing how to preserve food is also part of the design and management of the system. Sergio (IF2_9) illustrated this point well: "The part of the preservation of food is a great benefit, knowing how to make canned food, how you can keep a product in different ways during the year is something that was not done and is now done. This is a very important element in the adaptation".

[5] Type of grass for animal feed.

During the peak of the mango season, for example, one can make the sauces so the family can have mango all year long and the fruit is not wasted. Furthermore, the family ensure eating healthy sauces and jams and saves money, answering to the health and financial needs.

- Moreover, part of the design as well is having diversity of fruits, vegetables and animals, which is identified as crucial for adaptation by the participants: "One of the most important elements of the farm is the diversity in life forms: microbial life, diversity of insects, diversity of microorganisms, diversity of animals and crops, and such things. And industrial farming, one of the problems it has, is that it eliminates this diversity" (Juan, IF1_1). In *finca* Rio de Agua Viva (IF2) they made it clear, if something happen they would survive for a long time. Raul (IF2_7) said "We have the tomato there, the tomato puree, the canned food... the grains stored in the warehouse, and so on. And we keep the corn, the beans, the rice, we are ready. We have chickens, which are refrigerators in hot, because they are animals that are alive hot there, and if we want chicken, if there is an event that something big happens we kill 10 and they are saved. We also have pigs, rams, goats, which can also be used when necessary".
- As well, part of the management of the farm household is about managing the economy. As Ana (IF5_18) explained: "It is very important to know how to manage the money, economize to be able to move forward, I think. To learn to save and not waste unnecessarily. That is very important in a house".

To work with intelligence relates directly with the energy needs, in terms of the diversification of energy sources. It also connects with the comfort needs, in the long term, if the innovations are done properly they may very convenient for the good development of the household, and also to the financial needs, because they do not need to spend money on the reparations. To create a system that can work in multiple ways connects to the comfort need: to have several options, so if one does not work the other is there to help, but it also relates to the mental health, being a relief for the brain with the solution focused-approach, instead of always looking at the problems. The preservation of foods relates directly with the health need. To finalize this element, etymologically speaking, economy (*Oikonomia)* is the "management" (*nomos*) of the household (*oikos*). Knowing how to manage the economy of the household clearly relates to the financial need.

<u>To live on the farm with the family – comfort, affective and relational needs</u>

- The most important thing to be able to adapt is to live on the farm with the family. That is to live with the productive system. And if the family is there for a long time then this also adds time on the dimension, making it much more complete, because knowledge may be accumulated and possibly transferred, in the case that the children of the family want to continue the farm, otherwise knowledge may be lost. Pedro (IF3_10) talked very proudly of how his grandchildren already works in the system: ¨ As you can see already this is my oldest grandson, who is a child still, is 13 years old, and he works like a man here. He knows how to do everything. We have educated him, he studies in the village and during the holidays he comes here, where he loves to be, behind the animals, so you can see that the generation that is going to supplant is already being created. And the others are little ones who are getting ready, Alejandro and Rosi. And those who are not, for example Angely, the daughter of Raquel, which is not blood line of us, but is developing here, she is going to see what we do and when she will become a woman. if continues with us, will carry those same principles". To have the family at the farm allows the system to create a collective and intergenerational memory that can prepare the farm for changes on climate, due to the accumulated and transferred experience.
- Being united is very important when facing a change. As Raul (IF2_7) said: "We love each other. And as our Comandante [Fidel Castro] says 'en la unión está la fuerza' (in the union there is the

strength). Being altogether makes it easier for the farm household to pull towards the same direction and to help each other when necessary".

- It is good to have roles and specific duties, but is also highly important to be able to adapt and go forward. In the face of change, it is crucial to have the capacity to be plastic and able to make some other activity when help is needed like Raquel (IF3_13) who said ¨I'm usually working in the house but if somebody needs a hand I help in whatever I can. If something needs to be charged, I will do it as far as I can¨.

This element has a strong interdependency with the affective need of being together with the family and having the beloved one close, working towards the same direction to build up the comfort on the farm and sharing responsibility and ideas. It also reveals the connection with the relational needs regarding the possible intergenerational knowledge transfer when the family lives together at the farm.

<u>To study, collect and share information – energy, health, relational, financial and political needs</u>

- The investment in knowledge enables one to become independent in most of the areas of the farm. If there is the knowledge on how a certain technology works it might be more possible to adapt it so that it fits into the system, and to repair it when necessary. So, not only theoretical knowledge but practical, developing new skills. In *finca* Del Medio (IF1) they are specialists in construction, in creating tools to work the land, in the assembly and dismantling of the wind mills, the ram. They are also improving the ways to preserve the fruit when it is in the peak of the season, so that they can store it for long, and they are also now working on the way in which they eat, their diet. Knowledge is vital to be able to adapt. Having knowledge is having the power to decide what, when, where and how to do things to meet their needs. Like Pedro (IF3_10) explained that they are not using all the fungicide for the tobacco because they know other biological ways to control phytophthora, and they are also a diversified farm, that is very different from a typical tobacco farm.
- Also, that some of the children of the farmers went to the university or have some academic knowledge brings other perspectives to the farm, so, apart from the empirical knowledge, they can also grow from other types of knowledge and can exchange more. Nico (IF4_16) put the example of his son ¨Liuver is studying to become a vet, and that him studying with experience and practice will provide much to the farm and he might come out new achievements, to help the system work better¨.
- Furthermore, part of the collection of information there is a very important part that is to observe, experiment and keep track of the results. To learn from/with humans and non-human others. For example, select the animals or vegetables that stand after a dramatic event, i.e. a cyclone or a long drought, is highly important to increase adaptation, and that is linked with the fact that the family lives in the system, so that they can accumulate years of experience and observation in the same land, mastering the conditions, even though conditions change they may have different strategies to cope with them. In *finca* Del Medio (IF1) this year no cow died because the animals are highly adapted to the *finca*, thanks to the selection that has been made throughout the years, whereas in other farms in the surrounding, because of the drought, farmers lost an important amount of the herd. Juan (IF1_1) explained that he used to take a lot of care of the cows, giving them a lot of sugarcane and "when the sugarcane was over there were cows who died. And we left those cows die. And we began to leave the young cows of the ones that survived, the ones that grazed well and they proved to be prosperous in the environment that the farm offered. And those are the ones we have". Another example is in San José (IF3), they have a map of the places where each vegetable functions best, due to experience and experimenting: "I know that in this piece of land I can plant cassava because it is better, I plant the malanga there because it is better, and I go like that. I make a kind of a sketch, we have as a sketch that tells us what we can do in each place" (Pedro, IF3_10).

Being patient and able to appreciate the tempo of nature, which slowly teaches us on how she works. Have the time to sit and observe is crucial in this learning process. It is also important to try, make mistakes and learn from them. Listen to the advices, but be aware that each system is dependent on the specific biophysical and social context it is placed and thus the general rule may not apply, so it is important to try always with open mind and keep track of the results, so is possible to learn from the experience. Use the farm also as a laboratory, where experimenting is a tool to get to conclusions that fit the system, like Adrián (IF6_24) who explained that a strategy he found is "sowing early, because the pests do not attack so much, it rains a little, you save more water, the crops are better. Otherwise, if it goes out of time you have to apply other things, more chemicals, which is no good for the food nor for the system".

This feature connects to most of the needs because knowledge is a transversal quality. It connects to energy needs because it gives the ability to recognize how the system can be efficiently improved and it also decreases the external dependency on reparations, relating with the financial needs. Knowing how to preserve food results in high quality canned food, much better than the ones in the supermarket which is a direct investment in health, and at the same time decreasing the financial needs. Studying and sharing information can be also a start for debate with others, connecting with the relational needs, and at a major scale, to the political needs.

<u>To have the freedom to implement changes – comfort, energy, health, financial and political needs</u>

When farmers have freedom to make a change there is potential to be improved.

- To be sovereign, as much as possible is considered a necessary condition for adaptation. As Nico (IF4_16) put it "I have more freedom because I am my own boss. I work when I want, when I do not want, I do not work, I do things in my own way. I am creative, because when I work outside I have to do what others want me to do, here I do not need to follow others' orders. Here is what I want to work, and I can do the changes I consider necessary". This freedom allows families to follow the *finca* rhythms, not the market demands: "What we have done is to descend on the energy consumption, and go down and adjust and adjust to the point that is following a human rhythm, the rhythm where the farm feels, harmonizes with what you want and with what it can offer you. In this way, you don't plant every year the row of cassava, or beans or rice because it is the market demand, no, no. You have to respect the cycles here" (Juan, IF1_1).
- Also, having this freedom allows farmers to be able to implement what they learnt in the workshops from PIAL or BIOMASS and come out with new innovations. For example, Mireia (IF2_6) explained that "now [once they knew about energy saving methods, provide by the PIAL workshops] if I had the opportunity to do the house again, I would make it not as spacious as we have it. I would make it smaller to save more. We would save more of our economy, space and we will have more health, because it is not the same to clean a room of 1.80 by 2 than a bigger one". Besides the freedom, is also essential to have the ambition to make things better every day. For example, the biodigestor was a great improvement for the farms, because it was a big step from cooking with wood, full of smoke and less constant, to have a constant flame, odourless and coming out from the residues. Elena (IF3_11) talked about the biodigestor with a smile "Biogas has been here for a long time now. It was a very important change because I used to cook with wood on the wood stove, that was my youth. All life cooking with firewood. It was a complete revolution!". Apart from the cooking benefits, they stopped sending nitrates to the atmosphere and can collect the by-product of the biogas for fertilization of the fields "the biogas, gives you fuel and, at the same time, gives you fertilizer, which is already an added value" (Julio, IF1_3).

If there is freedom to implement changes comfort needs can be covered more easily. Energy sources can be adapted to the specific context demands, decreasing the financial needs, and improving the health status of the members, like in the example of Mireia (IF2_6). Also having the freedom to follow the finca rhythms, and not the market demands, have a direct connection with agrarian policies that should promote those choices, relating it with the political needs.

To educate the new generations – comfort, affective and relational needs

- As Pedro (IF3_10) exposed "we [family farm households] are given the possibility of educating our children in a specific profile and preparing them for life, from the younger generations to the more developed ones. In other words, there is an integrity in the farm".
- In Rio de Agua Viva (IF2), Mireia (IF2_6) also referred to the education with the principles of sharing and self-reflection of what is a need and what not: "they are taught to choose since they are born".
- The fact of living altogether in the farm, where they live and work, allows parents to spend much more time with their kids and, as Luisa (IF5_19) says "living at the farm I can personally take care of my children, the education, the training, that is very important at this early age".

This element has some connections with the principal needs. Regarding affective needs, by living together at the farm, parents can invest more time in the education of their children. Also relating to comfort, by educating the children on the farm, they will accumulate the knowledge and comfort will be more easily attainable. And, drawing on the specific example of Rio de Agua Viva (IF2), it has also a link with the relational needs, regarding the sharing and the decision-making capacity.

To have a good network among friends and neighbours – comfort, affective, relational and financial needs

- Create this network is a very necessary element identified by the participants, so that they can support each other when needed: "neighbours here help each other. Yes, the neighbours help each other! There are neighbours who are like brothers and for anything, they go forward and help you with whatever" (Ana, IF5_18).
- Also, the importance of the network is appreciable when the cooperative cannot provide a specific material, then you need other ways of getting those materials, as Luisa (IF5_19) explain "I go to the cooperative, to get things, manage things like "cujes"[6], supplies, inputs... there are things that come normal from the cooperative, but there are others that you have to solve by other means".
- Having a good network and the possibility to meet with other people: "It is sometimes good to have the opinions of other people, and sometimes you are going to listen to the opinion of the neighbours who may help you coming up with new ideas" (Marta, IF6_23).

Having a good network is a synonym for the relational needs. Furthermore, this element also connects with the comfort needs because if, i.e. a tractor is needed a neighbour may have it and can help in that, also directly related with the financial needs, because then there is no need to buy or rent one. And having friends it has a direct link with the affective needs, because they are constructing relations of love and respect.

Summing up

These seven capacities needed to adapt, function as a binding glue to hold together the principal needs, highlighting the interdependency among the needs. For example, having an open mind (being able to

[6] The wooden sticks for drying the tobacco leafs.

break with traditions, focus on solutions and recognize when a change is needed) is important to create spaces of comfort, to meet the energy needs as well as creating a better atmosphere related with the affective and relational needs. Like this, the other characteristics also have multiple relations with the principal categories, as noted in each characteristic. As repeatedly expressed by some participants it is important to have multiple ways to tackle a situation. Because of that, also multiple adaptive capacities are needed to meet a specific need, and the correct articulation of those elements might result in a success story in the construction of socio-ecological resilience. It is necessary to stress that the unit of analysis is the family farm, and thus those needs are from the collective. There is an interdependency of the needs but also of the members of the household, and also beyond the household. Others outside the household also provide the necessary conditions to meet those needs, as is the case with the relational needs and having a good network among friends and neighbours.

Although it seems there are a lot of needs, family members acknowledged that they had most of the basic resources for their development. The land, the family, the food, the health and the house. The basic needs were, more or less, covered in the studied farm households.

6.1.3 Negotiating the needs

After the identification of the needs, an important issue for this research is to know *how those needs are negotiated*. In this subsection, the interdependency among family members and their needs is negotiated with the intention of ensuring the well-being of all the members.

Because they live altogether in the farm, negotiation is a continuous process present all the time. In some farms, they negotiate over what needs are more urgent to meet and how to meet them every day. In the negotiation of the needs there are always discussions, but for most of the participants the important part of the discussion is that all ideas are presented: “I am the one with the most experience and I always share when I have an idea, and we are always sharing” (Juan, IF1_1). Whenever somebody has an idea s/he is encouraged to share it with the others, this is the way to start negotiating about it.

After sharing the ideas, it is important that the agreement can comprehend all the different visions, or at least try to, and with the focus on reaching a consensus. That is understood as the key point in any negotiation. Probably not everybody will have the same opinion about a topic, but the important step about the negotiation is that an agreement is reached, trying to accommodate everybody’s interests, as Sergio (IF2_9) said “that our differences, what differentiates us or the differences that we may have, are not the barrier to the decision. The attitude is to try to put together rather than disengage. When making decisions it does not matter that one does not think the same as another, but always try to make decisions that go forward and favour all”, having the proactive attitude of trying to unite instead of separate. When a decision is made in a collective the important feature of it is that it has benefits for all, even though not everybody has the same opinion about it.

Equally important is to have the capacity to recognize and accept that one’s position was wrong: “I listen to what others say, the criteria of others, and we bring them to a consensus and see what is the best idea, because is possible that I am wrong, because my children have had the opportunity to study more than I, have to know more. And, overall, we are a team, we cannot decide by oneself” (Pedro, IF3_10).

During a negotiation is also important to look at the benefits that a certain activity will bring, or the difficulties that may arise, having a look at weaknesses, strengths and opportunities so a better decision can be reached “Talking, talking, and looking the benefits that would bring us or what degree of difficulty we will have to achieve this... we look at weaknesses, honourabilities, we look at strengths and so on...” (Sergio, IF2_9).

There are decisions that are based on previous experience and because there is the knowledge of what works better there is no much room for discussion, nor negotiation: “In a discussion each one gives its criteria and we arrive at agreements well. The negotiation is something progressive. If we have done it before, we have tested and did not work, we have changed to another and this one has worked better... it is a constant redesign, looking for the most sustainable and attractive system possible” (Claudia, IF1_5). But sometimes experience is not needed, but creativity. In this sense, the young ones are the ones giving the best ideas, because they have a broader vision and they can accommodate everybody’s interests. Rio de Agua Viva (IF2) gave an example of that with the creation of the new honey tank. in combination with the tank for water collection. Ruth (IF2), the middle daughter, she combined the creation of the honey tank with the creation of the tank for water collection, two necessities in one, considering the needs of his dad for the honey, and the needs of her mum to clean the clothes, coming up with the best idea, Raul (IF2_7) explained.

Negotiation is also based on the strategy and the mission and vision that the farm has. For this reason, it is crucial that everybody participates and brings their perspectives on it, because it is not only about the decisions but more on what the farm wants to obtain and where they want to go, directly related with the comfort and energy needs.

“Decisions are always taken as a family. In a family, we all participate, not only from the decisions but in what we want to achieve and where do we want to go” (Sergio, IF2_9). When there is division of labour, one does not necessarily share the decision making with the other members of the household. For example, Nico (IF4_16) explained that if he has to take a decision about the crops he does it by himself since this task became part of his task in the existing division of labour with the household, but if it is about the family, or the house, then they sit altogether and discuss about it, to reach an agreement.

Also, negotiation is dependent whether a fundamental need is met or not. For example, decisions can be made much more easily, otherwise, if there is shortage of fundamental needs (i.e. food or water), the decision range will be much narrow and conflict may arise. Most of times, the negotiation depends on the money available and the pressure of having something done, resources and priority. Giving priorities is also a way of deciding. Oliver (IF5_20) gave an example of their priorities as family: “Today, priority is to finish the construction that is being done, to be able to have more space, since we are too many under the same roof. Investments are prioritized depending on the moment. A year ago, we bought a turbine. We had a single turbine, and we decided to buy another one”. Then they must present the arguments depending on the scale, which may be tricky sometimes.

If there is a conflict about some issue, like what needs to be done first (i.e. buying material for the new house or a new wheel for the cart) or who will have new clothes first, usually the family talks through it and try to reach an agreement, relating to their scale of priorities. Sometimes there are arguments around some issues but talking discordance can be solved. If there is no agreement then they keep on discussing and talking until they reach a common point. In a collective a decision cannot be made by one individual, because it might be that is the wrong decision for others. And, as Pedro (IF3_10) said “100 brains think more than one and have different ideas, and it is really enriching to be able to listen to all of them and have the ability to let go one’s own ideas to accept the suggestions of others”.

Having relationship with other peasants is very beneficial for negotiation. Doing the workshops together with other farmers opens the mental space for other ways of dealing with situations, for other perspectives, and one can compare oneself with others, to see which can be the best way of doing a type of crop, or a new kitchen. As Marta (IF6_23) exposed “in the project workshops, we exchange with other producers, we visit farms and you take ideas from others. That help you to open more the idea of what you are going to do, and you have other experiences with whom to compare”.

There are also other perspectives on that, like Juan (IF1_1) who said "that there are some studies that have the error to assume that everybody creates ideas, and this might not be true. Probably everybody can make ideas bigger and add to it, but generally, in all the groups there is somebody who dedicate more time to think on it, so eventually there will be one having more ideas. Generally, it happens to me, because I am the oldest, but also the one with most experience". The importance of leadership on the farm is here stated, as a way to follow the strategy and build on that resilience.

What is clear about negotiation is that an agreement must be reached. Negotiation is the first step towards the well-being of the household and their members, where individual and collective needs are considered and actions are carried to fulfil those. From this starting point, any conflict can be dealt with a healthier environment, having in mind the importance of the collective. Experience is a big factor in determining agreement in a situation of negotiation. Sometimes because of experience the agreement is easier to reach, but other ideas may be left aside. If consensus cannot be reached then is most of the family that decides. Otherwise taking decisions would be impossible.

There is a division of labour that makes negotiation a bit vague sometimes. Everybody is respected on their positions but mainly the ones working the land will be the ones deciding about i.e. crop and irrigation issues, and the ones working at the house will decide about i.e. the diet of the family and the day to clean the floor. Gender, age and position within the household are determinants of the negotiation. Most of the times the oldest couple are the ones taking the final decision, and the blood related family members tend to have more decisive power over the non-blood related.

To be able to negotiate there is a fundamental quality which needs to be present: flexibility and being open to change, as for adapt to changes. So here there is a connection between negotiation and adaptability. And, the recognition that in a family farm everybody is part of the team and they all must row in the same direction if the ship has to reach the shore.

If there is a place to reflect on the activities and behaviours it is more difficult that conflict arises. For this reason, it is important to have this space in everyday life, so small discordances can be talked through and solved together.

Conflict and negotiation have a direct dependency on the resources available and the priority scale, set by the particular family needs of the moment. Marta (IF6_23) gived a good illustration of this: "we needed to enlarge the house more, because the family was growing, we had a grandson, the two girls and then, we needed to create better conditions and enlarge the house to be more comfortable. A new tobacco house was also needed because Adrián (IF6) has been increasing the tobacco plantation. We talked about it, we made the plan, we saw all the investments we had to make, how we had to save, the expenses we had, and then we decided". It might be that the priority is to finish the house, but then some equipment for the land breaks and then priorities are also adaptable, depending on the moment.

Sharing ideas with the others is part of the relational needs, which increase knowledge and have a direct influence on negotiation, by acknowledging the others.

Summing up needs

So, *"How do family farm household members negotiated decisions over what needs should be met to survive together well?"* Each family farm reality is a very specific one. One that comprehends that the collective is more than the sum of the parts, and recognizes that to co-exist, adapt and transform decisions need to be negotiated and talked through. In this section, we could see how the seven needs become one big need, that is to be connected and coordinated to overcome the changes. To be connected among the family members, and connected with the exterior of the farm household. This diversity of needs and features necessary to adapt gives the possibility for the interdependency to be visualized. To

negotiate is necessary to be flexible, as to adapt there is the necessity of an open mind. And to exist together well is necessary to be loved and respected, as to make decisions is important to listen to all the ideas and consider the best option.
There is a great diversity of structures in family farming (IPC, 2014) leading to a great variety of strategies and ways of dealing with situations. What is clear is that family farms are prepared to adapt and transform because they know the space they occupy and the relations they are fostering with their everyday activities, stressing out the importance of this interdependency, necessary when building resilience.

6.2 SURPLUS

To answer the second sub question of the research (SRQ2.2) "*How is the surplus from family farm households produced, appropriated and distributed to meet the identified needs?"* information on surplus production and distribution within the household and beyond was obtained from the participants and linked to the above-mentioned needs.

In this section, first there is a definition of surplus and its various forms (production surplus, labour surplus or value surplus). Then there are explained five types of practices that help this surplus production (6.2.1): tourism, re-design, food practices, recycling and working the land of the others. Following those practices there is how the surplus is produced and distributed, with differentiation between surpluses generated and distributed within the household (6.2.2), within and beyond the household (6.2.3), beyond the household (6.2.4), and finally, scaling up, changing from the scale of the household to a bigger one, the one of the cooperatives, how cooperatives generate and distribute that surplus (6.2.5).

As explained previously in the first chapter, in Cuba most of the land is owned by the state and all the peasants have a contract with the state to deliver part of their production, what is called the social object. It can be tobacco, milk, meat, diverse crops, or others. The farms of this research are diverse in the social object, as explained in the profile section (Chapter 4). Most of them have as social object the tobacco, some others milk and meat, and in general they all sell what is left once they covered their self-consumption of other productions like rice, beans, bananas, malanga, yuca and other basic elements of their diets. **Surplus** is what is leftover once they covered their own needs regarding comfort, energy, health, affective, relational, financial and political requirements. To be able to cover those needs there is a necessary step of planning. For example, regarding health and financial needs, they think about their food requirements before they plant the crops, so they ensure their own food. If, after selling (financial need) and keeping for themselves (health need), there is still product leftover, this is what is understood as surplus. There is also the surplus in the context of caring labour, understood as the care labour produced beyond oneself needs (Fraad, Resnick & Wolff, 1994). In the following section I will first, go through the practices to help better surplus production, to understand how is surplus produced, illustrating those practices with concrete examples from the field. Then I will focus on how this surplus is distributed within the household, beyond and also, in the bigger scale, focusing on the cooperative, as a form of autonomous association of the farmers, united to meet their needs and aspirations.

6.2.1 Practices to help better surplus production

The farms, besides their production, they also do other activities and receive money and material assets from other sources.

- **Tourism**: Finca Del Medio (IF1), in addition to the money gained by selling the contract for milk, has an income from the rural tourism they host at the farm. Part of that serves to re-invest on the farm, so that is part of the comfort need, and what is left is surplus. The other farms also receive visits from international and national groups as a way of sharing and exploring other manners of agroecological management.
- **Re-design:** "There is a lot of economy and few expenditures" (Juan, IF1_1), meaning that there is lot of investment in re-designing. This constant re-design of the farm and house environment is also part of the creation of surplus, since it influences directly the needs creating a more comfortable space, meeting the energy needs by introducing new sources of renewable energy and re-investing the money coming from other operations to attain the financial needs. The re-design has much to do also with the good design and management and the freedom to apply changes on the farm, otherwise this re-design would not be possible.
- **Food practices:**
    - Food production without chemicals is a big choice for some of the families. So that they invest in their own health with the vegetables, the fruit and the preserved food, meeting the health need. They also grow their own rice and beans, but not all the families (4 out of 6) do this. Here we can see a clear link between the identified needs and the production and distribution of surplus. Health is a central need. With the food that is produced at the farm the surplus, in terms of health, is huge, as well as in terms of saved money (financial needs). If they would buy what they produce it would cost them much more and because health is a precious need, there is considerable added value (monetary and non-monetary) on that surplus creation. Apart from what they save for the self-consumption they also keep part of the surplus aside in case there is a bad harvest and they can ensure some food, at least.
    - Also, the preserved food is a very important achievement in food conservation. They were not doing it before and the tomatoes were rotting on the floor. Now they have sauce for the whole year, to give to friends as gifts and more! For most of the farms the family consumption (in terms of production) is more important than what they can sell, because if they can ensure their food, then they have much less to be dependent on, and they know what they are eating, meeting the comfort, health and financial needs at once. In most of the farms food is self-provided, so there is no major need of buying, but that is not the case for all. Like in Flor del Cayo, Ingenito and Las Dos Rosas they depend on others more than Del Medio, Rio de Agua Viva and San José, mainly because on the first three the social object is tobacco, which demands a lot of land that cannot be farmed to provision the family.
- **Recycling** is a very common practice in all the farms.
    - The bottles are always re-used and replenished. The plastic bags as well. The beer bottles of 33cl or the 1L glass bottles are also recycled in the preparation of preserved food, like tomato sauce or mango jam. And then there is the fact that before they will throw anything they will try to repair it. Engines that work for more than 100 years and still working, that can make four different functions at a time, motorbikes that have been also repaired, and endless bikes, like the one in Ingenito (IF5) "That bicycle was first from Luisa, then from Luis and now it is from José-Luis" (Ana, IF5_18). This part of recycling connects directly with the financial needs because, if kept in good conditions, material things can be used for a very long time, diminishing the monetary needs to buy more things.
    - Food is never wasted in a family farm. There is no problem if one day there is too much food for lunch or dinner. Once the food requirements of the family are covered, that food will be collected and, at the beginning of the next day, cooked to give it to the animals (pigs, chickens or dogs), what is commonly called '*sanchocho*'. This relates to

the adaptative feature of good design also, by creating multiple ways of using one element and increasing the synergies among those elements.

- Another way of generating surplus is **working the land of others**. Like Adrián (IF6_24), from Las Dos Rosas and Nico (IF4_16), from Flor del Cayo.

6.2.2 Surpluses generated and distributed within HHs

From the moment that the unit of analysis is the family farm household, all types of work involve a form of care, as Laura (IF1_4) said "I am working for the well-being of everyone, everyone cares for everyone and everything". There is care for the place, the house and the farm, and care for the people (household members and non-household members). We can distinguish then two types of care: (1) the care on the place, caring for the house and having the area clean and the preparation of healthy food; and the care for the land, caring for the animals, the crops, the soil, the water and everything related with the farm production; and (2) the care that involves people: giving attention, love, education, washing the clothes, sharing moments or giving advice.

- **Care for the place**
    - In the house, the activities are very diverse. They involve mechanical work of cutting and preparing food, but there is also a mental work of preparing the recipes and providing with healthy food to the family and the workers. The preparation of preserved food to keep the fruits and vegetables from being waster it is a very important one and it has a great outcome in terms of household food provisioning. Also, caring for the place involves the maintenance of a clean area, for the creation of a good environment.
    - The work related to the land has lots of different activities as well. Going to the town to bring the milk in the milk tank in the morning, preparing the soil, watering, spreading the biodigestor residues on the fields, seed the new crops, and take care of the vermiculture, among others, to have the production to fulfil the contract with the cooperative. Having the animals integrated in the system is a way of creating surplus, if there are the appropriate technologies to use it, such as the biodigestor. Without the animals that organic matter would just be degraded in the soil, but no meat, milk, fertilizer or biogas would be produced. As Juan (IF1_1) explained: "I don't have to do composing, it is produced by the cows in a highly efficient way". The cows are processing the food, organic matter, into manure, that once passes through the biodigestor is a very rich amendment for the soil. Moreover, the biodigestor creates biogas that is used for cooking.

The preparation of food for the whole family relates with the affective and health needs, and the canned food is a direct improvement on the financial and health needs: they do not need to buy extra and they are eating without preservatives. The maintenance of a clean place is related with the comfort of the family. Concerning the farm, it basically relates with the financial needs, because all the surplus produced in the care for the soil is harvested in terms of production that is sold to the cooperative and exchanged for money. Moreover, the fact of having the animals integrated in the farm and the appropriate technologies decreases the external input dependency and closes cycles in a more natural way, improving health, because there will be less chemicals and decreasing the financial needs, because they will have to buy less (or none) inputs. Also, connecting to the animals and the biodigestor there is the production of biogas, which increases the comfort in the kitchen.

- **Care for the people**

This is a very important part in the family farm household, which produces surplus in forms of caring labour, attending to the comfort, health, affective and relational needs.

- Being mom generates a lot of surplus in care because now is not only about oneself but about a new human, who is completely dependent on the mother, the first years at least "Taking care of my child is my main activity. Be with him all the time. I wash the things of him, the clothes, I give him

pampering, when he sleeps I clean, things like that, make him food, what he eats..." (Lola, IF3_14). As Pedro (IF3_10) said "having a kid is also a contribution to the family, in this boat of life". What makes the connection between generations and the place, and might improve, someday the design and management of the system.

- Most of the children spend a lot of time with their grandmothers, who care not only themselves but also other family members, specially their grandchildren. Because of the age, they cannot be working on the land, and because of previous experience raising children, they take this important task of caring, seen, from the grandmother perspective, as a surplus in caring labour.
- In the care for people there is also the fact of working together and lowering the burden of the work. There are several activities that are carried out in company, like in finca Del Medio (IF1), Juan father, Julio and Claudia share the milking in the morning, and then they also share the manure collection to drop it in the biodigestor. In Rio de Agua Viva (IF2), Sergio and Raul work together in the heavy jobs because Raul has some problems with the hands and the knees and cannot make big efforts, so the fact that they work together is also a caring work.

Having the children in the system is seen as a huge necessary investment in knowledge and hope, part of the adaptive need of living at the farm altogether and being able to educate them. It is also covering part of the affective and health needs. Affective needs are functioning bidirectionally, between the children and the other family members, and health needs relating to the proper development of the children, in an environment free of pollution and chemicals, as Raul (IF2_7) said "Because here [in the *finca*] we breathe air, we breathe health. However, you go to the city and you are breathing polluted air, air that I do not like nor for me or my children". There is the hope they can continue the farm without being asked for but because they want to, and this might have an importance on the financial needs, because they will be living all together, but also part of the affective needs, being close to the beloved ones. The fact that they work together creates a surplus to fulfil the comfort needs, as well as the health and affective needs of the members who are working together. Care is shared and everybody is also cared by others. The ones working the land care for the land, grow healthy vegetables and the ones at home prepare the food to be tasty and fulfilling, so it is a perfect synergy, structured by the division of labour.

Luisa (IF5_19) and Yolandas (IF5_22) are an example of a mix between care of the house and the care of the people. They both are taking care of their parents, the children and the house. Preparing all the meals, breakfast, lunch and dinner. Luisa (IF5_19) brings the children to the school, together with Oliver (IF5_20), who, as she expresses, helps her a lot. She said that is all day running around doing things, taking care of everybody, the children and also her parents, who are already old and need a lot of attention. She also goes to town to buy things needed and collect things from the quota[7]. Yolanda (IF5_22) has invested a lot of time and care on one of her children, who was born with a problem of the extremities and had to go to Habana for operations a lot of times. During this period, she invested all her time on him, and she started working only five years ago, when he could go to school.

The distribution of surplus among the members of the farm has much to do with the negotiation of the need, and each farm has their own strategies. In finca Del Medio (IF1) for example they have an equal distribution for all the family members as well as the farm, they count the farm has another member, so if something is needed for the house there is already money apart for it, actually the farm has a bit more than any other member, since it needs much more. This relates directly with the comfort and financial needs. The cook (Laura, IF1_4) is receiving a bit more to give extra motivation to her, because she is still in the process of adapting in the family, and her salary is ensured, which relates to a good system

[7] The quota is the food that every Cuban receives from the State at a very affordable price which includes the basics: rice, beans, bread, milk and meat for kids and elderly, salt and sugar.

management, one of the adaptive needs. At the moment, the idea is that all the expenses are covered by the visitors to the system (rural tourism), and the rest divided among the members of the family and the farm. In finca Rio de Agua Viva (IF2) the distribution is different, similar to most of the other farms. When everybody is working at the same place there is no reason to split the earnings "the money that is here in the house has no owner, is for everybody because the seven of us work here in the house" (Raul, IF2_7). The money is put in the common pot altogether for everything and to reinvest for the next growing season. They have a system where everybody knows where is the money and when somebody needs something goes there, takes what is needed and writes it down in a paper, with the concept, the date and the description of what for, so they keep a record of their expenses as well as the entries. When there is a lot of money at home they bring it to the bank. In San José (IF3), Pedro and Elena are the ones making the accounting, as well as in Flor del Cayo (IF4) and Las Dos Rosas(IF6), the oldest couple are the ones managing the financial matters. In *finca* Ingenito (IF5), Ana (IF5_18) is the money keeper of the house, and the one who distributes what and when is needed.

Part of the surplus created on the farm, is spent on going on holidays, meeting the health and affective needs. To take care of each other outside the farm environment. Time is a barrier, because the farm is very demanding, and sometimes going on vacations is not a possibility, even though there is money to do so.

6.2.3 Surpluses generated and distributed within HHs & beyond HH

In this sub-section, surplus that is generated and distributed beyond the household is discussed. The family that lives outside the farm but that visits often sometimes are brining money or materials for the development of the farm, and the farms are also gifting food to friends, extended family and neighbours.

In *finca* Rio de Agua Viva (IF2) they sell the milk, the eggs, and the pigs every 6-7 months, to the cooperative, who gets 10% of the benefit. "I always accomplish the contract with the cooperative, and I even over accomplish it." said Raul (IF2_7). This extra production is the surplus, which is what is produced after attaining the contract and after self and household consumption is covered.
With the money from the selling they invest in new pigs, the food for the pigs and the rest they try to invest in the improvement of the installations, the house or for their clothes. There are also other ways of distributing the surplus, like in Las Dos Rosas (IF6) where sometimes there is people going there to buy some of the production and sell it directly on the *feria* (the informal market).

The surplus created outside of the farm are used privately or collectively within the household. As examples, there are Yanina (IF2_8) and Sergio (IF2_9) at the church, Alejandro (IF3) at the mission in South Africa, or Yolanda (IF5_22) at the school. The surplus generated is usually kept with the ones that produced it. So Yanina and Sergio would keep it for them, Alejandro to sustain his wife, Lola (IF3_14) and their children, and Yolanda for her and her son, Juan-Luis. But because they also live from the farm production, whenever there is an emergency at the farm, they will be the first to offer that money to solve the situation. Again, here we see how the distribution of surplus has much to do with the negotiation on the household. For example, Yolanda (IF5_22) has a salary from the school and she says that helps Luis (IF5_21) out, because in the farm Luis have to invest a lot, and when he makes the accounting there is almost nothing left. So, depending on that year's harvest and the needs of the household, the surplus will be distributed in one or another way.

- **Care for people – Gifts to family, friends and neighbours -**

What is left after covering needs (surplus) is saved for unexpected events or spread among family and friends. Sharing with the neighbours and the people of the village, covering not only one's household needs but the needs of the broader community, strengthening the community economies.

- There is people who need it for their children or sick people, and most of the times is given in a gift form, strengthening the interdependencies. Rio de Agua Viva also brings food to the orphanage, to the church, to the primary school, to the paediatric and make donations to the cooperative on special dates. This has much to do with their relational needs.
- Mireia (IF2_6) goes every week to her mum to bring her the basics of milk, maybe a chicken and some vegetables, as a way of supporting her well-being. She also gives 200 pesos to her sister, who is taking care of her mum. Jacinta (IF4_15) also brings food to their parents at the village. And most of the participants do so. Whenever they go to the village they bring some milk, vegetables and fruits to the family and friends. Yolanda (IF5_22) takes care of her grandparents, who live in a town close by the farm. Her grandparents do not have water at home, so she goes every day to supply them with two full buckets from the house of her mum. Taking care of the loved ones relates to the affective needs.
- Also, related with the care for people there are the visits to the family members who do not live on the farm. Whenever they have a moment (surplus time, after having covered the fundamental needs), most of the participants go to spend some time with them, attending to the relational and affective needs. Ana (IF5_18), from Ingenito (IF5), tells me that they go out only to go to the hospital, or to visit some familiar, maybe also in the hospital.
- On special days and holidays the farms are a place to gather with extended family and friends. And then those days they share the food, they kill a pig or a sheep, and enjoy altogether.
- There are also other relations of reciprocal exchange. For example, in Rio de Agua Viva (IF2) they give milk to a guy that lives nearby and this guy brings all the milk to the milk container.

- **Remittances from family members**

Another type of surplus production comes from the remittance from outside.

- In *finca* Del Medio (IF1) there is Leidy who brings things that are needed, when she finds them. In finca Rio de Agua Viva (IF2), Yanina and Sergio work at the church. In *finca* San José (IF3) the oldest son of Elena and Pedro is working on a mission in South Aftica and in *finca* Ingenito (IF5), Yolandas works at the school nearby the farm. All those types of outside farm works bring cash and/or things to the system. Also, when somebody from the family goes abroad they bring back things for the household investing directly on the household. Some members receive help from the outside of the country. Like in Ingenito, the cousin of Oliver (IF5_20) that lives in Spain, and she sometimes sends things for the children and for the family such as clothes, or a laptop.

Those entries to the household help the family farm with their financial and relational needs. This network of mutual support increases their capacity to adapt.

6.2.4 Surpluses generated and distributed beyond HHs

This last section from within and beyond the household, focusses specifically to the surplus that is solely generated and distributed beyond the household.

- **Care for the place – surplus labour**

Some farms practice the labour exchange among peasants of a neighbouring area, collectively producing surplus that will be distributed among all the members. This reciprocal labour works during the season of the tobacco harvest for example, that a group of peasants join forces to work together without being paid (instead of hiring people to do it). They just do it altogether and share the facilities of all the farms, like cultivating machines or turbines, directly relating with the financial and relational needs of the household and the other farmers, enhancing the community economy of the area.

- **Care for the people – material and immaterial exchange**

Moreover, apart from a labour exchange it also occurs, simultaneously, a knowledge exchange because while working they share novel practices so work can be optimized. It is like a cooperative but without institutionalization, it is a form of mutual support. There is also surplus of knowledge production. As Juan (IF1) posed it: "At this moment, our major income is product of the level of consciousness and the realization level that have allowed us to have almost no expenditure. We have almost no extra costs, almost everything is investment. Investment in construction materials, in new trees or for the fencing material, which are things that will, probably, last forever", highly related with the financial and comfort needs.

The exchange and collaboration among neighbours is a big part of their practices. On those days of extreme drought in Cuba, water is a precious element. In Rio de Agua Viva (IF2) and San José (IF3), for example, they share their resources with the neighbours, as long as they can. And Adrián (IF6_24) from Las Dos Rosas got help from a neighbour nearby with the turbine to help him pump the water to the fields. The exchange is not only of knowledge (immaterial), but also of material things, which also has a strong influence in the financial needs.

In the encounter with other peasants there is a fruitful exchange. Pedro (IF3_10) expressed that for him that knowledge exchange with fellow farmers is a fundamental activity, because it gives them the possibility to nurture themselves with their needs and because it gives the opportunity to exchange seeds (material), and practices and knowledge (immaterial), which is essential for their development. The encounter with other peasants has a direct connection with the relational needs, gaining new knowledge to survive well as a family as well as a community.

Regarding care, there is also the case of Juliet (IF2_8) and Sergio (IF2_9), who are an active part at the Church. Because the work from the church is not only going there and talking but also visiting at home and talking and listening there, this particular form of care meets their affective, relational and financial needs, as well as meeting the affective and relational needs of people they visit.

The distribution beyond the household also reaches the macro level. Distribution of knowledge, in Cuba and internationally, in the construction of biodigestors, efficient wood stoves, planting techniques and others "We have helped many people advising the construction of biodigestors, stoves ... here in Cuba and abroad" (Juan jr, IF1_3).

Another level, where the distribution of surplus is negotiated is the cooperative, which is explained in the next sub-section.

6.2.5 Cooperative – appropriation and distribution

The cooperative is a bigger institution than the family, where the farmers organize together and share machinery and knowledge. Is a collective in which workers appropriate their own surplus, thus not exploited (Gibson-Graham, 2005). Cooperatives also make a pool of funds available to cooperative members, similar to what finca Rio de Agua Viva (IF2) does, but on a different scale.

All the farms of this research are part of a CCS (Cooperative of Credit and Service), covering relational, financial and political needs. Being part of the cooperative gives the farmers the possibility to work on

the land, fundamental to cover the comfort needs, ensuring that the land won't be abandoned. The farmers conforming the cooperative pay a social quota, which is part of their financial and relational needs, to guarantee the well-functioning of the cooperative. The quota (3%) is paid with the money from the harvest. From this 3%, there is a 1% that is for administration and a 2% that is for the cooperative collective. The fund collected through the quota serves to cover a wide range of needs. This fund serves to:

- Pay the administrators, who are in charge of the management of the products and inputs of the whole cooperative. The management also consists of paying the harvest to the farmers, directly so the farmers do not have to be wasting time on the bank.
- Help any member of the cooperative in case there is an emergency, i.e. a farmer lost all the harvest, some natural hazard destroyed everything or in case of sickness. This money can be used to restore the area, or pay the trips to the hospital, helping the farmer, and the family, financially. This cooperative bank is key in relation with the financial needs.
- Provide the farmers with materials, inputs and machinery when needed, at a subsidized price.

Apart from the social quota, Pedro (IF3_10) explains that any production surplus they have they give it in form of gift to the cooperative, because since they produce more, the cooperative will gain more "Any surplus is a contribution we make to the cooperative, because at the same time that we produce more, the cooperative produces more profits. They have better economic solvency, and that, brings benefits for all the collective."

All those decisions about to whom, what and how much is decided on an assembly, once per month. Adrián (IF6_24) makes a bit of fun about it, he said: "we talk a lot, but we do not really take decisions. As commonly known, the cooperatives can lose decisive power on the assembly because everybody wants to give their opinion and sometimes can be hard."

The cooperative is a clear example of how needs and surplus meet, in the search for a better economy of the broader community. Cooperatives marshal and distribute surplus in ways that will strengthen and expand the capacity of the existing community economies (Gibson-Graham, 2005). The farms part of the cooperative cover their relational, financial and political needs. They have periodic encounters with other farmers where they can share practices and knowledge (relational need), they create this common fund out of the surplus produced to be able to allocate it when necessary to some farm (financial need) and is a form of organization that can be better heard at an institutional level, rather than one farm alone (political need).

Summing up surplus

Following, to sum up this section and answer the question (SRQ2.2) "*How is the surplus from family farm households produced, appropriated and distributed to meet the identified needs?"* first, it is important to notice that surplus, itself, is a direct definition of community relations. If people would only care about fulfilling their individual needs there will be no surplus, so, from the moment that surplus exists, negotiation on the distribution of this surplus is the critical point which deserves attention to ensure positive relations within members involved in the appropriation of the surplus, far from negative relations of exploitation.

In this section, it was possible to observe that all the needs appeared in the interdependency among surplus and needs, since the surplus is what is left once the needs are covered. Practices to better generate surplus, such as tourism or the farm re-design were influencing the needs of comfort and energy; food practices like having no chemicals or preserving food, were part of the fulfilment of the health and financial needs. Because, as just stated, surplus is contingent to being with others, the affective and relational needs were present throughout the whole exploration of the surplus generation and

distribution. And last, but not least, the meso level of surplus generation and distribution (the cooperative), related to the political need.

In the following section, encounter among humans and between humans and non-human others are going to be explored in order to understand how those encounters have also an influence on the needs of the family farm households.

6.3 ENCOUNTER

To answer the last sub question of the research (SRQ2.3) *"How do family farm household members encounter human and non-human others in ways to support one others' needs?"* is a matter of how relations with human and non-human others influence the well-being of the family farm household members, the importance of those encounters and how they are fostered to fulfil the identified needs.

This section is divided in two: encounters with other humans (within the household and beyond the household, 6.3.1) and encounters with non-human others (6.3.2).

In this last part of the presentation of the results from the interviews, the analysis is centred on the relations that participants have in their everyday lives with other farmers, friends, extended family and other actors of society (such as scientists) as well as the relation they have with the non-human others like chemicals, the microorganisms of the soil or the climate. "In community economies, we take ethical action by considering the well-being of others in encounters that meet our needs" (Gibson-Graham, Cameron & Healy, 2013 p.112), so having a look at those encounters and relating them to the needs identified by participants is a way to become more conscious of the interdependencies that are playing a role in fulfilling those needs.

The fact that the family lives at the site of work it adds a transgenerational importance of the family farm. Generations encountering each other and learning from generations. And like Ana (IF5_18) said, "my grandchildren were born to make our life happier. I take care of them and they take care of me." Living in the family farm also allows the members to spend more time with their beloved ones, which may appear sometimes is difficult when working outside of the household. This is connecting with the affective needs and the necessary feature identified of living at the farm. Marta (IF6_23) said that she loves living in the farm so she can take care of their family and be altogether at one place. This constant encounter with others can help realizing the main needs and develop further the necessary features to adapt.

6.3.1 Encounters with other humans

- **Within the household**

Because they live together with the family the encounter with human and non-human others is continuous. They are all the time interacting with other family members to achieve their work, and most of the work is done in a collaborative way. In finca Del Medio (IF1), Juan father (IF1_1) , Julio (IF1_3) and Claudia (IF1_5) milk the cows together in the morning and talk about what should be done during the day. In Las Dos Rosas (IF6), Adrián (IF6_24) works with their two nephews hand with hand and Marta (IF6_23) and a woman helping her prepare everything for the meals of the workers of the tobacco house. In San José (IF3) Elena (IF3_11) and Raquel (IF3_13) are together in the kitchen and Pedro (IF3_10) and his son Angel (IF3_12) take care of the pigs and the tobacco, mainly. In Rio de Agua Viva (IF2), Mireia (IF2_6) and their daughters take care of the house and also help out Raul (IF2_7), Yanina (IF2_8) and Sergio (IF2_9) with the animals and the garden. In *finca* Ingenito (IF5), Luisa (IF5_19) takes care of the house together with Yolanda (IF5_22) and Ana (IF5_18) while Luis (IF5_21) and

Oliver (IF5_20) manage the fields with the advice from Joaquin (IF5_17) and his experience. And in Flor del Cayo (IF4), Nico (IF4_16) works with Armando (a permanent worker) taking care of the cows and the pigs and Jacinta (IF4_15) is at home preparing everything for the workers breaks. Within the household every member has multiple encounters with other humans, affecting directly to the health and the affective needs. Relating to health because when working together, there is less work per person, which makes it less tiring, improving the body condition at the end of the day, which in long term will improve the health. And encountering others is contingent of the affective needs, because you can share the work, the responsibility and be close to the beloved ones.

- **Beyond the household**

Encounters happen also beyond the household with friends, extended family, other farmers (via cooperative or via projects) and institutions.

  - Friends and extended family: each family has their friends and broader family with whom they also share their stories and create together new realities. For example, Juan (IF1_1) explained how important it is to make a good team of people interested in a common goal, like keeping local seeds or restoring degraded land. He stresses the point of sharing interests and having people to talk about it, so that you don't feel alone in the "battle". This, again, connects with the health need, matter of concern for the participants of this research, as well as connecting with the political need to promote this way of farming. If there is a bigger team working on that maybe policies will be changed. Moreover, he acknowledges how people leaves the farm inspired by their work and motivation, which fuels their own motivation. Jacinta (IF4_15) and Nico (IF4_16), from Flor del Cayo (IF4), they go every Sunday to the market, to buy stuff but also to meet friends a share a moment outside of the farm routine. Even though Jacinta (IF4_15) said there is no real routine because there is something new every day or somebody visiting.
  - Other farmers
    - Each farm is part of a cooperative where they have monthly meetings. In those meetings, they also exchange and share practices with other peasants and take care of the well-functioning of the cooperative. Exchanging practices has to do also with improving the energy needs, as well as improving the farm and the house (comfort needs), that will turn, on the long term, in health benefits.
    - All the families of this research are part of the project BIOMAS-CUBA and by this, and other projects, all the farm members are connected through a bigger network of innovative practices and gives them the opportunity to meet with other people. And at the same time foster the integration of different practices and techniques, directly working on having an open mind and improving the management and design of the system. Participation in the projects and workshops makes direct connections among the farmers and with technicians and scientists on the field, which answers the need for a better connection with society, and it is a step towards a higher peasant's valorisation, answering the political need.
  - Institutions: like the FAR (*Fuerza Armada Revolucionaria*, revolutionary armed force) with finca Rio de Agua Viva (IF2), as an exchange of land for care of the land. Raul (IF2_7) can put their cows on the field to graze and in exchange he takes care of the area, their premise is: you take care, I lend you, creating a relation based on trust to each other, which is highly connected to the relational and political needs.

Beyond the household also reach other scales, like the country and other parts of the world.

- National and international events: There are also some families that participated in national and international events, like the case of Claudia (IF1_5) going to Italy for the Slow Food meeting or Adrián (IF6_24) going to Costa Rica to see how other farmers perform in other countries. This it relates to the political as well as relational needs, in the sense that exchanging information with farmers from other parts of the world can create a stronger movement around family farming, all around the globe, which may be able to put pressure on governments to change policies.
- National and international visits: Some of the farms receive visits from national and international people interested in what they are doing. This is a way of connecting and exchanging knowledge, to share views and experiences and bring farming to a broader audience. For example, José (IF1_1) explains how much he likes to have people from different disciplines coming to visit the farm and the family, because it brings them other perspectives that support their project, again connecting with relational and political needs.

6.3.1 Encounters with non-human others

The fact that all the participants lived on a farm showed a strong relation with the non-human elements. The relation with non-human others finds the space on the farm creating multiple interconnections and interdependencies among the elements itself and the identified needs.

- **The farm**

'The Farm' is sometimes referred as another member, as someone who provides for all the family. Like Claudia (IF1_5) exposed "the finca is like a painting. This idea that papi (Juan) is a painter and made a painting with the farm, where the materials are the brushes, and all the things around are the materials to paint this art work". In the farm, there are a lot of elements that directly interfere with the well-being of the members of the house but also of the environment which is composed of non-human others, like:

- Chemicals
  - On the food: As Raul (IF2_7) says: "I do not want to use poison to have bigger tomatoes and endanger the health of my kids." Here there is a direct connection between humans, non-human others and the health need.
  - On the soil: Besides, for many farmers, the adoption of agroecology as philosophy has much to do with the non-human world. There are several reasons for the adoption of agroecology, but a crucial one is the restoration of soil. There is a lot of degraded land, which has been too many years exploited and now it doesn't want to give anything anymore. There is a need for new land, a call for restoration and appreciation. Juan (IF1_1) has it very clear "we cannot expect that the land will be producing forever if everything is being extracted at a very high speed and not giving back even the half of it. If only 3 or 4 of the elements of the periodic table are given to the soils, from the 118 that are there, then there are no demands possible. But even if more things can be added later, all the soil life would have been already destroyed so it is very important to take care of it". The adoption of agroecology has much to do with having an open mind, to be able to break with traditions carried during years.
- Renewable energy sources: are a way to interact with nature and become less dependent on finite resources which are scarce and expensive, in Cuba, and elsewhere, relating with the energy and financial needs. And at the same time be more kind to nature, without depleting its resources, acknowledging the interdependency among humans and non-human others.

- Soil: is a crucial element in the farm, because is the living organism where other life forms can flourish (microorganisms, small vertebrates, worms and plants). For this reason, soil gets a lot of attention from participants.
    - To re-green the land for a proper use of the rain water. Otherwise, if the land is uncovered that water would just run-off and the soil erosion would be every time more and more. Old land has problems with erosion, as Oliver (IF5_20) pointed out "The soils are getting tired, they are eroding, decreasing the possibilities for water storage". This has a relation with a good system management, what can lead to less erosion and better nutrient retention, increasing comfort.
    - The relation with the worms of the vermiculture. Because there is a constant relation between the worms, the earth, the manure and the farmers, this is an interesting case of relation between humans and non-humans. The farmer is taking care of other life forms and feeding them for the creation of good soil, the decomposition of manure while giving more life to the farm. Claudia (IF1_5) takes care of the vermiculture, together with her father and she said "I am watering it every day, and I see the process. I see when everything is turned into humus and then I know they [the worms] need more manure". Here there is a conversation between the farmer and the non-human element, which is part of the recognition of this interdependency, and connects to the relational needs.
    - Also to know which plants fit best with the crops to re-green and make a life cover, like Adrián (IF6_24) explained "I now plant *canavalia*. The *canavalia* contributes to the soil, it is green fertilizer, and it helps the weeds. It helps me too, because here there is a flower, people call it the flower of the tobacco, the *orobanche*, that destroys the tobacco plants, and *canavalia*, does not complete eliminate them, but it helps quite a lot on controlling the growth of *orobanche*". This knowledge increases the adaptability of the crops on the farm, and it fulfils the comfort need of the farmers.
    - The work with the efficient microorganisms and organic amendments to improve soil fertility.
- Seeds: the creational element of the farm: the seeds. Seed knowledge for seed saving and storage. Yanina (IF2_8) explained that sometimes the beans come out with a colour degradation, because they got mixed up, but they know they have to choose the one with only one colour, that is the good one for the next generation.
- Air: The appreciation of the fresh air on the farm, not contaminated like in the cities as Luisa (IF5_19) said "I like that I'm breathing pure air, that I am not on the polluted streets of the city".
- Animals: The creation of stocks of food for us and for the animals for the dry season, when there is no food to be grazed, like the example of Raul (IF2_7) with the making of hay (pag 54 of this thesis). Also the selection of the animals in relations the climatic events, to have more resilient animals which can adapt better to changing conditions.
- Climate: "Climate teaches us?" Juan (IF1_1) said "it explains how nature works and interacting with it is a great way of preparing us and the farm for future events". Here there is a recognition of the interdependency between us, humans, and climate, non-human other. Most of the farms keep a register of the rainwater fallen on farm. This is a great cultural and scientific heritage produced by the farmers, connecting with the necessary feature of study and collect information to improve comfort. The farm goes with the climate, not only as one wants. Nico (IF4_16) said "el campo no tiene techo (the farm has no roof). You need to adapt and play with the climate variability". Being aware of the climatic cycles, that are

rapidly changing, and finding the ways to adapt to that. Like Raul (IF2_7) explained "A cyclone passed by here. Before it came we knew that the hard cyclone was coming from Trinidad and we killed some rams, we killed a pig, we killed some chickens and we fried everything, and we store it fried in butter", as a way to adapt to this climatic event and still cover the family needs.

- Vegetables, crops and trees: It exists a body knowledge with the needs of the plants, the crops and the trees that acts as a language to communicate with those elements, like Angel (IF3_12) said "we see the plants every day and if we think they need more water we give it to them".
    - The knowledge and consumption of some fruits, like Acerola, which has more vitamin C that what a person needs, or Sachainchi, which has more omega 3 than any fish, but from a vegetable, gives a strong and solid foundation for the diet development. In finca Del Medio (IF1) they are re-educating their diet. They said it makes them feel good, they enjoy more the eating moment and they can be sure that are not eating any type of chemical, because the land is fertilized with their own manure, which it directly enhances their well-being.
    - There is also knowledge about the trees, that is being gained through the environmental stress. These past years of drought, the trees learnt, and some just gave up, but the ones that stand and gave fruits will probably last forever in the farm and become much stronger. Juan (IF1_1) has the phylosophy that "if [a vegetable] wants to stay at the farm, the vegetable has to work. If it demands too much of labour or input then it will have to leave. But if it is grateful [it demands few and it gives good yield], then it will happily stay with us. We are not going to force any animal or crop to stay with us just because. We help at the initial stage, for the adaptation to the farm, but once this period passed the animal, the crop or even the human, needs to show that wants to stay, otherwise it can go". Here we find a strong co-adaptation between the human and non-human elements, where the interdependence is negotiated after an initial stage of support.

Experience and the encounter with other humans, with the exchange of knowledge can also improve the relations with the non-human others, in ways that some measures can be adopted such as: having less animals, usually better because when there is a period of drought like those years there will not be major loses, like a lot of farmers are having, and it opens up the possibility to diversify the farm with other elements which help being more stable. In the case of tobacco, some type of chemical needs to be used, to give the texture to the leave, the colour, the softness… but farmers try, with the knowledge that they have and they received, to combine it with biological methods, like Pedro (IF3_10) explained. Also in the tobacco there is the *Phytophtora,* known in Cuba also as 'para prieta' (dark leg). It is necessary to leave a fallow of 3 or 4 years on the land that you use for tobacco, but is not always possible to do so because otherwise farmers don't have income from it. Either farmers have a very big area of farm, so that farmers can rotate, or they have to seek other pieces of land in the area nearby, which difficult the work, because who is not at home anymore and s/he needs transportation

Observation is key in the development of a relation with the non-human elements. Observation is also crucial with the humans, but because humans can speak sometimes is a bit more difficult to just observe. So as Juan (IF1_1) explained, he decided to stop feeding the cows with sugarcane because he observed, one year that he run out of sugarcane, that suddenly the cows got better. And gave more milk. The sugarcane was supressing their appetite for the grasses and pastures. Also, because it is sugar it gives less quality milk and therefore, less quality cheese.

There is also relation with technology. The whole experience with the biodigestor is of great importance for all those farms. The biodigestor is appointed several types by participants, because of its numerous benefits. How, from the faeces, a product that at first sight seems useless and harmful for the environment, turns to a highly appreciated and giving nutrients back to earth. The biodigestor is like the mechanical cow of the system according to the participants. It provides with monetary benefits because it saves up money of the electricity bill; organic benefits, because the manure of the cows and the pigs go there and from a residue they create again a valuable product for the fields, while decreasing the impact on the atmosphere; and energy benefits, because gas is being produced from the feces of the cows.

One of the farms, Rio de Agua Viva (IF2) has a strong relation with God. Raul (IF2_7) exposed the correlation between God, the good harvests and the availability of water: "Here all the wells dried up. However, God gave me the opportunity to have that well there, and it did not ever get dry yet." The participants have a lot of faith in God, they believe that God is helping them with what they do. Sergio (IF2_9) allocates time to be with God every morning, and Yanina (IF2_8) acknowledged that "God gave us the capacity to be able to develop further, to acquire all this new knowledge and be able to implement it." This relation with God has to do with the emotional health. Having faith helps farmers to not lose desire for what they are doing.

Some farmers have also the connection with the broader society, and the world and national politics. As Nico (IF4_16) said "If the country improves I will also improve", which has to do with the political needs.

Summing up encounter

The participants acknowledged dependence, for their well-being, on: the synergy that the family creates, their love, their partners and children, on the climate, on the rain, on the sun, on the microorganisms' present in the soil, on the birds, on the bees, on the policies, on the projects and workshops, on God, on the productions (i.e. tobacco and pigs), on their own effort, on their health, on the country economy and on their motivation. All those elements relate in one way or another to the above identified needs. Living at the farm makes encounters, with human and with non-human others, constant, relating directly with the affective needs. Here there is a new dimension appearing, the respect and love not only for the humans, but also for the non-human others. This it also relates with the adoption of agroecology, that has soil as one of the main concerns. If there is respect for the soil, no chemicals will be used, turning into better health and more comfort in working the land. Also, sharing the work with humans, mostly the family, and non-human others, like the microorganisms of the soil, or the manure from the cows, it also improves physical and mental health, by diminishing the work load. The encounter with other humans, exchanging practices during the cooperative meetings or during the workshops organized by BIOMAS, increased comfort because it opened up the possibility to use of other methods by the transfer of information and knowledge, and it also related to the emotional health. Seeing that other people is also struggling or having success in what they do, help to connect and feel part of society, which also relates with the political needs. Also, by observing the non-human elements, such as the animals, the plants, the climate or the soil, information can be collected, and, if properly related, lead to an increase of the comfort at the farm. Exchanging practices and attending the workshops also has a direct effect on the energy needs, like the implementation of the biodigestors on the farm, which also turned out to affect the financial needs, since the electric bill diminished. At the same time, the biodigestor connected and made visible the interdependencies among human and non-human others, bringing benefits for all (biogas, less nitrate emissions to the atmosphere, and organic amendments for the soil. Last, the faith in God and the correlation with the successes on the farm have a strong influence on the emotional health of the farmers.

Overall, the encounter with human and non-human others is strongly connected with the relational needs. Because living on the farm participants have learnt to share the space with their family and with 'The Farm', what makes more powerful the interdependencies among all the elements and the needs.

In the next chapter (Chapter 7), the discussion of the ideas of this two last chapters will be articulated in order to answer the main research question.

7. DISCUSSION

In this chapter, I answer the main question of the research (RQ): *How do practices of community economies contribute to the understanding of the resilience of the socio-ecological system?* To do so I first explain what are the commonalities (7.1) and the divergences (7.2) between the indicators obtained by the MERS methodology and the indicators obtained from the community economies (CE) framework, what are the aspects that both are covering, and what is new from the community economies point of view. In the divergences section the strengths and weaknesses of the indicators of Casimiro (2016), as well as the community economies perspective are mentioned. Finally, I draw on the complementarity of both methodologies on the attempt to better understand the practices that foster the socio-ecological resilience of the family farm households (7.3) and their interdependencies within and beyond the family farm household members.

7.1. COMMONALITIES BETWEEN MERS AND CE

The indicators obtained following the methodology for evaluating the socio-ecological resilience (MERS) and the ones obtained by the reading of the household members practices using community economies have six points in common.

First, they both identify **food self-provisioning** as a must to build resilience. From one side, there is the Food Sovereignty Index, which includes one indicator that is basically what is the percentage of the food eaten at the farm that is produced on the farm (Af). From the other side, there is the fact that surplus regarding food production appears once the food self-provisioning is covered, meeting the health need, and ensuring also the food sovereignty of the farm. Food sovereignty is a central theme when discussing resilience of family farms, so the appearance in both is an expected outcome.

Second, they also share the concern about **the energy needs** and how the energies consumed on the farm household is produced, where it comes from and how it can be efficiently used. From the MERS, there is a whole Index just for the Energy Sovereignty, which considers the efficiency, the import of energy from the exterior, the energy utilized from the system itself, the energy balance (meaning the MJ entering and leaving the system via food production) and the energetic cost of the production of protein. Of course, from the community economy point of view this is not so specific, but rather relational, connecting them also with the relational neds. High energy demand is identified as a mining element for resilience shown by the indicators of the Energy Sovereignty Index. If demand is high, more dependency from the exterior will be needed, and means more vulnerability, which undermine resilience. But this is not always the case, as exemplified by the results from CE. If we have a look at the indicators after having integrated the information from community economies, new lectures appear: Fincas 3,4,5 and 6 have tobacco as the main cash crop. Tobacco needs a lot of attention, inputs and energy, what makes EF (percentage of energy used on the farm from their own resources in relation with the total energy demand) usually low. Fincas 4,5 and 6 have a much lower EF than finca 3, because finca 3 do labour exchange with other farmers, which do not count as external, because they are also part of the system of the others, constituting a big group of farmers. The dependency from the exterior turns to be a positive aspect that helps reduce the overall demand and the working hours per person. The fact that all the farms are part of the BIOMASS project, which is promoting innovative solutions for the use of renewable energy sources, has a direct impact on the appearance of this need in the community economies section.

Third, another point in common, is **the innovation** as a necessary process for building resilience. In the indicators of Casimiro (2016) there is one indicator that is named Innovative Intensity of the Farm which consider several aspects like the generation of innovations itself, the capacity for technological change and the external and internal information flux, among others. The later, the

information flux, has a strong relation with the community economies because if there is external and internal flux of information it means conversations are happening, where negotiation of the interdependency might occur. From the interviews, there are two of the necessary characteristics to adapt, the ones binding the main categories on needs, that relate to innovation as well: have an open mind (focussing on solutions, break traditions and recognize needed changes) as well having freedom to apply changes. CE encourage experiments, since the approach of CE is experimental, opening new spaces for reframing, what leads to innovation.

Fourth, the **economic efficiency** is one of the four indices needed to create the socio-ecological resilience index (SRI), which is based on the cost/benefit relation and the external input dependency index, building on monetary dimensions. It is not of a surprise that is need also appeared on the community economies framework since we still need money to buy things and finance their present and future generations. In the interviews, the participants identified the financial needs as the necessity to have money to buy commodities, and the fact that living and working all the family together at the farm made the monetary possibilities a bit broader and the negotiation on the one's and others survival needs possible.

Fifth, more broadly, MERS and community economies also have in common **the external dependency**, and the relations that this creates. It has in common that it appears in both, but is thought quite differently. This point will be discussed below on the divergences section.

Last, but not least, there is the transversal conception from the indictors point of view about the **good design and management** to build up resilience, which also came out during the analysis of the interviews as part of the characteristics needed to adapt, including: multiple ways of dealing with one situation, having diversity, have enough water and keep track of the money. Within the need to adapt for a good design and management diverse eceonomies are acknowledged which illuminates the interdependent relationships within which one's and community's survival and well-being.

Those six points are identified as common elements between MERS and CE. The indicators based of the MERS methodology have a lot to do with the relations between demands and possibilities of the system, as well as community economies recognize the intrinsic relation among the needs and how members try to meet those needs by using the resources. CE is concerned about processes, and the interdependency also between the needs and the strategies that relate with human and non-human others for their mutual survival. The MERS methodology it also acknowledges that in the pursue for resilience, a good design and management alone will not lead to favourable indicators, rather it needs to be related and connected to the socio-cultural, political and historical context.

Following in the discussion, the divergences between the methods is explored. What has CE that is not visible from the MERS point of view, illuminating on the strengths of CE, the weaknesses, and the strengths and weaknesses of the MERS methodology.

7.2 Divergences: Only coming from Community Economies

There are at least seven most silent aspects that cannot be illuminated by the indicators provided using the MERS methodology to understand resilience: 1) the negotiation process between the members of the family about the needs; 2) the interdependencies between the needs and the strategies; 3) the adaptive needs itself; 4) the importance of the family on the farm; 5) the affective and comfort needs; 6) the network with people with common interests; and 7) the external dependency. All thos aspects also relate to each other, because negotiation is transversal to the needs, and the needs are the core of the discussion in the CE.

First, and very important, there is the **process of negotiating the needs**, which is key in the CE framework and for the definition of resilience. The indicators provided by MERS give no attention to the process, but rather it focuses on the present state. The indicators are static, which is not a bad thing if we want to assess one farm at one point in time, but then loses the link with resilience, which is not a character or attribute of the farm, nor seen as primarily located in the capability of the farmer to navigate change. But in relations that are never stable, that must be enacted, performed every day (Darnhofer, Lamine, Strauss & Navarrete, 2016). Depending on the purpose, having a set of indicators can be very useful to evaluate the more "technical" resilience of family farms. Is a fast method that allow comparison among farms, providing with the indices of socio-ecological resilience for each farm, which can be updated over time to see changes in the farming practices and possibly giving some attention to the process. But the indicators, as they where used in this thesis, miss completely the transformative capacity and the importance of the decisions and everday performances.
Basically, the process of negotiating the needs is the rope that tights together humans and humans with non-human others, in the understanding of our interdependency, like Ana (IF5_18) said: "my grandchildren were born to make our life happier. I take care of them and they take care of me". This quote is a clear example on human interdependency, specially on the affective needs, adding, as well, the temporal dimension by including generations, which gives more room for learning, transformation and adaptation, connecting with resilience. Resilience proposes an alternative conceptual lens to one building on equilibrium, thus highlighting complex dynamics and the role of farmer's agency in navigating change (Darnhofer, 2014). If transformation is a desirable process to occur there is a need for more experimental and ethically driven conceptions of economic dynamics and a less utilitarian view of economy–ecology interdependence (Gibson-Graham, Hill & Law, 2016). For this reason, it is important that negotiation of this interdependency is a central part in the future discourses on socio-ecological resilience building.

Second, the **interdependencies between needs and strategies** are highlighted. In the indicators obtained by MERS some strategies are poping out, but just as mere strategies. This is good if they need to be replicated somewhere else, but there is the risk that the needs on that place are very different, thus the strategy will not be suited and might fail. The interdependency between the needs and the strategies is highlitghed by CE, for example in the way that each farm might solve the same need in a different way, because of the specific context. Drawing on financial needs, the strategies of Del Medio (IF1) and Rio de Agua Viva (IF2) differ completely. One has equally distributed the money, while the others have it altogether. Again, this is part of the negotiation of the needs, and finding the strategy that best serves each family. As there is no one solution for all the problems, there is no strategy that covers all the needs.

Third, *if resilience is the ability of a system to persist, it needs to include both the ability to 'bounce back' and the ability to 'bounce forward', i.e. both adaptive and transformative capability* (Darnhofer, 2014). Thus, the emergence of **the adaptive needs** (i.e. having an open mind, live with the family, have freedom to change and study, collect and share info) is completely understandable and necessary to take into account in the understanding of farm households' socio-ecological resilience. Because resilience is not a fixed state, is a practice of the capabilities, and in this sense, resilience has much in common with CE theoretically, because both theories are talking about processes rather than elements, about dynamic rather than static situations. The indicators are reflecting a point in time, losing all the capacity to disclose processes. Even though, the methodology itself might be able to reveal processes in the long term, because the idea of the whole methodology is that the evaluation through indicators is done with the farmers, every two or three years (see Appendix A), so time adaptative dimension can be included, reporting the imporovements. If we come to understand that socio-ecological systems are complex adaptive systems, then we will be able to also understand that a long stable state is

barely possible to attain, thus resilience is always in construction, and there is no final equilibrium state that needs to be reached. Instead is necessary to learn how to live with uncertainty. Resilience needs to be understood, not with the assumption that future events are expected, but that they will be unexpected (Darnhofer, 2014). Only a qualitative capacity to devise systems that can absorb and accommdate future events in whatever unexpected form they may take' (Holling, 1973, p.21). This might be community economies practice, since it is also dealing with the unexpected while unveiling the shaded practices of the diverse economies.

Fourth, the importance of the **family living together** is a blind spot for the indicators. Even though the methodology is meant to evaluate the socio-ecological resilience of family farms, and there are few sections in the questionnaire that give information about the family composition, no attention is given to it in the indicators themselves. From the interviews, there are a lot of references to the importance of having the family on the farm, from all the points of view. The main points are that it satisfies the affective and comfort needs, but also that helps make work faster and that is possible to enjoy the place one lives with the place one works, making explicit the interrelations. As Juan (IF1_1) explained:

> the miracle is finding the connection among all the human beings and between all the non-human others because is only then that you start seeing that there is something to be discovered from each place. There is a culture of each space that relates to the preferences of each family, with the culture, with the climate... Each family will have to adapt to the system at their own way. This is the solution. It is a way of obtaining results, even though at small scale, but all the days of your life.

Juan (IF1_1) said: *"*Each family will have to adapt to the system at their own way*"* But which way? Labour division and cooperation are present at the family farm level. Those divisions are highly gendered, in the sense that most of the times men are just working the land and women stay mostly at the kitchen, with some exceptions. CE gives no attention to that, and other theories that give importance to intersectionality might be important to look at. The division of labour makes the perception of the needs connected with the role they have in the farm and the power in the negotiation. Which, again, is overlooked by both, the indicators obtained using MERS and CE.

The fifth element, which connects strongly with this last one, is the recognition of **affective and comfort needs**. Living together with the family relates directly with those needs, and gives the possibility to meet them. Marta (IF6_23) exemplified both needs when she said that she loves living in the farm so she can take care of their family and be altogether at one place. The importance of the unity in creating the social conditions for better resilience, by cooperating and acknowledging the needs of the others, is highlighted in CE: "We rely on others close by to provide care for us, mainly at the first and last stages of our lifes, but also throughout life" (Gibson-Graham, Cameron & Healy, 2013, p. 104). The indicators provided by MERS give no attention to those needs, skiping one of the fundamental basis of family farms.

Sixth, and very important ones, are the **affective and relational needs**, those that are directly connected with the encounter with human and non-human others and the creation of mutual support networks. This element of interdependency in the creation of relations with others (human and non-human) is essential if we wish to study socio-ecological resilience. Understanding resilience as a process, not a fixed asset, but a continually changing process (Porter & Davoudi, 2012). These elements relate directly with the creation of relations, our human need of continual learning from each other to make better choices and improve the capacity to handle change (Cutter et al., 2008; Davoudi, Brooks and Mehmood, 2013). All these meetings enlarge the perspectives of the family farm members,

providing them with the opportunity to share and exchange visions, strategies and practices for a better understanding of nature and people and the interdependency among us – human and non-human others. The type of relations that members have with human and non-human others is dependent on their specific role at the farm. Angel (IF3_12) said "we see the plants every day and if we think they need more water we give it to them", and Laura (IF1_4), who mainly works in the house said, "I am working for the well-being of everyone, everyone cares for everyone and everything". Probably the ones working the land will have more opportunities to meet other people and will be more connected to non-human others, but not necessarily. As Juan (IF1_1) said, the importance also is to let adaptation flow, via observation and serenity:

> Sometimes you look around and you don't understand, but you adapt also to not understand, and to see that nature it is wise by herself. And that by being in harmony with oneself and with the family the farm also gets influenced.

And the last element, which is connected to the relational needs, it relates with the **external dependency**, which was mentioned in the commonalities, because they both tackle it but from different perspectives. On the one hand, from the MERS point of view, having external dependency is very negative, because it is always better if the cycle is closed, so no big loses are made. All the indicators used to create the Socio-ecological Resilience Index are punishing external dependency. The boundaries of the system for this methodology are set at the farm, and fail to recognise the importance of the relations and the interdependencies with other actors. On the other hand, from the CE perspective, the relational needs are a must for the farm household to survive well together, they turn out to be an essential need to shape the construction of resilience. CE are looking at an open system, while the indicators are looking at a closed one. On the one hand, approaching the farm as a closed system may have some benefits in defining cycles of nutrients, for example, and aiming at closing them within the system. On the other hand, looking at the farm as a closed cycle dismiss the relations beyond the farm, which are also contributing to the needs of the farm, and viceversa. Gibson-Graham, Cameron and Healy (2013) have further linked these encounter dynamics to the building of more than human community economies in which being-in-common is negotiated with all other life forms, enhanching adaptability, so resilience is fostered.

Drawing upon the conceptual framework, focusing of family farming, is crucial to understand the importance of the diversity of structures (IPC, 2014) present on the families. There are as many diverse strategies as types of family. For this reason, the focus of this thesis is important. Although the indicators are good in providing an overview of the good practices and the missing ones, are not able to capture those differences between strategies, they miss the concrete examples such as the division of labour inside the family or the network that has with other farms, and they cannot capture the process of negotiation to adopt certain practices to meet the needs, which influence the adaptability and transformability of the system.

The reading of practices using community economies reemphasizes that resilience is not a 'thing' that can be seized, held or measured, it is not an attribute or property of a farm or a farmer. Rather, resilience is the emergent result of ever changing patterns of relations, relations that are material, social, cultural (Darnhofer, Lamine, Strauss & Navarrete, 2016). But there are aspects of CE that are not covered, and that are also important for resilience. Some of them came up during the analysis, but the theoretical framework was not meant to unveil them. Power dynamics and gendered relationsare completely skipped. The approach of CE does not necessarily enable the researcher to highlight power dynamics, what is very important considering that CE is based on the negotiation of the interdependency. In most of the farms there is a more powerful decision-maker, mostly the father of the family, the one working on the land, and this might sometimes undermine the power decision of the women of the family, which

also have much to say about how things should be managed and dealt. This is because it is considered that the men are the ones with more experience, and maybe with working the land is true, but what about caring for the children and for the whole family? This reflection relates to the quote of Juan (IF1_1) regarding the creation of ideas: "some studies have the error to assume that everybody creates ideas, and this might not be true. Probably everybody can make ideas bigger and add to it, but generally, in all the groups there is somebody who dedicate more time to think on it, so eventually there will be one having more ideas. Generally, it happens to me, because I am the oldest, but also the one with most experience".

In a family farm, the well-being of the family is as important as the crops that will be planted, or more. There is no recognition from this part of the experience, not even from the women side, and they do not see it as a problem. Experience becomes, finally a paradox of solution/problem itself.

Family farming is a unit of consumption as well as a unit of production, produced by family labour - even though some families also have permanent and occasional workers. Surplus is circulating and thightening the relations among the members. Surplus, by definition, is part of community creation. If you only do things to cover your own needs, there is no surplus. Therefore, when surplus is created and negotiated upon, better distribution can be achived and the collective can develop better.

In the diverse economy, relationships are contingently rather than deterministically configured; economic value is liberally distributed, not attached to certain activities and denied to others; economic dynamics are proliferated, not restricted to a set number of governing laws and logics; and multiple temporalities and storylines are untethered from one linear narrative (Gibson-Graham, 2005).

7.3 Understanding practices that foster the socio-ecological resilience of the family farm households

Community Economies are not "the" method to understand resilience, but they add important contributions to the understanding of resilience, the adaptive and transformation capacities of families, by highlighting the interdependencies and the processes of negotiation of those interdependencies. Having a look at the socio-ecological resilience of family farm households with the framework of community economies opens the space for interdependency recognition and negotiation and construct a more sustainable society. This research opens possibilities to integrate the CE framework to understand socio-ecological resilience, making a stronger bridge between those theories. CE has mainly focused on economic resilience and this thesis went beyond that, identifying multiple dimensions of needs that help illuminate multiple the strategies that family farm household members use to meet their needs as well as interdependencies among those needs and strategies. Moreover, the ever-exploring nature of the theory, connects with the dynamic idea of resilience. What is important to acknowledge is that a mixed method research gives much more texture to the understanding of the farms, and many more elements to play with in adapting to change. The indicators alone do not explain much. They are just a number in a scale from 0 to 1. For this reason, is essential the practice of interpretation, which when done in combination with other methods, can lead to a better understanding of the complexity of the resilience building of family farms, embracing the complex adaptation and transformation of socio-ecological systems to govern their interdependence (Gibson-Graham, Hill & Law, 2016; Darnhofer, Lamine, Strauss & Navarrete, 2016).

From the indicators point of view, the households are treated as an homogenouse group, which they are not, since every person will have a concrete perception and creation of their own reality. For the collection of the data to obtain the indicators, the questionnaire is usually performed with only one of the members, usually the oldest man of the family, giving no attention at all to power dynamics. By using CE, unity was point out as an important element. Being together with the family as a necessary feature to adapt and transform. Focussing on the process rather than the elements allowing the

negotiations to happen, over and over, fostering resilience, because resilience is the combination of processes and practices embedded in a socio-ecological system, whose constituent parts are integrated and interdependent (Adger, 2000).

Related to the external dependency, and the diverse ways in which the indicators and the CE treat the topic, it is important to note that they are not contradicting, as it may seem, but they are complementing each other. It all depends from the perspective we look at the system and the boundaries we assign. Moreover, in the thesis of Casimiro (2016) there is recognition, that in the macro level, external dependency is needed: "The achievement of socioecological resilience in a family farm depends not only on efficiency in agroecological design and management to achieve favorable levels of food sovereignty, technology, energy and economic efficiency, but also on the sociocultural and political context in which it develops" (p. 144).

At the beginning of this thesis I clarified that the situation with food shortage is not going to be solved with a production increase, rather it is more about the distribution of this production. Regarding distribution, the exploration of these three coordinates of CE (looking at needs, the negotiation of those needs, how is surplus produced, appropriated and distributed and how the encounters among humans and between humans and non-human others support those needs) is an important addition to the indicator creation approach of understanding socio-ecological resilience. It considers the individual, and the collective mechanisms to ensure the durability of the system, as well as the potential transformation capacities, which are usually missed. Adopting the ethical coordinates proposed by Gibson-Graham and Miller (2015) provides a space for the researcher for more experimental and ethically driven conceptions of economic dynamics and less utilitarian view of economy-ecology interdependency (Gibson-Graham, Hill & Law, 2016). The theory of CE is a radical approach to transform society (Gibson-Graham, Cameron & Healy, 2013, p.103) which is necessary if we wish to radically re-design, adapt and transform farming systems to a changing world.

8. CONCLUSION AND RECOMMENDATIONS

Agriculture is the result of a coevolution of culture and nature, an integral nexus of society and ecology over time (Zimmerer & Bassett 2003; Wells, 2011; Bacon et al., 2012), which makes it challenging but at the same time very interesting to study from a socio-ecological perspective. Since those agroecosystems don't exist in an empty social space, but they went through a co-evolving process, the ecologic resilience is intertwined with the social resilience (Altieri, 2013). For many years, agriculture has been seen from a human dominant perspective, meaning that humans had the power over the natural systems. This, together with the dominance of economic practices associated with capitalism, resulting in the exploitation and appropriation of resources (Gibson-Graham, 1996), resulted in degradation of soils, air, water, human relations and the relation with the non-human others. An attempt towards the construction of more sustainable systems, therefore, demands attention to its social-ecological nature, and an understanding that agriculture produces landscapes that are at once social, cultural, and ecological (Cronon, 1996; Wittman 2009; Bacon et al., 2012). Gibson-Graham, Hill and Law (2016) point out "if resilience has replaced sustainability as 'the buzzword of the moment' as Porter and Davoudi (2012, p. 329) argue, it is probably because it speaks to the need to theorize dynamics of transformation across the broad fronts of natural systems, social systems, psyches and built environments" (Gibson-Graham, Hill & Law, 2016, p. 704). A first step towards strengthening resilience at a human scale involves appreciating, caring for and repairing the longstanding ecological relationships that have supported life over the millennia (Gibson-Graham, Hill & Law, 2016). If we want to achieve sustainability, if we are to create resilient systems that can cope with change and adapt and transform (Darnhofer, 2016), it is necessary to start building the capacity to see our interdependency among humans and between humans and non-human others, negotiate our relationships and the needs of ourselves and the others (human and non-human), to create a sense of care (Gibson, 2017), that can lead to other system representations.

A diverse reading of the socio-ecological resilience that can capture the interdependency of economies and ecologies (Gibson-Graham, Hill & Law, 2016) in the farming system and the surrounding dimensions like society, governments and institutions, to make transformation possible and attainable.

The result of this thesis suggests that to better understand the complexity of socio-ecological resilience indicators need to be obtained from mixed methods research (i.e. using a combination of MERS and CE), not necessarily following CE, but methods that allow to analyse the system from different perspectives and academic fields, and integrate data to give a complete overview of the situation. This is important because then the relations and synergies among the diverse elements become explicit and make possible the identification of the strong and the weak points, so the good practices can be enhanced and the prejudicial re-designed, adapting practices and strategies to the specific socio-ecological context and enhancinh resilience. On top of that, if systems are portrayed with more complexities, closer to reality, policies and programmes can be best shaped to meet the needs of family farms, enhancing their socio-ecological resilience building capacity.

But not all has been done yet, and much work needs to be done still. Based on this research, few recommendations for future research directions are made. The fact of having interviewed all the household members, added special value to the research. Usually the questionnaires for the creation of indicators only ask one or two people of the farm, who will be mainly men, and probably the more adult ones. The logic for this choice is that they are the ones working the land, so are the ones working to make the system advance. But, as Jacinta (IF4_15) said, very wisely "Everything [farm production] is sold in his name [Nico], yes, but if I do not support him here he could not work because: who would do the things here? Nico always told me [Jacinta] that: this [the farm] is yours [Jacinta's] just like mine, if you [Jacinta] were not cooking and taking care of the house and the people, I [Nico] could not take care of the field". In this case, Nico acknowledged the interdependency among them and shared the

responsibility as well as the pride. He recognized and valued the contribution of Jacinta to the farm household economy, as much as he values himself. This is the only explicit quote of this topic, regarding gendered division of labour and negotiation of the interdependency. Exploring the intersectionality of the negotiation, to get more acquainted with the power relations among the family members and the external actors (neighbours and friends), which is intersting to investigate from the resilience point of view because as pointed out by Aregu et al. (2016), being blind to gender-related issues may undermine the resilience of a social-ecological system. However, it is unclear how this can be done, due to the strong Cuban culture, their values and the family norms, but it would be interesting, for the strengthening on socio-ecological resilience to investigate it.

This research could have been also more complete, from a CE point of view, if all the six ethical coordinates (needs, surplus, encounter, consumption, commons and investment) would have been investigated. During the process of analysis, the other coordinates appeared (i.e. financial needs), but it was not possible to examine deeply due to time limitation. On the one hand, would be enlightening to continue the research with the three other coordinates (commons, consumption and investment in the future) (Gibson-Graham, Cameron & Healy, 2013) to have the complete picture of the community economies, which might shed light to other aspects. On the other hand, would be also very interesting to look at different Cuban land tenure forms (UBPC and CPA), not part of family farms to make a comparative study among them. It would also be interesting to expand the number of farms, to have more diversity, and if possible cover also other regions of the island, or even in other countries, also validating the methodology of Casimiro (2016) outside of Cuba.

There are as well some recommendations on the process itself. First, I strongly recommend having at least one good contact in the place where the fieldworkd is going to be done, which helps to land, adapt and develop. In my case Casimiro was of great support, not only for her research, but emotionally and for the logistics of the thesis. Second, it is important to consider the methods in relation with the actual availability of time and the practicality. From the proposal to the completion of this thesis some things changed because of too optimistic planning. One of the methods to capture the perceptions of farmers was to do photo-documenting, so that the participants would take pictures of what resilience meant for them with two or three pictures. This was not possible to do mainly because of time. The field work was only four months and the first month was invested on getting to know each other to build a relation of trust between the researcher and the participants for the good completion of the interviews. Then, some participants understood very easily what I meant, but some did not know where to start. At the end, I had to skip it. But it would also be interesting to do in the future, to innovate with the methods and see what comes out. The fact that I did my research in a place where I knew nobody also has an influence on the time spent at the beginning. It might be better to start where the researcher is already familiar, where she is confident and know the place and the people, although is not always possible.

In the process of the analysis with the lens of CE it also emerged the importance of intergenerationality in the construction of the resilience capacity, which neither the indicators nor CE consider. The different strutures of family farms and the ways in which the leadership is performed might point out that if the leader is missing a social shock may occur, but because of the knowledge transferred through generations, this shock might be absorved, and the situation will give room for transformation, enhancing resilience. Quoting Pedro, “there is an exchange between the generations and between nature and life, I believe that is a fundamental.” The intergenerational dimension came through due to the particular historically situated context, but it is not implicit in the theory. So, for future research, considering intergenerational dimension, adding time to the concept of socio-ecological resilience, would be essential since resilience is a continually changing process (Porter & Davoudi, 2012). Linking it to the different generations present at the farm, it would also be highly stimulating to investigate the vision of the children of the different farm households. After all, they might be the next generation, and

their perspectives might include new aspects that adults, due to the years, have forgotten how to look at. Furthermore, examining their views would be adding information for their motivation to stay or leave the farm, which is very interesting, because rural migration is one of the big challenges in Cuba, and in the world (Nicholls, Altieri & Vázquez, 2016; Casimiro, 2016) and a threat to socio-ecological resilience.

This thesis is of special importance for the broadening of the socio-ecological resilience concept because it tries to escape from the persistent vision of an economy ordered by the market (Gibson-Graham, Hill & Law, 2016). Instead of providing only numbers and indices, the research was focused on family farm household needs, in conversation with non-human others, as a way for ethical negotiation between human and non-human others. A non-capitalocentric framing allows for resilience to be explored within this ecology of interacting economic diversity (Gibson-Graham, Hill & Law, 2016), to create new worlds.

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APPENDICES

APPENDIX A - METHODOLOGY FOR THE INDICATORS OF SOCIO-ECOLOGICAL RESILIENCE (MERS, CASIMIRO 2016)

This is the methodology created by Leidy Casimiro for the PhD. I translated all the information from Spanish to English to include it in this thesis.

From the proposal of indicators that she made and the later validation with the experts a methodology was created for the first time to determine the socio-ecological resilience of family farms. The experts panel gave their different criteria based on the questions and although the diversity of variables and the number of experts that participated, the Kendall Concordance Coefficient was always bigger than 0,5. So, as explained in Medina et al. (2011), there was coincidence among the criteria defined by all the members of the panel. This allows us to declare that this study is trustable and the proposal is valid. For more information check Casimiro (2016).

From this analysis, the different index where evaluated and the corresponding indicators for the calculation of each index: Food sovereignty, Energy sovereignty, Technology sovereignty and Economic efficiency. Those indices altogether gave the final socio-ecological resilience index for each farm.

In the following tables, there are the indicators, the conceptualization and the valorisation for the Food Sovereignty Index (FSI), Energy Sovereignty Index (ESI), Technology Sovereignty Index (TSI), Economic Efficiency Index (EEI), and finally the Socio-ecological Resilience Index (SERI). (references)

Table 12. Indicators evaluated to measure the Food Sovereignty Index

Indicator	Variable	Conceptualization	Valorisation of the indicator
Pp	People fed/ha/year, from protein source (Funes-Monzote et al., 2011; Altieri et al., 2012)	Amount of people fed from animal or vegetal protein source per hectare in one year.	$P_p = \frac{\sum_{i=1}^{S} \frac{m_i * \frac{r_i}{100} * \frac{p_i}{100}}{A}}{R_p}$ Where: S = number of products mi = production of each product (kg) ri = percentage of the weight of each consumable product pi = protein content of each product (g/100g) A = Farm area (ha) Rp = Requirement of one person (kg/year)

Pe	People fed/ha/year from energy source (Funes-Monzote et al., 2011; Altieri et al., 2012)	Amount of people fed from animal or vegetal energy source per hectare in one year.	$P_e = \frac{\sum_{i=1}^{S} \frac{m_i * \frac{r_i}{100} * e_i}{A}}{R_e}$ Where: S = number of products mi = production of each product (kg) ri = percentage of the weight of each consumable product ei = energy content of each product (MJ) A = Farm area (ha) Rp = Requirement of one person (MJ/year)
Af	Percentage of food for the family produced on-farm (Altieri et al., 2012)	Percentage of the food that feeds the family produced on-farm.	$\mathrm{Af} = \frac{\mathrm{Aff}}{ATT}.100$ Where: Aff = Food for the family produced on-farm ATT = Total food necessary to feed the family

For the TSI measurement five indicators where evaluated (table 3): list 5. Among those five indicators, two of them are a new proposal from the thesis of Leidy (Casimiro, 2016) related with the innovative processes on-farm (with more information on the appendix) and the adequate use of renewable energy sources linked with the appropriate technology.

Table 13. Indicators evaluated to measure the Technology Sovereignty Index

Indicator	Variable	Conceptualization	Valorisation of the variable
LER (IUT)	Land Equivalent Ratio [8] (Funes-Monzote et al., 2011; Altieri et al., 2012)	Number of hectares needed to seed in monoculture and obtain the same yield obtained in a hectare of polyculture.	$IUT_S = \sum_{i=1}^{S} \frac{P_i}{M_i}$ Where: S = Number of products Pi = Yield of the crop (kg) in polyculture Mi = Yield of the crop (kg) in monoculture
IE	Percentage of external inputs used for production. (Altieri et al., 2012)	Level of inputs not generated or used on-farm that are used on the productive system (%)	$IE = \frac{IEf}{ITT}.100$ Where: IEf = inputs used on the production system that come from the outside of the farm ITT = total inputs used on the production system
H	Diversity of production using Shannon index (Funes-Monzote et al., 2011; Altieri et al., 2012)	Value the diversity of the production, considering association and/or rotation. Includes the total production of each element (crop or animal) and the total production.	$H_S = -\sum_{i=1}^{S} \frac{p_i}{P} * \ln\left(\frac{p_i}{P}\right)$ Where S = Number of products Pi = Production of each element P = Total production of the system
IUPRES	Index of the Usable Potential of Renewable Energy Sources associated with the appropriate technology	Usable potential of the renewable energy sources associated with the appropriate technology, considering the utilizable potential on-farm (%)	$IAFRE = \frac{PAFRE}{DES}.100$ Where: (PAFRE) UPRES = Useable potential of the renewable energy sources associated with the appropriate technology (DES) SED = System Energy Demand
IIF	Innovative Intensity of the Farm. Modified from Suárez (2003) and Hernández (2010)	Level of execution of the innovative activities that exist on the farm for the agroecological management and design. (%)	$IIF = \frac{\sum(Pi \times Wi)}{5 \sum Wi}.100$ [%] Where: IIF = Innovative Intensity of the Family Farm Pi = Punctuation given to I variable Wi = specific weight of the variable depending on the importance; 1 > Wi > 0

For the Energy Sovereignty Index (ESI) four indicators (EE, EF, EB and ECP) were evaluated. Focusing on the socio-ecological resilience and the lowest external dependency possible, the MERS methodology includes the energetic costs of the inputs imported to the system, including the food for the family. What differs from the methodology of Funes-Monzote (2009a) and Funes-Monzote et al. (2011), as in those studies the energetic indicators are evaluated with the total energetic cost, but they do not include the importation of food for the family nutrition.

[8] For this calculation, the reference was mean yields of each crop/ha in the Cuban cooperative sector (source ONEI, 2015a).

Table 14. Indicators evaluated to measure the Energy Sovereignty Index

Indicator	Variable	Conceptualization	Valorisation of the variable
EE	Energetic efficiency (Funes-Monzote et al., 2011; Altieri et al., 2012).	Relation between the total Megajoules (MJ) produced on the farm (from food production, using RES with appropriate technology, labour force, animal jobs or fertilizer production) and the ones imported to the system.	$EE = \frac{\text{MJ produced on farm}}{\text{MJ imported to the farm}}$
EF	Percentage of energy used from the farm (human, animal, RES) (Altieri et al., 2012).	Energy used on farm from the farm own resources. (%)	$EF = \frac{EAf}{ETf}.100$ EAf = Energy from the farm ETf = Total energy used on-farm
EB	Energetic balance (Funes-Monzote et al., 2011)	It considers the volume of production and its energetic content, and the energetic cost that was necessary to produced that food energy with external inputs	$BE = \frac{\sum_{i=1}^{S} m_i * e_i}{\sum_{j=1}^{T} I_j * f_j}$ S = number of products M = production of each product (kg) e = energetic content of each product (MJ/kg) T = number of productive inputs I = amount of productive inputs (kg) f = required energy to produce the input (MJ/kg)
ECP	Energetic cost of the protein production (Funes-Monzote et al., 2011)	Total energetic cost that was necessary to produce the food protein with external inputs.	$CEP = \frac{\sum_{j=1}^{T} I_j * f_j}{\sum_{i=1}^{S} m_i * \frac{p_i}{100}}$ T = number of productive inputs I = amount of productive inputs (kg) f = required energy to produce the input (MJ/kg) S = number of products m = production of each product (kg) Pi = protein content of each product (%)

The energy used from the farm itself is valued as energetic production, as well as the agricultural production, the family labour force, the animal labour force, the production of organic manures, the use of RES with appropriate technologies, etc.

The following table contains the indicators that determine the Economic Efficiency Index (EEI). For the production costs, the salary that each family member should receive for their work is considered; those are included in the farm total inversion.

Table 15. Indicators evaluated to measure the Economic Efficiency Index

Indicator	Variable	Conceptualization	Valorisation of the variable
CBR	Cost-Benefit Relation (Astier et al., 2008; Sarandón et al., 2006; 2014).	Relation that indicates the cost per weight.	$RCB = \frac{C}{B}$ C = total cost of the farm operations, including the expenditure assumed by the family for the food coming from the outside and other expenditures. B = Total of income generated.
EIDI	External Input Dependency Index (Astier et al., 2008; Sarandón et al., 2006; 2014).	Relation among the inversion on external inputs related with the total inversion (including endogenous resources)	$IDIE = \frac{IIE}{ITF}.100$ IIE = Inversion on external inputs ITF = Total farm inversion

Once applied the methodology of Füller triangle to the criteria obtained from the expert panel, each variable receives a specific weight and a specific scale. Depending on the value of the variable, each indicator receive a scale (from 1 to 5) and then that number is multiplied with the specific weight assigned, accordingly to the values reflected on the next table:

Table 16. Punctuation scale and relative weight for each indicator to determine the correspondent indices. Once each indicator was obtained, looking at this table a punctuation was determined (i.e. if the Pp had a number of 6,7 the Pi would be 4 and then 4 would be multiplied by the relative weight, having the relative number of Pp in the construction of the Food Sovereignty Index) and the index obtained.

Variable	Weight (Wi)	Punctuation scale (Pi)	Index
Pp	0,3332	Pp > 7; 5 7 >= Pp >= 5; 4 5 > Pp >= 3; 3 3 > Pp >= 2; 2 2 > Pp > 0; 1	Food Sovereignty
Pe	0,0012	Pe > 10; 5 10 >= Pe >= 8; 4 8 > Pe >= 6; 3 6 > Pe >= 4; 2 4 > Pe > 0; 1	
AF	0,6656	AF > 75%; 5 75%>= AF> 60%; 4 60%>= AF>45%; 3 45%>= AF>30%; 2 30%>= AF =0; 1	
IUT	0,0054	IUT > 1,5; 5 1,5 >= IUT >= 1,3; 4 1,3 > IUT >= 1; 3 1 > IUT >= 0,7; 2 0,7 > IUT > 0; 1	Technology Sovereignty
IE	0,2013	20%> IE =0; 5 20%<= IE < 35%; 4 35%<= IE <50%; 3 50%<= IE <70%; 2 70%<= IE <100%; 1	
H	0,2814	H > 2; 5 2>= H >= 1,5; 4 1,5> H >= 1; 3 1> H >= 0,5; 2 0,5 > H > 0; 1	
IAFRE	0.4011	IAFRE > 75%; 5 75%>= IAFRE > 50%; 4 50%>= IAFRE >35%; 3 35%>= IAFRE >20%; 2 20%>= IAFRE =0; 1	
IIF	0,1108	IIF > 80%; 5 80%>= IIF > 70%; 4 70%>= IIF >50%; 3 50%>= IIF >30%; 2 30%>= IIF =0; 1	

(Continuation of Table 15)

Variable	Weight (Wi)	Punctuation scale (Pi)	Index
EE	0,4024	EE >3,5; 5 3,5 > EE >= 2,5; 4 2,5 > EE >= 1,5; 3 1,5 > EE >= 1; 2 1 > EE 1	Energetic Sovereignty
EF	0,2824	EF > 70%; 5 70%>= EF > 60%; 4 60%>= EF >50%; 3 50%>= EF >30%; 2 30%>= EF =0; 1	
BE	0,2015	BE > 10; 5 10 >= BE >= 7; 4 7 > BE >= 4; 3 4 > BE >= 1; 2 1 > BE > 0; 1	
CEP	0,0033	30 > CEP =0; 5 30<= CEP < 60; 4 60<= CEP <90; 3 90<= CEP <120; 2 120 <= CEP; 1	
RCB	0,1	0,35 > RCB ; 5 0,35 <= RCB < 0,50; 4 0,50<= RCB <0,75; 3 0,75<= RCB <0,95; 2 0,95 <= RCB; 1	Economic Efficiency
IDIE	0,9	20%> IDIE =0; 5 20%<= IDIE < 40%; 4 40%<= IDIE <60%; 3 60%<= IDIE <80%; 2 80%<= IDIE <100%; 1	

Since IIF is a novelty of the investigation of Leidy concerning family agriculture and socioecological resilience, this indicator was considered as important as the other indices of FS, TS, ES and EE. Because the calculation of IIF depend from diverse variables each of it had a specific weight and scale for the final calculation:

Table 17. Scale and relative weight of the variables to measure the Innovative Intensity of the family farm.

Variable	**Variable valorisation**	**Relative weight (Pi)**	**Weight (Wi)**
Generation of patents, innovations and/or registers (IPR)	PIR/number of workers Where, PIR: number of patents, innovations and registers	IPR > 2; 5 2 >= IPR >= 1; 4 1 > IPR >= 0,5; 3 0,5 > IPR >= 0,2; 2 0,2 > IPR > 0; 1	0,0205
Products based totally on agroecological practices (IPA)	AP/TP Where AP: agroecological products and TP total products	IPA > 80%; 5 80% >= IPA > 70%; 4 70% >= IPA > 50%; 3 50% >= IPA > 30%; 2	0,1063

		30% >= IPA = 0; 1	
Annually worker's improvement (WI)	WI > 75% 75% >= WI >= 60% 60% > WI >= 40% 40% > WI > 20% 20% > WI > 0	5 4 3 2 1	0,0912
Farm strategy	Formulated and implemented Is not formulated but there is an existing project of strategic development being applied Strategy or development project in construction Short term plan There is no plan of development at all	5 4 3 2 1	0,1224
Proportion of polyvalent workers (PPW)	PWP > 85% 85% >= PWP >= 70% 70% > PWP >= 60% 60% > PWP > 50% 50% > PWP > 0	5 4 3 2 1	0,0455
Technological change capacity	High generation of technologies and/or innovations, to the point of having more than 3 technologies from their own. Frequent assimilation of technologies and innovations from the outside or developed in cooperation. Good level of generation of technologies and/or innovations, to the point of having 1-2 technologies from their own. Frequent assimilation of technologies and innovations from the outside or developed in cooperation. No technologies developed on their own. High level of assimilation of technologies and innovations from the outside. No technologies developed on their own. Medium level of assimilation of technologies and innovations from the outside. Few adoption of outside technologies or innovations	5 4 3 2 1	0,178
Long-term contracts and narrow link with clients and providers	Usual practice Regularly Not regularly, but growing Sometimes Almost never	5 4 3 2 1	0,0912
Level of technological and commercial surveillance of the local environment	Excellent Good Regular Not sufficient Bad	5 4 3 2 1	0,0303
Environmental protection of the farm	Only agroecological practices are developed and used. Only organic inputs are used for plant and animal nutrition. Residues are recycled and all the potential of Energy Renewable Sources (ERS) is used. Some agroecological practices are developed and used. Mix of organic and chemical inputs are used for plant and animal nutrition, mostly the later. Residues are recycled and some potential of ERS is used. Some agroecological practices are being developed. Mix of organic and chemical inputs are used for plant and animal nutrition, mostly the later. Residues	5 4 3 2	0,1625

	are recycled and the potential of ERS is not exploited. Maybe some agroecological practice is used but mainly conventional practices. Chemical inputs for plant and animal nutrition are used. No use of ERS. Productive system totally based on conventional practices and chemical inputs. No use of ERS:	 1	
Farm orientation	To satisfy the local market and the family consumption, with selling to the national food industry and the touristic sector. To satisfy the local market and the family consumption, with selling to the national food industry. To satisfy the local market and the family consumption. Family consumption and selling of some surplus. Only focus on selling, without family consumption.	5 4 3 2 1	0,0608
External and internal information flux	Value the local articulation and the level of stable communication among the farm actors and their environment with: Excellent Good Regular Not sufficient Bad	 5 4 3 2 1	0,0152
Innovative culture	Consider if the ones taking the decisions (proprietary, manager and/or family) are taking risks and motivating all the other actors (including paid labourers). Always One of the aspects is done always, the other sometimes One of the aspects always, the other never. One of the aspects sometimes, the other never. None of the two.	 5 4 3 2 1	0,0761

In the following table, there is an overview of all the variables with the specific weight attached for the creation of each index. At the bottom of the table there is the formula for the creation of the Socio-ecological Resilience Index.

Table 18. Overview of all the indicators, the relative weight and the punctuation scale. On the last column there is the formula for the creation of each indicator.

Indicator	Variable	Weight (Wi)	Scale (Pi)	Index (%)
Pp	People fed/ha/year, per protein input	0,33	1-5	Food Sovereignty $SA = \frac{\sum_{i=1}^{n}(Pi \times Wi)}{5 \sum_{i=1}^{n} Wi}.100$
Pe	People fed/ha/year, per energy input	0,001	1-5	
Af	Percentage of food for the family produced on farm	0,66	1-5	
LER	Land Equivalent Ratio	0,005	1-5	Technology Sovereignty $ST = \frac{\sum_{i=1}^{n}(Pi \times Wi)}{5 \sum_{i=1}^{n} Wi}.100$
IE	Percentage of external inputs used for the production	0,201	1-5	
H	Production diversity using Shannon index	0,281	1-5	
IAFRE	Index of the potential use of RES with appropriate technology	0,401	1-5	
IIF	Innovative Intensity of the Farm	0,111	1-5	
EE	Energetic Efficiency	0,402	1-5	Energetic Sovereignty $SE = \frac{\sum_{i=1}^{n}(Pi \times Wi)}{5 \sum_{i=1}^{n} Wi}.100$
EFE	Percentage of energy coming from the outside	0,110	1-5	
EF	Percentage of energy from the farm	0,282	1-5	
EB	Energetic balance	0,201	1-5	
ECP	Energetic cost for the protein production	0,003	1-5	
CBR	Cost-Benefit relation	0,1	1-5	Economic Efficiency $EEco = \frac{\sum_{i=1}^{n}(Pi \times Wi)}{5 \sum_{i=1}^{n} Wi}.100$
EIDI	External Inputs Dependency Index	0,9	1-5	
Socioecological Resilience Index (%) $SRI = \frac{FS + TS + ES + EE}{4}$				

Table 19. Example of Socioecological Resilience Index (IRS) calculation in Finca del Medio (2006-2015) (Casimiro, 2016, pag 122).

Variable	Value	Pi	Wi	Pi x Wi	Sovereignty Index	SRI (%)
Pp	8,00	5	0,3332	1,666	FS= 0,99	**99,98**
Pe	6,11	3	0,0012	0,0036		
Af	98,00	5	0,6656	3,328		
Sum			1,0000	4,9976		
LER	2,74	5	0,0054	0,027	TS= 1	
IE	10,00	5	0,2013	1,0065		
H	2,15	5	0,2814	1,407		
IUPRES	83,61	5	0,4011	2,0055		
IIF	95,44	5	0,1108	0,554		
Sum			1,0000	5,0000		
EE	17,26	5	0,4024	2,012	ES= 1	
EFE	15,06	5	0,1104	0,552		
EF	84,94	5	0,2824	1,412		
BE	10,86	5	0,2015	1,0075		
CEP	0,58	5	0,0033	0,0165		
Sum			1,0000	5,0000		
RCB	0,34	5	0,1	0,5	EE= 1	
IDIE	1,81	5	0,9	4,5		
Sum			1,0	5,0		

On the long term and through periodic applications, is possible to show progress and the dynamics of the agroecological transition to support this process of evolutions from the past experiences and the future projections.

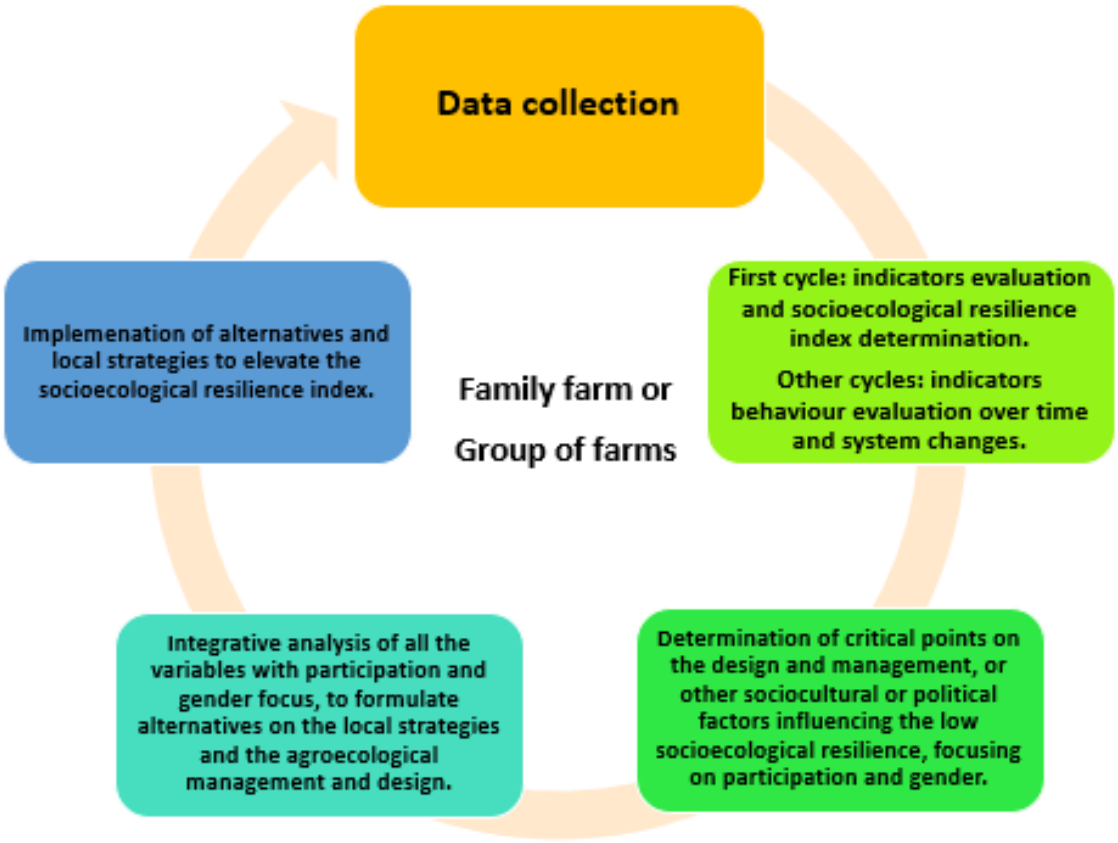


Figure 21. Representation of the practical application of the Methodology for the Evaluation of the Socioecological Resilience (MERS) of family farms. In this thesis only the data collection and the index determination was elaborated.

APPENDIX B – FARM DIAGNOSIS QUESTIONNAIRE

FAMILY FARM DIAGNOSIS FORM

Date _____ Evaluated year_____

Interviewee_____

Farm name and Cooperative name: _____

Province: _____ **Municipality**: _____

1. **Farm areas** (Measuring Unit, M.U. ha) TOTAL _____

Crops		Forest trees	
Annual crops		Natural vegetation	
Fruit trees		Water	
Grasslands		Installations	
Fodder		Other	

2. **Water availability** (in %)

Aqueduct ___ Dike ___ River___ Pipe___ "Tranque"____ "Pozo"_____ Other___

Watering installations

3. **Energy sources for the system** (estimated %)

Source	**%**
Electric	
Fossil fuels	
Eolic	
Biogas	
Photovoltaic	
Other	

4. **Farm infrastructures** (conditions of the farm: good (G), regular (R) or bad (B)[9]:

Installations:

Machines and implements:

Fenced perimeter and access roads (describe the perimeter and the fence type and the % that represents of the total, as well as the # of divisions):

[9] Make clear between brackets with BC and the date, each infrastructure that is part of the BIOMAS-CUBA project

5. Composition and characteristics of the family that lives at the farm, participating or not in the agricultural production process and the workers that work at the farm.

Name and surname	Gender	Family	Age	School level	Occupation	Working hours/year	Year income

Human total working hours per year: _____

Animal total working hours per year: _____

Description:_____
_____
_____
_____
_____

Mean cost of a day salary in the zone (8 hours) _____

6. Total year farm production[10]

Product	M.U.	Amount	Price per unit	Production destiny				Income/saving
				State	Agropec.	Family or animal consumption	Other	
Soy								
Rice								
Maize								
Beans								
Malanga								
Manioc								
Pumpkin								
Sweet potato								
Onion								
Garlic								
Small garlic								
Sesame								
Potatoes								
Sugar cane								
Bananas								
Coffee								
Mamey								
Guayaba								
Mango								
Tomatoes								
Pineapple								
Lemon								
Orange								
Toronja								
Coconut								
Cow meat								
Fish meat								
Rabbit meat								
Chicken meat								
Pork meat								
Cow milk								

[10] Reflect also the production of organic fertilizers/green manures, biogas and animal feed.

Eggs								
Honey								

Total income:

Savings (family and animal consumption, seeds generated and conserved on farm):

7. Productive inputs (all the inputs off-farm, food as well as energy):

Input	M.U.	Amount	Cost x unit	Use	Total cost
Concentrate					
Soy					
Bagacillo					
Honey					
Urea					
Fodder					
Antiparasitic					
Antibiotics					
Other					
Urea fertilizers					
NPK					
Other					
Herbicide 1					
Herbicide 2					
Herbicide 3					
Insecticide 1					
Insecticide 2					
Insecticide 3					
Diesel	L				
Gasoil	L				
Lubricants	L				
Electricity	Kw/h				

Seeds					

Food that the family buy

Food	M.U.	Amount	Cost x unit	Total cost	Origin (where do they buy it)

Other inputs

Services	Cost	Others	Cost
Equipment rent		Inversions	
Specific work		Amortizations	
Occasional labourers			
Reparations			

8. **Residues treatment** (explain the treatment of yield residues and other like water residues on the studied farm)

9. **Agroecological practices present in the system** (point out with BC the ones that were introduced after the intervention of the BIOMAS-CUBA project):

Practice	**Check if present**
Crop rotation	
Polyculture	
Wind-breaker curtains	
Contention barriers	
Level curves	
Holes against the slope	
Residues management	
Holes around	

Stone terraces	
Infiltration lines	
Mulch	
Compost	
Lombicultura	
Green manure (specify)	
Crop association	
Biological control	
Organic fertilizers (specify)	
Efficient microorganisms	
Hummus	
Biodigestor effluents	
Bocachi	
Compost	
Mod	
Other	

Measuring scale and relative weight of the variables to measure the Innovative Intensity of a Family Farm:

Variable	**Variable valorisation**	**Relative weight (Pi)**	**Value**
Generation of patents, innovations and/or registers (IPR)	PIR/number of workers Where, PIR: number of patents, innovations and registers	IPR > 2; 5 2 >= IPR >= 1; 4 1 > IPR >= 0,5; 3 0,5 > IPR >= 0,2; 2 0,2 > IPR > 0; 1	
Products based totally on agroecological practices (IPA)	AP/TP Where AP: agroecological products and TP total products	IPA > 80%; 5 80% >= IPA > 70%; 4 70% >= IPA > 50%; 3 50% >= IPA > 30%; 2 30% >= IPA = 0; 1	
Annually worker's improvement (WI)	WI > 75% 75% >= WI >= 60% 60% > WI >= 40% 40% > WI > 20%	5 4 3 2	

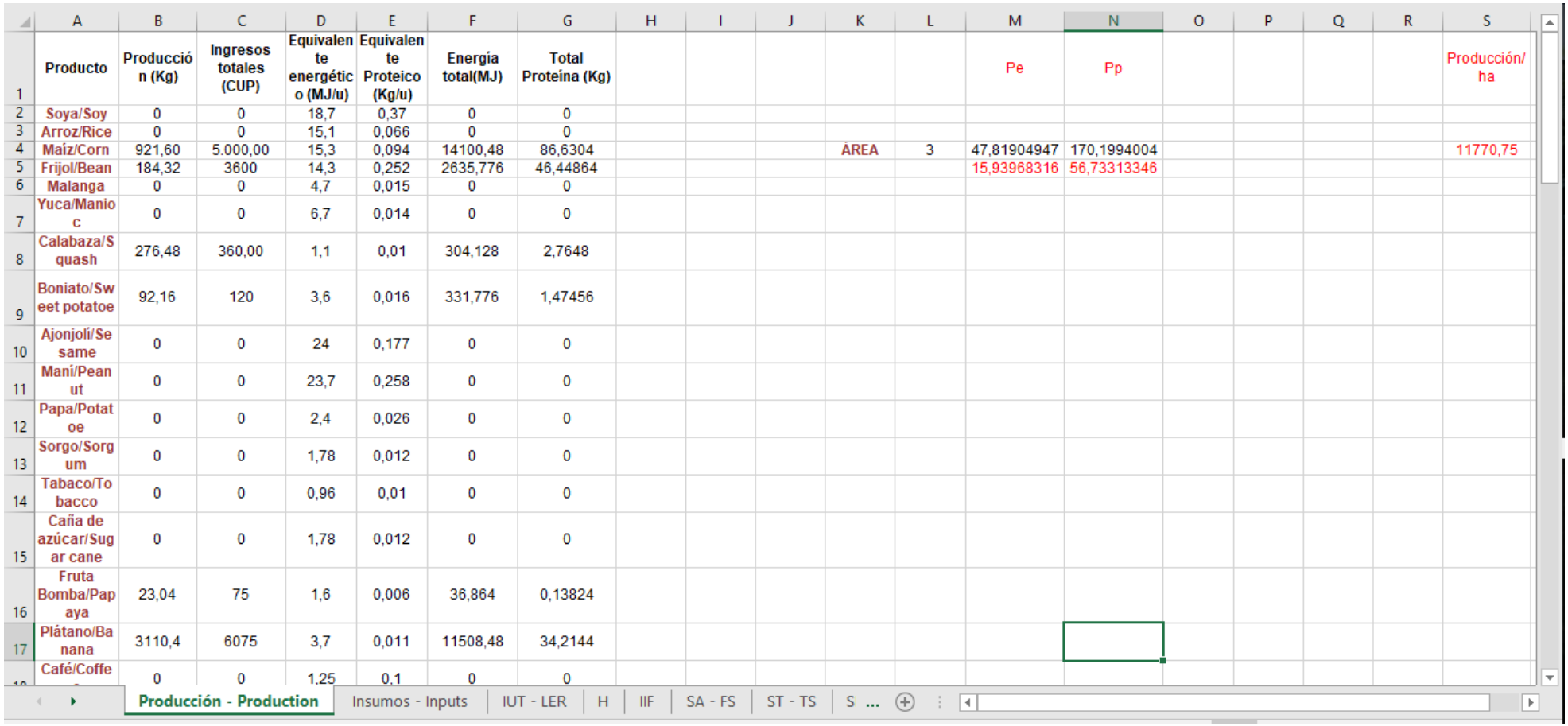
	20% > WI > 0	1	
Farm strategy	Formulated and implemented Is not formulated but there is an existing project of strategic development being applied Strategy or development project in construction Short term plan There is no plan of development at all	5 4 3 2 1	
Proportion of polyvalent workers (PPW)	PWP > 85% 85% >= PWP >= 70% 70% > PWP >= 60% 60% > PWP > 50% 50% > PWP > 0	5 4 3 2 1	
Technological change capacity	High generation of technologies and/or innovations, to the point of having more than 3 technologies from their own. Frequent assimilation of technologies and innovations from the outside or developed in cooperation. Good level of generation of technologies and/or innovations, to the point of having 1-2 technologies from their own. Frequent assimilation of technologies and innovations from the outside or developed in cooperation. No technologies developed on their own. High level of assimilation of technologies and innovations from the outside. No technologies developed on their own. Medium level of assimilation of technologies and innovations from the outside. Few adoption of outside technologies or innovations	5 4 3 2 1	
Long-term contracts and narrow link with clients and providers	Usual practice Regularly Not regularly, but growing Sometimes Almost never	5 4 3 2 1	
Level of technological and commercial surveillance of the local environment	Excellent Good Regular Not sufficient Bad	5 4 3 2 1	
Environmental protection of the farm	Only agroecological practices are developed and used. Only organic inputs are used for plant and animal nutrition. Residues are recycled and all the potential of Energy Renewable Sources (ERS) is used. Some agroecological practices are developed and used. Mix of organic and chemical inputs are used for plant and animal nutrition, mostly the later. Residues are recycled and some potential of ERS is used. Some agroecological practices are being developed. Mix of organic and chemical inputs are used for plant and animal nutrition, mostly the later. Residues are recycled and the potential of ERS is not exploited. Maybe some agroecological practice is used but mainly conventional practices. Chemical inputs for plant and animal nutrition are used. No use of ERS. Productive system totally based on conventional practices and chemical inputs. No use of ERS:	5 4 3 2 1	
Farm orientation	To satisfy the local market and the family consumption, with selling to the national food industry and the touristic sector. To satisfy the local market and the family consumption, with selling to the national food industry. To satisfy the local market and the family consumption. Family consumption and selling of some surplus. Only focus on selling, without family consumption.	5 4 3 2 1	
External and internal information flux	Value the local articulation and the level of stable communication among the farm actors and their environment with: Excellent	5	

	Good Regular Not sufficient Bad	4 3 2 1	
Innovative culture	Consider if the ones taking the decisions (proprietary, manager and/or family) are taking risks and motivating all the other actors (including paid labourers). Always One of the aspects is done always, the other sometimes One of the aspects always, the other never. One of the aspects sometimes, the other never. None of the two.	 5 4 3 2 1	

Percentage of energy generated and used on farm, in one year, with ERS and the use of appropriate technologies, measuring the equivalent in MJ and the energetic cost in Kw/h, that would take to use this same energy from electricity imported from the outside.

Appropriate Technology	Use	Description	Equivalent in Kw/h for one year	Equivalent in MJ

APPENDIX C – EXAMPLE OF EXCEL SHEET FOR THE PRODUCTION



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Producto	Producción (Kg)	Ingresos totales (CUP)	Equivalente energético (MJ/u)	Equivalente Proteico (Kg/u)	Energía total(MJ)	Total Proteína (Kg)						Pe	Pp					Producción/ha
2	Soya/Soy	0	0	18,7	0,37	0	0												
3	Arroz/Rice	0	0	15,1	0,066	0	0												
4	Maíz/Corn	921,60	5.000,00	15,3	0,094	14100,48	86,6304				ÁREA	3	47,81904947	170,1994004					11770,75
5	Frijol/Bean	184,32	3600	14,3	0,252	2635,776	46,44864						15,93968316	56,73313346					
6	Malanga	0	0	4,7	0,015	0	0												
7	Yuca/Manioc	0	0	6,7	0,014	0	0												
8	Calabaza/Squash	276,48	360,00	1,1	0,01	304,128	2,7648												
9	Boniato/Sweet potatoe	92,16	120	3,6	0,016	331,776	1,47456												
10	Ajonjolí/Sesame	0	0	24	0,177	0	0												
11	Maní/Peanut	0	0	23,7	0,258	0	0												
12	Papa/Potatoe	0	0	2,4	0,026	0	0												
13	Sorgo/Sorgum	0	0	1,78	0,012	0	0												
14	Tabaco/Tobacco	0	0	0,96	0,01	0	0												
15	Caña de azúcar/Sugar cane	0	0	1,78	0,012	0	0												
16	Fruta Bomba/Papaya	23,04	75	1,6	0,006	36,864	0,13824												
17	Plátano/Banana	3110,4	6075	3,7	0,011	11508,48	34,2144												
	Café/Coffe	0	0	1,25	0,1	0	0												

Producción - Production | Insumos - Inputs | IUT - LER | H | IIF | SA - FS | ST - TS | S ...

APPENDIX D - INTERVIEW FAMILY FARM

INTERVIEW FAMILY FARM

Date:

Name interviewee:

Farm name:

Cooperative name:

Village:

Family farm

1. What is the best thing of working in the farm with the family living on-site? Do you think is it important that the family lives on the farm? Why or why not?
2. What does working in the family farm mean to you?
3. What are your activities on the farm? And what is your main role?

Community Economies

4. What do you consider necessary / essential to be able to adapt to changes? (Do you have all the basic resources you need to live well?) What do you miss? – needs

5. I will ask for each need: Who decides on this need? And how is the negotiation made? Get a specific storycase to illustrate

6. Is there a conflict about what needs to be met in order to live well together?
   If so, how are decisions being negotiated about what needs to be met in order to live well together?
7. What do you do to satisfy your needs? (On the farm, off-farm, other -specify) - production of surplus value
   On the farm - do you produce and sell to the market? What do you do to sell your products?
   [If they have not already told, ask] Is the farm part of a cooperative?
   Outside the farm: Do you do paid activities off the farm? Like what?
   Outside the market: care, reproductive labor. What other activities do you do to meet your needs?
8. How are leftover crops, profits, and care redistributed? - distribution of surplus value

9. In whom (human) or in what (nonhuman, like the environment) do you depend to live well? (Members of the family, other peasants ...) – meeting.

APPENDIX E – OVERVIEW OF ALL THE INDICATORS IN THE SIX FARMS

The following table contains all the indicators for the six farms, with the primary data obtained following the MERS methodology (Casimiro, 2016) and secondary data obtained from Casimiro's PhD thesis:

FARM	PP	PE	AF(%)	LER	EI(%)	H	IUPRES(%)	IIF(%)	EE	EF(%)	BE	CEP	CBR	EIDI	FSI	TSI	ESI	EEI	SRI
1	8	6,11	98	2,74	10	2,15	83,61	95,44	17,26	84,94	10,86	0,58	0,34	1,81	0,99	1	1	1	0.99
2	56,7	15,93	95	1,48	88	2,14	10,15	82,6	0,2	11,48	0,09	506,98	0,98	38,4	0,86	0,52	0,52	0,74	0,66
3	14	8	95	1,5	45	2,1	15	84,5	1,3	20,8	1,02	95,7	0,4	57,7	1	0,6	0,34	0,62	0,64
4	10,7	6,5	82	0,9	86	2,2	8,9	71,8	0,5	13,72	0,4	269,3	1,2	70,8	0,99	0,49	0,2	0,38	0,51
5	7,94	5,2	92	1,2	89	1,9	2,18	55,6	0,4	11,16	0,3	338	1,08	51,3	0,99	0,41	0,2	0,56	0,54
6	19,3	12,3	70	1,6	70	1,7	15	67,4	0,7	5,1	0,7	161,4	0,37	86,3	0,87	0,42	0,2	0,26	0,44