THE ECOLOGICAL AGRARIAN QUESTION IN THE NICARAGUAN AGRICULTURAL FRONTIER - HOW TO PROMOTE MORE SUSTAINABLE DEVELOPMENT PATHWAYS

DE ECOLOGISCHE AGRARISCHE KWESTIE - HOE DUURZAMERE ONTWIKKELINGSPADEN PROMOTEN

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LIST OF ABBREVIATIONS

ALBA	Alianza Bolivariana Para los Pueblos de Nuestra América
CcD	Conservación con desarrollo
CIERA	Centre for Research and Studies on Agrarian Reform *Centro de Investigación y Estudios de la Reforma Agraria*
ES	Ecosystem Services
FAI	Family Agricultural Income
FSLN	Frente Sandinista de Liberación Nacional
FW	Family Worker
GP	Gross Product
ha	Hectare
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
INAFOR	National Forest Institute *Instituto Nacional Forestal*
INEC	National Institute of Statistics and Census *Instituto Nacional de Estadísticas y Censos*
INETER	National Institute of territorial studies *Instituto Nicaragüense de Estudios Territoriales*
INIDE	National Development Information Institute *Instituto Nacional de Información de Desarrollo*
IPES-Food	International Panel of Experts on Sustainable Food Systems
Kg	Kilogram
L	Litre
m	Metre
MAGFOR	Ministry of Agriculture and Forestry *Ministerio Agropecuario y Forestal*
MARENA	Ministry of environment and natural resources *Ministerio del Ambiente y los recursos naturales*

Mza	Manzana
NGO	Non-governmental organization
NIO	Nicaraguan córdoba
NVA	Net Value Added
PES	Payment for Ecosystem Services intervention
PRICA	Proyecto Rigoberto Cabezas
SRC	Stockholm Resilience Centre
STEPS	The Social, Technological and Environmental Pathways to Sustainability Centre
SC	Suckler Cow
UCA	Central American University *Universidad Centroamericana*
UNA	National Agrarian University *Universidad Nacional Agraria*
US$	United States Dollar
VA	Value Added
WB	World Bank

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ABSTRACT

The ongoing transformation of forests into agricultural land, in what are known as agricultural frontiers, is recognized worldwide as a key issue. On the one hand, the related land use changes account for huge transformations in the biophysical environment at local and global levels and play a crucial role in the current global environmental and climate crisis. On the other hand, processes of land use changes in agricultural frontiers are also related to the emergence and expansion of specific cultural and social agrarian systems, mainly geared towards products for the world markets (e.g., coffee, dairy and meat, soy, and palm oil), which often bring conflicts over the appropriation and use of resources and create huge inequalities both locally and between local and external actors (i.e., related to the adverse insertion of smaller farmers into global value chains). As such, the processes taking place in forested agricultural frontiers bring huge challenges in terms of governance, environmental and social sustainability, and fairness both at local and global levels.

This Ph.D. dissertation contributes to a better understanding of these processes and challenges taking place in forested agricultural frontier regions. It focuses on analysing the socio-ecological transformations related to agrarian change processes in the Nicaraguan agricultural frontier with the objective of bringing insights that could better inform development practices and interventions. In Nicaragua, agricultural frontier dynamics have been a key component of agrarian development and a common thread has been a process of specialization (in cattle breeding and coffee production), land concentration, expulsion of small farmers towards still active pioneer fronts and huge deforestation rates. Lately, new trends have influenced these historical processes such as the increasing presence of the State, the growing insertion of local producers in global value chains, or the emergence of new actors (NGOs, private agro-industrial investors, and conservationist organisations). These imply changes in practices and rules regarding access and use of natural resources as well as the distribution of the benefits extracted from them, while they also engender new struggles over the meaning of sustainable development (as for instance tensions between conservation and agrarian production).

Drawing on the debates related to the ecological agrarian question, the dissertation argues for the adoption of an integrated nature-society approach to better understand and describe the processes of socio-ecological transformations taking place in agricultural frontiers. This implies taking distance from approaches that conceptualise nature and society as two different but overlapping categories and embracing the idea that nature and society are part of the same whole that cannot be disaggregated. Concretely, this means moving from looking at what society does with and to nature towards focusing our attention on the processes of co-evolution of nature and society as a whole. In order to achieve this, the dissertation proposes an analytical framework that conceptualises rural landscapes as complex socio-ecological systems and focuses on trying to better understand the evolving dynamics of such systems, particularly the emergence of dominant development pathways in relation to the establishment of a specific matrix of land uses. Within this framework, particular attention is given to analysing the socio-institutional and relational elements related to these processes of change in order to better understand the actual space that exists for individual and collective actors' agency and the margin of manoeuvre for the implementation of development interventions and policies.

The empirical part of the dissertation applies this framework in two small regions within the Nicaragua agricultural frontier with a multi-fold objective. First, it tries to identify and characterise the 'development pathways' that exist within the Nicaraguan agricultural frontier. To achieve this objective, it focuses on the case of a small region where the transformation of forested areas into agricultural land started in the 1960s. The historical analysis of the dynamics of socio-ecological changes implemented includes the analysis of the processes of both land-use change and social differentiation that have taken place in the region. Altogether, it demonstrates the existence of a dominant cattle-based development pathway characterised by social inequalities, power imbalances and negative environmental outcomes. Nevertheless, the analysis also shows that, despite the dominance of this cattle-based pathway, alternative pathways always exist, with the existence, for instance, of a peasant-like pathway characterised by family-based diversified production systems where cacao plays a key role.

Second, building on the previous insights about the existence of alternative development pathways that could be more socially and environmentally sustainable, the dissertation tries to better understand the margin of manoeuvre that exists for the design and implementation of development interventions and policies that could promote those alternatives. It moves then to the analysis of a concrete development intervention in the Nicaraguan agricultural frontier. The intervention is a Payment for Ecosystem Services intervention where a local conservationist NGO introduces a payment for farmers to motivate them not to clear the remaining forested areas on their farms. The focus of the study is on the interplay between farmers' agency and decision-making processes and the historically built rules and norms, social structure, culture, world views and macro-economic structure that characterise the dominant cattle-based development pathway, trying to bring insights on how to design and implement interventions that could promote a change in farmers' practices. The analysis demonstrates the strength of the dominant pathway in shaping actors' decisions and actions, not only for farmers but also for development practitioners and other actors. As such, it highlights to what extent actors involved seem to be locked within historically evolved practices embedded in the production logics and socio-cultural and socio-ecological contexts that characterise the dominant development pathway. As a result, the dominant cattle-based pathways appear to be hegemonic, leaving little space for alternative views and practices and for the emergence of more sustainable alternative pathways.

The dissertation argues that a drastic change must therefore occur in the way development interventions are designed and implemented and in the way issues are problematised. It calls for a more thorough engagement with the realities of local territories and their actors, in order to have a more realistic view of what problems and solutions might be. This implies escaping from the implementation of blueprint types of designs that would fit all time and space contexts, instead being explicitly flexible in the design and implementation of those interventions and policies for them to be adapted to the specific and concrete development pathways in which they are embedded and that they are attempting to challenge and transform. It also implies thinking of processes where development interventions and policies are constructed bringing into the debate

the views, perceptions and power of different actors in order to collectively negotiate and co-create a common understanding and valuing of the issues to be dealt with, the results hoped for and the strategies to implement. Finally, the recognition that the emergence of dominant pathways is also shaped by broader-level (national and global) structural factors implies that development interventions and policies need to be thought through and problematised taking these factors explicitly into account, becoming part of broader strategies and alliances aimed at transforming those global structural elements as a result.

CHAPTER 1

GENERAL INTRODUCTION. SETTING THE STAGE FOR THE RESEARCH

1. INTRODUCTION. A FRAMEWORK TO MAKE SENSE OF THE RESEARCH PROCESS.

Implementing a research process is a weird and disturbing journey. It is full of ups and downs, of personal and professional contradictions, of rewarding and disappointing moments. Sometimes you feel satisfied with your work and sometimes you believe that you are continuously moving from one dead end into another and you just want to quit. After several years of doctoral research, I now realise that each time I talked about my work, whether in a professional or personal context, I was constantly faced with the torment of answering once and again the same question: *What is my research about?*

Dealing with this question has turned out to be a very insightful endeavour in my journey. Looking back, I can recall the huge variety of answers I gave depending on the context and/or the person asking the question, for instance when participating in academic conferences or doctoral courses, dining with family members, sharing beers with friends, doing field work, talking to journalists, or simply explaining to my wife and children what I did all day long instead of spending time with them.

Sometimes I insisted on what was to me the empirical relevance of my research. Other times I tried to focus on how my research was related to some broad theoretical debates and still other times I emphasised some very concrete elements or concepts I used. And every so often I simply explained to what extent my empirical results could be related to other people's opinions, points of view or research results, whether these other people were academics, journalists, civil movement leaders, friends, or family members. When thinking retrospectively about the diverse answers, it is striking to realise that all these answers had truth in them and represented different perspectives on my research topic. Saying it in another way, they represented different versions/interpretations of my research endeavour. Going even further, I can now say that while none of these answers was enough to explain the whole picture of the research I was engaged in; each one of them was, in a general sense[1], enough to indicate what I was doing (and why I

[1] I say 'in general' because sometimes, more often than expected, I was not able to answer the question in a satisfactory way, either for myself or for the person asking.

was doing it) to the person who was standing in front of me. I start from this question that accompanied me during my Ph.D. journey, and draw on the framework of Lund (2014) [2] to clarify my research project for the reader of this dissertation .

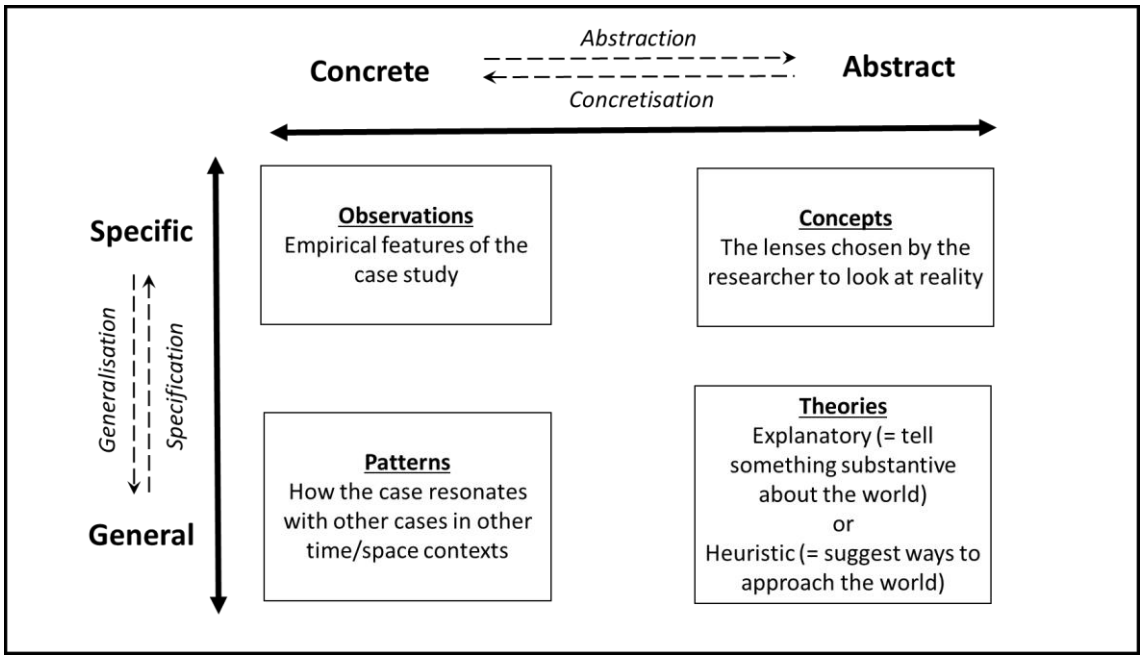
In his paper, Lund (2014) explains that qualitative social science research -the category to which my research belongs- is generally based on the analysis of case studies, which most often appear as being self-evident for the reader. However, as explained by Lund:

> "[a] case is an edited chunk of empirical reality where certain features are marked out, emphasized, and privileged while others recede into the background. As such, a case is not 'natural,' but a mental, or analytical, construct aimed at organizing knowledge about reality in a manageable way" (2014, p. 224).

There is therefore a need to make this '*mental, or analytical, construct*' explicit in order to make sense of any research. To solve this issue Lund proposes an analytical matrix where, he argues, we should locate any qualitative social science research process in order to make it understandable. This matrix is composed of two open-ended dimensions; the first one goes from the specific to the general and the second one from the concrete to the abstract. Lund argues that we can make sense of any qualitative social science research process by locating the research within this matrix and describing the analytical movements of abstraction/concretisation and generalisation/specification the research deals with.

[2] There have been several inspiring moments during this research process, some personal and others academic. It is not my intention here to describe all of them. One of these inspiring moments was a course I attended in June 2012 by Professor Christian Lund where he presented a preliminary version of the analytical matrix to make sense of qualitative research processes in social sciences, on which I draw in this general introduction. That is why I use Lund's framework as the starting point of this dissertation.

Figure 1.1: A two-dimension matrix to look at qualitative social sciences research processes



Source: adapted from Lund (2014)

Lund explains that when the concrete and the specific overlap within this two-dimensional matrix, we are dealing with specific (i.e., limited or circumscribed) events, relations and/or interactions which involve concrete (i.e., real, palpable) people and concrete things (objects, resources), in a specific space-time situation. In other words, it is about the empirical features of the case, i.e., specific and concrete observations. According to Lund, the generalisation process comprises two analytical movements which can be related to the external validity of the research. The first consists of moving from some specific and concrete observations towards the identification of more general patterns. The second is related to the analysis of how the research resonates[3] with other cases in different historical and geographical contexts. The aim of the movement of generalisation is, however, not to derive universal claims or theses, but simply to "say something about the typicality and rarity of particular observations" and "to enter into a dialogue where one's research resonates with others"(Lund, 2014, p. 227). The abstraction process is different. At a specific level, it is related to the way

[3] I use here the term 'resonance' as defined by Lund: "By resonance, I mean that different elements, dynamics, and relations could be recognized from one case to the other. Such cases are not necessarily similar. Indeed, they may be quite different, yet there are some elements that resonate between them." (Lund, 2014, p. 226)

concrete issues are understood and analysed through abstract concepts chosen by the researcher. At the general level, by contrast, the abstraction movement is related to theorising, i.e. "moving from observation of empirical events, through concepts, to be able to say something about the inherent qualities and dynamics in contexts other than the ones studied" (Lund, 2014, p. 229). For Lund, however, theory does not have to be considered solely as an explanatory framework (i.e., as saying something substantive about reality). On the contrary, and this is the approach I take in this thesis, theory can also be seen as a heuristic framework, i.e., "a set of conceptual tools, which, rather than telling us anything substantive about the social world, suggests ways of approaching it" (Lund, 2014, p. 229). As such, this is linked to the epistemological issue that we can never directly observe reality unless through the theoretical concepts (or lenses) that we use to apprehend it.

At the concrete and specific level, my research analyses socio-ecological transformations related to agrarian change processes in Nicaragua's agricultural frontier. I consider the country's agricultural frontier to include all the central highland and eastern lowland regions that have been transformed, essentially by family farmers, from a tropical humid forest into agricultural areas over Nicaragua's history. In terms of land-uses, these areas are now characterised by a patchwork of plots where pastures predominate, interspersed with small plots for staple crops, cacao, coffee and remaining forested areas. The density of forested areas as well as the level of differentiation among family farmers and the area's connection with the rest of the country will vary depending on how long ago the once-forest land was appropriated by migrating peasant families (i.e., recently appropriated areas show more forest cover, less differentiation between farmers and less presence of roads and state institutions, and less access to public services). The main economic activities in the frontier are related to agriculture and therefore most actors present in the areas are linked to agricultural production: farmers' organisations (e.g., cooperatives), merchants of agricultural inputs, buyers of agricultural products, agricultural credit providers (formal banking system and microfinance institutions), agribusiness companies, NGOs working in rural areas. But, the frontier is not homogeneous. In the eastward regions, where the pioneer front is still active and forested areas are still important, indigenous populations and institutions

remain key actors as are actors linked with the extraction of timber and non-timber forest products. In some regions we can also find mining activities and nature conservation processes, with their respectively different types of actors (e.g., mining companies, artisanal miners, conservationist NGO participants).

Within this diversity, my focus is on areas where the appropriation of the forest took place several decades ago and where agriculture, especially livestock raising, is the main activity. As such, my interest is twofold. First, I intend to study the evolutionary processes of agricultural production, changes in land-use patterns, and socio-institutional relations processes that have occurred together with the expansion of agricultural areas at the expense of natural tropical forests. Second, I aim to reflect upon the concrete outputs and the potential for development interventions that try to make a change within these processes and dynamics. This will be dealt with in Chapters 3, 4 and 5 of this dissertation. In this introductory chapter, however, my focus is on the general dimension of Lund's matrix. With respect to the general-concrete level, I introduce some elements necessary to make my research resonate with other cases in different geographical and historical contexts. As such, in section 2 following this introduction, my objective is twofold: i) to introduce the concept of agricultural frontier and briefly locate the role of the agricultural frontier in Nicaragua's historical agrarian dynamics; and, ii) to give a broad overview of the setting in which this dissertation is embedded; i.e., the issue of agriculture within the current corporate food regime and multidimensional global crisis. Subsequently, in section 3, I move to the general-abstract level. My objective there is to introduce the theoretical discussions in which my research can be located, i.e., the broader debate around what has been framed in the literature as the Agrarian Question, focusing specifically on its the ecological dimension. By starting at the general level of Lund's analytical matrix, and adopting theory as a heuristic framework, my intent is to draw upon a theoretical discussion to derive the research questions that I will use to look at the empirical phenomena I am interested in. These research questions are introduced in section 4, where I also present the outline of the dissertation as a whole and give an overview of my main findings and arguments.

2. AGRICULTURAL FRONTIERS, THE GLOBAL ENVIRONMENTAL CRISIS AND THE FUTURE OF FARMING

2.1. AGRICULTURAL FRONTIERS

2.1.1.TOWARDS A CHARACTERISATION OF AGRICULTURAL FRONTIERS

In its most common definition, a frontier represents an -often imaginary- limit between two different things, as for instance when we talk of the imaginary line that represents the border between two countries. More figurative definitions also refer to frontiers as the last limit of what is known, for example in the expression 'the frontiers of knowledge'. The concept of agricultural frontier entails both literal and figurative dimensions. Literally speaking, the agricultural frontier is indeed a limit that divides two different worlds. On the one side of this limit is the agricultural world, a world of farmers where land use is dominated by agricultural plots. On the other side of this limit is the non-agricultural world, the natural world, most often considered as virgin and idle unknown land full of natural resources only waiting for human beings to exploit them.

Very much in line with the imaginaries that lie behind the XIXth-Century Wild West conquest in the USA, the natural world that exists behind the agricultural frontier is often characterised as a wilderness, a savage place, which has not been discovered yet by human beings and, therefore needs to be colonised[4]. In her analysis of the Nicaragua agricultural frontier, Larson (2001) uses the term 'Land of plenty' to describe this world, explaining that the agricultural frontier was considered by Nicaraguan society a place where

> "natural resources were there for the taking, for the peasant, the extractor, the merchant, the company or the state", a place with a "seemingly endless supply of land for the landless, to be converted to productive uses. Forests were for clearing, or for harvesting the best trees and then clearing" (Larson, 2001, p. 90).

In the same line, talking about the agricultural frontier in Central America, Pasos et al. explain that the world on the other side of the frontier is imagined as "a promised land, full of richness and treasures, or simply a land of opportunities where thousands of

[4] That is why the processes that take place within an agricultural frontier ore often characterised as colonisation processes and the colonisation of the frontier is often also seen as a civilising mission.

impoverished peasants look for their livelihoods" (Pasos, Girot, Laforge, Torrealba, & Kaimowitz, 1994, pp. 16–17 own translation).

The dichotomous vision introduced above between neatly separable agricultural and natural worlds, the former civilised and the latter savage, is one of the pillars of the imaginaries behind the processes of internal migration that occur in agricultural frontier regions, especially when talking about tropical-forested frontiers (de Jong, Tuck-Po, & Ken-ichi, 2006; Pasos et al., 1994). Jones (1990), for instance, even considers the continued process of '*colonisation',* i.e., the migration of peasant populations into forested areas of Central America to clear the forest, as part of the Central American '*culture'*[5]. In reality, however, the differences between the two worlds on each side of the frontier are fuzzier, and more than clear-cut borders, agricultural frontiers have to be considered as transition areas. To start with, it is important to underscore that there is no such thing as a wild non-humanised world on the natural side of the agricultural frontier. What is imagined as pristine nature, is indeed often a place where human populations have lived for a long time, even if sometimes their presence can be diffuse and sporadic in terms of territorial occupation (i.e., characterised by a very low population density). Tropical forests, for instance, have been inhabited for centuries and forest communities have constantly been fighting to have their historical rights recognised locally, nationally and internationally in front of other actors (Barry & Taylor, 2008; Larson, Barry, Dahal, & Pierce Colfer, 2010; Rights and Resources Initiative, 2010). In that sense, Héritier et al. (2009) describe the frontier as a place where one dominant socio-ecological order is being replaced by another one (e.g., moving from forests managed by indigenous communities towards an agricultural dominated landscape managed by a peasant society)[6]. As a result, they propose that, instead of talking of c*olonisation*, we should use the word *invasion* when describing the processes of human immigration taking place in these regions. Then, agricultural frontiers as such cannot be conceptualised as imaginary one-dimensional lines that separate two independent

[5] I use the terms *colonisation* and *culture* in italics to emphasise the fact that these terms, often used to talk of the dynamics taking place in agricultural frontiers, are charged with normative and subjective elements and need to be used with critical care.

[6] These authors also introduce the concept of Ecological Frontiers as a place where the new socio-ecological order that is being set in place is not dominated by agricultural production but by nature conservation activities (e.g., nature reserve, nature-based tourism).

worlds as in the case of the border between two countries. Instead, they are battlefield areas where actors belonging to different socio-ecological orders vie with each other to gain control over the territory and its natural resources. These struggles are not resolved overnight; they can last a long time, and their outcomes gradually result in concrete landscape transformation processes.

Thus, agricultural frontiers should be approached as vague, extended areas where we witness gradual landscape transformations resulting from the arrival of outsiders with different worldviews in a previously established socio-ecological order. The time dimension, i.e., the fact that landscape changes do not happen from one day to another but take place gradually, is a key characteristic of agricultural frontiers. According to Héritier et al. (2009), frontiers analysis often distinguishes three phases in the evolution of pioneer fronts: the opening (i.e., the arrival of actors who promote a new socio-ecological order); the establishment of a new socio-ecological order, which is often a conflictive period; and the closure (i.e., when a new socio-ecological order is in place). By socio-ecological order I understand both the socio-institutional elements (e.g., migration; rules of the game as tenure rights systems; social structure and power relations; and market integration), and the way natural resources are used in relation to specific land use patterns. This would imply that through these three phases the pioneer front would move from an 'old' to a 'new' equilibrium and the frontier would stop being a frontier to become part of the 'society' as a whole. However, Héritier et al. (2009) argue that frontiers are always characterised by complex dynamic equilibria, even in the supposed closure phase. They say that each phase could bring unpredictable results leading to unpredictable trajectories ranging from: (1) a consolidation of the new socio-ecological order in replacement of an old one (which would mean not the closure of the frontier but the stabilisation of its state in a new configuration); (2) a crisis of this new socio-ecological order and new processes of change; or, (3) the establishment of a new equilibrium where both socio-ecological orders remain and keep vying with each other. For these authors this unpredictability and the related instability of frontiers, which resonates with elements of complexity theory, to be introduced in Chapter 2, is the result of the fact that frontier dynamics result from the above-mentioned complex interactions -sometimes collaborative and sometimes conflictive- among a diversity of

actors whose interests depend both on the socio-ecological orders to which they belong and on the scale in which they are located and behave (local, regional, national, international). As such, there is no clear-cut way to decide when a frontier stops being a frontier. Altogether, Héritier et al. (2009) argue for the need to adopt holistic, dynamic and multiscale approaches to analyse the diversity of processes playing out in agricultural frontiers.

In a nutshell, agricultural frontiers could therefore be described as areas where we have been witnessing ongoing gradual changes from non-agricultural towards more agricultural landscapes related to: i) processes of socio-institutional changes, and, ii) processes of land use change towards a landscape dominated by crop or pasture land.

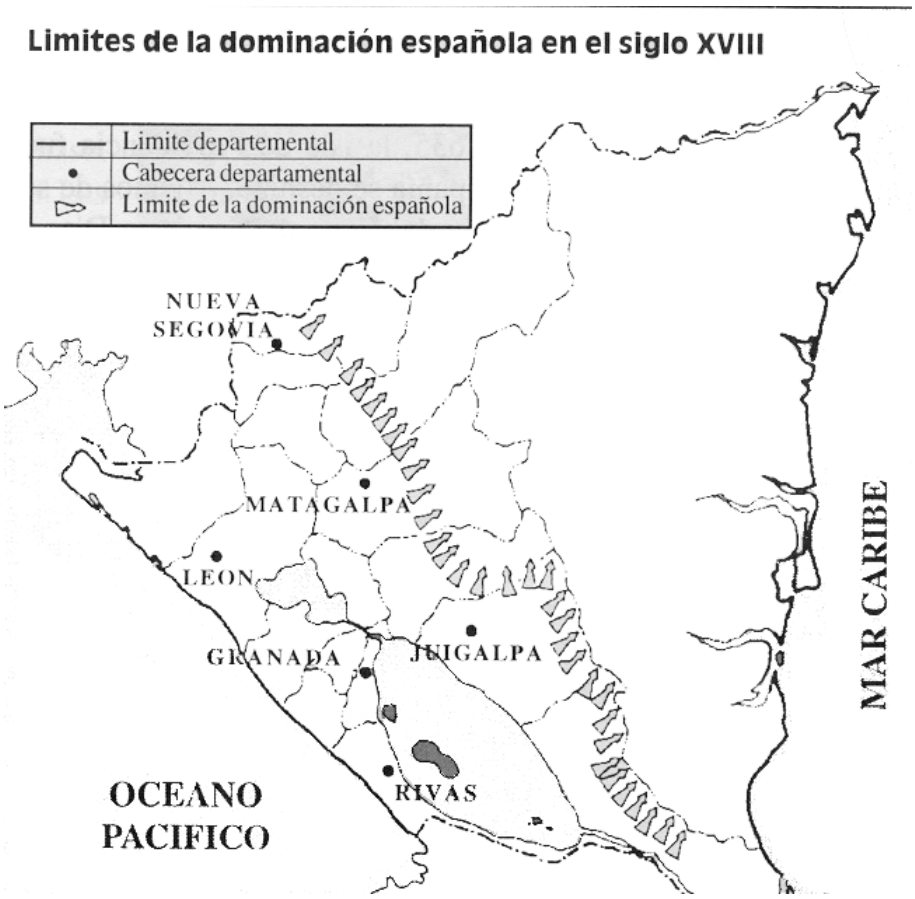
2.1.2. THE AGRICULTURAL FRONTIER IN NICARAGUAN AGRARIAN HISTORY

According to Merlet (n.d.) and Merlet et al. (2000), what is nowadays known as the Nicaraguan territory was occupied by two types of pre-Columbian societies before the Spanish colonisation. In the lowlands of the western side of the country and the mountains of the north-centre of the country we could find socially well differentiated societies related to the Mesoamerican culture based on the production of maize. The eastern lowlands on the other side were inhabited by socially less differentiated societies more related to people from the Northern regions of South America characterised by the production of cassava. Moreover, Merlet (n.d.) identifies a geographical differentiation in terms of habitat and use of the resources by those societies. Western volcanic lowlands were the regions with the highest population density and the habitat was concentrated in big villages. Agriculture consisted of established permanent fields complemented by shifting slash and burn parcels cultivated at the periphery of the villages and in the forested areas close to the villages. In the most remote areas, huge patches of humid or dry tropical forests or savannahs, depending on the regions, remained. The highlands at the north-centre of the country were characterised by the same kind of organisation but with a much lower population density and an agriculture based almost exclusively on slash and burn processes. The eastern lowlands were covered by a dense tropical humid forest. The population density was very low with the existence of small villages along the rivers and the Caribbean

coast. Even if agriculture existed, especially for the production of tubers (cassava), most of the alimentation came from hunting, fishing and gathering activities in forested areas and rivers or sea.

Colonisation disrupted the evolutionary processes of these pre-Columbian societies differently. Spanish colonisation impacted the western lowlands and highlands (see Figure 1.2) and the limits of the Spanish control corresponded also to the limit of the large tropical humid forest of the eastern lowlands (see Figure 1.3). In regions under Spanish control, most of the indigenous population was decimated due to wars, diseases introduced from Europe, over-exploitation of the indigenous labour force and the fact that for years indigenous populations were turned into slaves and displaced by force to work in the mines of Southern America (Merlet, n.d.; Merlet et al., 2000).

Figure 1.2: Limit of Spanish control over the territory in the XVIIIth Century

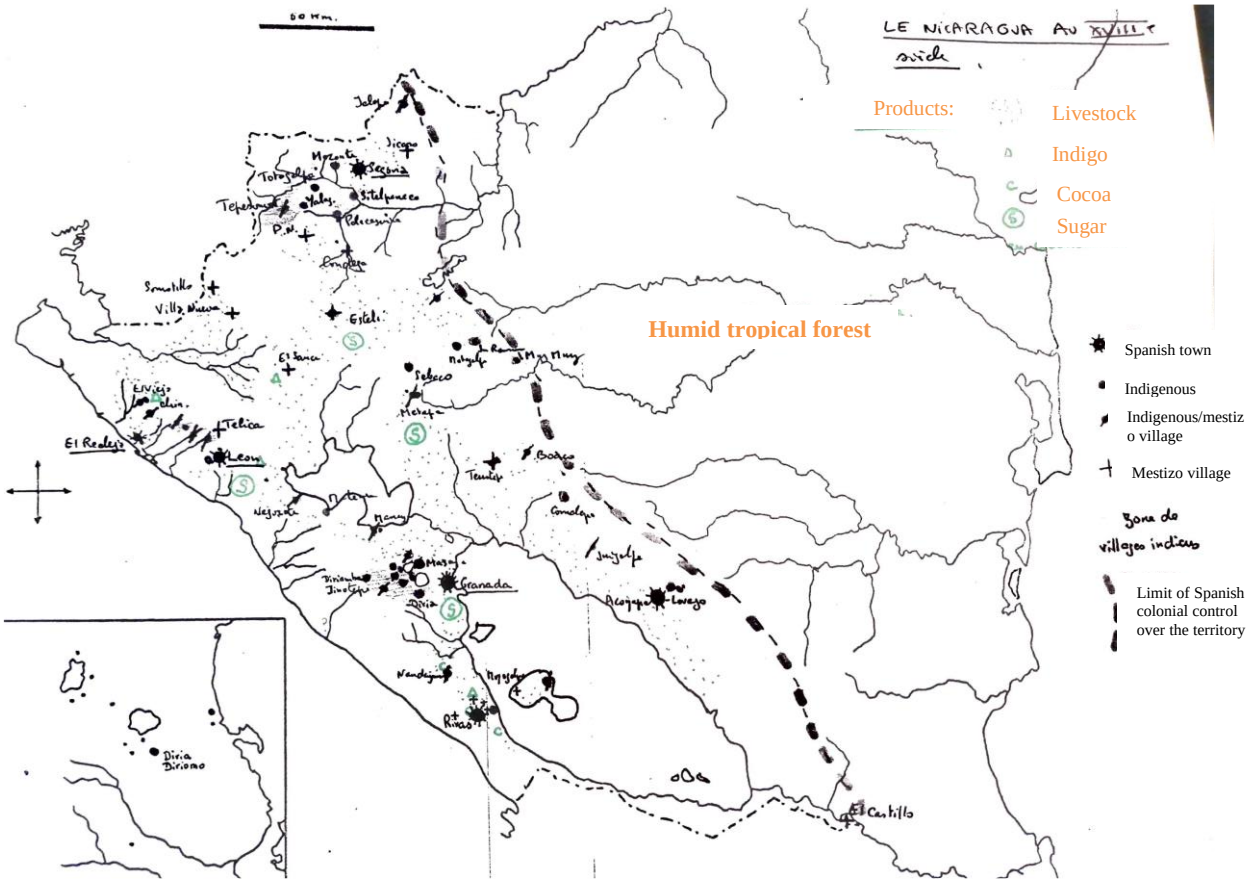


Source : Merlet et al. (2000, p. 19)

Spaniards took control of all the land and introduced the production of cattle, indigo, and to a much lesser extent sugar cane and cacao in large-scale haciendas using

indigenous labour, initially as slaves and then making use of the system of encomienda and tribute to be paid in agricultural and artisanal products and labour (Merlet, n.d.). Indigenous populations were regrouped in small villages around or within the haciendas to which they were bonded by colonial rule. As the colonial presence was not homogeneous in the whole country, farmer populations also established themselves in areas where Spanish rule was weaker, mainly in the highlands. These populations were largely ladinos-mestizos (i.e., mixed populations born in Nicaragua who were not considered as Spaniards or indigenous) but also indigenous people who escaped from colonial control (Merlet, 1990; Merlet et al., 2000) (see Figure 1.3). These ladino-mestizo populations settled in unoccupied areas, mainly the remaining forested areas in between colonial haciendas and indigenous villages in a process that could be considered the colonisation of various multi-located internal agricultural frontiers. As we will see later on, this is very important in shaping the peasant imaginary of these forested areas as a kind of defensive refuge from the dominant colonial rule.

Figure 1.3: Nicaragua in the XVIIIth century



Source: adapted from Merlet (n.d.)

In the eastern lowlands of the country, colonisation was attempted by England. English impact and presence were, however, much more sporadic than the Spanish one. And, in some specific places along the coast the English negotiated with indigenous leaders the right to have direct access to the land in order to establish huge plantations with slaves stolen from Africa. Therefore, contrary to the rest of the country, the way the eastern lowlands were organised did not change drastically during the colonial period, with the exception of these areas of direct control (Merlet et al., 2000).

Central America gained its independence in 1821. After independence, population growth reinitiated at a rate of 1.3% per year between 1815 and 1920, according to the historical data gathered and analysed by Merlet (1990). Looking at the historical demographic data available, Merlet identifies interesting regional disparities with respect to population growth, demonstrating that the regions where the colonial haciendas dominated in the past showed a lower population growth rate than regions where Spanish presence was weaker, i.e., the central highlands and the limits between the area of influence of the Spaniards and the humid tropical forests of the eastern lowlands. Referring to the latter, and in line with the historical analysis of Pasos et al. (1994) on the Central American forest frontiers, Merlet considers this period as the start of the opening of a large agricultural frontier from North to South along the Nicaraguan territory. Along this agricultural frontier, mainly ladino-mestizo farmers coming from the western half of the country started to migrate eastward to take control of large patches of humid tropical forest that covered the eastern half of the country in order to transform them into agricultural areas. As explained above, indigenous presence in the western lowlands was concentrated in the Caribbean Coast and along the main rivers. Population density was very low and therefore the new areas occupied by these farmers seemed to be empty of any other population and were as a result considered to be 'virgin areas' free to take. Farmers' expansion in this newly opened agricultural frontier relied upon a few key products that started to be exchanged in national and international markets: livestock (bovine and to a lesser extent porcine) in the eastern lowlands, coffee in the highlands (introduced in Nicaragua during the XIXth Century) and sugar cane (Merlet et al., 2000). In the Caribbean coast, dynamics were again different.

This region witnessed the creation of territorial enclaves[7] with the installation of foreign companies linked to international markets, extracting precious goods and non-timber products (rubber), establishing gold mines, or producing bananas in large scale plantations (Merlet, n.d.).

Figure 1.4: Forest cover in Central America in 1940

Source: Pasos et al. (1994, p. 18)

As shown in Figure 1.4, despite the opening of the agricultural frontier in the XIXth Century, the advancement of the pioneer front towards the east was still limited at the beginning of the XXth Century and a huge area of tropical forest still remained in the eastern lowlands of the country. It was during the Somoza family dictatorship (1934-1979), and especially after World War II, that a strong intensification of the dynamics of migration towards the agricultural frontier occurred, accompanying the development of an agro-export based economy (Maldidier, 2004; Pasos et al., 1994). In that period Nicaragua's economic development relied upon the expansion of a few agricultural products for international markets, mainly coffee, sugar, cotton and beef. As an illustration of the latter, we can refer to Maldidier and Marchetti (1996), who state that

[7] An enclave could be defined as an area where a foreign company receives a concession for the use of land and other natural resources with the possibility to grab and expatriate the surpluses produced and which is largely disconnected from the rest of the national economy.

between 1960 and 1978 the nominal value of Nicaraguan agro-exports multiplied by ten, passing from 40 million USD to 400 million USD. In terms of volume, they say that between 1950 and 1978 the production of sugar increased by 250% of coffee by 51%, of cotton by 500% and of beef by 377%, while staple food output only increased 60%. The dramatic growth in the production of sugar and cotton was concentrated in the western lowlands of the country and was accompanied by a strong process of land concentration, the impoverishment of huge layers of the rural population who lost their access to land[8] and the deforestation of the remaining forested areas to expand sugar cane and cotton plots (Maldidier & Marchetti, 1996). Similar processes happened in the central highlands with the expansion of large-scale coffee production and in the older agricultural frontier areas, i.e., the regions bordering Lake Nicaragua's eastern coast, with the development of cattle production. As a result of these land concentration processes in most of these western regions, farmers started to migrate towards the agricultural frontier in search of available land (Lévêque, 1986; Maldidier & Marchetti, 1996; Pasos et al., 1994). In addition to these somewhat spontaneous migration processes of farmers losing access to land in other regions of the country, the expansion of the agricultural frontier in that period was also accelerated by the implementation of a state policy of colonisation of forested areas in the scope of an agrarian reform law enacted in 1963 (Jones, 1990; Merlet et al., 2000). This law foresaw the implementation of both land expropriation-redistribution processes and the incorporation of new areas as agricultural land, i.e., the expansion of agriculture in forested areas. In practice, however, only the latter was implemented, within a national-level program named Proyecto Rigoberto Cabezas (PRICA). Out of the 23 main projects implemented under this legislation, 17 were located in agricultural frontier regions potentially affecting a total of around 3.456 million[9] ha (Merlet et al., 2000). The objective seems to have been twofold: i) represent a release valve to the problems and social tensions generated by the development of agro-export crops in the western regions of the country; and ii) promote the insertion of the Nicaraguan economy within the international meat market, especially the North American market through the development of pastures and the improvement of roads

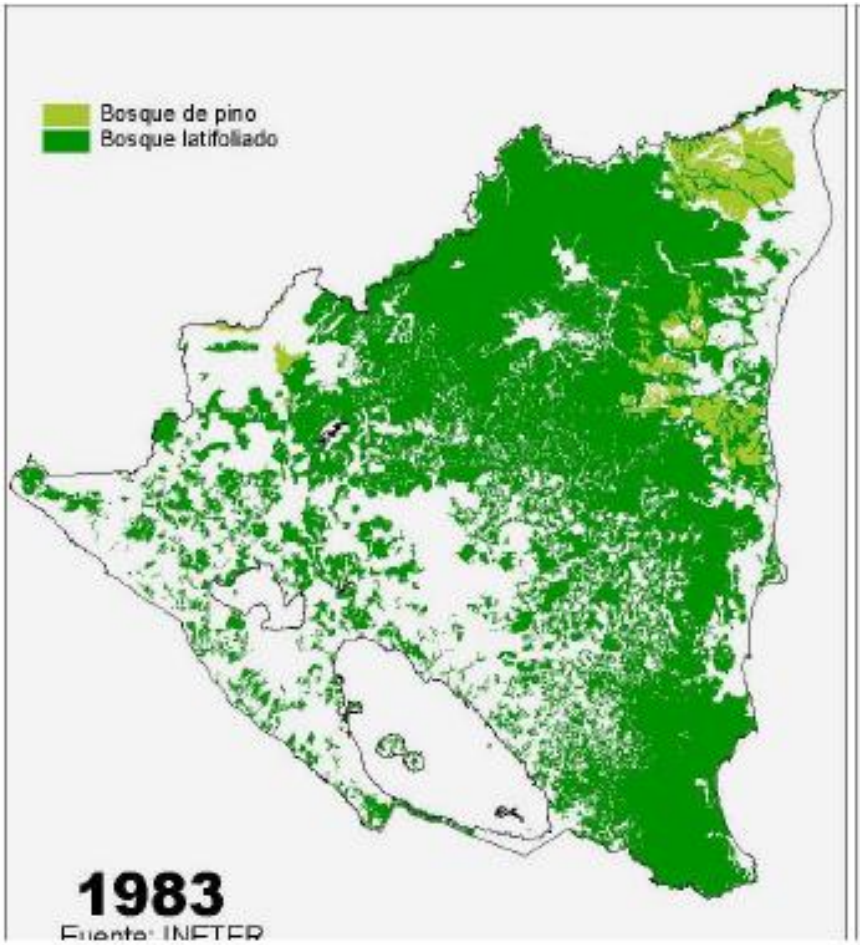
[8] In a few cases, areas of land were distributed to farmers´ families in order to secure the existence of an available labour force near large-scale cotton and sugar-cane plantations.
[9] Jones (1990) talks of a total area of 5 million ha. However, the total area actually affected seems to be lower.

in the agricultural frontier (CIERA, n.d.; Jones, 1990). The latter is indeed part of what has been labelled as the 'Hamburger connection', i.e., the processes which link deforestation in Central American tropical forests and the supply of cheap beef for the US markets in the second half of the XXth Century (Myers, 1981).

One of these projects was, for instance, implemented in the area of Nueva Guinea in connection with the opening of the road to El Rama. It planned to distribute a total of 860,000 ha (Jones, 1990) and its impact was not negligible. Indeed, the population increased by 82% in the region between 1963 and 1974, as compared with a 30% population growth rate for the country as a whole, and the area cultivated with staple foods multiplied by 20 between 1970 and 1981 (Lévêque, 1986). Four other projects were also implemented along the San Juan river in the south-eastern part of Nicaragua, affecting an area of 164,780 ha and resulting in an impressive increase in the number of farms in the regions, from 1,367 farms in 1953 to 2,440 farms in 1978 (CIERA, n.d.).

Although there is little reliable historical data about land use change and deforestation during that period, the limited available data show a consistent trend of increased agricultural land at the expense of forested areas. First, based on data from national agricultural censuses, Baumeister (2009) estimates that agricultural land increased in Nicaragua from 3.78 million ha in 1963 to 5.67 million ha in 1978. Second, this increase could be related to the high deforestation rates registered for similar periods by several authors. Marchetti and Maldidier (1996), for instance, talk of a rate of forest loss of 105,000 Ha/year between 1950 and 1970, and even 192,500 ha/year in the 1970's. Álvarez and García (2004) give different data, but similar in scale, talking of an annual deforestation rate of 56,000 ha/year between 1952 and 1966, and of 224,444 ha/year from 1964 until 1975. Altogether, as shown in Figure 1.5, this implied an important expansion of the agricultural frontier and decrease in land covered by forest in the eastern lowlands at the end of this period.

Figure 1.5: Forest cover in Nicaragua in 1983



Source: Instituto de Estudios Territoriales (taken from Álvarez & García, 2004, p. 19)

The 1980s saw huge political, economic and social changes in Nicaragua with the end of the Somoza dictatorship and its replacement at the head of the state by the Frente Sandinista de Liberación Nacional (FSLN), the revolutionary movement which had fought the Somoza dictatorship during two decades. With respect to agriculture, the Sandinista government implemented a huge agrarian reform at national level, which touched 1,3 million ha that were redistributed to 60,500 farm families (Baumeister, 1999). Merlet (2002) explains that during the 1980s the reformed sector came to represent 20% of all agricultural production at national level. According to Baumeister (1999), this reform was part of a broader agrarian policy that should respond to a national development strategy and was based on the combination of productive 'modernisation', collectivisation of the access to land (within cooperative or state farms) and a strong state control over assets, production organisation, markets, credit, and technical

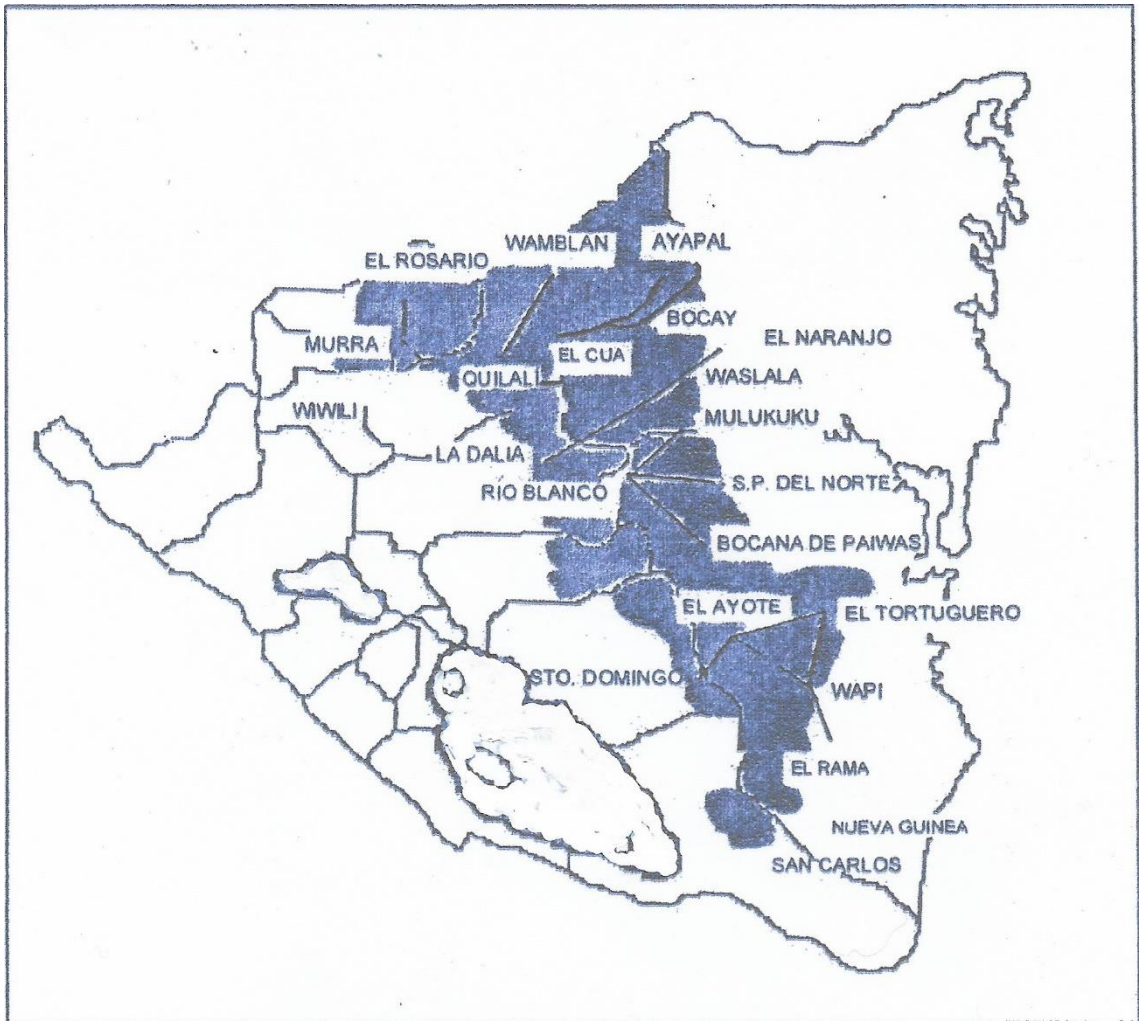
assistance. The aim was to support the development of a strong state controlling the agro-industrial export sector for coffee, cotton, sugar, cooking oil and meat (state control also concerned the agro-industrial plants for coffee, oil, sugar refineries, cotton mills and slaughterhouses, for instance). As a result, in the first years of the Sandinista government the land allocated by the agrarian reform was mainly distributed to state farms (66.7%) and cooperatives (30.9%), while only an anecdotal area was given individually to farmers families (2.4%) (Baumeister, 1999). Nevertheless, these policies were at odds with the way the farmer society had been organising itself, i.e., a society where farmers were quite autonomous in the way they produced and exchanged their products and where land was managed at individual level with little state influence (Johan Bastiaensen, D'Exelle, & Famerée, 2006; Merlet & Merlet, 2010). This created huge discontents within rural populations and farmers became the main supply for the counter-revolutionary armed forces that started fighting fiercely against the Sandinista government with the support of the USA (Marti i Puig, 2001). As explained by Nuñez et al., the counter-revolutionary army was:

> "an army composed of peasants who were fighting against a regime that threatened their mercantile identity and their traditional axiology; a regime that had committed the error of undermining the authority of peasant leaders and of restricting freedom of movement; a regime which, through its military service[10], took away these people's sons, their most precious asset and their main source of work" (Nuñez et al. cited in Marti i Puig, 2001, pp. 34–35).

In order to decrease these tensions, state-controlled policies were softened in the second half of the 1980s. As a result, , the area redistributed to state farms under the agrarian reform decreased (36.3%) during that period while at the same time the area transferred to individual farmers families increased dramatically (20.7%) (Baumeister, 1999).

[10] Refers to the forced conscription of young Nicaraguans imposed by the Sandinista government to maintain its military force.

Figure 1.6: The area of influence of the counter-revolutionary army in the 1980s



Source: adapted from Marti i Puig (2001, p. 33)

With respect to the agricultural frontier, the most important factor that shaped agrarian dynamics was the internal armed conflict, which mainly happened in the central agricultural frontier regions of the country, as shown in Figure 1.6. Indeed, this violent conflict led to the migration of farmer populations out of the affected areas and the corresponding abandonment of their farms, leading to a massive desertion of agricultural land in the agricultural frontier regions and a halt in the advancement of the agricultural frontier towards the east (Maldidier & Marchetti, 1996; Pasos et al., 1994). Supporting this statement, Baumeister (2009) identifies, for instance a clear decrease in the total agricultural area of the country from 8.1 million ha in 1978 to 7.7 million ha in 1988. Other authors also detect an important decrease in the deforestation rate during the Sandinista period, confirming this process of pausing of agricultural frontier

expansion. According to Álvarez and García (2004), for instance, the rate of loss of forested areas fell to 26,100 ha/year in the 1980s (while, as stated above, it rounded 200,000 ha/year in the 1970s). Pujol et al. (1999) give more details about deforestation dynamics during the Sandinista period in their analysis of land-use changes in an agricultural frontier region in south-eastern Nicaragua between 1983 and 1993. First, these authors show that the deforestation that still existed during that period was not concentrated in the pioneer front areas (i.e., the more recent areas of agricultural frontier) but in regions much further west in remaining forested areas (i.e., older agricultural frontier regions). Second, they also identify an important increase in sparse-forested areas, 46.4% of which they attributed to processes of natural regeneration in abandoned pasture areas. Pasos et al. (1994, p. 46) confirm this trend of abandonment of pasture areas at national level showing an important decrease in the area of land covered with pastures in Nicaragua in that period, which fell from 4 million ha in 1983 to 2.7 million in 1991 (accompanied by a decrease in heads of cattle from 2.8 million in 1978 to 1.5 million in 1991). Pujol at al. (1999) claim that these changes were certainly a direct consequence of the armed conflict which was mainly concentrated in regions most recently affected by agricultural frontier dynamics and led to important population displacement (partly voluntary, partly forced) to escape from the battlefields. Stevens et al. (2011) came to a similar conclusion analysing forest cover changes in two sites in Nicaragua and relating them to the intensity of the conflict (which they determined as depending on the flow of refugees leaving or returning to the country and the level of US congressional funding to the contra rebels in Nicaragua). In their findings, these authors highlight that

> " forest regeneration occurred during the time period that the conflict intensified as determined by US Congressional funding and refugee movement" and that "total forest cover was highest when the conflict was most intense and decreased as the number of refugees declined and US funding tapered" (Stevens et al., 2011, pp. 2605–2606).

The Sandinista period ended in 1990 with the electoral defeat of the FSLN, which led to the end of the armed conflict. Peace agreements were accompanied by a new process of agrarian reform with the distribution of 514,500 ha of land, mainly state-owned land and land within the agricultural frontier regions, to 44,100 families of demobilised soldiers from both sides, whether through cooperatives or individually (Baumeister,

1999, p. 20). Moreover, from 1990 onwards, a neo-liberal model was imposed in the country regardless of the type of government in place (right-wing oriented with three Liberal Conservative administrations from 1990 until 2016 and a left-wing oriented one with the FSLN's return to power from 2016 onwards[11]). With respect to the agricultural sector, this model aimed at supporting the development of agro-export products. It consisted of the withdrawal or weakening of the state control and regulations over access to land, credit, technical assistance and agricultural markets (both for agricultural inputs and products)[12] as well as in establishing important subsidies and tax incentives to promote the development of the agribusiness sector (Martí i Puig & Baumeister, 2017; PRONICARAGUA, 2018). Attracting foreign capital to invest in agribusinesses for the export market in Nicaragua has even become one of the pillars of the work implemented by Nicaragua's official investment promotion agency, PRONICARAGUA[13], which was created in 2002 (PRONICARAGUA, 2019). A limited number of private Nicaraguan business groups, often related to bigger international agri-business companies, have been the main winners of the implementation of this neo-liberal model, thanks to the control they had over most of the international trade of the country's main agricultural export products (coffee, tobacco, beef meat, dairy products, peanuts, sugar), often related to the control over important steps in the chain of transformations of such products (e.g., slaughterhouses, milk processing plants, coffee mills and sugar refineries). For instance, working on economic elites in Nicaragua after the Sandinista period, Spalding (2017, p. 173) identifies that, in 2005, 2 companies controlled 90% of the access to the international sugar market; 4 companies controlled 90% of beef exports to the international meat market; 2 companies controlled 60% of the links to the international coffee market and 1 company controlled 40% of Nicaragua's participation in international dairy product markets. With respect to land

[11] Interestingly, the return to power of the Sandinista party did not represent a change with respect to this model and it seems that it even amplified it with the opening of new markets related to the countries participating in the Alianza Bolivariana para los Pueblos de Nuestra América (ALBA). The Sandinista government has, however, implemented specific programs to fight poverty in rural areas, mainly with Venezuelan funding and implemented through para-state and partisan networks (Martí i Puig & Baumeister, 2017).

[12] The space abandoned by the state was partly occupied by an increase in international cooperation projects and programs

[13] www.pronicaragua.gob.ni

distribution, this period led to huge transformations, especially in the land previously affected by agrarian reform processes. Finally, the land that was under state property was privatised, most of it returning to its previous owners while most cooperatives, where land was collectively owned, were parcelled out de facto by their own members becoming individual farms (Baumeister, 1999; Martí i Puig & Baumeister, 2017).

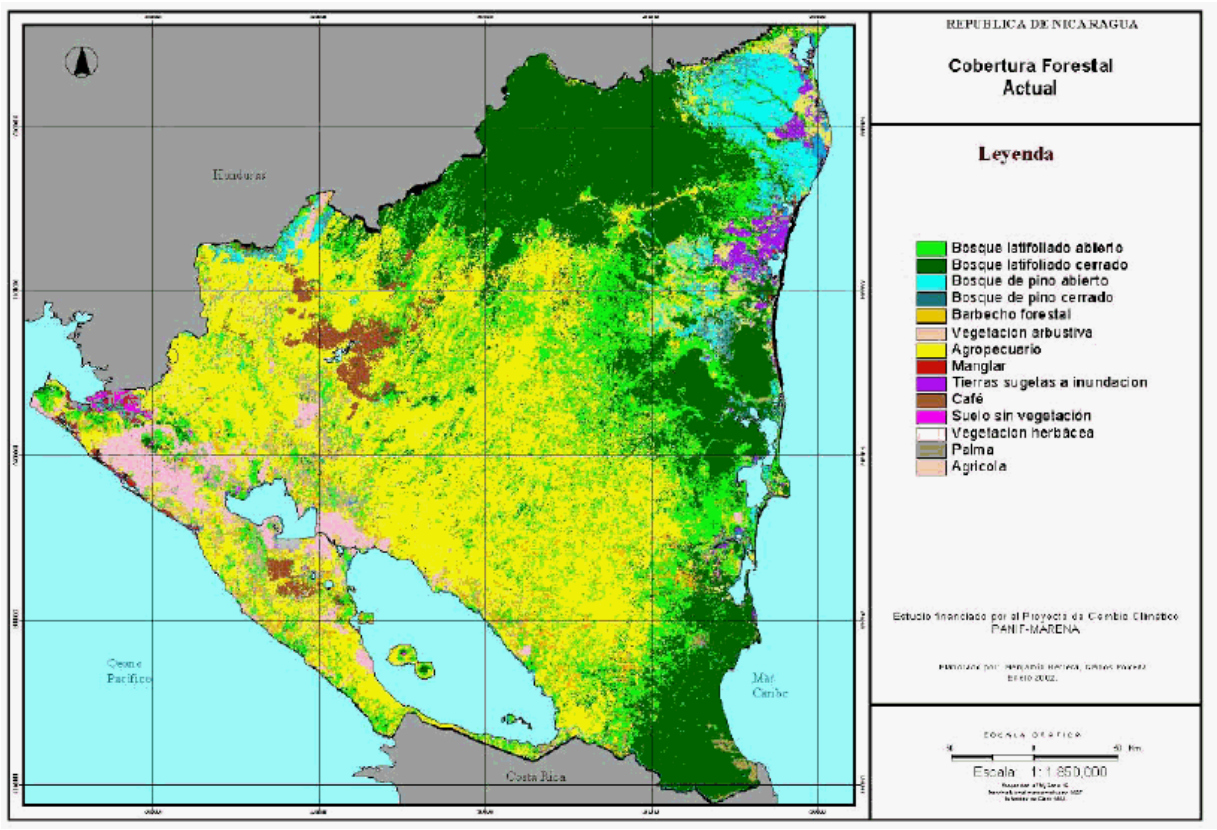
Together with the privatisation and/or individualisation of the land transferred during the agrarian reforms, and the implementation of this neo-liberal policy framework, one of the most important aspects of this period is the re-opening of the agricultural frontier and the resuming of the processes of expansion of agricultural areas, mainly pastures, towards the Caribbean coast at the expenses of forested areas. This expansion of the frontier was crucial at national level at that period. Indeed, as demonstrated by Marin and Pauwels (2001, p. 20), the weight of agricultural frontier regions within the total national agricultural production is very important. Referring to some key agricultural products, these authors estimate that these regions accounted at the beginning of the 2000s for:

- 88% of the national area covered by coffee and 92% of the coffee production at national level
- 76% of the national area covered by maize and 92% of the maize production at national level
- 89% of the national area covered by beans and 87% of the beans production at national level
- 74% of the national cattle herd

With respect to deforestation dynamics, Álvarez and García (2004) estimate that the deforestation rate in Nicaragua reached 130,141 ha/year between 1990 and 2000 (as compared with a rate of 26,100 ha/year during the Sandinista period). From 2000 onwards data from Global Forest Watch reveals that Nicaragua has lost 1.4 million ha of tree cover between 2001 and 2018, corresponding to a deforestation rate of around 77,800 ha/year (Global Forest Watch, 2019). Altogether, as shown in Figure 1.7 and Figure 1.8, the decrease in forested areas in the eastern lowlands has been continuous and dramatic and nowadays remaining forested areas only cover a very small part of the country. In addition, the 2015 official land use map of Nicaragua, reproduced in Figure

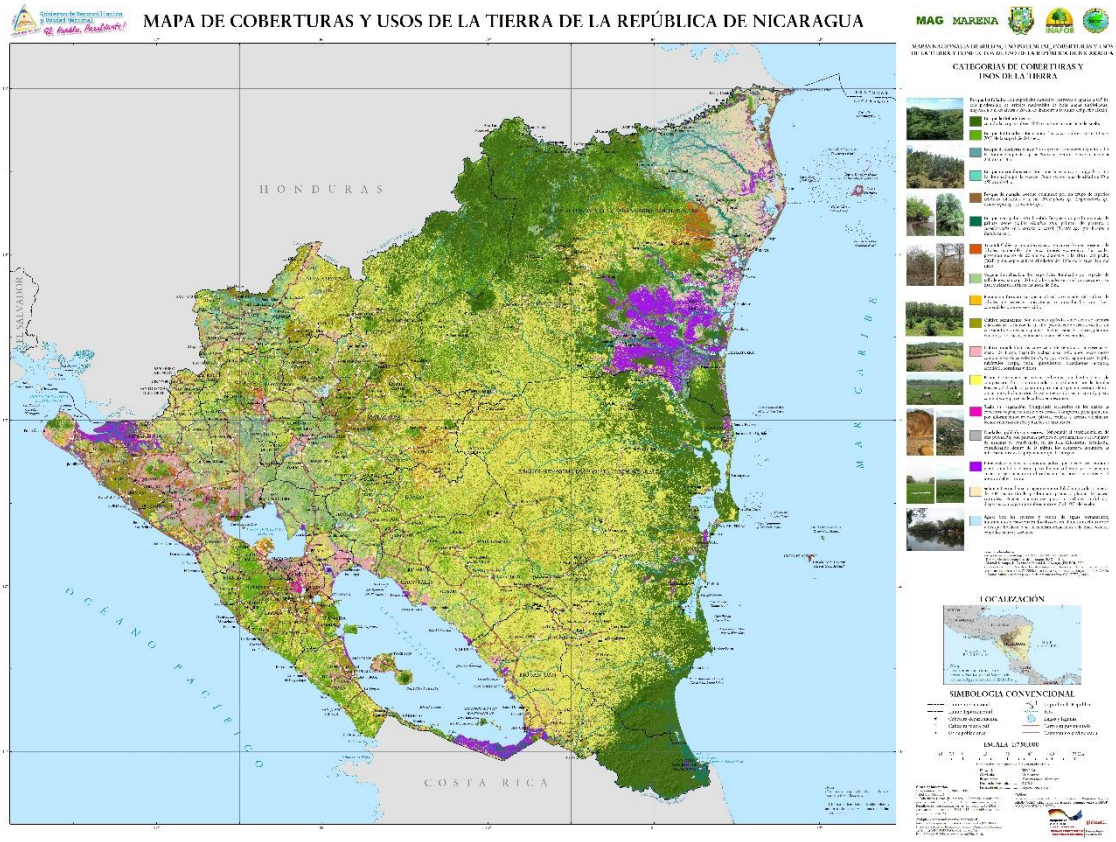
1.8, shows that most land previously covered by forests in the eastern lowlands has actually been transformed into pastures.

Figure 1.7: Forest cover in Nicaragua in 2000



Note: forest area in dark and light green
Source: Ministry of environment and natural resources (MARENA)

Figure 1.8: Land use map of Nicaragua in 2015



Note: forest area in dark and light green, pastures in yellow

Source: Ministry of environment and natural resources (MARENA) and Ministry of Agriculture (MAG), National Forest Institute (INAFOR), National Institute of territorial studies (INETER), National Agrarian University (UNA)

Livestock expansion related to the above-mentioned increase in pasture areas seems to be one of the most important elements with respect to agrarian dynamics during that period. For instance, the important increase in the agricultural area, in large part related to the re-introduction of areas that were abandoned in the centre of the country during the armed conflict, from 5.39 million ha in 1988 to 6.23 million ha in 2001 identified by Baumeister (2009) has to be directly related to this increase in area dedicated to livestock production. For instance, when looking at data about pasture areas in the country, it appears that pastures have increased by 0.3 million ha between 1991 and 2001[14]. In order to have an idea of the growth of livestock production in Nicaragua between 2001 and 2011 we can compare the results of the third and fourth National

[14]Pasos et al. (1994, p. 46) estimate pasture areas in Nicaragua in 2.7 million ha while the III National Agricultural Census shows that almost 3 million ha were covered by pasture in 2001 (INEC, 2001).

Agricultural Censuses, respectively, from 2001 and 2011 (see Table 1.1). However, it must be said that 2011 data need to be handled with care because, as explained by Baumeister (2015, p. 83), the census has failed to cover important areas of the country, thus certainly giving an underestimation of the changes that actually happened on the ground. Despite the shortcomings of the 2011 census data, Table 1 shows a clear upward trend with respect to livestock production in the country. As shown in Figure 1.9, this trend is confirmed by statistics from the Nicaraguan Central Bank for livestock-related products taken from 1994 to 2014.

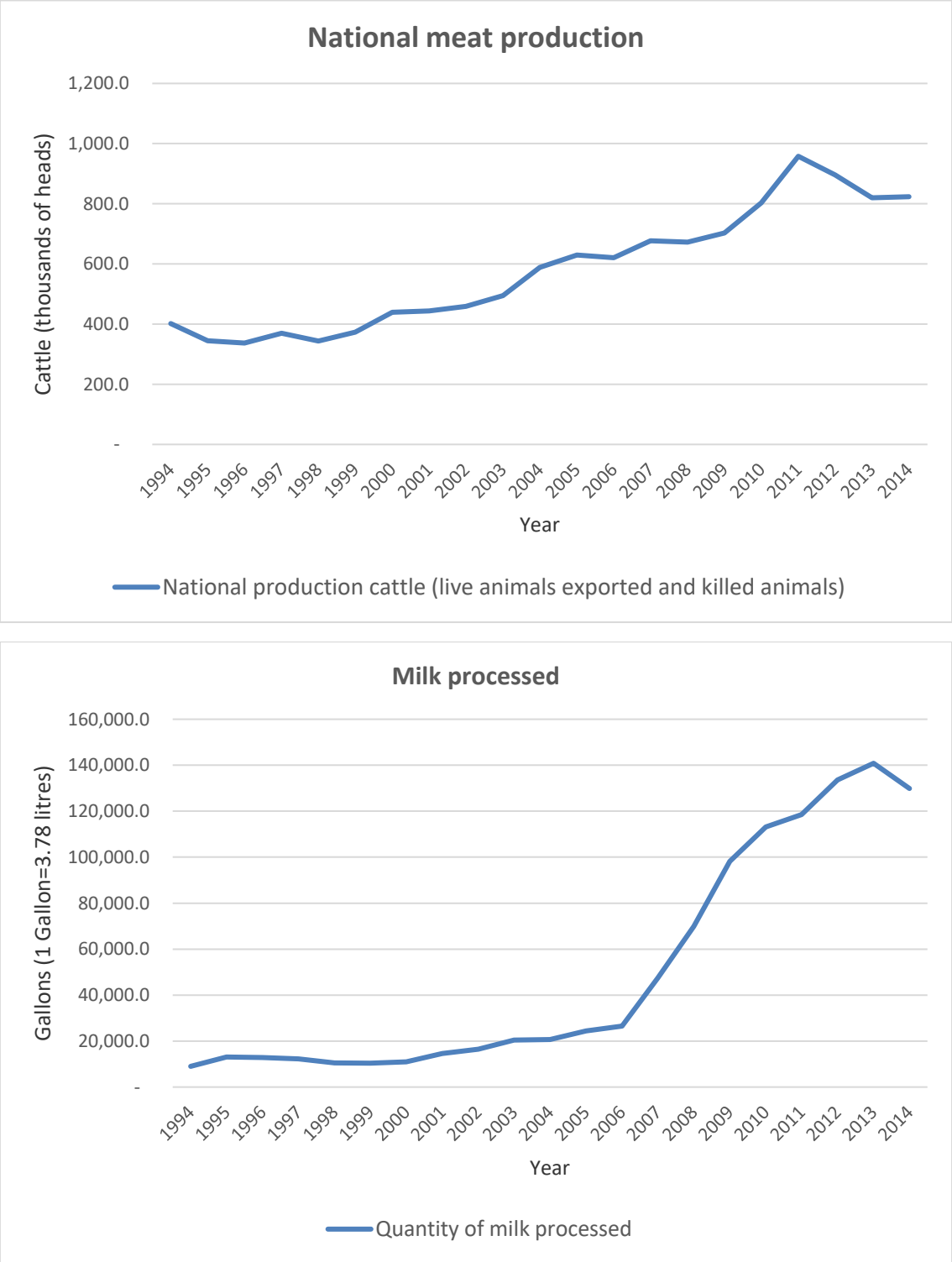
Table 1.1: Comparison between III and IV National Agricultural Censuses

	2001	**2011**	**Variation**
Agricultural area (Total, millions ha)	6.23	6.02	**- 0.21**[15]
Farms (Total)	206,631	268,527	**+ 61,896**
Pasture area (natural + seeded, in million ha)	2.98	3.25	**+ 0,27**
Number of farms with cattle	96,994	136,687	**+ 39,693**
Heads of cattle (Total, in million heads)	2.66	4.14	**+ 1.48**

Source: INEC (INEC, 2001), INIDE and MAGFOR (2011)

[15] This decrease in total area is very unlikely and must be related with the gaps in the IV census that have been explained above.

Figure 1.9: National production of meat and dairy products from 1994 to 2014



Source: Nicaraguan Central Bank[16]

This trend of livestock production growth related to the expansion of the agricultural frontier towards the east has been accompanied by a state effort to connect these

[16] www.bcn.gob.ni

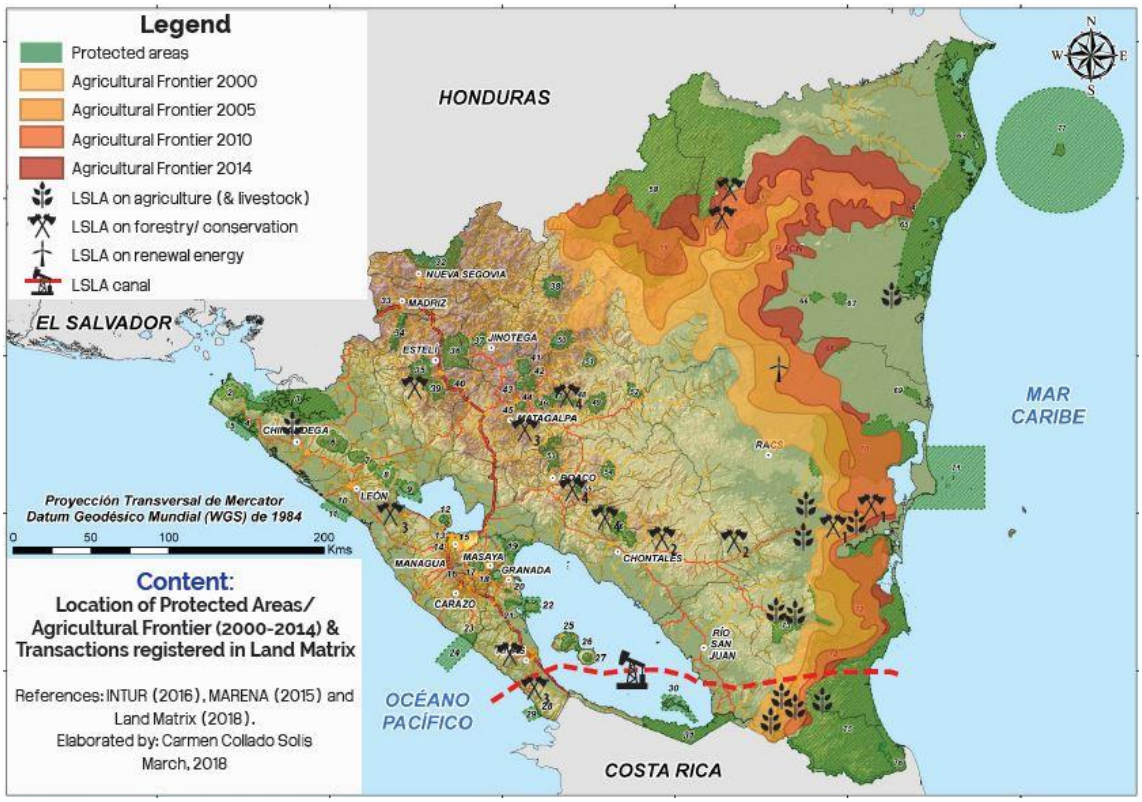
regions to the rest of the country and economy through important investments in roads and electrical networks, which are crucial for facilitating access to markets and preserving dairy products. Baumeister (2017, p. 12), for instance, demonstrates that between 2006 and 2014 the Nicaraguan road networks expanded by 4,500 km, of which 95.5% concerned roads located in the eastern lowland regions of the country. At the same time, this author states that between 2001 and 2015 access to electricity increased from 40% of rural households to 69.5%. Altogether, this seems to confirm a crucial process in Nicaraguan agrarian dynamics since the 1990s in the agricultural frontier based on the replacement of forest by cattle. Nowadays, Piccioni and Barea (2015, p. 22) estimate that 25% of total land and 60% of agricultural land in Nicaragua is used for extensive livestock production, the *Hamburger connection* identified by Myers (1981) seems to be continuing in Nicaragua but it has now taken the appearance of a *Hamburger-milk connection*.

In recent years two important new elements must be related to the dynamics of expansion of the Nicaraguan agricultural frontier in the most eastern region of the country. The first one is related to the fact that, in addition to the historical processes described above of expansion of agricultural areas in the eastern lowlands, mainly for cattle production, new actors are being involved in land use change dynamics in these areas. In line with the ongoing Nicaraguan policies to attract international investors in agribusinesses, most recent agricultural frontier regions have become a privileged location for large-scale land acquisitions by international investors (often in partnership with national investors) for agricultural production (e.g. palm-oil plantations, Robusta coffee plantations, cacao plantations), hydro-energy projects, timber plantations or forest conservation projects (see in Figure 1.10 the location of large-scale land acquisitions identified by the Land Matrix initiative[17] in Nicaragua as of 2018). The second new element is related to the increased level of tensions that the expansion of the agricultural frontier has been causing in indigenous territories existing in the Caribbean coast region. Indeed, while in the past the expansion of the agricultural frontier happened in less densely populated areas, in recent years it has reached areas

[17] www.landmatrix-lac.org

where most consolidated groups of indigenous population live, make use of natural resources (especially forests), and have legally recognised property rights[18]. Disputes over land are therefore becoming more and more frequent between historical indigenous land-holders and incoming non-indigenous farmers, leading often to violent conflict and an exodus of indigenous populations dispossessed of their land and forests (Bataillon, 2016; Salinas Maldonado, 2014).

Figure 1.10: Location of large-scale land acquisitions identified by the Land Matrix initiative at as of 2018



Note: The area labelled here as agricultural frontier refers to the pioneer front, i.e., the most advanced area of the frontier, or the border with tropical forests
Source: Collado Solís (2019, p. 178)

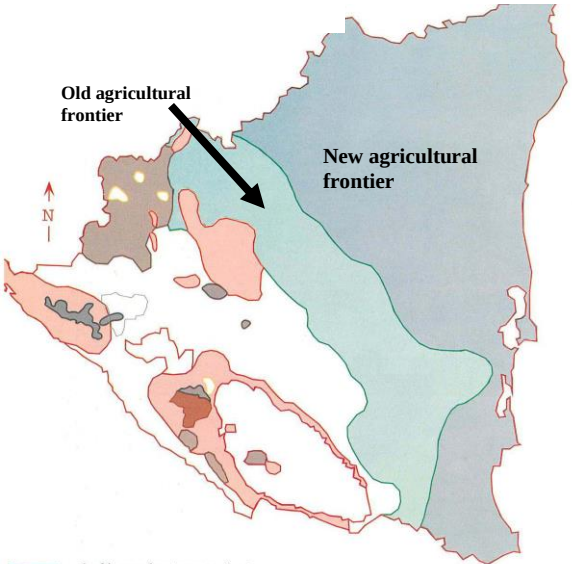
Altogether, it can be said that agricultural frontier dynamics have been an important element in the shaping of Nicaraguan agrarian history. Nowadays the pioneer front has almost reached the Caribbean coast of the country and the expansion of agricultural

[18] Article 5,89,107 and 180 of the Nicaragua Constitution; Law 28 on the ´ Autonomy Statute of the Caribbean Coast regions of Nicaragua'; and, Law 445 'Law on the communal property regime of the indigenous peoples and ethnic communities of the autonomous regions of the Atlantic Coast of Nicaragua and the Bocay, Coco, Indio and Maiz rivers´.

areas is encroaching indigenous territories and the last remaining areas of forest, which are classified as nature reserves.

This dissertation does not deal directly with processes happening in this pioneer front but with dynamics of older agricultural frontier regions where the appropriation process of forested areas and their transformation into agricultural land started decades ago. In the mid-1990s, Maldidier and Marchetti (1996), for instance, made a difference between old and new agricultural frontier, depending on the moment when this initial settlement process was happening, the old agricultural frontier corresponding, for instance, to areas settled before the 1980s (see Figure 1.11). Nowadays, due to the expansion of the frontier, the old agricultural frontier would include also areas settled in the 1990s and early 2000s. There is, however, still a direct link between dynamics in these older agricultural frontier areas and current processes happening in the pioneer front. Poor small-scale farmers are indeed 'pushed' to participate in a two-step migration process in which they first move to unoccupied forested areas to convert land into pasture and then sell it to wealthier livestock ranchers, thus giving rise to a concentration of land into the hands of better-off cattle ranchers in the old agricultural frontier (Maldidier, 2004; Nygren, 2000). The smaller farmers are then pushed and pulled further inside the agricultural frontier, fostering deforestation in the new agricultural frontier as a means of asserting property rights over cleared land, after which the cycle reinitiates. It is this strong linkage between dynamics within the old agricultural frontier and the new pioneer front that justifies the need to analyse the former if we want a better understanding of the dynamics of expansion of the agricultural frontier as a whole.

Figure 1.11:Old and new agricultural frontier regions in Nicaragua in the mid-1990s



Source: adapted from Maldidier and Marchetti (1996, p. 40)

2.2. Farming in the Nicaraguan agricultural frontier as one element of the current corporate food regime and global environmental crisis

Farming in one specific place and at one specific moment does not happen in a vacuum; it is embedded within a broader historical and geographical context and Nicaragua's agricultural frontier dynamics need therefore to be located within this broader context. The current global context in which farming is embedded is characterised by:

- the expansion of neo-liberal capitalism and globalisation (increased financialisation of economic and social activities, ongoing commodification processes and expansion of world markets to exchange those commodities, retreat of the state from its role to organise and regulate its economy and society, expansion of world markets, concentration of power and resources within some multinational entrepreneurial groups, increased influence of financial actors and speculation processes)
- global demographic trends (demographic growth globally, differentiated pace of demographic transitions, urbanisation, increased national and international migrations)
- global ecological crises related to climate change dynamics, pollution, biodiversity loss and more broadly natural ecosystems' degradation

Within this broad setting, farming, as a crucial element of food production, is intrinsically part of what has been characterised by McMichael (2009) as an (emerging) 'corporate food regime', which is, compared with past food regimes, is more and more market-based, globalised, standardised and set up to differentiate food-quality features depending on consumers' socio-economic profile, mainly their purchasing power and willingness to pay. I add to these features the increasing demand for agriculture to cover other functions than only its traditional role in providing food, feed or fibre products. This broadened demand implies that the agricultural sector has to produce new outputs, such as bio- and agro-fuels for the world market as demonstrated by the rise of flex-crops worldwide (Borras, Franco, Isakson, Levidow, & Vervest, 2016). This also relates to the increasing awareness that agriculture is multifunctional and participates in the provision of "a range of public and private goods and services for citizens and the environment, including ecosystem functions" (IAASTD, 2009, p. 23) with a tendency towards the commoditisation of some of these goods, as shown by the emergence of ecosystem service markets, for instance (Engel, Pagiola, & Wunder, 2008).

Mc Michael (2008:151) argues that "the trajectory of this so-called 'corporate food regime' is such that it poses a fundamental threat to the survival of a substantial proportion of the inhabitants of the planet (especially those who do not participate in the global marketplace), and to the ecology of the planet". As such the emergence of this corporate food regime is therefore one of the components of the multidimensional crisis our world is facing. With respect to environmental issues, dynamics in the tropical agricultural frontier turn out to be a crucial dimension of this crisis. As demonstrated by Hansen et al. (2013) in a study based on the analysis of satellite data from 2000 to 2012, most forest losses worldwide are happening in tropical rain and dry forests. According to these authors, 2.3 million km2 of forest were lost during this period, 48%[19] of which were located in tropical regions (32% corresponding to tropical rain forest and the rest to tropical dry forests). Moreover, looking at the global scale, while agricultural frontiers have existed in many agro-ecological contexts, as in the Cerrado Savannah in Southern America nowadays or in the great plains in the US in the past, for example, forested

[19] Calculated from the data available in the supplementary material of the Hansen et al. paper (Hansen et al., 2013).

areas, and particularly tropical forests, are often considered as the last frontiers for agricultural expansion (Bryant, Nielsen, & Tangley, 1997). This implies a possible logical link between tropical deforestation rates and the expansion of agricultural areas. Causes of deforestation in tropical regions have indeed been analysed by Geist and Lambin (2002) at the global level. In their work, these authors identify both deforestation's proximate causes (such as timber extraction, infrastructural expansion -e.g., roads- and the transformation of forest into agricultural land) and more general underlying driving forces (such as population growth, consumption patterns and food requirements). They conclude that tropical deforestation is the result of multiple causal factors working and interacting differently depending on specific contexts. However, they also stress that "agricultural expansion is, by far, the leading land-use change associated with nearly all deforestation cases (96%)" (Geist & Lambin, 2002, p. 145). Moreover, they identify that pasture creation is the major process accompanying deforestation in tropical Latin American lowland forests such as in Nicaragua (see above). There is little doubt that tropical deforestation for livestock expansion is one of the key issues related to the current global environmental crisis because of its consequences in terms of exhaustion of water resources, soil degradation, increased greenhouse gas emission and destruction of critical biodiversity (Bryant et al., 1997; Steinfeld et al., 2009). For instance, in the case of Nicaragua, Piccioni and Barea (2015) state that one of the main causes of biodiversity loss is the change in ecosystems related to deforestation process. They also indicate that 79.9% of greenhouse gas emissions in Nicaragua come from land use change related to deforestation while 5.5% extra emissions are due to livestock production (enteric fermentation and manure management). Therefore, analysing and better understanding the dynamics of land use change in agricultural forest frontiers in tropical areas, especially related to pasture expansion in Nicaragua, and more broadly in Latin America, becomes a crucial issue within the scope of the current global environmental crisis.

In addition to these environmental considerations, the current food regime has also dramatically changed the pattern of agricultural production, resulting in the shaping of an agriculture sector globally characterised by: i) more disconnection between agricultural practices and biophysical cycles (i.e., increased use of chemical inputs, oil

dependency, mechanisation and industrial practices); ii) a growing market dependency; iii) a specialisation process; and iv) an increased entrepreneurship rationality in farmers' decision-making process (McMichael, 2009). As such, the emergence of this global food regime in the last decades has led to the setting up of an unlevel playing field that has favoured the development of capitalist and entrepreneurial ways of farming related to the establishment of production systems which get closer to specialised and industrialised systems than diversified agro-ecological family or indigenous farming. One emblematic example of the consequences of this situation has been the so-called global land grabbing process, i.e., large-scale transfers of property rights associated with growing global markets around the provision of food -but also agro-fuels and other natural resources or 'environmental services'- and the establishment of large-scale industrial specialised farming systems (Borras, Hall, Scoones, White, & Wolford, 2011; Deininger et al., 2011; Fairhead, Leach, & Scoones, 2012). The brief review of the role of the agricultural frontier in Nicaraguan history presented above demonstrates that the agrarian dynamics in that region follow several features of this cooperate food regime with, for instance, a trend of specialisation towards livestock production, a high level of insertion within international markets, a serious negative environmental impact and new processes of large-scale land acquisitions by capitalist investors. But, as argued by the international panel of experts on sustainable food system (IPES-Food, 2016), the result of the implementation of farming systems geared towards industrialisation and specialisation can be disastrous. In its report, the IPES-Food (2016, pp. 15–29) provides a long list of negative outcomes of industrial agriculture within different dimensions:

- Productivity: the panel of experts highlights the fact that, while industrial farming was responsible in the past for great production increases, the reality we witness nowadays is that of stagnation or even decrease in the yields of several crops (maize, wheat, soybean, rice) in some regions of the world. The panel also identifies the emergence of plant resistance to pesticides/herbicides as a threat to productivity.
- Environment: the experts identify as negative outcomes land degradation, soil erosion and runoff, greenhouse gas emissions due to large-scale deforestation and expansion of livestock production, water contamination due to excessive use

of chemicals and nutrients, excessive use of water, erosion of genetic resources, negative impact of wildlife such as loss of pollinators.

- Socio-economy: the experts underscore that, in general, industrial farming goes hand-in-hand with low agricultural income (due to high production costs and low product prices), low on-farm employment rates, bad employment conditions, fierce competition over the use of natural resources (related to natural resources grabs and displacement of populations), and loss of traditional knowledge.
- Nutrition and health: the IPES-Food highlights negative outcomes in terms of loss of dietary diversity as well as the high exposure to agrochemicals which can be responsible for several diseases, development and reproduction issues, and the development of resistance to antibiotics due to their high use within animal production.

Altogether, this broad context has been redefining the debates around the evolution of agrarian structures and their relation to the pathways of development. In particular, the discussion related to identifying and supporting the type of agricultural production systems that could better trigger socially and environmentally sustainable development (with a specific focus on a continuum that places small-scale family-based diversified farming at one end and large-scale specialised industrial capitalist farming at the other end) is still not resolved and remains an important point of attention for scholars, policy-makers and activists worldwide (Altieri, 2008; Deininger et al., 2011; Hebinck, 2018; IAASTD, 2009.; IPES-Food, 2016; Perfecto, Vandermeer, & Wright, 2009; van der Ploeg, 2009; WB, 2008). In my view, these considerations about the relationship between agriculture and development resonate with the broader debates around the evolution of the role of agriculture and farmers in society and economy, which can be traced back to the broad theoretical debate around the Agrarian Question that initiated in the late XIXth Century and which I will briefly introduce in the following section.

3. THE ECOLOGICAL AGRARIAN QUESTION, FROM A POLITICAL ECONOMY OF AGRICULTURE TOWARDS A POLITICAL ECOLOGY OF AGRICULTURE

3.1. THE CLASSIC AGRARIAN QUESTION: OR 'ARE WE FACING THE END OF THE PEASANTRY?'

The Agrarian Question finds its origins at the end of the XIXth Century within the work of Marxists interested in the processes of change of (and within) the peasantry in the context of the emergence of capitalism in Europe and Russia (e.g., Kautksy (1988) and Lenin (1982)). For these scholars, the Agrarian Question relates to "the continuing existence in the countryside of a poor country of substantive obstacles to the unleashing of the forces capable of generating economic development, both inside and outside agriculture" (Byres, 1991, p. 9). Originally, within Marxist thought, this meant that resolving the Agrarian Question implied overcoming a certain level of "economic backwardness" (ibid. 1991a, p. 9) through the implementation of a complete transition towards capitalism, which, in the countryside, would need the disappearance of pre-capitalist forms of peasantries[20]. In their historical survey of the past and current debates around the Agrarian Question, Akram-Lodhi and Kay (2010a, 2010b) explain that the most common perspective on Marx's ideas on this issue is that, as the peasantry is a remnant of pre-capitalism, its maintenance represents an impediment for the complete establishment of capitalism. In this perspective, the emergence of the proletariat, which is the necessary condition for the transition towards capitalism (but ultimately also for transcending capitalism), would mainly be achieved through dispossessing the peasantry from its means of production (mainly the land) and freeing the peasantry to sell its labour power. Altogether this would allow the unleashing of the ongoing processes of exploitation, surplus grabbing and capital accumulation which characterise the rapid expansion of the forces of production under capitalism. At first sight, a historically progressive solution to the Agrarian Question would concretely mean

[20] Here the term Peasant has to be understood in its Marxist meaning, i.e., a class of agricultural producers who possess and employ both their labour and their own means of production , including land and capital (as opposed to classes of wage-labourers, landlords or capitalists) (Byres, 1991b).

achieving the disappearance of the peasantry and its transformation into a class of rural waged labour.

Nevertheless, Akram-Lodhi and Kay (2010a) warn the reader about adopting a too simplistic interpretation of Marx's thinking and they stress that Marx indeed wrote that "there could be multiple and differential ways by which a set of capitalist social relations of production could be established or consolidated in agriculture […] while peasants may be dispossessed as capitalism develops, capital can also subsume peasant labour through hybrid forms that consolidate the peasantry" (Akram-Lodhi & Kay, 2010a, p. 182). The dynamics of change of the peasantry related to the process of establishing capitalism are therefore not pre-defined and there is not a unique path-dependant and linear way for the peasantry to evolve. This has been clearly demonstrated in the work of Byres who identifies differentiated country-based paths of capitalist agrarian transitions (Bernstein, 1997; Byres, 2009). Consequently, this means that the core conceptual condition within Marxist thought stating that the disappearance of pre-capitalist forms of peasantries is necessary for achieving the complete development of capitalism can actually be translated in very different ways in different historical and geographical concrete situations. The main issue is therefore not whether the Agrarian Question is solved or not, but *the way it is being solved*. I mean here that what is at stake when studying issues related to the Agrarian Question is engaging thoroughly with the way the development of capitalism has shaped the transformation of the peasantries in order to better assess "the place of farming and agriculture in emergent and mature capitalist societies" (Akram-Lodhi & Kay, 2010a, p. 179). Very broadly, this is related to processes of capital accumulation within agriculture and how these processes influence the differentiation of the peasantry, the distribution of labour in society and the political positioning of the peasantry vis-a-vis other social groups.

In this vein, Byres (1991a) and Akram Lodhi and Kay (2010a) identify three main strands in the analysis of the Agrarian Question at the end of the XIXth and beginning of the XXth centuries that can be considered as different possible formulations of the classic Agrarian Question. The first one, in line with Engels' work, mainly looks at the political dimension related to the establishment of capitalism in the countryside, i.e., to what extent rural politics change, and specially how political struggles between different

strata of peasants and other classes evolve. The second one, following Preobrazhensky, is related to the process of primitive socialist accumulation in the Soviet Union at the beginning of the XXth Century. Here the concern relies more on how to unleash the capacity of agriculture to generate the necessary surplus for the establishment of the socialist development project in the Soviet Union. The last one focuses on the processes of change in the rural social structure and agricultural production processes due to the development of capitalism. This implies issues of specialisation and social differentiation of the peasantry but also questions related to the development of wage labour within the countryside, the emergence of processes of indebtedness for the peasantry and the commoditisation of agricultural production and its increased incorporation within market relations. The works of Lenin and Chayanov on the processes of social differentiation of the peasantry in Russia in the same historical period of the late XIXth Century are examples of this strand. Interestingly, however, their interpretation of the same reality is quite different. On the one hand, Lenin (1982) argues that the establishment of capitalism in the countryside will lead to a differentiation of the peasantry that is polarising and permanent and which would result fatally in the disappearance of the peasantry as a social class. For Lenin, while some few peasants would be able to enter in a capital accumulation process and give birth to a new class of rural capitalists, the majority of peasants would finish by being separated from their land and become part of the rural proletariat class (i.e., they would be obliged to sell their labour to agrarian or industrial capital). On the other hand, Chayanov, even if he also recognised the class differentiation in Russian rural society, did not believe that the fate of the peasant class was to disappear (Thorner, 1988). On the contrary, he argued that the peasant society had specific features (e.g., self-exploitation of family labour, no wages paid, different rationale than capitalist investors), i.e., a type of moral economy that would allow peasants to survive, even if that meant surviving through impoverishment and drudgery. As a result, Chayanov saw the differentiation of the peasant class as a demographic and cyclical process. He believed in the specificity of the peasantry, even in a context of expanding capitalist relations, as well as in its capacity to survive. Legacies from these original formulations of the agrarian questions can be identified in the way processes of agrarian change have been analysed and conceptualised in the following century. This shows to what extent these issues remain

relevant in today´s debates around the future of agriculture worldwide. For instance, Scholars such as Bernstein (2009,2010a) or Byres (2009) clearly adopt a Marxist class-based approach more in line with Lenin's work. On the other hand, the work of Scott (1976) or Shanin (2009) as well as the political positioning of some peasant movements such as 'La via campesina' (Edelman, 2005) can be linked with Chayanov's approach.

3.2. THE AGRARIAN QUESTIONS OF TODAY

More than one century after the Agrarian Question was first introduced, it is a fact that, despite having suffered huge transformations, peasants have not disappeared. Even if more specialised, more linked with markets and more dependent on wage labour, agricultural production worldwide is still largely in the hands of families that own part of their means of production and their labour and are dependent on social relations more in line with elements of moral economy (e.g., importance of cooperation processes at community level, preference towards risk aversion and security). Putting it a different way: not all peasants have become wage labourers, nor can all remaining units of agricultural production in the countryside be considered as capitalistic farms geared towards a rationale of capital expansion. Thus, while a capitalist market economy has become the predominant global model in which peasants are embedded worldwide, the peasantries all over the world, in their huge diversity, have adapted and proven to be very resilient. This demonstrates that the preoccupation related to the relation between agriculture and the development of capitalism that cemented together the initial formulation of the Agrarian Question remains crucial. And, although the term or concept Agrarian Question is often not explicitly brought in (or only anecdotally), analysis of rural and agrarian change still largely focuses on unravelling the core characteristics of today's peasantries, their ongoing processes of change and transformations and to what extent they relate to each other and to the rest of society and the economy (Bernstein, 2010; Bryceson, 2000; Byerlee, De Janvry, 2007; Byres, 2004; Deininger et al., 2011; Hervieu & Purseigle, 2013; Mazoyer & Roudart, 1997; Popkin, 1979; Sourisseau, 2015; Van der Ploeg, 2009; Woodhouse, 2010). Also, within the realm of agrarian political economy, where the assessment of agrarian change and rural transformation processes are explicitly formulated under the common umbrella of the Agrarian Question, it appears that the content of the debates has evolved, and

scholars differentiate now between several dimensions of the classic Agrarian Question. Bernstein (2010), for instance, argues that the current context of globalisation and neo-liberalisation has revealed "a far wider range of interests and agents than those encompassed by the classic Agrarian Question –that of transitions to capitalism- with its focus on classes of landed property, capital and labour in the countryside" (ibid, 2010:301). In the same line Akram-Lodhi and Kay (2010a, 2010b) identify different competing approaches to analyse processes of agrarian change in the current context which represent "competing approaches to framing the contemporary agrarian questions and their salience for rural development" (ibid. 2010b:264). According to these authors, these approaches maintain as a common denominator the critical assessment of the relations and transformations of capital and rural-labour in capitalist countries but they diverge in several dimensions, as for instance: i) the scale of analysis (world, local or national); ii) the unit of analysis (differentiation of the peasantries, rural politics, processes of emergence of wage labour); or, iii) their approach to the predictability of agrarian transition processes (path dependency vs. uncertain and context specific). Akram Lodhi and Kay also identify "*two 'missing links' that should be there but which are largely absent from the debate"* in gender and ecology (Akram-Lodhi & Kay, 2010b, p. 268). As such, they argue that the 'gendered Agrarian Question' and the 'ecological Agrarian Question' are not sufficiently adopted in the debates around agrarian change. The ecological agrarian question is of particular importance in the context of the Nicaraguan agricultural frontier, i.e., a relatively young agricultural landscape where the emergence and development of agricultural production are intrinsically related with:

- the setting up of human settlements in formerly little-populated forested areas
- the development of new social relations mainly based on agricultural production relations within those settlements and with the rest of the country
- an important market integration at national and international levels and
- drastic ecological transformations based on land use changes related to agricultural production

In this specific context, the ecological dimension of agrarian change processes is of particular importance. The essence of the frontier is to be a place where nature is

transformed from forest to agricultural land, i.e., a landscape in which ecological conditions change rapidly and drastically resulting from continuous and complex interactions among a myriad of inter-related elements (e.g., social structure, market relations, production techniques, knowledge, power relations, individual and collective motivations, world views, history, and culture) (Bastiaensen, Merlet, & Flores, 2015).

3.3. THE ECOLOGICAL AGRARIAN QUESTION: SOCIAL METABOLISM AND THE BIOPHYSICAL CONTRADICTIONS OF CAPITALISM

The ecological agrarian question recognises the importance of biophysical ecology in the agrarian change processes. It draws especially on the idea that "rural production process, agrarian accumulation and rural politics have ecological dynamics" (Akram-Lodhi & Kay, 2010b, p. 269). Adding ecology to the classic formulations of the agrarian question implies that "the agrarian question must critically investigate the character of ecological relationships and the ways in which they impinge upon and alter the resolution or otherwise of the agrarian question" (ibid 2010b, p. 269). In this vein, Bernstein (2010) argues that the challenges posed by political ecology must be incorporated into the study of agrarian change in the current context. Moreover, he specifies that these challenges are mainly related to the biophysical and environmental costs of the development of industrial capitalist agriculture worldwide.

While the actual weight of ecological issues within Marx's work remains an unsettled debate in the literature, Bernstein's claim is in accordance with the way natural resources are approached within Marxian Economics, especially the recognition of an ongoing and increased disconnection between ecological conditions and the agricultural production processes characterised by the development of capitalism (Burkett & Foster, 2006; Burkett, 2006; Foster, 2011; Martinez-Alier, 2011). Indeed, despite the fact that Marxian Economics sees labour as the main source of value and consequently considers labour-value to be the main focus of analysis (Gómez-Baggethun, de Groot, Lomas, & Montes, 2010; Hubacek & van den Bergh, 2006), there seems to exist a relation between nature appropriation and value creation, especially surplus-value as explained below:

> "Marx often refers to the natural conditions of production as 'gifts' of nature. These gifts are freely appropriated by capital whenever they provide conditions enabling the extraction of surplus labour from workers and its objectification in vendible use-values, without adding to the wage labour needed to produce

> commodities. Nature's gifts can serve as free gifts for capital, in other words, because even though they are not products of wage-labour, they still provide use-values that capital needs to produce and realise surplus-value. […] Marx argues that such gifts 'create use-value without contributing to the formation of exchange-value'. He sees the free appropriation of nature's gifts as a key factor in capitalist development, but in a way that recognises the essential role of capitalist production relations. For Marx, capitalism's conversion of nature's gifts into conditions of surplus-value production is enabled by the 'freeing' of labour power from the land and other necessary conditions of production" (Burkett, 2006, p. 36).

At the core of this link between nature and value is Marx's concept of social metabolism, i.e., the fact that there are numerous flows of matter and energy between society and nature. It is through the use of this concept that Marx identifies issues of soil depletion due to agricultural production, a problem that would be characterised later as a 'metabolic rift' (Clark & Foster, 2009; Foster, 2011). Concretely, the metabolic rift corresponds to the process of soil impoverishment resulting from the fact that agriculture extracts nutrients from the soil without an adequate return of the same quantity of materials. As a result, the biophysical nutrient cycles are disrupted, leading to what Moore calls a 'biophysical impasse' (Moore, 2010). Weis (2007; 2010) arrives at the same type of conclusion when he tries to understand the impact of the global food economy on the environment. He illustrates the 'biophysical contradictions' of the current global food system in terms of ecological footprint[21], loss of biodiversity, pollution and toxicity and therefore underscores the ecological irrationality of the current system. Altogether this brings into the debates the issue of agricultural production's efficiency and sustainability not only in terms of economic results but also in its ecological dimensions. Drawing on these insights, Woodhouse (2010) and Weis (2010) propose to challenge the conventional conception of productivity (i.e. ratio of agricultural outputs with respect to specific inputs) as the sole concept to assess the efficiency of an agricultural mode of production. Both authors argue for the necessity to re-conceptualise productivity by introducing a much wider range of measurable costs and outputs. Woodhouse (2010) claims that it is necessary to take into account energy efficiency issues when assessing efficiency and sustainability, while, according to Weis

[21] Weis even talks of 'ecological hoof print' to point out the negative effects of the 'meatification' of diets worldwide

(2010), both energy and biophysical budgeting are indispensable to really evaluate the efficiency and sustainability of agriculture. In the same line, Ecological Economics[22] also argues that the *embeddedness* of human societies within broader ecological spheres implies the need to "go beyond the money values by including […] physical appraisals of the environmental impacts of the human economy measured in their own physical 'numeraires'" (Martinez-Alier, 1999, p. 114). The latter can be approached by referring to indicators such as the Human Appropriation of Net Primary Production ; the Energy Return On Energy Input ; the Ecological Footprint (Martinez-Alier, 1999), and methodologies such as Material and Energy Flow Accounting (Haberl, 2001a, 2001b).

3.4 FROM BIOPHYSICAL CONTRADICTIONS BETWEEN NATURE AND SOCIETY TOWARDS THE NEED FOR AN INTEGRATED NATURE-SOCIETY APPROACH

Social metabolism is constructed upon the belief that ´nature´ and ´society´ are two separate but interrelated spheres or boxes. When adopting social metabolism, the focus is on the nature of the flows which go through the interface that separates both boxes, i.e., to look at what society <u>*does*</u> with, and to, the ecological environment. The idea of metabolic rift implies that the feedback between both boxes disrupts the ´nature´-box so much that it leads to environmental degradation and eventually to biophysical contradictions and to ecological crisis. But, in his analysis of the development of capitalism at the world level, Jason Moore challenges the conceptual underpinnings of such dichotomous analysis (Moore, 2015). He explains that there is a need to overcome the dominant vision, which states that 'nature' and 'society' are two different overlapping and interrelated categories and to start acknowledging that both are part of a same whole and co-evolve constantly. He refers to this as adopting the idea of a double internality: "humanity-in-nature and nature-in-humanity" (Moore, 2015, p. 5). Referring to system thinking, this implies moving from considering 'nature' and 'society' as two sub-systems towards seeing them as a unique and indivisible system, which Moore refers to as *the oikeios*. In order to achieve this, Moore proposes to move from

[22] More generally, Gómez-Baggethun et al. (2010) and Hubacek and Van den Bergh (2006) give an overview of the dominant Neo-classical economics thinking has dealt with nature. They explain that, initially Neoclassical economics gave little attention to nature, considering that natural resources could be totally substitutable by capital. Here, everything that was not valued in monetary terms, especially nature, was left outside the scope of analysis. Nature was only brought back in the economic debate later on, first with Environmental Economics, which developed ways to value environmental externalities in monetary terms, and finally with Ecological Economics.

the dominant concepts of 'nature' and 'society' towards those of *human nature* and *extra-human nature,* which are both part of the same whole, the 'web of life', which he defines as follows:

> "The 'web of life' is nature as a whole: *nature* with an emphatically lowercase *n.* This is nature as us, as inside of us, as around us. It is nature as a flow of flows. Put simply, humans make environments and environments make humans -and human organizations" (Moore, 2015, p. 3)

Moore's argument does not imply that it would be useless to analyse the impact of human activity on the environment. Adopting Moore's ideas, though, points towards changing the focus of analysis, from issues related merely with the ecological impact or footprint towards taking seriously the dynamics of "co-production of life" (Moore, 2015, p. 3), i.e., the ongoing reconfiguring of nature as a whole (human and extra-human). This has important implications for research questions, but it also introduces huge epistemological, ontological and methodological challenges as it comes to operationalise this approach in a concrete research process (I will tackle some of these challenges in Chapter 2).

With respect to the formulation of the ecological agrarian question, Moore's analysis of capitalism in the web of life brings interesting insights. Moore approaches capitalism as a 'world-ecology', i.e., as regime where processes of accumulation of capital, wealth and power are intrinsically bounded with a way to produce or shape (human and extra-human) nature. As a result, he sees capitalism not as an economic or social system, but as a particular way of "organizing nature" (Moore, 2015, p. 2). In order to better grasp this process of organising nature, he proposes to move beyond the idea that labour (especially through wage-labour, i.e., commodified human work) is the main source of value, and thus of the surplus value necessary to capitalist expansion. Instead, Moore uses the concept of work/energy, saying that it is the transformation of nature's work/energy (both human and extra-human) into value which is at the core of the development of capitalism as a world-ecology. While focusing on issues related to labour implies looking first and foremost at social processes (and what they do to the environment), Moore's approach obliges us to enlarge our vision and to take seriously both human and extra-human dimensions. That brings him to take some distance from the idea of metabolic rift and to say, instead, that "capitalism has survived not by

destroying nature (whatever this might mean), but through projects that compel nature -as oikeios- to work harder and harder for free, or at a very low cost" (Moore, 2015, p. 13). In his vision, 'free' or 'low cost' does not refer to market values, as he is very aware that not all of nature's work/energy has to be appropriated, commodified and transformed into capital by economic means to be useful for capitalist development (for instance, the work/energy of a river used for hydro-electrical production, the work/energy of pulse crops which fix nitrogen into the soil, or the work/energy of a cow that transforms soil nutrients and vegetables into milk or meat). Instead, working harder and harder at low cost refers here to the ongoing process of creating a surplus that can be appropriated and used by capitalism (even without a commodification process). This is what Moore calls the Cheap nature project, which entails the production of four cheaps: cheap labour/power, cheap food, cheap energy and cheap raw materials.

Following this vision, agriculture is therefore based on the coupling and co-evolution between social relations of production and concrete agricultural practices (i.e., human nature work/energy) on the one hand, and, on the other hand, biophysical processes such as water, energy and nutrients cycles (i.e., extra-human nature work/energy). When this coupling entails "extra-economic processes that identify, secure, and channel unpaid work outside the commodity system into the circuit of capital" (Moore, 2015, p. 17), agriculture is able to create a surplus that, because of its own nature, can be appropriated and used to produce cheap food, in the sense of "more calories with less average labour-time in the commodity system" (Moore, 2015, p. 241). Thus, agriculture becomes a crucial element within the implementation of capitalism's Cheap nature project.

What is important to underline, though, is that the surplus produced by agriculture "does not refer to large or small amounts of 'stuff' but rather to a bundle of socio-ecological relations" (Moore, 2010, p. 393).The four broad questions of political economy introduced by Borras (2009) and Bernstein (2010) to analyse processes of agrarian change and peasant dynamics -*Who owns what? Who does what? Who gets what? What do they do with it?* - only allow a partial approach to these socio-ecological relations. Indeed, as they focus of the human dimension, they are not enough to adequately grasp how extra-human nature *works* and, particularly, they fail in looking

explicitly at the way biophysical processes (i.e., water, energy and nutrients cycles) relate with social relations and agricultural practices. Thus, the formulation of the agrarian question in the web of life takes on new shades that will imply analysing: i) the specific combination of the work/energy of human and extra-human natures that allow this surplus creation; ii) the way this surplus is actually appropriated; and, iii) the bundle of socio-ecological relations that allow for this surplus creation.

Moore makes an attempt to analyse specifically agricultural development at the world level using the lenses of world ecology. His main argument here is that, while capitalism had been very effective in generating cheap food through important productivity increases during the industrial and green revolutions, the recent neo-liberal shift, on the contrary, creates huge negative values (climate change and superweed effect), implying a huge increase in costs and no durable increase in productivity, which results in the end of cheap food (Moore, 2015). For instance, he explains that the emergence of industrial agriculture in the XIXth Century allowed huge increases in agricultural yields and labour productivity, mainly through: i) the appropriation of extra human cheap nature (i.e., new areas for production in America where slavery was implemented); and, ii) technological developments (steamships, railroads, mechanisation closely related to colonisation). While the latter refers mainly to technical elements, the former relates to issues of power and unbalanced social relations. The Green Revolution was different, in the sense that, here, the increase in productivity was the result of the introduction of hybrid plants and the use of chemical products and enormous amounts of water. The increase in the use of chemicals is interpreted by Moore as a way to appropriate extra human nature 'vertically', i.e., not from one continent to another but from one geological layer to another, often in another part of the world starting as such a process of decoupling farming from local agro-ecological conditions. The spread of neo-liberalism worldwide and, in agriculture in particular, from the 1970s did not generate any agricultural revolution. Despite the introduction of agro-biotechnology and the increased use of chemicals we witnessed a slowdown in yield growth as well as very low productivity growth. As a result, Moore argues that in this period cheap labour was not achieved through the creation of cheap food by agriculture (i.e., through an increase in agricultural productivity resulting from the appropriation of cheap human and extra-

human natures) but through specific neo-liberal policies that allowed food surplus to ve produced in the North that flooded the world market, directly impacting farmers in the South, displacing them for agricultural production to other sectors. Moreover, Moore argues that neo-liberal agriculture also implies huge increases in negative values (toxification, superweed effect, climate change, epidemics, cancer etc..) which "can be understood as the accumulation of limits to capital in the web of life that are direct barriers to the restauration of the four cheaps: food, labour-power, energy and raw materials" (Moore, 2015, p. 277). As such, for Moore, extra human nature and human nature are co-producing a new world ecology where there is a need to make more efforts to appropriate human and extra-human natures, which implies greater environmental impacts. As Moore explains, in this new world ecology, "every great movement of appropriating new streams of unpaid work/energy implies a disproportionately larger volume of waste" (Moore, 2015, p. 279), and this is particularly true for agriculture.

Two main conclusions can be drawn from the previous discussion. First, the analysis of the evolution of agrarian structures and particularly the role of agriculture within society has been and still remains a key issue, especially in the current context of globalisation, neo-liberalisation and capitalist expansion. Second, this issue has an important ecological dimension, whether in terms of the role played by the appropriation of nature in the production of an ecological surplus (as argued by Moore (2008,2010)) or in terms of ecological efficiency and sustainability (as implied by Woodhouse (2010) and Weis (2010)). In this research I will draw on these insights to inquire into some aspects of the ecological agrarian question in the Nicaraguan agricultural frontier. Indeed, my point of departure is the argument that control over natural resources is at the centre of the process of wealth creation and distribution within agriculture, and as a result at the centre of the debate around rural development. Therefore, the objective of the research is to investigate the way natural resources are appropriated, used and transformed by agriculture to create wealth and, conversely, how agriculture has an influence on these natural resources.

4. RESEARCH QUESTIONS AND DISSERTATION OUTLINE

By positioning my work within the general-concrete and general-abstract settings in which the phenomenon I am interested in is embedded, this introductory chapter set the stage for the research process as a whole. As introduced above, my research is about analysing processes of agrarian change in specific geographical places, tropical forested agricultural frontiers. In these regions we witness important land-use changes which result in agricultural production, especially cattle raising, at the expense of the loss of the last remaining patches of tropical forests. This has dramatic environmental consequences and plays a crucial role within the current environmental crisis, both at local and global levels. The ecological dimension of the agrarian change processes in this type of context is therefore particularly relevant. In order to better analyse agrarian change processes in these regions, fully acknowledging their social and environmental dimensions and their interrelatedness, I have argued above that there is a need to adopt an integrated nature-society approach to the study of the evolution of agricultural production. That is why the first objective of my research is to propose such an integrated analytical framework. Implementing this framework in a concrete-specific context to better understand dominant development pathways, especially their social and environmental features, in the Nicaraguan agricultural frontier is the second objective of my research. Finally, the third and last objective is to bring insights for action, especially to improve the design of development interventions that could promote more ecologically and socially sustainable development pathways within the Nicaraguan agricultural frontier.

Drawing on these insights, the main research questions that guide my work is as follows: **What does an explicit focus on the complex interactions between nature and society contribute to the understanding of agrarian change processes within social-ecological systems in the Nicaraguan agricultural frontier, and what insights can be derived to inform proposals for policies and interventions to promote more sustainable and inclusive collective development pathways?**

In order to bring elements in answering these questions, my work will draw upon three inter-related sub-research questions:

- Sub-research question 1:

  How can agrarian change processes be analysed adopting an integrated nature-society approach?

- Sub-research question 2:

  What are the main characteristics of the emerging dominant development pathways in the Nicaraguan agricultural frontier (i.e., the socio-ecological collective processes of change, the individual trajectories followed by farmers and their environmental and social outcomes)?

- Sub-research question 3:

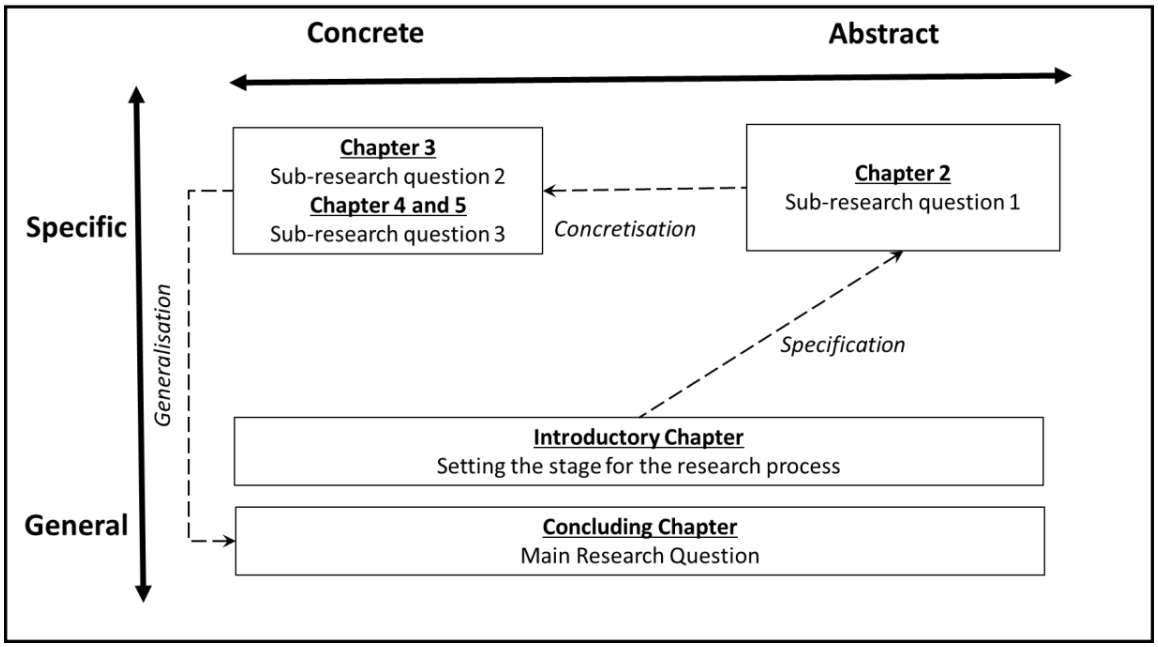
  Within emerging dominant development pathways in the Nicaraguan agricultural frontier, how should we envisage and implement development policies and interventions that could promote more sustainable and inclusive pathways?

I deal with these sub-research question in the following chapters of this dissertation where I follow a specification process according to Lund's Matrix (see Figure 1.1). Chapter 2 is related to Sub-research question 1. Here I remain in the abstract dimension, relocating the theoretical at the abstract-specific level of the matrix. In this chapter I present the conceptual framework I use to approach and analyse the 'ecological agrarian question' in the Nicaraguan agricultural frontier by putting together a set of concepts in a way that allows the study of couple human-environmental dynamics within rural landscapes in the scope of broader debates related to agrarian issues. The concepts on which I draw are the following: social-ecological complex systems; development pathways (Bastiaensen et al., 2015); Nature's matrix (Perfecto, Vandermeer, & Wright, 2009); agrarian systems (Cochet, 2012; Mazoyer & Roudart, 1997); peasantisation/depeasantisation (Van der Ploeg, 2009); and, access mechanisms (Ribot & Peluso, 2003).

Following a movement towards concretisation, Chapters 3, 4 and 5 show the empirical part of my work, i.e., the concrete-specific level in Lund's matrix. Chapter 3 deals with sub-research question 2 and focuses on a detailed analysis of the historical agrarian change processes in a small region of the highlands in the centre of Nicaragua, trying to unravel some elements of the dominant development pathway that characterise the

cattle-based Nicaraguan agricultural frontier in both its collective and individual dimensions, i.e., looking at the socio-ecological collective processes of changes and the individual trajectories followed by farmers in this region. In Chapters 4 and 5, I focus on sub-research question 3, moving the discussion to a critical reflection on a concrete development project (a Payment for Ecosystem Services intervention (PES)) that tries to have an influence on the dominant cattle-based development pathway. The discussion presented in both chapters is embedded within a long-term research-action process implemented together with a local environmentalist NGO and my objective there is to offer insights about the design of development interventions in the Nicaraguan agricultural frontier. In Chapter 4, my aim is twofold. First, I intend to analyse the relations between the motivation of individual farmers for land use change in the agricultural frontier and collective societal pathways that generate particular opportunities and constraints, as well as guiding ideas and habits that 'work' within these pathways. Second, I reflect on the way the new institutional framework introduced by the project interact with those motivations. In Chapter 5, I develop a new methodological tool, a PES simulation game. My argument there is that the use of tools similar to this simulation game can improve the design of development interventions in the agricultural frontier context through a better understanding of: i) complex negotiations among diverse actors participating in dominant development pathways in the agricultural frontier; and, ii) farmers' decision-making constraints. Indeed, the game mimics historical agrarian change and social differentiation processes, simulates a range of interventions, and creates space for participants to collectively reflect on the motivational and socio-political dynamics triggered by the interventions. Finally, in the concluding chapter, I connect these empirical insights with the initial discussion presented in the introductory chapter with respect to both the general-concrete (i.e., agricultural frontiers and their relation to agrarian change processes) and the general-abstract (i.e., the issue of the ecological agrarian question) of the phenomenon I am analysing. To sum up, the rationale of the Ph.D. dissertation as a whole is presented within Lund's matrix in Figure 1.12 below.

Figure 1.12: Rationale of the dissertation



Source: own elaboration based on Lund (2014)

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CHAPTER 2

DEVELOPMENT PATHWAYS IN THE AGRICULTURAL FRONTIER: UNRAVELLING COMPLEXITIES OF RURAL LANDSCAPE DYNAMICS

1. INTRODUCTION

As explained in the introductory chapter of this dissertation, the ecological agrarian question brings ecological issues into the analysis of agrarian dynamics. In order to investigate this, we need therefore to focus on both environmental and social dimensions of agrarian change and their interrelations. I follow Rizzo et al. (2013), who argue that the appropriate scale to analyse this kind of issues is the landscape level. For these authors, "agriculture is a place-based human activity*, thus embedded into landscapes* where natural environments, social networks and cultural features are closely tied" (Rizzo et al., 2013, p. 72, emphasis added). They define landscapes very broadly as areas "whose character is the result of the action and interaction of natural and/or human factors" (Council of Europe cited in Rizzo et al (2013, p. 72)). This definition highlights the fact that landscapes are much more than a combination of physical elements governed by natural processes. At the same time, it also underscores that they are much more than only 'cultivated ecosystems', i.e., ecosystems shaped by human activity as argued, for example, by Mazoyer and Roudart (1997). For instance, landscapes' human dimension goes well beyond the simple consequences of human activities over natural elements. In the establishment of specific landscapes other elements, such as aspirations, culture and actors' world views also play a key role. As explained by Setten, a landscape is also a moral construction; it "is bounded by the people shaping it, through their ideas and aspirations as they have been both historically and geographically constituted. It is a lived and practised landscape that grows out of a series of seemingly 'natural' processes" (Setten, 2004, p. 391).

Therefore, rural landscapes entail both a human and a natural dimension. However, following Moore's argument of looking at the world as a ´web of life´ (Moore, 2015), these landscapes should not only be approached as being the sum of interrelated natural and human elements but as a whole (as an *oikeos*, nature as whole, in Moore's words), i.e. as a unique and indivisible system where the human cannot be seen apart from the natural (and the natural cannot be seen apart from the human). This means moving away from the idea that in order to understand those landscape dynamics it is enough to look independently at human and natural elements and afterwards to focus

on the interactions between both. But it also means moving away from the idea that rural landscapes are the result of what human beings have done with -and to- a specific natural environment. This implies understanding that rural landscapes are co-produced by the constant interactions between *human* and *extra-human* natures (using Moore's terminology). A similar argument is put forward by van der Ploeg (2009, p. 24) in the domain of rural sociology, when he argues that agrarian dynamics are shaped by a process of co-production, i.e., the "ongoing interaction and mutual transformation of man and living nature". This co-production is not only related to the way rural landscapes change and evolve in time in their bio-physical dimension, but also to the way human beings approach and understand those landscapes and, as a result, take decisions and actions, having as a result an important impact on the dynamics of agrarian change. The question that arises at that point, and which will be the focus of this chapter, is how those rural landscapes' dynamics, especially the human/extra-human co-production process, can be analysed in order to bring relevant insights into the debates around agrarian issues, i.e., around the agrarian questions of today. In other words, the question that guides my reflection process in this chapter is how Moore's theoretical insights can be translated into a workable conceptual and analytical framework for the analysis of agrarian change processes in concrete-specific situations.

A rapid overview of some academic literature dealing with the problematic of human-nature linkages (broader than in the domain of agrarian studies), shows some kind of consensus in the acknowledgement that human and natural elements are always intertwined, coupled or linked. However, depending on scholars and particularly on scientific disciplines, the literature shows very different ways to understand and deal with the human-nature interweaving (see e.g. Zvoleff and An (2014) for an overview of some approaches and Liu et al. (2007), Folke (2006), Martinez-Alier (1999), Ostrom (2009), Leach, Scoones and Stirling (2010), Foster (2011) for specific examples). In the scope of their critical reviews of some of these approaches, West, Haider, Sinare and Karpouzoglou (2014) and Hukkinen (2014) highlight that a crucial element that differentiates those approaches is their ontological and epistemological underpinnings. The ontological question addresses the issue of defining what the reality we are dealing with is. The epistemological issue, on the other hand, deals with the creation of

knowledge about this reality, i.e., what we can actually know about this reality. Later in this chapter I will address both issues with respect to my research process.

Following a movement of specification within the abstract dimension of Lund's matrix (2014) presented in Chapter 1 to describe qualitative social-sciences research processes, this chapter is located at the abstract-specific level of that matrix. My starting point here is the adoption of a critical-realist posture, which means that I believe that there is a material world out there and that this material world exists independent of human beings knowing it and that we will never be able to have a complete understanding of this reality (Neumann, 2014). In section 2, I deal with the realist aspect trying to propose the conceptualisation of the reality (i.e., rural landscapes) I am adopting in this dissertation. This conceptualisation draws mainly on two main theoretical pillars, complexity science and the concept of development pathways as developed by Bastiaensen et al. (2015). To a lesser extent, it takes some inspiration of the work of Pefecto, Vandermeer and Wright (2009), especially their concept of Nature's matrix. Afterwards, section 3 is devoted to the critical side of my critical-realist positioning. In this section I develop an analytical framework that allows me to unpack some elements of this reality related to the ecological agrarian question. This framework is largely inspired by the French-speaking agrarian system approach (Cochet, 2011; Mazoyer & Roudart, 1997). However, after identifying some gaps in this approach I complement it with two main amendments: i) the introduction of the concept of access mechanisms used by Ribot and Peluso (2003) to operationalise their Theory of access ; and, ii) the insertion of a clearer conceptualisation of what the peasant condition is on the basis of the work of van der Ploeg (van der Ploeg, 2009, 2010; van der Ploeg et al., 2008). Finally, I conclude with some elements that will introduce how this analytical framework is operationalised to investigate empirical situations in the following chapters of the dissertation.

2. CONCEPTUALISING RURAL LANDSCAPES AS COMPLEX SOCIO-ECOLOGICAL SYSTEMS

2.1. AN ONTOLOGY OF COMPLEXITY

In December 2014 I participated in the First Latin American congress on environmental conflicts in Buenos Aires (Argentina). In this event, I was introduced to the Latin American political ecology school (Alimonda, 2011; Leff, 2004; Toledo, 2013). This congress, especially a keynote lecture given by Enrique Leff, was very inspirational for me and largely shaped my research process. During that lecture, Leff said that our planet is facing a civilisation crisis of which a main concrete translation can be witnessed in the global environmental crisis. This is nothing very novel, but , what was a discovery for me was Leff's main argument, which states that the most important cause of this crisis resides in our failure to understand the reality in which we are embedded and especially the relation between mankind and nature. In order to solve this issue, he argues that we need to implement a radical shift in the way we create knowledge and problematise the world we are part of. Reflecting upon Leff's ideas in the scope of my doctoral research process, I came to realise that my research journey was indeed a personal quest towards being able to implement the kind of shift Leff is talking about within my own personal way of thinking. The question that arises then is what this shift is really about. Leff gave some clues during the conference and within his writings. He argues the need to move from 'normal' towards 'post-normal' science[23] and he specially talks about the need to embrace complexity thinking as a starting point. I do not literally adopt a post-normal science perspective, but I have taken Leff´s argument as a source of inspiration to initiate my reflection moving from my pre-existing positivist and western-European dominant way of thinking towards considering that reality in general, and rural settings in particular, must be looked at with lenses that introduce elements of diversity in world views, subjectivity, unpredictability and uncertainty. It is paying attention to

[23] Funtowicz and Ravetz (1993, p. 740) define normal science as "the unexciting, indeed anti-intellectual routine puzzle solving by which science advances steadily between its conceptual revolutions. In this 'normal' state of science, uncertainties are managed automatically, values are unspoken, and foundational problems unheard of." On the contrary, within post-normal science "uncertainty is not banished but is managed, and values are not presupposed but are made explicit. The model for scientific argument is not a formalized deduction but an interactive dialogue. The paradigmatic science is no longer one in which location (in place and time) and process are irrelevant to explanations. The historical dimension, including reflection on humanity's past and future, is becoming an integral part of a scientific characterization of Nature."

unpredictability and uncertainty which has brought me into the realm of complexity science and has led me to adopt complexity as an ontological approach within my work.

As explained by Martin and Sunley (2007), embracing complexity can take different forms and have different implications. On the one hand, it can entail a kind of operational approach where the aim would be to focus on the development of a set of methodological tools used to mathematically model complex systems[24] in order to understand them and to some extent foresee their possible evolutions (Page, 2015; Pines, 1988; Thurner, Deffuant, & Carletti, 2012). Within this strand, which has been adopted by scholars belonging to a diversity of scientific disciplines from natural sciences to economics (see for instance Pines (1988)), it seems to be acknowledged that the world can be seen as a complex system composed of a multiplicity of interrelated variables and that this world *can* be discovered, at least partly, by paying attention to the different relations between these variables, and/or that its representation and analysis is merely a descriptive task. Complexity appears here to be an issue of epistemology and embracing complexity leads to the development of concrete tools to explain the world and predict its evolution.

But there is also another strand of complexity science where complexity is seen much more as a question of ontology. This second strand is in line with how Ramalingam and Jones (2008) or Walby (2007) bring complexity in relation to the social sciences. For these authors, working within a complexity paradigm implies taking up some features of complexity theory as "a particular view on how reality […] is structured and behaves (evolves)" (Martin & Sunley, 2007, p. 579). More precisely this means focusing on some key concepts or principles of complexity science that are very useful to make sense of the multiple and interacting problems social sciences are dealing with. Drawing on Ramalingam and Jones (2008), Walby (2007) and Ambrosio-Albalá and Bastiaensen (2010), this implies:

[24] There is a direct link between complexity science and systems science. As argued by Ramalingam and Jones (2008, p. 5): "Systems thinking is particularly close in its origins and scope to complexity science […] complexity can only emerge in the context of a system, and certain aspects of complexity, such as feedback, find clear parallels in systems thinking[…]systems thinking focuses on seeing interrelationships rather than linear cause-effect chains, and seeing processes of change rather than snapshots".

- moving beyond linear causal relations between components (concept of non-linearity)
- explicitly incorporating reciprocal relations and interactions with multiple variables and feedback effects (concepts of reciprocity, interconnection, interdependency)
- acknowledging that the consequences of such interactive relations depend on initial conditions (concept of path-dependency or legacy effect)
- recognising that these consequences are generally uncertain, non-deterministic and unpredictable (concepts of emergence and self-organisation[25])
- being aware that the 'whole', i.e., the interrelated sum of a large diversity of components always evolves towards several possible 'steady states' (concepts of attractors, thresholds, phase state and multiple-equilibrium)

Rural realities are therefore complex and rural landscapes can be approached as complex socio-ecological systems (see Ambrosio-Albalá (2010), Leloup (2010) for similar arguments). This is not a novel positioning. There is huge amount of academic literature that analyses human-nature relations acknowledging that these relations happen within complex systems. This literature shows, however, a large variety of ways to conceptualise these complex systems: Anderies, Janssen and Ostrom (2004) and Ostrom (2009) introduce the concept of Social Ecological Systems; Folke (2006) talks about Complex adaptive systems[26]; Hukkinen (2014) uses the concept of Autopoietic systems; Liu et al. (2007) refer to Coupled human and natural systems; and Leach et al. (2010) adopt the idea of Social-ecological-technological systems[27]. All these conceptualisations share the main principles introduced by complexity science with respect to the relations between systems' components (non-linearity) and with respect to the behaviour of the systems as a whole (path dependency, emergence, multiple equilibria). Even if this literature does not always pay enough attention to a reflection on what the limits of complex socio-ecological systems are, it appears that those systems should be

[25] Even if the organisation of human systems is always partially intentional, full control of the systems by human actors can never exist.
[26] This concept is one of the foundations of the 'resilience perspective' developed by the Stockholm Resilience Centre (SRC) (www.stockholmresilience.org)
[27] This is the basis of the work of the Social, Technological and Environmental Pathways to Sustainability Centre (STEPS) in Sussex (www.steps-centre.org).

conceptualised as open entities with fuzzy borders. This implies that both the elements and the behaviour of systems influence and are influenced by their environment and by surrounding systems (this corresponds to the concept of co-evolution introduced also by Ramalingam and Jones (2008)). The state of these systems at one moment therefore depends on broad social and environmental trends (e.g., population changes, national and international policies) and the dynamic of surrounding systems, as well as the fact that this state can be disrupted by external shocks (e.g., natural disasters, or economic and social crises). One important implication of this feature is that it becomes difficult to set a predefined geographical scale when trying to delimit this kind of complex system for the analysis. In line with Long's concept of 'relocalisation', i.e., "the 'reinvention' or creation of new local social forms that emerge as an integral part of the process of globalisation" (Long, 2001, p. 23), local, national and global scales should be seen as mixed within a same concrete reality and not as hierarchical geographical spaces. This has led Hukkinen (2014) to argue that such complex systems are scale-free, i.e., that their dynamics are the result of macro- and micro-scale processes and that their analysis should always entail a multiscale dimension. As complex systems' boundaries are open, porous and permeable, they are never pre-determined. On the contrary, systems' boundaries are conceptual and/or practical constructions set by the observer depending on his/hers objectives (Martin & Sunley, 2007). Setting boundaries for the analysis of a complex socio-ecological system is therefore a construction and a reduction of reality. It is a practical need in order to delimit the object of study (Ambrosio-Albalá & Bastiaensen, 2010) and a necessary step to move from the 'real' complex world towards an artefact that we use to try to analyse this 'reality' (Leach et al., 2010). This process of defining the limits is not value free and is far from being a neutral process.

Finally, the literature also shows important differences in the way to conceptualise the interweaving between human and natural elements and the level of controllability and knowledgeability of these complex socio-ecological systems (see West et al. (2014) for a discussion about this element). One stand, which could be defined as dominant, corresponds to those approaches influenced by natural sciences or economics. These approaches seem to argue that the broad system as a whole can be disaggregated in two different subsystems, a natural subsystem and a human subsystem (Anderies et al.,

2004; Liu, Dietz, Carpenter, Alberti, et al., 2007; Ostrom, 2009). Moreover, the understanding of natural-human linkages can be approached understanding the mechanism governing the dynamics of both sub-systems separately and afterwards focusing on the linkages or coupling mechanisms between them (an illustrative example of this kind of approach is given by Werner and McNamara (2007)). Another strand, the one I adopt in this dissertation, is in line with the concept of *oikeos* introduced by Moore (2015), who argues that it is impossible to look separately at human and natural subsystems because human and natural elements and the dynamics of the system as a whole only exist in interaction between each other. Trying to artificially separate both elements is therefore impossible and even pointless (see for instance Hukkinen (2014), Leach et al. (2010), Folke (2006)).

2.2. MAKING COMPLEX SOCIO-ECOLOGICAL SYSTEMS' HISTORICAL AND SOCIO-INSTITUTIONAL DIMENSIONS EXPLICIT: INTRODUCING THE CONCEPT OF 'DEVELOPMENT PATHWAYS'

One crucial feature of complex systems is that they are dynamic. Their dynamics are shaped by the main concepts of complexity science that we have introduced above. The concept of path-dependency implies that the state of the system today depends directly on historical trajectories. The concept of emergence implies that the future evolution of a system is not pre-defined and can therefore not be predicted with certainty in advance. On the contrary, future paths will depend upon the aggregate consequences of the multiple non-linear interactions between elements within the system and the system's environment, including critical events or decisions taken by actors (Liu, Dietz, Carpenter, Alberti, et al., 2007; Mahoney, 2001). Thus, even if outcomes depend on initial conditions, there are always a variety of possible outcomes. The previous has two main implications in the scope of this work. First, the historical reconstruction of the evolution of the studied systems as a whole has to receive sufficient attention. Second, the objective of this historical analysis is not to predict the changes that could occur in the future, but rather to better understand the paths that have been followed in the past and investigate the processes that underlie them. In that sense we follow Leach et al. when they say that "appraisal methods need to move beyond static 'snapshot'

approaches to the assessment of benefits and impacts, to adopt a dynamic perspective" (Leach et al., 2010, p. 115).

I conceptually approach this historical dimension using the concept of 'development pathways' introduced by Bastiaensen et al. (2015). For these authors rural development can be understood as the emergent dynamics of a complex socio-ecological system. The concept development is not related here to economic growth or the reductions of deprivations but, as put forward by van der Ploeg et al. (2008), it corresponds to ´the development of the rural´, i.e., the process of emergence of the system as a whole. Within this process, collective 'development pathways' emerge from these systems' dynamics, interacting with (shaping and being shaped by) individuals´ trajectories of change. A 'development pathway' is a concrete socio-institutional environment (i.e., a set of rules and regulations in interaction with specific social and power structures and biophysical setting) which, together with a set of sufficiently shared legitimating, actionable ideas, condition and inspire the individual and collective actions of the actors involved, in particular with respect to economic activities to be developed. This opens or closes opportunities to implement certain individual livelihood trajectories, which in turn shape the socio-institutional context and the shared ideas that characterise it. As such, the approach tries to better understand and analyse individual and collective action in a dynamic context making explicit their ecological underpinnings and consequences. Similar arguments about the relation between collective an individual dimensions of change have been put forward explicitly by several authors interested in the understanding and analysis of rural dynamics. Within livelihood studies, for instance, De Haan and Zoomers (2005, p. 42) propose to "use the concept of pathway for the observed regularities or patterns in livelihood among particular social groups and to use trajectories for individual actors' life paths". The link between livelihoods' pathways and trajectories relies on the fact that individual decision-making processes are embedded within a specific socio-institutional and cultural context which has both individual and collective causes and consequences. Indeed, as explained by the authors:

> "pathways are best defined as patterns of livelihood activities which arise from a coordination process among actors. This coordination emerges from individual strategic behaviour embedded both in a historical repertoire and in social

differentiation, including power relations and institutional processes, both of which pre-structure subsequent decision-making" (ibid. 2005, p. 43).

A similar approach can be found in the concept of 'farming styles' (van der Ploeg, 2010) introduced by the rural sociology group at Wageningen University. This concept has been developed in order to analyse the heterogeneity of farming processes within the same overall conditions. As explained by these authors, a farming style is a way of farming that is shared by a large group of farmers and that has to be understood as a historical process. Indeed, "talking about farming styles is identical to talking about often highly complex and strongly differentiated processes of change over time […] Farming styles 'resist' radical changes, just as they imply style-specific trajectories for change" (van der Ploeg, 2010, pp. 10–11). Farming styles are collective but they also have an individual dimension in the sense that they are shaped by structural and environmental factors but also by individual elements, including individual decision-making models, concrete agricultural practices, and social relations.

'Development pathways' is therefore an approach that draws on complex system thinking and conceptualises rural landscapes as complex socio-ecological systems composed of human and natural elements that cannot be separated and analysed independently of each other. The approach is, however, heavily rooted within social sciences disciplines. This implies that, even if it takes into account ecological dynamics, its main focus is on social-institutional elements and processes within these systems. In that respect, it draws on the broader agency/structure debate within the social sciences situating itself among theories that recognise that, even if human agency is shaped (whether bounded or enabled) by structural factors, there is always some margin of manoeuvrer for innovative and non-determined human individual and collective agency (e.g., Giddens' structuration theory (Giddens, 1984), Long's development sociology (Long, 2001), Cleaver's work on collective action and natural resources management (Cleaver, 2007)). The result of this room for manoeuvre implies that the evolving ideas and actions of actors, even if always structurally informed and conditioned, also have the potential to become starting points for transforming the structural conditions of the system. This potential would be unfolded provided that these actors manage to enrol a sufficient number of others in their projects, a process which would depend on power

and social relations. Thus, the ´Development pathways´ approach pushes us to focus our attention on two elements: i) the description and analysis of the structurally determining elements that enable/constrain individual-collective human agency and the implementation of specific livelihood trajectories; and, ii) the power-laden social and institutional processes that shape actor's ideas and actions (e.g., collaboration or conflictive relational processes). As a result, the concept of 'development pathways' highlights the importance of political arenas[28] where relational and power elements shape the implementation of specific dynamics of change at both individual and collective levels in rural territories, bringing a political dimension into the debate around agrarian change.

In reflecting upon individual and collective action processes, the approach allows one to answer Cote and Nightingale's suggestion to engage "with social theories about structure/agency as a way to formulate questions that were previously invisible from a systems theory standpoint" (Cote & Nightingale, 2012, p. 481). More precisely, Bastiaensen et al. bring in three dimensions of the socio-institutional environment which shape the emergence of individuals' trajectories and broader collective development pathways: the social structure (i.e., the actors and their networks); the rules in use (i.e., the norms and regulations that are actually enforced and implemented); the culture (i.e., actors' ideas and knowledge). The third dimension corresponds to the "the ideas, perceptions, knowledge and meanings that underlie, legitimise and motivate the actors' aspirations and actions, their ways of organising and relating to each other and the rules of the game they negotiate and employ" (Bastiaensen et al., 2015, p. 25). These elements are socially constructed by the actors themselves depending on their own interest, their relations with others and the power they hold to have their ideas and knowledge prevail over those of others. These three elements will influence actors' individual trajectories and the processes of exclusion/inclusions of some actors within specific development pathways. Consequently, it allows one to identify the 'poor' as defined by Bastiaensen et al. (2005, p. 981) as "those human beings who, for one reason or another, almost systematically end up at the losing end of the multiple bargains that

[28] A political arena is "a place of concrete confrontation between social actors interacting on common issues" (Bierchenk and Olivier de Sardan (2003, p. 240) cited in Bastiaensen et al 2005, p. 981).

are struck around available resources and opportunities". The poor will therefore be the actors who finish at the losing end of the emergence of specific development pathways in specific rural landscapes.

2.3. MAKING COMPLEX SOCIO-ECOLOGICAL SYSTEMS' ECOLOGICAL DIMENSION EXPLICIT: DEVELOPMENT PATHWAYS AND THE BUILDING OF NATURE'S MATRIX

The way I approach the ecological dimension that characterise socio-ecological systems is inspired by the concept of Nature's matrix introduced by Perfecto et al. (2009). These authors propose a new paradigm to deal with biodiversity conservation in tropical areas. This paradigm entails a move from a binary perspective which opposes 'conservation of pristine forested areas' and 'conversion to agricultural land use' towards paying more attention to the importance of the quality of a matrix (in terms of biodiversity conservation) composed of plots with different land uses, including agricultural areas. Perfecto et al. summarise their argument as follows:

> "If we accept the fact that most tropical areas are highly fragmented and that for biodiversity conservation the matrix matters, and we recognize that 'the matrix' consists of managed ecosystems, mostly agriculture, then the way we manage those agricultural systems becomes crucial for biodiversity conservation. If […] all populations are Metapopulations, migrations among natural habitat fragments is key to their conservation, and those migrations do not occur in a low-quality matrix, which is to say a biodiversity-unfriendly agricultural ecosystem" (Perfecto et al., 2009, p. 7)

Their reflection starts from the recognition that most tropical landscapes consist, de facto, of a "patchwork of forest fragments in a matrix of agriculture" (Perfecto et al., 2009, p. 5)[29]. Therefore, if we are interested in conservation issues in these regions of the world, we must look at the characteristics of this matrix. This implies not only focusing on the matrix's bio-physical elements, e.g., in terms of land use distribution, but also looking at the way this matrix has emerged. Referring to the 'development pathways approach' introduced above, the latter corresponds to a need to better

[29] In the Mesoamerican area, for instance, it has been estimated that around 80% of the region's natural vegetation has already been converted to agriculture (Harvey et al., 2008)

understand and analyse the process by which the dominant development pathways and individual livelihood trajectories that have co-produced this matrix emerged.

Harvey et al. (2008) propose a similar argument in their proposal for an integrated landscape management approach for the Mesoamerican region. They advocate for an approach "in which conservation and production units within the agricultural matrix are managed jointly for long-term sustainability", arguing that "conservation efforts should be based on the recognition that how agriculture is conducted and how different land uses are distributed spatially and temporally determine the region's biodiversity" (ibid 2008, p. 8). The advantage of such a conceptualisation is that it makes a direct link between ecological and agrarian issues, in the sense that it posits that different ways of farming (or 'farming styles', using van der Ploeg's vocabulary) will bring different environmental outcomes at both the farm and landscape levels. Perfecto et al. and Harvey et al. also focus mainly on biodiversity conservation to sustain their argument, explaining, for instance, the extent to which landscapes with abundant tree cover within the matrix (patches of forests, riparian forests, tree plantations, live fences, trees within pasture areas) and connected with forested conservation areas contribute to maintaining high levels of biodiversity. But these authors also suggest that this type of tree-abundant matrix has other positive environmental outcomes, such as "natural pest management, carbon sequestration and water and soil conservation" (ibid. 2008, p. 9). This suggests that the environmental quality of the matrix goes well beyond the biodiversity dimension.

I will refer to the concept of Nature's matrix in a twofold dimension. First, it is the concrete patchwork of land and natural resource uses that emerges from the ongoing mutual interactions between collective development pathways, individual trajectories and natural elements in a specific rural landscape. Second, the concept also entails a direct link between the emergence of this matrix, resulting from the implementation of dominant development pathways in rural landscapes and environmental outcomes (beyond the merely 'biodiversity' dimension). The matrix is therefore the specific patchwork and its ecological outcomes in every dimension.

The quality of the matrix in environmental terms refers to the extent to which the matrix as a whole will be "environmentally (un)-friendly". This is linked to the types of

agricultural production systems that have emerged within the dominant development pathways. For instance, the land and natural resource use patterns, the size of farms and plots, the level of diversification, the presence of trees within the farms, the use of chemical inputs or mechanised workforce, the animal and vegetal varieties used will have altogether a direct impact in terms of the matrix's environmental features. Martinez-Alier (2011), for instance, analyses the Via Campesina discourse, which states that 'peasant agriculture cools down the Earth,' saying that this discourse is based on ecological calculations that show how different types of farming have different consequences with respect to the net use of energy within farms. Another example is given by Holt-Gimenéz (2002), who demonstrates how different ways of farming have different outcomes in terms of resistance to natural disasters (in that case a hurricane). Weis (2010) also brings a similar argument when he demonstrates how the industrial way of farming leads to biophysical overrides in terms of resource use (nutrients in soil, water, energy etc..).

It is important to underline nevertheless that my work does not focus on evaluating the environmental features of the matrix but on the process of emergence of the matrix through the dynamics of complex socio-ecological systems, mainly the co-production process resulting from the ongoing interaction between human and natural elements. As for assessing the quality of the matrix, I will simply refer to pre-existing works that have shown the positive environmental outcomes of farming based on agro-ecological principles in comparison with other ways of farming (Altieri & Toledo, 2011; Harvey et al., 2008; Holt-Giménez, 2002; IPES-Food, 2016; Perfecto et al., 2009). These principles are described by Altieri and Toledo (2011, p. 588):

> "The core principles of agroecology include recycling nutrients and energy on the farm, rather than introducing external inputs; enhancing soil organic matter and soil biological activity; diversifying plant species and genetic resources in agroecosystems over time and space; integrating crops and livestock and optimizing interactions and productivity of the total farming system, rather than the yields of individual species (Gliessman 1998). Sustainability and resilience are achieved by enhancing diversity and complexity of farming systems via polycultures, rotations, agroforestry, use of native seeds and local breeds of livestock, encouraging natural enemies of pests, and using composts and green manure to enhance soil organic matter thus improving soil biological activity and water retention capacity. […] Agroecology is highly knowledge-intensive, and is

based on techniques that are not delivered top-down but developed on the basis of farmers' knowledge and experimentation."

Drawing on these insights I argue that Nature's matrixes where agricultural production processes are geared towards such kinds of principles will have a better quality than others. Therefore, collective development pathways that open opportunities for individual trajectories where the way of farming is tinted with agro-ecological features will participate in the co-production of environmentally friendly matrixes.

3. UNPACKING COMPLEXITIES: INTRODUCING AN ANALYTICAL FRAMEWORK TO INVESTIGATE THE ECOLOGICAL AGRARIAN QUESTION

3.1 TOWARDS AN ENGAGED EPISTEMOLOGICAL STRATEGY

The question that interests me now is an epistemological one, i.e., I need to make explicit my positioning with respect to what can be known, described and analysed about the conceptualisation of the reality I have developed above. Even if I approach the reality of rural landscapes as indivisible complex socio-ecological systems where natural and human elements cannot be separated and analysed separately from each other, I am also aware that the process of knowledge creation (as we know it at least) is realised solely by human beings. The question I try to answer here is therefore whether human beings are independent from the reality they want to describe and analyse and to what extent they can have access to it and describe it objectively.

In order to bring insights in answering this question I draw on the work of West et al. (2014) who compare two very influential approaches that have been developed to analyse human-nature relations in the scope of the challenges raised by the quest for a more sustainable future: the 'resilience perspective' developed by the Stockholm Resilience Centre (SRC) on the one hand; and the 'pathway approach' of the Social, Technological and Environmental Pathways to Sustainability Centre in Sussex (STEPS). According to West et al. (2014), even if both approaches adopt a similar positioning in looking at reality as complex socio-ecological systems and share the similar objective of bringing insights into the search for sustainability, they differ greatly with respect to their epistemological underpinnings. The STEPS approach, on the one hand, highlights the fact that several competing framings over a same concrete reality always co-exist and that these framings shape the features of the systems as such. Then, systems do not exist per-se but are constructed by the way these different competing framings compete in their understanding of reality. That is why West et al. consider the STEPS approach as constructivist, i.e., an approach where reality is only created through the process of knowing it. Hukkinen (2014) takes a similar posture when he proposes the 'theory of embodied cognition' as a way to create knowledge about a socio-ecological system. Embodied cognition starts from the argument that the way to create knowledge cannot

be separated from the identity, ideas, culture and physical existence of the human being creating this knowledge, particularly the way human beings are related to its social and natural environments. In his article Hukkinen explains that:

> "First, the way an organism conceptualizes the surrounding world depends on the kind of body it has. Second, an organism's body in interaction with its environment questions the representational processes that form the core of the information-processing view of cognition. Third, the body and its environment play a constitutive rather than just a causal role in cognitive processing" (ibid. 2014, p. 102).

Therefore, it can be said that within the STEPS approach systems are subjective realities, framings of the reality. When searching to solve concrete complex issues to reach sustainability, this implies the need to acknowledge and explicitly take into account all existing framings that co-exist around the understanding of these issues. The role of power is crucial here because power will influence which framings emerge and dominate the understanding of a given issue. Indeed, as explained by West et al., power "closes down around particular interpretations, defining the 'ends' of knowledge by framing 'problems' and proposing 'solutions'" (ibid. 2014, p. 8). The attention of the STEPS approach is on how different actors frame different ways out of un-sustainability, with the objective of supporting those powerless actors whose framings are not taken into account. The final aim is explicitly to empower the powerless and their marginalised pathways to sustainability.

The SRC approach, on the other hand, considers systems as a reality in themselves. The issue related to knowledge creation processes is thus different than in the STEPS approach. Here the question resides in whether we can obtain a complete, objective understanding of these systems in order to make decisions. In that dimension, West et al. (2014) argue that the SRC approach can be classified as post-positivist in the sense that "while recognizing that knowledge will forever be incomplete, [it] holds out that approximations to a kind of objective truth may be obtained, and in fact must be obtained if decisive action is to take place on issues that threaten a sustainable Anthropocene". The SRC approach recognises that the process of creating knowledge is always biased and limited. This is due to the fact that numerous mediating factors shape this process, such as identity, world views, interests, any reference framework to which human beings adhere and in the case of research processes, research tools and

methods. The approach also argues that it is possible to reach an understanding of reality that, even if always incomplete, would allow for the promotion of an environmentally sustainable development with positive social characteristics. But it is crucial to underscore that power plays an important role in the process of knowledge creation around concrete socio-ecological realities. For instance, Cote and Nightingale (2012) argue that there is a need to engage with normative issues when dealing with the question of the resilience of socio-ecological systems (especially in its social dimension). According to them, we cannot escape from asking "important questions about the role of power and culture in adaptive capacity, or to unpack normative questions such as 'resilience of what?' and 'for whom?'" (ibid. 2012, p. 479). This implies dealing with social inequity issues and reflecting on which actors to engage with in order to foster social change. This brings power issues into the process of knowledge creation within the realm of the SRC's 'resilience perspective'. The creation of knowledge about concrete socio-ecological realities must therefore include a political dimension consisting of the analysis of which actors obtain which benefits from the emergence of a specific system's dynamics. Acknowledging this political dimension is necessary if we want to be able to debate the adequacy of different processes in light of different development objectives.

Thus, both approaches include the need to bring politics back into the analysis of socio-ecological systems. This overlaps with the ´development pathways´ approach introduced above, which acknowledges the existence of political arenas within complex socio-ecological systems that shape the emergence of dominant collective pathways and individual livelihood trajectories. These political arenas play a role at two levels: in the concrete social relations in the field but also in the definition of legitimising ideas about what is correct or fair (i.e., the process of knowledge creation). Understanding and analysing these arenas is crucial not only to identify the 'poor' (as described in the 'development pathways' above) but also to better understand the processes that impede them from living the life they value. With respect to the role of researchers, acknowledging these power dimensions also implies acknowledging that neutrality is not possible and that we need to engage with the 'poor' and support their struggles within these political arenas. This leads to moving the research effort towards processes

of action-research where we position ourselves alongside some actors in the field and engage with them in their struggles.

Concretely, within my research process I have been inspired by the discussion of the approaches of STEPS and SRC in designing my own epistemological strategy. As such, the analytical framework I develop in section 3 in order to analyse concrete rural settings has to be seen as only one of the possible framings about this reality, i.e., only one of the possible ways to create knowledge about reality. I acknowledge that this framing is subjective because it is shaped by my initial training as an agronomist and my engagement as a practitioner alongside peasant movements. Using the vocabulary of the STEPS approach, my framework can therefore be understood only as one of the possible framings that deal with the ecological-agrarian question within the Nicaraguan agricultural frontier. The peculiarity of this framing is that it should make possible the visibility of one *marginalised pathway* to sustainability, a peasant pathway[30]. My research process thus has to be seen as being part of a political arena where several other co-existing framings conflict around the same issue. Therefore, I am not pretending that I am as a researcher only describing reality. On the contrary, I acknowledge that I am also an actor of this reality and therefore am actively creating and performing in it, and, as a result, am participating in the political arenas around development ideas and proposals regarding agrarian change issues. As such my work is related to development practice processes in which I am embedded in the field but also to activist processes implemented by the groups I am working with. This will be shown in Chapters 4 and 5 of this dissertation where I present the results of an action-research process implemented together with a local NGO. Therefore, my work is about actively struggling to promote a certain alliance with some actors in the field. Paraphrasing West et al. (2014) when they analyse the SRC approach, what I do in this dissertation is

[30] Referring to the work of Perfecto et al. (2009), another related framing whose main objective is to achieve biodiversity conservation in the tropics could be the one politically aligned with food sovereignty movements: "The very farmers who practise agro-ecological methods have frequently been driven off their lands, legally or not, and those who have preserved their farms are today faced with enormous economic, ecological, and political pressures. While there are many obvious reasons for wanting food sovereignty, for the specific purposes of our argument the crucial aspect of this new social movement is that it normally contains within it the assumption that the production system will preserve biodiversity and be based, to whatever extent possible, on the functioning of the local natural system. This is precisely what we claim is needed" (ibid 2009, p. 9).

develop a framework that permits me *to reach an approximation to the truth that allow[s me] to take decisive actions on an issue that threatens a sustainable Anthropocene,* namely, the socially and environmentally unsustainable development of agricultural production systems in the Nicaraguan agricultural frontier.

3.2 WHAT IS NEEDED: HOLISM, DYNAMISM, AGENCY AND STRUCTURE, AND A MULTIPLICITY OF SCALES

Section 2 has highlighted the way I conceptualise reality. In a nutshell, I have argued that rural landscapes can be defined as complex social-ecological systems in which dynamics of change result in the emergence of collective development pathways conditioning individual trajectories. These development pathways are shaped by (but at the same time influence) actors' agency, which is itself enabled and limited by structural factors belonging to both the natural and social realms. With respect to the latter, three specific dimensions of the institutional context, all of them influenced by issues of power, seem to play an important role: the actors and their network, the rules in use, and culture and ideas. Finally, the implementation of particular development pathways will have differentiated consequences for different individuals and groups. There will be winners, i.e., actors able to engage others in their own views that grab most power, resources and benefits, and losers, generally the 'poor', i.e., those who hold less voice and power, whose views are taken into account less and who get few benefits from these development pathways.

In order to develop an analytical framework that allows this conceptualisation of reality to be unpacked, several dimensions appear to be crucial. The first is holism, which is a direct consequence of adopting complex system thinking. Indeed, seeing reality as a complex system implies acknowledging that the system is composed of a multiplicity of elements inter-related to each other in a non-linear way. The properties of the system cannot be explained by the simple sum of their parts and the system has therefore to be seen as a whole. I.e., we need to simultaneously discern the social-human dimension of the development pathways and the agro-ecological characteristic of the Nature's matrix of the landscapes. Whatever the focus of analysis is, trying to simplify the processes taking place within those systems as a direct relationship between a limited number of dependent and independent variables is not an option. On the contrary, what

is needed is to embrace a holistic perspective that focuses on the processes more than on their outcome. Putting it in another way, it is not about analysing if 'variable A' is the cause of 'variable B' but about the processes that links both variables in a bidirectional way and with the interventions of 'variables C,D,E,F,….'. Several approaches to dealing with agrarian issues try to take holism into account as, for instance, the livelihood approach (Chambers & Conway, 1992; de Haan & Zoomers, 2005; Scoones, 2009), the activity system approach (Gasselin, Vaillant, & Bathfield, 2014; Paul, Bory, Bellande, Garganta, & Fabri, 1994), or the French agrarian system approach (Cochet, 2011, 2012) (see below for a comprehensive description). Within the literature I have reviewed, the most comprehensive way to take holism into account is certainly through the concept of 'web', introduced by van der Ploeg et al. (2008) to define rural development. According to these authors, the 'web' "is the pattern of interrelations, interactions, exchanges and mutual externalities within rural societies. This pattern embodies and describes 'the mutual interactions' that take place between agriculture, the socioeconomic context in which it is embedded and the rural development process(es) within which it is a constituting element. In short: the web interlinks activities, processes, people and resources and, simultaneously, it shapes the ways in which they unfold" (van der Ploeg et al., 2008, p. 2). In order to better approach this holism, taking a multidisciplinary approach is certainly a condition.

The second dimension, systems dynamics, is directly tied to the first one. The consequence of holism is that the outcome of the interactions within the system cannot be predicted, leading to the emergent property of the system. This leads to the need to take into consideration the dynamics of the system as part of the analysis and therefore look at historical patterns of change. Within livelihood studies, for instance, this has been done by De Haan and Zoomers (2005) with the introduction of the concepts of livelihood trajectories and livelihood pathways (see discussion about these concepts above in this chapter). Historical analysis is also a crucial element for scholars working with the agrarian system approach. The work of Mazoyer and Roudart (1997), which analyses the evolution of agricultural production from its birth until today is certainly the best example. van der Ploeg et al.'s 'web' is also seen as dynamic, and the authors explicitly acknowledge that it emerges from the continuous interaction of six

interrelated elements (endogeneity, novelty production, sustainability, social capital, institutional arrangements, and governance of markets). This leads van der Ploeg to advocate for the relevance of longitudinal studies to analyse dynamics of agrarian change (van der Ploeg, 2009).

The third dimension is related to an issue of scale. Our conceptualisation of reality implies integrating several geographical levels in order to get a full understanding of Nature's matrix: the plot level (where agricultural practices are implemented); the farm level (where decision-making processes over these practices take place); the landscape level (where the aggregation of the previous levels happens). But it also leads to taking into account several social levels in order to illustrate both individual trajectories of change and collective development pathways. Few approaches dealing with agrarian issues seem to embrace a multi-scale dimension in both geographical and social realms. Taking the discussion about this aspect a little bit further, it can be said that the scope of the science that studies agricultural processes, i.e., agronomy, is often too narrow to analyse the whole picture of human-nature relationships. Agronomy's unit of analysis is often limited to agricultural practices and its level of analysis is usually a plot of land, or more broadly the farm. This has two consequences. First, it narrows the scope of analysis too much to the only technical aspects of specific agricultural production processes within the farms. Second, it leaves aside most social aspects, at least when they happen outside the farm, or are not directly linked to the production process (i.e., value chain relations, rules around access to land, credit etc…) (Cochet, 2012; Rizzo et al., 2013). Social sciences can participate in solving the latter; however, as explained by Cochet (2012), when the analysis of agricultural processes is realised by social scientists, the focus is so much on social attributes that little attention is given to the technical processes that underlie agricultural practices, losing as a result the connection between the human and the natural spheres (see for instance Hervieu and Purseigle (2013) for an overview of approaches in rural sociology). To some extent, rural geography helps address this dichotomy as it allows the level of analysis to expand beyond the borders of the farm and to combine both social and environmental elements in the analysis of the changes of geographical spaces to a certain extent. However, it often loses the focus of what is happening at the level of the farm, which is the level where most decisions

are actually taken (Rizzo et al., 2013). Within the literature I have read, the most comprehensive approach with respect to this multiscale dimension would be, again, van der Ploeg's with: i) the concept of farming styles, which deals with the individual-collective, relating agricultural practices to broader collective patterns of farming; and ii) the concept of 'web,' which deals with dynamics of change at a regional level in interaction with global issues because "nowadays, any reference to the region […] necessarily and unavoidably intersects with the debate on the changing interrelations of the local and the global and the ways in which these are to be conceptualised" (van der Ploeg et al., 2008, p. 15).

The fourth dimension is related to the debate around agency and structure. Our development pathways approach calls directly for an actor-oriented approach, which takes into account structural elements. In that sense I take distance both from structuralist class-based approaches (e.g., Bernstein (2010)) and from more individualist neo-classical or neo-institutional approaches (e.g., Popkin (1979)). I am more in line with approaches such as De Haan and Zoomers (2005, p. 41), who argue that "individual strategic behaviour is acknowledged while, at the same time, it is bounded not only by structural constraints imposed by geography or demography, but pre-conditioned (a better term is probably embedded), as it were, by the available historical repertoire". And they add that "people do make their own livelihoods but not necessarily under conditions of their own choosing" (ibid. 2005, p. 43). A similar argument is put forward by van der Ploeg (2010, p. 3) in the conceptualisation of farming styles, where he argues that several farming styles always co-exist in a given rural setting, resulting from the fact that "the same set of parameters (related to markets, technological development and agrarian policy) have been interpreted and actively translated into different courses of action."

What this previous overview demonstrates is that there is no unique set of literature that allows the main dimensions that characterise my conceptualisation of reality to be taken into account. As a result, there seems to be a need for an approach that allows me to take a more detailed account of both human and natural elements and their reciprocal two-way relations at different scales in rural landscapes. I build my own approach drawing on Rizzo et al. (2013), who argue the need to integrate both

agronomical and geographical sciences. As argued by these authors, one key federating element between most of the approaches that mix agronomical sciences and geography is the argument that analysis must be realised at the level of the landscape. For these authors the reasons seem to be twofold. On the one hand, it is the scale where we can actually see the aggregated consequences of agricultural practices implemented individually by farmers in their farm (giving rise to a specific Nature matrix). On the other hand, landscape appears to be the best scale for effective collective decision-making processes to reach collective action (i.e., it is not about improving agricultural practices in an individual farm but improving collective/aggregate processes involving several actors). Another key federating element between these approaches seems to be the idea of holism, i.e., the need to consider in the analysis elements from different interconnected realms such as physics, ecology, biology, politics, economy, and culture (Cochet, 2012; Rizzo et al., 2013). Cholley (1946) already argued in the middle of the XXth Century that rural geography must acknowledge the fact that rural landscapes' constituting elements cannot be analysed independently[31]. He introduces the concept of 'solidarity' to illustrate that all these elements are in relation to all the others, but also to the combination of elements as a whole as well as to external elements. He also argues that the result of these interactions is an evolution of the landscape as a whole in a specific direction. However, when changes happen in one or several elements, and when these changes are able to alter the solidarity of the combination as a whole, bifurcations become possible. These insights taken from the roots of French rural geography can clearly be translated into what is called today system thinking and complexity theory, and as a result it overlaps with our ontological posture presented above. That is why I build my own analytical framework in the following sections, starting from one approach that links agronomy and geography ,the agrarian systems approach, which has been developed by French-speaking scholars within the scientific

[31] "Chaque fois donc qu'il s'agira d'étudier la nature ou le comportement d'un des éléments de la combinaison, nous devrons toujours avoir présent à l'esprit l'ensemble même dont il fait partie, c'est-à-dire les rapports qui unissent les éléments les uns aux autres. C'est à cette condition que le fait considéré prendra toute sa valeur géographique"(Cholley, 1946, p. 82)"Comme dans toute combinaison, une solidarité profonde unit les- éléments qui la composent. Ils réagissent les uns sur les autres, et ces réactions dérivent autant de leur nature propre que de la manière dont ils ont été mis en branle par les influences extérieure"(Cholley, 1946, p. 86)

discipline of Comparative Agriculture (Cochet, 2011, 2012; Dufumier, 1996; Mazoyer & Roudart, 1997).

3.3 STARTING FROM THE AGRARIAN SYSTEMS APPROACH

3.3.1.AGRARIAN SYSTEM: A DEFINITION

The concept of agrarian system has been developed by French scholars who tried to unravel the complexities that characterise concrete rural realities, or concrete agrarian situations. It has been described in different ways by different scholars. It is not our ambition to give an exhaustive overview, but, based on the reviews of the concept realised (see Jouve (1988) and Cochet (2012)), some common elements seem to be shared by most of them, elements that could give insights about the essence of the concept:

- *Collective dimension*. This implies that landscape patterns cannot be explained only as the simple sum of individual decision-making processes and agricultural practices implemented within independent farms, but as the result of historically built rules and norms, institutions, social structure, power relations, culture, and world views which are part of and characterise a broader rural society (broader in the senses that it can overstep the limited geographical space analysed).
- *Holism and interweaving between natural and human elements* (as already explained above)
- *Fuzzy borders*. There is no agreement on the way to identify the limits (whether geographical or social) of an agrarian system. As a result the concept can be used at different geographical scales, from the level of one rural village to the level of the planet Earth as a whole (as for instance in Mazoyer and Roudart (1997)).

Within the Comparative Agriculture discipline the concept of agrarian system has first been defined by Mazoyer as ‘‘a way of exploiting an agro-ecosystem that is historically defined and sustainable, adapted to the bioclimatic conditions of a given area, and responding to the social needs and conditions of the moment’’ (Mazoyer, cited in Cochet (2012, p. 130)). This definition introduces the idea that an agrarian system has reached an equilibrium and is to some extent socially and environmentally sustainable. However, Mazoyer also includes in his work the idea that the system can suffer crises that lead to

a re-organisation of the system towards a new equilibrium (see for instance his work on this history of world agricultures (Mazoyer & Roudart, 1997), which overlaps with our conceptualisation of complex social-ecological systems. Mazoyer's definition has been reworked later on by scholars within the Comparative Agriculture school to come with a more precise and complete definition given by Cochet which explicitly encompasses several elements of my conceptualisation of reality presented in section 2, i.e., social relations, natural elements that comprise the Nature's matrix, and historical patterns of change:

> "I would argue that the agrarian system encompasses first of all the mode of exploitation of a given environment. This mode of exploitation includes: (1) the characteristics of one or several agro-ecosystems; (2) a modus operandi, which itself is characterized by the farmers' technical heritage (tools, knowledge, practices, know-how that have evolved over time); (3) the way the environment has been transformed by man over time; (4) the resulting landscape; (5) the relationships between the different agro-ecosystems that make up the environment; and (6) soil fertility renewal mechanisms. The agrarian system also includes the social relations of production and trade that have led to its implementation and development (particularly the conditions influencing access to resources) as well as the conditions affecting the distribution of resulting value added. It includes a limited number of production systems, the mechanisms that differentiate these systems, and their respective trajectories. Finally, it includes the characteristics of the specialization and social division of labor, within each sector, and the economic, social and political conditions—particularly relative pricing systems— that influence the farmers' integration in global markets" (Cochet, 2012, p. 130).

3.3.2.THE FOCUS ON AGRICULTURAL PRACTICES

Cochet's definition of agrarian systems introduces the concept of production system as an entry point to unravel the complexities of agrarian systems. Production systems are understood here as the level where agricultural practices are implemented, i.e., the farm, and seem to be the relevant scale to analyse the functioning of agricultural production units, which is a necessary step to understand and analyse broader agrarian systems (Brossier, 1987; Cochet, 2012; Cochet & Devienne, 2006). Farms are indeed conceived as "the foundation of rural social fabric, where production processes are organised and production chains crisscross. Farm holdings are the elemental links that connect villages, giving rise to solidarities, contradictions, conflicts" (Cochet, 2012, p.

130). In the French tradition[32] the concept is broader than only what is related to agricultural production processes and often includes social as well as environmental elements. Analysing farms as production systems implies looking at the whole and not only the elements that are part of this whole, i.e., bringing attention to the processes that derive from the interconnection between different elements, including, but not only, agricultural practices. A production system is indeed more than just a simple sum of agricultural practices and that is why Comparative Agriculture always tries to understand and analyse the ecological, socio-ecological, and technical elements that lie behind these practices. Agricultural practices appear therefore to be a concrete illustration of how humans and nature are related in rural landscapes and are the visible outcome of complex interactions in a long-term perspective as well as in a specific natural context. In order to understand this combination of elements at the farm level, the production system comprised both cropping and breeding practices that could to some extent be approached independently in order to better the technical rationale of the system as a whole[33]. It is the combination of these sub-systems that give rise to a production system and it is the combination of production systems that give rise to an agrarian system and therefore to a particular Nature matrix. This breaking-down process has to be understood as a process of zooming in, i.e., the geographical scale is each time smaller, from the landscape to farm and afterwards from farm to the plot.

Any production system results therefore from a complex combination of social, technical and natural elements which are translated into concrete agricultural practices. Trying to understand how this combination works should allow one to grasp not only what farmers do but also how and why they do it, while also assessing their results (Cochet & Devienne, 2006). Moreover, it encompasses processes that are broader than the primary agricultural production processes, as for instance those which characterise farmers' insertion in value chains or other social relations (Cochet, 2011, 2012). Finally,

[32] In the English-speaking academic world, it is most often referred to as the concept of farming system. As explained by Cochet (2012), scholars using this concept "rarely integrated the historical dimension of agrarian systems nor did they examine the relationship between farmers' technical choices and the socio-political context".

[33] According to Cochet, "the cropping system concept is not applied to a crop, but to a plot (or group of plots) cultivated in a particular way. It encompasses the crop(s) that are cultivated, the crop associations, crop successions, and the ensemble of techniques used according to a specific sequence and pedo-climatic conditions" (ibid. 2012, p. 132). In the same way breeding sub-systems include a large range of practices (feeding, reproduction, veterinary care, etc…) and are applied at the level of the herd or group of animals managed in a same way.

in the cases where farming is not families' main activities, this production system could be considered as a sub-system of what has been called activity systems by some scholars (Gasselin, Vaillant, & Bathfield, 2012). As explained by Cochet (2011, 2012), the mental process of understanding a complex reality using the lens of Comparative Agriculture is therefore a process of zooming in, i.e., looking at more and more details in order to achieve a better understanding of the reasons that lie behind the agricultural practices implemented by farmers in a specific context. It is this rationale that motivates the breaking down of agrarian subsystems towards scales of analysis that allow one to better identify but also explain agricultural practices. Nevertheless, this process of zooming in has not been seen as a decomposition of a complex phenomenon in independent smaller scale and more understandable processes. We always have to keep in mind that these different scales are inter-connected and that this breaking down process is only a mental tool to better understand a complex reality. That is why, as already argued by Cochet, it remains very important that this zooming-in process comes together with a constant zooming-out process which allows always concrete agricultural practices to be situated in a broader reality than only within the borders of a plot, or a farm. This combination of scales of observation, analysis and understanding is certainly one of the strengths of the Comparative Agriculture approach and it allows for the linking of agricultural practices with the emergence of a specific Nature's matrix.

3.3.3.TOWARDS A BETTER UNDERSTANDING OF DYNAMICS OF CHANGE

Moreover, referring to Comparative Agriculture implies avoiding looking at a specific reality in a static way but trying, on the contrary, to locate current practices in a historical pattern of change, trying to answer questions such as: how have practices evolved in time? Under what conditions have they emerged and changed? What changes can we expect in the future? (Cochet, 2011; Cochet, Devienne, & Dufumier, 2007). As explained by Cochet (2011), working within the comparative school implies adopting a diachronic approach and acting as a historian. Dealing explicitly with these historical patterns implies tackling landscapes' physical patterns of change (i.e., the shaping of the Nature matrix) and at the same time identifying processes of differentiation between types of farmers, not only depending on the practices they implement but also on differentiated interests, power, social relations and world views (as explained below this is what is

expected in theory; in practice the way to unpack those social elements is not clear). This is indeed crucial to understand the different development pathways and the processes of inclusion/exclusion within these pathways. Therefore, it tries to open the black box of unified rural communities and will bring insights in the understanding of who is included/excluded and what kind of effects we can expect (but not predict) from certain interventions. As a result, this helps to achieve a better understanding of the emergence of specific development pathways.

3.3.4. WHY FARMERS DO WHAT THEY DO: CONCEPTUALISING THE RATIONALITY OF FARMERS

Finally, behind the approach of Comparative Agriculture and the utilisation of the concepts of agrarian system, production system, cropping and breeding system lie the search by the investigator to identify what farmers do and how they do it but also why they do it. The underlying idea behind this 'search' is the principle that everywhere around the world and at every moment in history, farmers have a good reason to do what they do (Cochet, 2011; Cochet et al., 2007), even if not necessarily consciously. This principle, called 'coherence principle' by Brossier (1987), implies that there is a rationality behind farmers' behaviour. Most importantly, it implicitly suggests that this rationality can be uncovered, which explains the effort of the Comparative Agriculture school to try to identify and explain the agricultural practices that characterise specific agrarian systems. The question that arises then is what factors/elements lie at the core of farmers' rationality. Cochet (2011) explains that this rationality is not merely economic. For him, farmers are not simply *homo-oeconomicus* who foresee to maximise their income or production. But he also recognises that farmers' behaviour cannot be explained only by culture or traditions. With respect to the latter, Cochet even argues that behind historical patterns of farmers' behaviour there are always material explanations which have to be unravelled by the researcher. Altogether, Cochet clarifies that, within Comparative Agriculture, rationality has to be understood as multidimensional but also as bounded. Rationality is multidimensional in the sense that, even if farmers behave in function of their own interests, not every farmer has the same interests, particularly these interests that overstep the mere economic dimension.

Rationality is bounded because farmers' decisions are always limited by a set of cognitive, material, and human factors.

3.4 AMENDING THE AGRARIAN SYSTEMS APPROACH: A DEFINITION OF THE PEASANTRIES, A FOCUS ON SOCIO-INSTITUTIONAL ELEMENTS THROUGH THE ANALYSIS OF ACCESS MECHANISMS

As demonstrated above, the agrarian systems approach explicitly acknowledges several key dimensions of our conceptualisation of reality: it is a systemic approach, it is holistic, it takes into account dynamics of change and it encompasses multiple scales of analysis. Moreover, it focuses on farmers' practices in a way that recognises that those practices are the result of the concrete farmers' choices, following a multi-rational decision-making process. The approach has shown to be very powerful to analyse agrarian issues at several levels, whether local (Cochet & Merlet, 2011; Garambois & Devienne, 2010), national (Anseeuw, Cochet, & Freguin-Gresh, 2016; Maldidier & Marchetti, 1996) or global (Mazoyer & Roudart, 1997). It has also been applied in almost every context around the world, from Europe (Garambois & Devienne, 2010) to Africa (Anseeuw et al., 2016; Bainville, 2016), Latin America (Bainville, Mena, Rasse-Mercat, & Touzard, 2005) or Asia (Devienne, 2013). With few exceptions it has, however, been restricted to the French-speaking academic world.

The application of the approach shows, however, that it is incomplete in some aspects and fails in encompassing some elements of my conceptualisation of reality, especially the political dimension. In section 2 I have argued that my theoretical approach brings politics in two different dimensions. The first one is related to the 'politics within' the system and is related to actors' margin of manoeuvre to decide and act. As explained above, it is about the processes happening within several political arenas that shape and are shaped by the emergence of collective development pathways and individual trajectories. This is related to the debate around actors' agency and to what extent this agency is bounded by structural factors and social relations. The second realm of politics concerns my engaged epistemology posture. It implies normative issues in relation to the process of knowledge creation, i.e., with my engagement as a researcher alongside the peasantry, which brings in the question of reflection on what the peasantry is. In his review of the seminal work of Mazoyer and Roudart (1997), where the agrarian systems

approach is used as a lens to describe and analyse the evolution of agricultural production around the world, van der Ploeg (2011) explains how the approach falls short in covering the previous two political dimensions. I will draw on van der Ploeg in order to touch upon both dimensions in the following sections and propose some amendments that complement the agrarian system approach in order to complete a comprehensive analytical framework that deals adequately with the way I conceptualise the reality I investigate.

3.4.1. BRINGING ACCESS MECHANISMS WITHIN THE AGRARIAN SYSTEMS APPROACH

One of the main criticisms of van der Ploeg on the work of Mazoyer and Roudart is related to the fact that even when these authors constantly mention the importance of social features in the development of agriculture, the exact nature of those social processes and the way they impinge upon agrarian dynamics are never explicitly unpacked. As explained by this author:

> "[I]n the theoretical model of book, farmers/peasants only figure as producers. There are, in this model, no class relations, no politico-economic relations, no contradictions – let alone peasant struggles. The main differences associated with being a tenant, a farmer, a peasant and/or being rich, being poor, being oppressed or having space are simply summarized in the nondescript term 'social category'. In the different chapters that highlight the concrete history of agrarian systems (notably the ones located in Europe), there are many references to class relations, to the unequal distribution of social wealth and so on, but these seem somewhat additional, which is evidently due to the lack of theoretical categories for grasping and expressing their significance" (van der Ploeg, 2011, p. 267)

This leads to a feeling that the very detailed reconstruction of the historical evolution of agricultural production around the world, which is the main contribution of this book, is merely an issue of an automatic evolution of agricultural production techniques shaped by exogenous structural dynamics. As a result, van der Ploeg rightly argues that the approach is not actor-oriented enough:

> "There are many peasantries in the book, and every now and then they are depicted as having 'strong abilities' – what is crucially lacking, though, is an affirmation (both empirically and theoretically) of their central role in the step-by-step development of agricultural practices and the ongoing improvement of the social and natural resources that are part of these practices." (van der Ploeg, 2011, pp. 267–268)

Interestingly, van Der Ploeg's analysis of politics and the agrarian systems approach is very close to the argument of Scoones (2009) about the lack of attention to livelihoods perspectives, power and politics. Scoones explains that this is commonly recognised as one of the main failures of the livelihoods approach. Nevertheless, he argues that this is factually not entirely correct. He states that several scholars within the livelihood school have indeed dealt with how social and political elements influence livelihoods, approaching these dimensions in very different ways referring to concepts as "'transforming structures and process', 'policies, institutions and processes', 'mediating institutions and organisations', 'sustainable livelihoods governance' or 'drivers of change'" (Scoones, 2009, p. 180). However, Scoones recognises that these debates have remained secondary within the livelihoods studies tradition and he argues that this is mainly due to the "sometimes confusing and contradictory theorisation of politics and power" within the livelihoods school (ibid. 2009, p. 182). I believe the same analysis holds for the agrarian systems approach. In my view, there is therefore space to bring politics within the agrarian systems approach but it implies some additions and adaptations. Indeed, the problem is not that power and politics are completely missing within this approach. On the contrary, they are recognised as a crucial element. The fact that Cochet sees a strong affinity between the agrarian systems approach and Political Ecology is an indication of that:

> "[a]lthough the agrarian system is not at the center of the conceptual underpinnings of American political ecology, the latter has some similarities to the French school of Comparative Agriculture. It posits that agrarian dynamics are the result of the evolution of nature/society relations and their expression at the interface of bio-technical processes and socio-economic developments" (Cochet, 2012, p. 134)

But, just as with the case of livelihoods studies, the problem seems to rest in the fact that these power and social issues are not explicitly theorised and are therefore often dealt with only at the margins or in a superficial manner. In order to solve this issue I refer again to Theory of Access of Ribot and Peluso (2003) and I make use particularly of the concept of access mechanisms introduced by these authors.

Following Cochet's argument about the affinity between the agrarian systems approach and Political Ecology, it appears quite natural to look at conceptualisations of social

relations that are rooted within the Political Ecology school, which is the case of the Theory of Access. But above all, Ribot and Peluso's conceptualisation looks directly at the focus of my research in this dissertation, which is to look at the nature-society interface within the complex social ecological systems described previously. Indeed, I am interested in the reciprocal relations between natural resources and human beings which are influenced by and in turn influence the socio-ecological situation/sustainability of the system as a whole. Therefore, I want to understand the agro-ecological relations that link the ecological and human dimensions of the system and the main processes and factors that allow for the appropriation of natural resources by some actors and their transformation into wealth. The agrarian systems approach is certainly too vague to deal explicitly with this issue and I believe that Ribot and Peluso's 'Theory of access' could overcome this flaw.

Ribot and Peluso define access as "the ability to derive benefits from things" (ibid. 2003, p. 153) and argue that 'access' is different from 'property' because holding property rights over natural resources is not the same thing as being able to benefit from these resources. They point to the importance of identifying and analysing the 'mechanisms of access', i.e., the processes, mechanisms and relations that mediate the transformation of available natural resources in wealth by specific actors within particular situations. In line with complex system thinking, Ribot and Peluso argue that mechanisms of access "are heuristic [categories]; none is distinct or complete. Each form of access may enable, conflict with, or complement other access mechanisms and result in complex social patterns of benefit distribution" (ibid. 2003, p. 173).

The mechanisms of access are classified by Ribot and Peluso in two categories. Firstly, they refer to rights-based mechanisms, which correspond to mechanisms of creation and regulation of property rights, and which may or may not be based on the formal regulatory framework state. In Nicaragua, for instance, several studies have already demonstrated that in rural areas –and in particular within the agricultural frontier– property rights rest to a large extent on non-state regulatory frameworks which are sanctioned at community level and mediate between different state and non-state legal principles (Bastiaensen, D'Exelle, & Famerée, 2006; Broegaard, 2005). Secondly, they introduce the category of relational and structural access mechanisms, which refer to

the fact that "[t]he ability to benefit from resources is mediated by constraints established by the specific political-economic and cultural frames within which access to resources is sought" (Ribot & Peluso, 2003, p. 164). This category is very broad. Although the authors argue that there is no pre-defined set of structural and relational mechanisms of access, they give a non-exhaustive list of mechanisms that belong to this category: access to technology, access to capital, access to market, access to labour, access to knowledge, and access to authority, identity and social relations. Through this second category it seems clear that mechanisms of access have both a relational and a structural dimension and their analysis can indeed bring interesting insights with respect to the processes of cooperation or conflict that characterise the overall socio-ecological system:

> "The access framework […] can be used to analyze specific resource conflicts to understand how those conflicts can become the very means by which different actors gain or lose the benefits from tangible and intangible resources. […] [W]e expect to find that those who control some forms of access may cooperate or conflict with others— or do both at different moments or along different dimensions" (ibid. 2003, p. 173)

Ribot and Peluso explain that what is at stake when looking at these mechanisms of access is not only the processes through which actors gain access but also the processes that allow these actors to maintain access and to control the access of others. Access is therefore related to all the means, processes and relations by which actors are able to gain, control and maintain their ability to benefit from resources which depends on a fragmented, shared and divided bundle of powers. As a result, this brings social relations and power into the debate. Talking about "bargains around available resources and opportunities" (referring to the definition of the 'poor' by Bastiaensen et al. (2005) introduced above) thus means talking about struggles over access mechanisms between actors, i.e., struggles around: i) which actor can (or cannot) benefit from resources; ii) what mechanisms allow these actors to get differential benefits from natural resources; iii) how they manage (or do not manage) to maintain these benefits and iv) what the nature of these benefits is or should be.

Putting this framework of access together with my conceptualisation of the rural realities as complex socio-ecological systems brings me to a twofold argument. First, the

belief that access mechanisms can be seen as one of the specific processes that link several interrelated components within each complex social ecological system, especially the interplay between the human and the ecological realms. Second, the idea that the interaction between different mechanisms of access and other components within and outside the system is a key factor that shapes the implementation of the collective 'development pathways' that characterise each system as well as actors' individual livelihood trajectories. At the same time, these collective pathways and individual trajectories will have an influence on the mechanisms of access. Altogether, I argue that identifying and analysing access mechanisms is a way to unpack some of the political arenas that are at play within complex social ecological systems and therefore a useful 'political' amendment to the agrarian systems approach. In particular, it allows the farmers' agency to be made explicit in the scope of an enabling and constraining environment in a much more elaborated way than simply recognising the fact that farmers have a good reason to do what they do and that these reasons depend on a multiple rationality.

3.4.2.TOWARDS A POLITICAL DEFINITION OF THE 'PEASANTRY'

Van der Ploeg (2011) also criticises Mazoyer and Roudart (1997) because, while the peasantry is omnipresent in their book, there is never a definition of what a peasant is. It appears for van der Ploeg that the book talks about agricultural producers in a very broad way with little or no social differentiation.

> "The omnipresence and relevance of the peasantry seem to be so self-evident that any further analysis or theoretical elaboration of the concepts of peasant and peasantry are deemed unnecessary" (van der Ploeg, 2011, p. 266)

This criticism may be true in the case of the book by Mazoyer and Roudart but it is nevertheless not totally accurate with regard to the agrarian systems approach as a whole. As explained by Cochet (2011) and Dufumier (1996), the approach proposes a way of classifying farmers in three broad categories: family farmers, patronal farmers and capitalist farmers. Dufumier explains that family farms employ only family labour, patronal farms depend on waged labour in addition to family labour and capitalistic farms only rely on waged labour. Cochet adds to this labour-based differentiation the issue of a differentiated economic rationality between those broad types. As family

farms are based only on family labour, they are held to seek mainly maximisation of the return on family labour and therefore aim to maximise family income (both monetary and non-monetary) that they get from the agricultural production processes and other non-agricultural activities). On the contrary, agribusinesses are run under a capitalistic rationale where the objective is to maximise the economic return of the financial capital that has been invested in the production processes. In between both, patronal farmers are those family farmers who resort to waged labour and invest large amounts of financial capital in their farm. As a result, they share many features of family famers but in some aspects tend to adopt the rationality of agribusinesses. As explained above, however, the approach recognises that this economic rationality is not everything for family farmers. What family farmers do is therefore to pursue a "plural optimization" (Cochet, 2011, p. 131) of the factors of production they have access to, which means that the economic family-based rationality will be balanced with issues such as food security of the family, resilience of the production system in the face of shocks or building a heritage for future generations. Altogether the way the agrarian systems approach characterises farmers, differentiating them with respect to issues of labour and capital and making a clear-cut difference between capitalists and non-capitalist agricultural production, seems to resonate with the way the classic agrarian question analyses the processes of differentiation of the peasantry in the countryside (see Chapter 1). Moreover, the concept of 'plural optimisation' introduced within the approach can also be related to Chayanov's idea of 'Peasant Economy' (Thorner, 1988) an to the concept of 'Moral Economy' as described by Edelman (2005). The approach, however, lacks clarity and precision about what this moral economy entails in more detail.

Within the agrarian systems approach, we do not talk therefore of 'peasants' but of (family and patronal) farmers. This leads to a broad assumption that the peasantry comprises all family farmers and patronal farmers, i.e., all those types of farms where labour is mainly family-based and whose rationality is tinted by a specific peasant moral economy. If this is the case, it leads to a very broad categorisation of the peasantry where the peasants could be defined negatively, as all the agricultural producers who do not follow a capitalistic rationality. The problem with such an unspecified definition

is that it comprises so many different actors that it makes it very difficult to politically engage alongside the peasantry as requested by my engaged epistemological stance. I need therefore to introduce a more comprehensive definition of the peasantry, a definition that explicitly recognises the agency of peasants in the implementation of specific trajectories but also in the emergence of collective development pathways[34]. I find this definition in the work of van der Ploeg (2009).

Van der Ploeg, also very much in line with the debates within the classic agrarian question, starts his reflection arguing that history has led to the segmentation of agriculture in 3 main categories: peasant farming, entrepreneurial farming and corporate farming. The point made by this author is that the difference between these types is an issue of 'farming styles', i.e., of ways of farming. There seems to exist a link between these categories and the one put forward by the agrarian systems approach. However, as explained below, with the introduction of the idea of 'peasant condition', van der Ploeg's typification of the peasantry is much more holistic in the sense that it goes beyond issues of labour and capital only. Paying attention to historical patterns of change and context and time specificities, van der Ploeg introduces a way to differentiate agricultural producers through a fine-tuned analysis of peasant moral economy and the importance of the way farmers relate to their natural environment and rural politics issues. In this way, his approach overlaps with more sociological (Hervieu & Purseigle, 2013) and anthropological (Silverman, 1979) approaches to analyse the peasantry. In that sense, van der Ploeg's work resonates more with the debates around the multiple agrarian questions of today, especially the ecological agrarian question, presented in Chapter 1.

With regard to the similarities with the agrarian systems approach, there seems to exist some level of overlapping between family and patronal farming and peasant farming on the one side and capitalist farming and corporate farming on the other, especially due to the importance of labour and capital factors. Indeed, peasant farming is characterised by van der Ploeg in such a way that it is:

[34] I therefore take distance from more structuralist class-based definitions of the peasantry as proposed by Lenin (1982) or more recently by Bernstein (2010)-

> "basically built upon the sustained use of ecological capital and oriented towards defending and improving peasant livelihoods. Multifunctionality is often a major feature*. Labour is basically provided by the family* (or mobilized within the rural community through relations of reciprocity), and *land and the other major means of production are family owned*. Production is oriented towards the market as well as *towards the reproduction of the farm unit and the family*" (ibid. 2009, p. 1 emphasis added).

Moreover, for van der Ploeg, corporate farming "comprises a widely extended web of mobile farm enterprises in which the *labour force is mainly or even exclusively based on salaried workers' [p]roduction is geared towards and organized as a function of profit maximization*" (ibid. 2009, p. 2 emphasis added). There is thus some kind of overlap between van Der Ploeg's approach and the agrarian systems approach. What makes a crucial difference is the existence of the third category of entrepreneurial farming introduced by van Der Ploeg. Entrepreneurial farming is characterised as "mainly (though not exclusively) built upon financial and industrial capital (embodied in credit, industrial inputs and technologies), while ongoing expansion, basically through scale enlargement, is a crucial and necessary feature. Production is highly specialised and completely oriented towards markets" (ibid. 2009, p. 1). This third category results from a very detailed and comprehensive conceptualisation of the peasantry based on the idea that there exists a peasant condition (i.e., the equivalent of a peasant moral economy) which translates into specific ways of farming. Van Der Ploeg describes the peasant condition with lots of details and with an explicit political tint:

> "Central to the peasant condition, then, is the struggle for autonomy that takes place in a context characterized by dependency relations, marginalization and deprivation. It aims at and materializes as the creation and development of a self-controlled and self-managed resource base, which in turn allows for those forms of co-production of man and living nature that interact with the market, allow for survival and for further prospects and feed back into and strengthen the resource base, improve the process of co-production, enlarge autonomy and, thus, reduce dependency. Depending upon the particularities of the prevailing socio-economic conjuncture, both survival and the development of one's own resource base might be strengthened through engagement in other non-agrarian activities. Finally, patterns of cooperation are present which regulate and strengthen these interrelations" (ibid. 2009, p. 23)

This definition introduces several elements that are central to the peasantry. The first one is the idea that the peasantry is characterised by an ongoing mutual interaction between human beings and nature which the author calls co-production. This is where

I believe there is an important connection between van der Ploeg's approach and the ecological agrarian question as presented in Chapter 1 drawing on the work of Moore (2015). This co-production is shaped by context and time-specific knowledge and by the predominance of manual skills, which brings the peasantry very close to craftsmanship. This, however, does not have to be confused with the idea that the peasantry is a remnant of the past, i.e., as a pre-capitalist form of production as put forward within the classic agrarian question. The peasantry has neither to be seen as a 'folk culture' or 'folk society' as put forward in some anthropological studies (Silverman, 1979). On the contrary, it implies an explicit acknowledgement of the ability of the peasantry to adapt and evolve in time. Therefore, the peasant condition does not represent a set of pre-defined factors written in stone, but an array of broad defining principles which will be constantly translated in different ways depending on biophysical, socio-institutional and historical contexts resulting in diverse and ever-evolving concrete practices. These practices, which are the concrete expression of the process of co-production, are very closely linked with the need to valorise labour, especially family labour:

> "Nearly all local repertoires stress the virtues entailed in labour and especially the values of the objects and relations created in and through the (self-controlled) labour process. Thus, the art of making good manure, breeding good cows and creating a horse of good character are all central elements of local repertoires that refer to farming as a socially constructed process. Connected with this is the importance attached to hard work, dedication, passion and knowledge – as strategic sources of the values created" (ibid. 2009, p. 28)

The second element is the corollary of this co-production. It corresponds to the fact that the peasantry is related in a direct way to the construction and maintenance of a specific resource base (i.e., infrastructures, natural resources, skills, tools, social relations). This resource base is at the same time the basis and the result of the co-production process. In other words, while the co-production belongs to the realm of 'production', the maintenance of the resource base belongs to the realm 're-production'. The specificity of this resource base is that it allows for levels of autonomy and freedom from the outside world and especially from market exchanges. This brings in the third element, which is key in the peasant condition: the political struggle towards autonomy and emancipation from the external world. Autonomy entails both a social and an agronomical dimension. Socially, it implies avoiding "being entrapped" (ibid. 2009, p.

27) within others' agendas. It implies some level of distrust towards external non-peasant actors. Agronomically, it relates to the search to avoid depending on external inputs:

> "Peasant farming is mainly, though not exclusively, built upon a relatively autonomous flow of resources produced and reproduced within the farm unit itself. […] thus creating a form of self-sufficiency (or self-provisioning) that is not related (as is still assumed in many theories) to the family consumption of food, but to the operation of the farm unit as a whole" (ibid. 2009, pp. 29–30)

The recognition that the peasant condition entails a constant struggle for autonomy implies the acknowledgement that there is manoeuvring room to strive for this autonomy and therefore that the peasantry has agency. This agency is geared towards achieving two levels of freedom: "one that secures at least some relative freedom from harsh relations of exploitation and submission; and the other (evidently linked to, and conditioned by, the first) freedom to act in such a way that farming is aligned with the interests and prospects of the involved producers" (ibid. 2009, p. 32). This agency of the peasantry is translated in a specific peasant way of farming which is geared towards producing as much value added as possible with respect to the resource base available, avoiding deteriorating this resource base, labour intensification and distancing from the markets (in the sense that not all relations and exchanges are governed by market using monetary valuations processes).

This definition allows one to differentiate entrepreneurial farming from peasant farming, moving away from the typical dualism of the classic agrarian question between farmers (pre-capitalist forms of production) and capitalist agriculture. Entrepreneurial farming is not implemented by capitalist investors but by family farmers whose behaviours are shaped by a specific moral economy, i. e., an entrepreneurial condition that, contrary to the peasant condition, puts the rules and norms from the market at the centre stage:

> "When the market is put centre stage, the argument is nearly always that in the future only a few farmers will remain and that the market is a highly selective 'arena' that will exclude many participants. The future is perceived as a scarce commodity and few will survive (although entrepreneurs will hardly use this word; they prefer to speak of those who will win). In the moral economy of agrarian entrepreneurs, the 'market' represents an ongoing and harsh contest. Only a few will win, and those who win (and this is an essential part of their moral

economy) are to be seen as the 'best'. And being the best, they have the moral right to win. The winning proves their moral superiority" (ibid 2009, pp. 140–141)

As a result, the entrepreneurial mode of farming differs from the peasant mode of farming in several ways, as presented in the figure below:

Figure 2.1: Main differences between peasant an entrepreneurial modes of farming

Peasant mode	Entrepreneurial mode
Building upon and internalizing nature; co-production and co-evolution are central	Disconnecting from nature; 'artificial' modes of farming
Distancing from markets on the input side; differentiation on the output side (low degree of commoditization)	High market dependency; high degree of commoditization
Centrality of craft and skill-oriented technologies	Centrality of entrepreneurship and mechanical technologies
Ongoing intensification based on quantity and quality of labour	Scale enlargement as the dominant trajectory; intensity is a function of technology
Multifunctional	Specialized
Continuity of past, present and future	Ruptures between past, present and future
Increasing social wealth	Containing and redistributing social wealth

Source: van der Ploeg (2009, p. 114)

One key element within van der Ploeg's conceptualisation of the peasantry is that, even if the categories of peasant, entrepreneurial and corporate farming can be conceptually defined, in practice the reality is much more nuanced with no clear boundaries between them. Indeed, more than a specific condition, as could be inferred from its name, the peasant condition has to be seen as a process, i.e., as a movement through time along a continuum of 'degrees of peasantness':

> "It is important to note that there is no clear-cut demarcation to distinguish in a definitive black-or-white way the peasant from the agricultural entrepreneur, nor are there any clearly cut frontier lines that separate the peasantry from the non-agricultural population. In ideal-typical terms, there are clear and fundamental differences; but in real-life situations there are –alongside clear empirical expressions of these ideal types– extended grey zones that link such expressions and at the same time demonstrate the gradual nature of these linkages" (ibid. 2009, p. 36)
>
> "At the empirical level, every time- and space-bound expression of the peasantry will represent specificity: particular features that reflect the society in which it is embedded and the history upon which it is built. […] [b]y actively moving along one, or several, or all indicated variables the peasantry can constitute itself as

> being more (or less) peasant like than was previously the case" (ibid. 2009, pp. 39–40)

This has important analytical consequences. The first one implies moving from snapshot analysis to historical context-specific analysis (van der Ploeg calls it longitudinal analysis). This is in line with my conceptualisation of the reality as a dynamic system and is already taken into consideration by the agrarian systems approach. The second one concerns the objective of such longitudinal analysis, and that is where van der Ploeg's contribution represents a useful amendment to the agrarian systems approach. While the latter focuses on the historical evolution of ways of farming, van der Ploeg advocates for the fact that the longitudinal analysis has to serve to move the focus towards the study of the historical evolution of the processes that lie behind the evolution of farming styles (in terms of re-peasantisation and de-peasantisation processes). In the scope of my research, this implies identifying to what extent specific collective development pathways open or close opportunities for the implementation of more (or less) peasant-like individual farmers' trajectories. In other words, to what extent development trajectories entail tendencies of de-peasantisation and/or re-peasantisation (and for whom), but also, and above all, what are the processes that lie behind these tendencies. My argument is that these processes can be unfolded thanks to the historical analysis of access mechanisms described above.

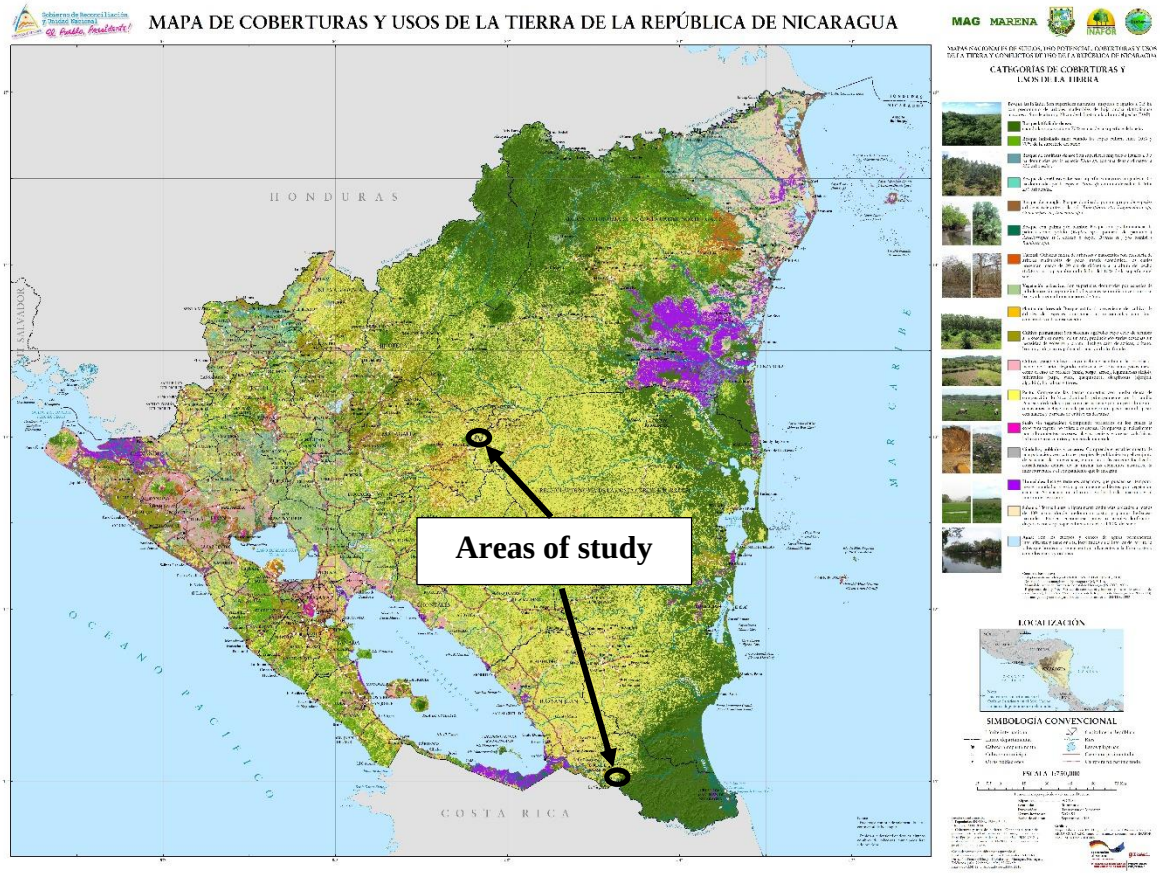
4. CONCLUSION: THE WAY FORWARD TO THE CONCRETE-SPECIFIC ANALYSIS

This chapter focused on the abstract-specific level of Lund's matrix to approach qualitative social sciences research (Lund, 2014). It presented a conceptualisation to approach rural landscapes and developed my analytical framework to analyse processes of agrarian change and land use change dynamics. Both the conceptual approach and the analytical framework are in line with the theoretical discussion introduced in Chapter 1 around the ecological agrarian question and will now be used to analyse agrarian and environmental dynamics in the Nicaraguan agricultural frontier in the following empirical chapters of the thesis. The movement from Chapter 2 to the next chapters is therefore a specification movement, where I move from the abstract-specific towards the concrete-specific, level of the research process, i.e., from the design of a lens to look at reality, towards the utilisation of this lens in a concrete and specific setting.

Through this specification movement, the research process will move to two small rural areas within the old Nicaraguan agricultural frontier; the first one in the highlands of the centre of the country and the second one in the south-eastern lowlands (see Figure 2.2). In line with the engaged epistemological strategy I adopt in this Ph.D. dissertation (see section 3.1), the choice of these areas of study is not a pure academic and neutral exercise. On the contrary, it is highly dependent on my active long-term involvement in broader development practice processes. These are indeed areas where I have been working closely with partners in the field to implement development actions: a development institute whose interventions have tried for more than 20 years to promote more sustainable agricultural production in the highlands; and, a conservationist NGO that aims at stopping deforestation in the Indio-Maiz nature reserve in the south-eastern lowlands. By explicitly embedding my work in the broader action of these organisations, my aim is to actively participate in the political arenas where the interventions of these two actors are designed, assessed, and implemented, i.e., to be part of a collective process of defining a way to better understand issues and shape actions. The dynamics that happen in both small areas are part of the broader phenomenon of the advance of the Nicaraguan frontier related to the growth of

livestock production introduced in Chapter 1. However, the processes of concrete land use and agrarian changes resulting from important inflows of farmers coming from the western region of the country initiated in different historical moments in each one of these areas: in the 1960s for the central highlands area and in the 1990s for the south-eastern lowlands area. The objective of the analysis implemented for both regions is not meant to be comparative, but to bring insights related to different processes or issues characterising the dynamics of land use and agrarian change in the Nicaraguan agricultural frontier. As such, the analysis implemented in each region will mobilise different elements of the analytical framework introduced in Chapter 2. In Chapter 3, I mobilise the complete analytical framework introduced above in the centre highlands of the country in order to better understand the emergence of dominant development pathways in the Nicaraguan agricultural frontier, and to what extent this emergence entails the implementation of re-peasantisation and/or de-peasantisation processes. Chapters 4 and 5 are embedded in a broader research-action process implemented in the south-eastern lowlands. In these chapters I intend to better understand the potential of development interventions in shaping collective development pathways and individual trajectories focusing mainly on the famers' decision-making processes.

Figure 2.2: Location of the small rural areas analysed in the empirical chapters of the dissertation



Source: own elaboration on land use map of Nicaragua in 2015 (Ministry of Environment and Natural Resources (MARENA) and Ministry of Agriculture (MAG), National Forest Institute (INAFOR), National Institute of territorial studies (INETER), National Agrarian University (UNA)).

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CHAPTER 3

DEVELOPMENT PATHWAYS IN A SMALL RURAL AREA OF THE NICARAGUAN AGRICULTURAL FRONTIER. A CASE STUDY

Note: Most of this chapter comes from the following publication: Merlet, P., Collado Solís, C., Lemoine, L., & Polvorosa Narváez, J. C. (2015). Acceso a tierra y rutas de desarrollo en el municipio de Río Blanco. In J Bastiaensen, P. Merlet, & S. Flores (Eds.), Rutas de desarrollo en territorios humanos. Las dinámicas de la vía láctea en Nicaragua. (pp. 191–228). Managua: UCA Publicaciones.

For the elaboration of this paper, the fieldwork related to the agrarian diagnosis resulting in the current farmers' typology and its historical evolution as well as the technical-economic calculations were realised in collaboration with a research assistant, Lea Lemoine. I was the main person responsible for the fieldwork related to the participatory mapping methodologies and related focus groups, the analysis realised using the Theory of access analytical framework (Ribot & Peluso, 2003), and the writing process.

Some parts of the original paper have been altered and additions to the original paper have been made in order to fit within the broader design of the Ph.D. dissertation.

1. INTRODUCTION

In this empirical chapter, I try to provide insights to answer Sub-research question 2: What are the main characteristics of the emerging dominant development pathways in the Nicaraguan agricultural frontier (i.e., the socio-ecological collective processes of change, the individual trajectories followed by farmers and their environmental and social outcomes)? My objective is to describe and analyse the historical agrarian change processes that characterise a concrete small rural area within the agricultural frontier in Nicaragua's central highlands in order to get a better understanding of the complexities of the rural landscape I am studying. More precisely, drawing on the theoretical and analytical frameworks presented in Chapter 2, I intend to investigate both the emergence of collective development pathways and the implementation of specific individual trajectories followed by different types of farmers.

The chapter is built as follows. After describing the methodology used to gather and analyse information in the field, I begin by approaching the dynamics of agrarian changes in the area of study using the agrarian systems analytical lenses proposed by the Comparative Agriculture school (Cochet, 2011, 2012; Dufumier, 1996; Mazoyer & Roudart, 1997). This allows me to elaborate a typology of farmers in the area depending on the current production systems these farmers implement as well as of the trajectories they have followed in time. Furthermore, I refer to the Theory of Access (Ribot & Peluso, 2003) to analyse these trajectories, trying to identify the historical evolution of the rights-based and structural and relational access mechanisms, which actually have allowed each type of farmer to profit from natural resources through the implementation of concrete production systems. Through this analysis, I identify some elements that have shaped the emergence of a dominant cattle-based development pathway in the area of study, particularly how this dominant pathway has actually opened or closed farmers' opportunities to implement concrete livelihood strategies but also how these strategies have consolidated the dominant pathway. Then, I offer insights about the outcomes generated by the emergence and development of this dominant collective cattle-based pathway with respect to several elements: i) the extent to which this pathway favours in different ways the distinct types of farmers (e.g.,

opening and closing opportunities in an unequal way); ii) the changes in the quality of the Nature's matrix; and, iii) the processes of (de)peasantisation (van der Ploeg, 2009) entailed. I also identify that, despite the strength and dominance of this cattle-based development pathway in shaping agrarian change dynamics, a subaltern, more peasant-like, cacao-based development pathway has also been able to emerge in the area of study. Finally, I reflect on the relations between both pathways, but also on the way the implementation of individual trajectories feeds back into the dynamics of change of these collective pathways, which give interesting insight into the possible futures we can expect for the area of study.

2. METHODOLOGICAL APPROACH

Methodologically, this chapter is mainly built on the implementation of the 'methodological package' put forward by the Comparative Agriculture school under the name of Agrarian Diagnosis to analyse specific and concrete agrarian systems (Apollin & Eberhardt, 1999; Cochet, 2011). An Agrarian Diagnosis is based on a process of immersion in the field and involves the realisation of transects, a participant observation process and the realisation of historical, technical and economic interviews with local farmers as well as open interviews with other stakeholders (community leaders, traders). This work served to classify farmers currently present in the area according to the production systems they implement and the historical trajectories they have followed, as well as to design technical-economic models of operation of each of these types. The economic results presented in this document derive from the calculations made for each of these models.[35]

Altogether, the use of these research methods allows the implementation of a landscape analysis, and historical and technical-economic analyses of the production systems. The landscape analysis aims at identifying landscape patterns in order to give insights for defining the borders of the agrarian system that will be studied. Moreover, it serves to map coherent agro-ecological units, i.e., geographical spaces characterised by a single way of managing and using natural resources (e.g., recurring combinations of crops) to try to reveal specific relations between agricultural practices and bio-physical conditions. The objective of the historical analysis is to identify and explain the trajectories followed by several production systems until the current situation. Finally, the economic and technical analysis provides a detailed and in-depth understanding of today's production systems, i.e., the agricultural practices that characterise them as well as elements that can explain the implementation of those practices. It is important to underscore that the identification and analysis of production systems within the Agrarian Diagnosis is not realised at the level of every individual farm existing within the borders of the agrarian system under scrutiny. Indeed, the former would be coherent

[35] 22 historical interviews and 31 technical-economic interviews were conducted and a total of 12 models of producer type were built, which were subsequently reworked under this chapter.

and relevant to bring individualised advice to farmers or within a census approach. But, as Comparative Agriculture looks at understanding dynamics of agrarian change at a landscape level, it focuses on describing production systems at the level of farmer types for which technical and economic models are built (i.e., a model represents a group of farmers with the same resources, embedded in a similar agro-ecological and socio-institutional setting and implementing the same combination of agricultural activities with similar practices and tools). The implementation of this methodology results in several concrete outcomes:

- The explicit linkage between natural resources and agricultural activity through the identification and analysis of landscape patterns.
- The reconstruction of agrarian system evolution over time. This includes a historical reconstruction of the production systems existing in the area as well as the description of the differentiation process that has led to the situation that can be observed nowadays. It also includes the description of the changes of the broad institutional context that have accompanied such differentiation processes (e.g., public policies, price relations, demography, migration processes).
- The elaboration of a typology of farmers
- The modelling of production systems for each type of farmer identified in terms of their technical functioning and economic results. Economic results will consist of different types of calculations according to the type of production unit. For family-based farms, the agricultural family income will be calculated. For farms managed in an entrepreneurial way (i.e., based on capital investment and wage labour), the focus will be on the calculation of the Internal rate of return. Both types of farms will be compared on the basis of the calculation of relative Value-Added measurements, whether in relation to area-unit or to labour-unit.

Agrarian diagnosis methodology is very useful to better understand the complexities of rural landscapes. Its specific tools help us unravel some elements that explain what people do and why they do it, especially in relation to economic, agronomic and structural factors. As argued in Chapter 2, interpreting the results obtained with the Agrarian Diagnosis through the lens of Ribot and Peluso's Theory of Access additionally

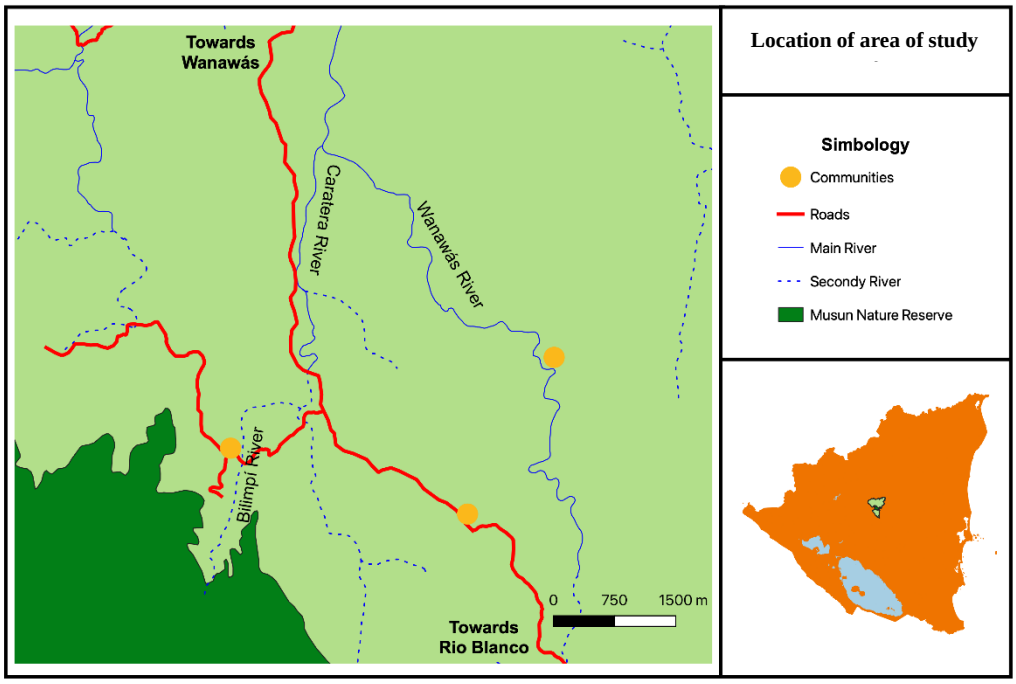
allows more social, institutional and cultural elements to be brought in, particularly issues of power relations that mediate those elements.

Finally, this methodological package was completed with the implementation of participatory community mapping exercises following the methodology presented by Gonda and Pommier (2004). Community maps developed during these exercises contain information on farm boundaries and land use in the community. They were used to hold specific workshops on the history of the community based on the maps drawn up by the community, in order to generate inputs of analysis on the historical evolutions of the territory in terms of agricultural production.

3. THE LANDSCAPE ANALYSIS: TOWARDS A ZONING OF THE AREA OF STUDY

The case analysed corresponds to an area of about 70 km^2 and is located north of Musún Hill, about 30 km from the city of Río Blanco. The study area consists of three micro-basins (Bilampí and Caratera rivers and upper Wanawás River basin) and is bounded to the south by the Musún Hill Nature Reserve (800 m high) and to the north by the confluence site of the Wanawás and Caratera rivers (200 m high) (see Figure 3.1).

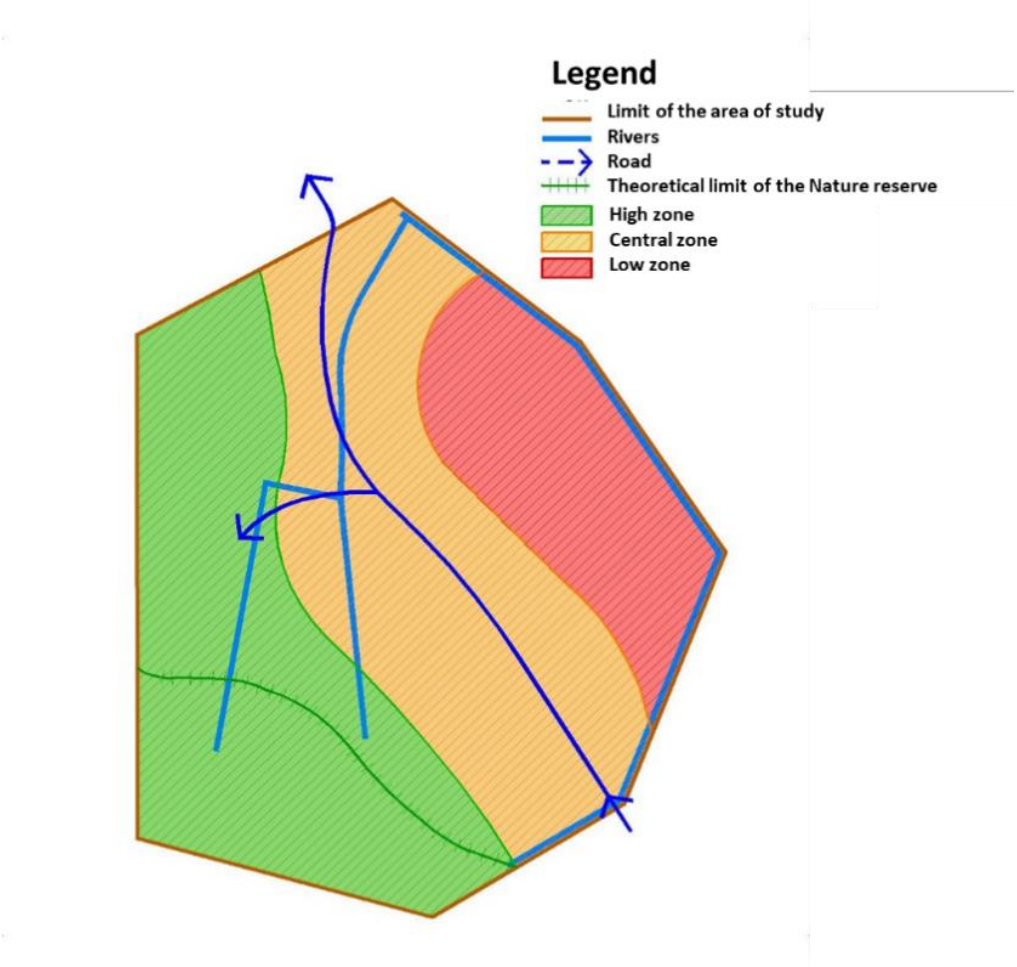
Figure 3.1: Location of the area of study



Source: Authors' own elaboration

It is an agricultural area where the soil is mostly covered with pastures with isolated trees. Other land uses consist of small agricultural plots for staple food production (maize and red beans), cacao and Musaceae and a multiplicity of diversified family gardens near the houses. Cacao plots are close to houses or at the edge of rivers, but always on land not prone to flooding; the plots for staple foods are always on slopes or in high parts that are in dry and sunny areas and houses are set in the middle of the slope. We can identify three micro-zones within the study area, which differ by the distance separating them from the main road (see Figure 3.2).

Figure 3.2: Zoning of the study area



Source: translated and adapted from Merlet, Collado Solís, Lemoine and Polvorosa (2015, p. 194)

The 'central zone' corresponds to a band about four kilometres wide with the road in its centre, so it is an area very well connected to the urban area of Río Blanco (collective and private transport, merchant entrance, milk collection routes, presence of a cacao collection centre). The houses make up a hamlet (although when moving north there are more and more isolated houses) and the slopes are 10-20%. The 'high zone' is further from the road, on the foothills of Musún Hill, on the edge of the nature reserve. In addition to being far from the roads, this area has steeper slopes (more than 25%), which makes it more vulnerable to erosion, but it also implies that some limited areas cannot be used for agriculture and livestock and remain covered in forest. It is also the area with the highest proportion of soils intended for cacao and red bean cultivation. There is a fairly large hamlet, but there are still many isolated houses (especially when climbing towards Musún Hill). Finally, the 'low zone' is also far from the road but to the east. In

this area the houses are isolated and the slopes are less steep (less than 10%); the proportion of bean and cacao plots is smaller, as is the area covered by forests.

4. PROCESSES OF AGRARIAN CHANGE IN THE AREA OF STUDY

This section is devoted to the analysis of agrarian change processes in the area of study, drawing on an analysis of the historical changes in the land access mechanisms which have allowed different types of farmers to benefit from natural resources. I have decided to take as a starting point our analysis of the arrival of the mestizo agricultural producers from the western regions in the 1960s, although this does not mean the territory has not had a previous history. In fact, there are indications of an indigenous presence in the zone (see below), but there is little information about the way those populations used the natural resources. Moreover, the arrival of the first mestizo settlers seems to have coincided with the departure[36] of the indigenous populations from the zone.

I have chosen to define four historical periods for the analysis, differentiated by the way the actors appropriated and used the resources. The initial phase was of exclusive appropriation of the forest and the creation of farms; then a phase of growth of the agricultural activity; that was followed by the war phase, during which agricultural activities were suspended; and a final phase of increasingly differentiated production systems. Naturally, this periodisation of history must be seen as a theoretical effort to facilitate our understanding of a complex reality, as the majority of the changes we describe are gradual and therefore the periods overlap.

4.1 THE 1960S AND EARLY 70S: APPROPRIATING THE LAND

The area was very isolated in that period; there was no access-road and it was a full-day walk to get to Río Blanco. As a consequence, social and market relations with external actors were scarce. The Nature's matrix was composed of small agricultural areas surrounded by an area still largely covered by forest.

Rather than a transformation of the entire forest into agricultural plots, this phase is viewed as a process of exclusive appropriation of the land and other resources by two types of actors: a lumber company that selectively extracted timber in an area of some

[36] It is not clear to what extent this was forced, or simply induced, by the arrival of mestizos.

800 *manzanas*[37] in the ´high zone' (only a small part of which is in the zone under our study) and peasant families coming from cattle regions in the west (essentially the department of Boaco) who we call ´pioneer front farmers´. The arrival of these first peasant families went on for some twenty years, starting in what we now characterise as the 'central zone' and 'low zone' and ending in the 'high zone'. During this process, poor peasant families arriving in the region independently took de facto possession of areas of land of some 100 *manzanas*, whose limits were generally natural borders such as a river or the top of a hill. There does not seem to have been a concrete differentiation between types of farmers at that time; rather they all implemented the same production system. They deforested the borders of the appropriated area, creating lanes to mark the farms' limits and they cleared small areas of forest (some 5 *manzanas*) to build a house, and produce staple food.

The access mechanisms that characterised the capacity of the lumber company and of the pioneer front farmers to benefit from the appropriated resources, however, were very different. The first could capitalise on the forest by combining the formal ownership right granted by the government of the time (a mechanism based on formal state rights) with a multiplicity of structural and relational mechanisms: access to wage labour (thanks to the migration from the western regions), finance capital and lumber export markets. All these structural and relational mechanisms were in fact related to two key elements. The first was the position of the company's owner within the social structure of the period as a business person allied to the Somocista dictatorial government, i.e., a member of the dominant and most powerful social group at that time (called ´bourgeoisie´ by Maldidier and Marchetti (1996)). The second was a national institutional framework very favourable to this type of 'mining' exploitation of the forest resources which created a rent related with the extraction of precious woods in the Nicaraguan agricultural frontier (Lévêque, 1986).

The access mechanisms to which the pioneer front farmers turned were very different. First, the legitimation in practice of the property rights acquired by the families that took possession of lands considered as 'empty' was not initially based on rights granted by

[37] 1 *manzana* = 0.7 ha

the State, but rather on what has been identified by some authors as "socially accepted 'routines' […] that have the potential to create and/or maintain locally legitimated land ownership" (Bastiaensen, D´Exelle, & Famerée, 2006, p. 15) such as:

- The 'improvements'[38] made on the land in order to transform it into a productive area.
- The efficiency of the farmer, i.e., the ability to demonstrate that he will be able to actually produce something on the land (e.g., because of his knowledge, work)
- Patron-client relationships. i.e., the fact that medium or large landholders can gain legitimacy regarding their tenure through their capacity to provide security/protection (i.e., sources of income, place to live, support in case of shock) to poorer people in exchange for various services.
- The purchase of property rights
- The inheritance of property rights

This informal, locally-based mechanism for constructing and legitimising land rights could then be legally formalised by the State. In fact, the State treated the lands in the agricultural frontier as national lands, i.e., it considered itself as the only owner with the faculty to transfer those ownership rights to private actors. As such the State was able to formalise pioneer front farmers' property rights. But this formalisation process needed to be done in Matagalpa, a larger city located at the west, which was not easily accessible from the region. Therefore, only in some cases were these families able to formalise their property rights. As a result, both tenure security and the faculty of legally transferring their rights to other actors were mainly accomplished through the local legitimation routines described above.

These families were also characterised by their weak or non-existent relational and structural access mechanisms, given that their financial, social, and physical capital was limited. As a consequence, they could only develop livelihood based on the family labour force they had brought with them from their original regions and on the land they had

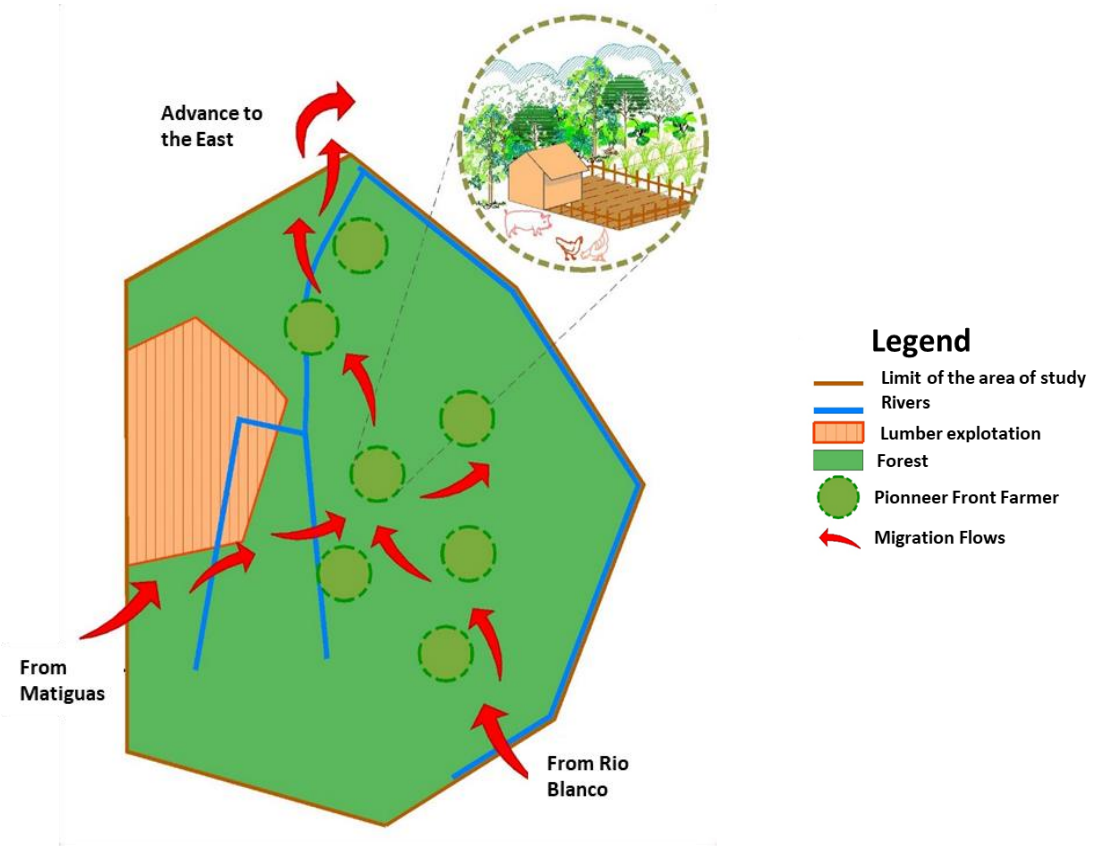
[38] This term has been translated by the authors from the Spanish term '*mejoras*' frequently used in Nicaraguan rural areas to refer to the investments, in money or in labour, that human beings realize on a piece of land to improve its production capacity.

managed to appropriate with that labour force. The production system they developed was characterised by limited social relations with external actors (with the exception of neighbours or some merchants) and was based on: i) producing staple foods for their own consumption under a slash and burn or slash and mulch[39] system; ii) using grain surpluses to fatten pigs for the market; and, iii) extracting non-timber forest products from hunting, fishing and gathering. This production system only allowed them to generate very little additional surplus, which was also difficult to sell in the market due to the zone's isolation.

We have not been able to identify any person among the current inhabitants of the zone who is a relative of those first colonising pioneers, which leads us to hypothesise that the medium-term strategy of these families was to sell the land and migrate further east. The improvements made on that land added value to it and allowed the pioneer farmers to trade it in the market with actors who had greater purchasing power. With the money obtained from that sale, these families could begin to accumulate financial and livestock capital and set themselves up farther east on the pioneer front. Figure 3.3 summarises the situation of the territory in that period.

[39] Term introduced by Maldidier et al. (1993) in situations in which the soil moisture prevents the use of fire to get rid of the organic material, as would happen in a traditional slash and burn system. With *mulching,* the material needs to be left to rot in the soil. Mulching is usually called '*mantillo*' in Spanish.

Figure 3.3: The agrarian system the 1960s



Source: translated from Merlet et al. (2015, p. 203)

4.2 THE 1970S: START OF A DIFFERENTIATION PROCESS AMONG FARMERS

The natural-resource appropriation process that began in the previous period ended in this one, but above all it initiated a process of transferring property rights to families coming from cattle areas more to the west (Boaco and Teustepe) that had more available capital and implemented production systems in which cattle-raising was key, thus leading to a growing transformation of forested areas into agricultural areas. Moreover, while the zone under study was still a day's distance from Río Blanco by a road only passable on foot or by animal in that period, the productive, commercial and social exchanges nevertheless increased within the zone as well as with the rest of the country.

During this period the lumber company's capacity to exploit the timber products improved due to better access to the market and to wage workers. Also, the access

mechanisms for the peasant actors changed substantially. With respect to the rights-based access mechanisms, the purchase of property rights appeared in the zone as a new mechanism to gain access to land in the areas that had been previously appropriated by pioneer front farmers. The families that bought property rights reinforced those rights through the same socially accepted routines presented above, such as making improvements (by gradually transforming the forested areas of their farm into agricultural areas), demonstrating their capacity to make the land produce and/or the social protection offered to more vulnerable actors through patron-client relations.

Furthermore, the relational and structural access mechanisms began to present key differences among producers, which unleashed a process of peasant differentiation. The following stand out among the access mechanisms that had an influence on this differentiation:

1. Access to financial and physical capital (in the form of heads of cattle), which corresponded to the capital the families brought with them to the area.
2. Access to social capital. The migration toward the agricultural frontier was not an individual process; on the contrary, it had a notable collective dimension (CIERA, 1981). In general, a family migrated to a region where friends or relatives had already settled and helped the newcomers to get land and set themselves up[40]. The social ties and relations characterised by trust that existed in the regions of departure of those families were therefore reproduced in the zone of arrival and self-help systems were developed among peasant families there (Gómez & Ravnborg, 2006). The social fabric was thus enriched and the social relations grew, which for us constitutes the birth of the first communities, defined as "'organic' human spaces with repeated 'face-to-face' interaction among their inhabitants" (Uphoff, 1993, p. 609, cited in Bastiaensen et al. (2015, p. 40)).
3. Patron-client relations. The relations of a clientelist nature were a crucial access mechanism in the rural zones from that time, as they shaped the capacity of both

[40] This does not imply that migrating families are able to implement livelihood strategies that allow them to stay in the region where they initially migrate, as illustrated in the case of study.

the patron and the client to benefit from the natural resources. The clientelist system consisted of a process by which a patron provided security and protection to poorer people in exchange for loyalty and diverse services rooted in a dependent relationship (Platteau, 1995; Powell, 1970; Scott, 1972). In that period, the patron was generally a cattle rancher who had a lot of land, cattle and capital in comparison to other farmers in the area. To be able to work all the land such a cattle rancher possessed, he needed to hire outside labour, which he found among the smaller farmers who couldn't survive just with the work on their own farms, and/or also among landless peasants. To assure the availability of that labour force, and also to strengthen his position in the community and slowly become the strong man or leader, the patron provided a multiplicity of services to the poorest peasants: access to land to grow basic grains as a 'colon' or tenant farmer (i.e., the peasant received a plot of land from the patron to grow staple food for his family in exchange for turning that plot into pasture after two or three years) or through sharecropping arrangements for both food staples; direct financial assistance in case of need, for example an accident, illness or death; acting as intermediary with outside actors, essentially merchant traders but also representatives of the State; and access to cattle through sharecropping (see the description further below). Despite the inequality of power in favour of the patron, the patron-client relationship appeared at the time as a mutually beneficial key access mechanism for both patrons and clients. While these types of relations act as an access mechanism for both, the kinds of access at stake are different. For the patron, it is an issue of control, i.e., being able to mediate the ability of the client to profit from the resources. For the client, on the other hand, the duties to the patron who controls access represent a way to maintain his own access to resources.

The interaction between the appearance of mechanisms for purchasing land rights and the relational and structural access mechanisms led to a differentiation among four types of farmers with diverse capacities to benefit from the land: (i) 'Patron cattle ranchers' who came to the zone with financial and livestock capital; (ii) 'client cattle ranchers' who arrived with less financial capital and fewer cattle; (iii) 'Client farmers'

who arrived with some financial capital but no cattle; and (iv) 'landless farmers' who came with almost no capital. It should be clarified that in that period the farmers who owned land also had forested areas on their farms from which they continued to extract non-timber forested products. They also grew staple food, essentially for their own consumption, and had small cacao plantations. Some also sold their surplus (for example, pigs, cheese and cattle) to the merchants who began to come into the area, even if the majority of producers still had to ride some hours to the main access road where these merchants passed, which meant that the producers closest to the road (in the central zone) had better market insertion in that period.

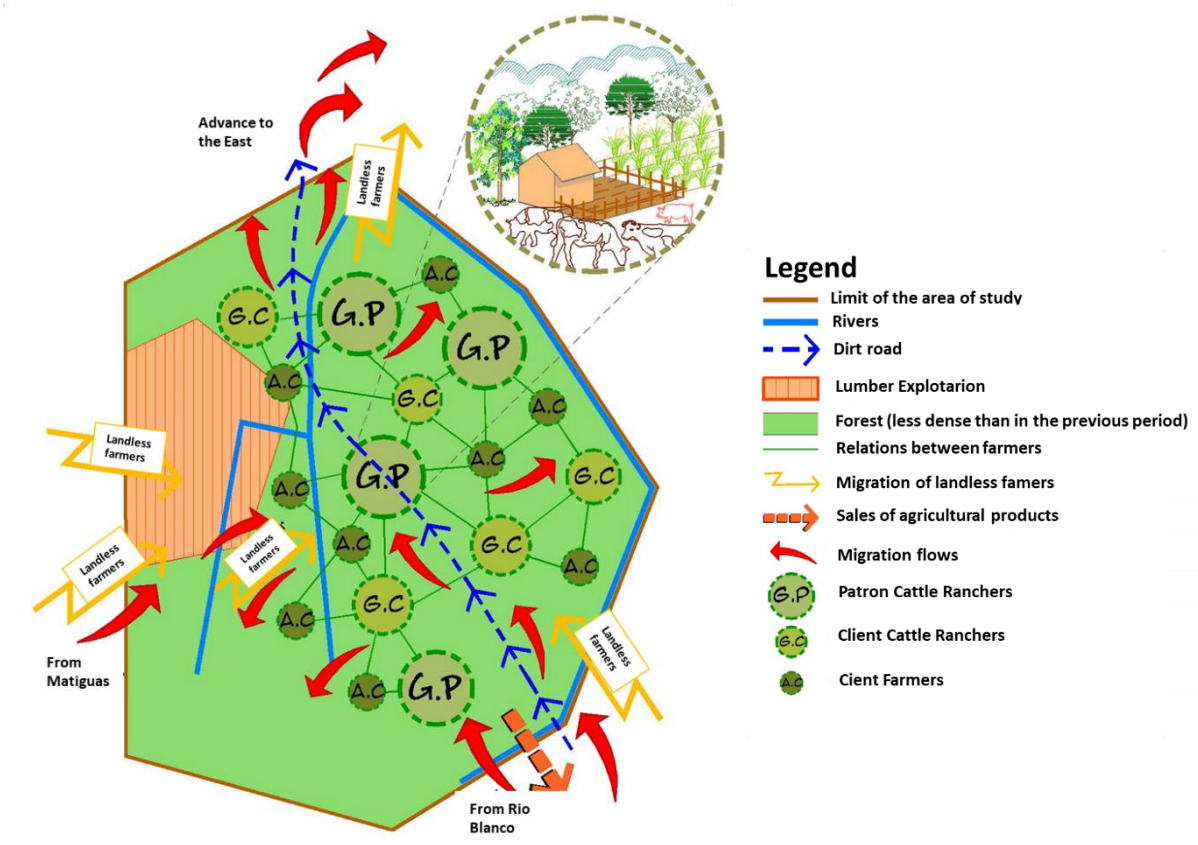
In addition to these characteristics, there were important differences among these types with respect to the presence or absence of cattle on the farm and to the gradual transformation of the farms' forested areas into agricultural plots. In the case of the cattle ranchers, they continued producing staple food, but after a few years, when the yields started dropping, they transformed those plots into pastures (avoiding new growth of bushes and thus privileging the growth of pasture grasses for the animals) and deforested new areas to plant staple food again. Some of these producers also sold some surpluses and succeeded in slowly becoming the patrons described above.

For their part, the farmers with no cattle tended to develop slash and burn systems to avoid the drop in grains yields (Mazoyer & Roudart, 1997). These farmers introduced fallow land or forest regrowth after two to three years of cultivation but, altogether, they slowly were replacing forested areas with agricultural plots, whether in production or fallow. Nonetheless, depending on the size of the land they could buy when they arrived in the region, they were or were not able to have sufficient fallow time (more than five years) to avoid an abrupt fall in yields. In those cases where they did not have enough area to develop the slash and burn system with enough fallow time, the yields tended to drop a lot, significantly weakening the capacity of those producers to maintain themselves with the same production system and, in the end, they had to sell their lands. Some of these producers managed to sell grains and pigs to merchants who came into the zone.

Finally, some farmers from all these types, when they could not reach enough financial returns, opted to sell their lands and migrate further east. These lands were generally bought by new families coming into the zone or by the accumulating cattle ranchers, the 'Patron Cattle ranchers' located mainly in the central zone near the main road. These transfers of land started a gradual process of land concentration that will be explained in the following sections. Even if there is no quantitative data available about land distribution at that time, insights from the historical interviews as well as the historical workshops held in the scope of the participatory mapping exercises, tend to indicate that land was still distributed quite equally. Most of the land was in the hands of a relatively large number of 'Client cattle ranchers' and 'Client Farmers' who hold farms of similar areas, while only a few 'Patron cattle ranchers' held bigger farms, mainly near the main road.

The situation of the territory in the 1970s is presented in Figure 3.4.

Figure 3.4: The agrarian system un the 1970s



Source: translated from Merlet et al. (2015, p. 206)

4.3 SUSPENSION OF THE DIFFERENTIATION PROCESSES DURING THE WAR OF THE 1980S

The overthrow of the Somocista dictatorship in 1979 by the FSLN was followed by a civil war that lasted a decade, in which counterrevolutionary and other disaffected groups supported and financed by the United States confronted the Sandinista government. The area of study was a combat zone until the end of the 1980s, with everything that implied in terms of physical violence and the requisition of products and animals by both sides. That period put a stop to the dynamics of differentiation of the production systems that had been occurring in the previous period.

In the case of the lumber company, the fall of the Somocista government in 1979 resulted in the end of the access mechanisms that had permitted it to exploit the forest for some 20 years. In fact, the owner of the company left the country and the property passed legally to the hands of the creditor bank and later the government. In practice, the land was abandoned, and despite the extreme shortage of workers in the zone and the danger of the fighting, a few families (peasants who were landless or had little land) took over very small areas to grow staple food.

Farmers' access mechanisms were also very affected by the war and the families had great difficulties continuing to benefit from the land through agricultural activities. Some of the men went off to fight in one camp or the other, leaving the farms in the hands of women, children and the elderly. Some families remained on their farms and continued working the land, but many others decided to take refuge in safer places, generally in the urban centres or in regions of the country further west that were not combat zones, or even left the country. On the farms that continued functioning, the productive activities were limited to the areas around the houses. Furthermore, the opportunities to sell the little surplus they could produce were scarce (the market for agricultural products was centralised by the Sandinista regime, the merchants emigrated from the zone and a price control system was applied that was disadvantageous for the producers in the interior of the country (Spoor, Mendoza, Visser, & Bakker, 1989).

The abandonment of certain farms and the concentration of agricultural activities around the houses on the farms that continued operating resulted in the abandonment

of a large part of the plots, above all the pastureland further from the houses, in turn leading to a drop in the herds on the farms.[41] Moreover, at the end of the 1980s and beginning of the 1990s, the cacao plantations that had existed on many farms in the zone and whose care had been affected by the war were decimated by Monilia (caused by the *Moniliophthora roreri* fungus), a mushroom which seems to have arrived in the region as an effect of Hurricane Joan in 1988 and which needs day-to-day treatment to avoid its development.

The end of the fighting by 1990 permitted a renewal of productive activities on the farms and plots that had been abandoned, but with serious limitations, as many farmers had lost animals, money and agricultural implements, and their families had suffered many deaths during the war. Even if the property rights of these producers were not questioned in practice (in fact, the majority of the old owners in the zone seem to have been able to return to their farm without major problems), the war meant a setback in their capacity to make the land produce. As a consequence, although they maintained their property rights, not all of them were able to maintain their access to it. Many who were unable to renew their productive process preferred to sell their land and migrate further east, where they could buy land relatively cheaper, thus recovering some financial capital that would allow them to restart their production. The families that could hold on to their lands were for the most part cattle ranchers and some client farmers who had managed to insert themselves in the market and accumulate capital before the war. In other words, they were the farms that had greater capacity to benefit from the land before the war. The farms that were sold were acquired by these same producers or other newcomers who immigrated from the west, gradually and slowly increasing the level of land concentration in the area.

4.4 INCREASING FARMER DIFFERENTIATION STARTING IN THE SECOND HALF OF THE 1990S

Starting in the second half of the 1990s, a new differentiation process was unleashed among producers related to the growth of agricultural production and the gradual

[41] This information was confirmed by a study done in another area of the country by Pujol et al. (1999), where an important change in soil from pasture to scraggy forest use was observed between 1983 and 1992, illustrating a forest regeneration process in pastures that had been abandoned during the war.

transformation of all the forested areas on the farms into agricultural plots. This shift was largely accelerated and expanded by the opening in 1996 of a road passable by motor vehicles that joined the area to Río Blanco. As in the previous stages, this differentiation was shaped by an interaction between rights based and relational and structural access mechanisms.

In general, the implementation of four rights-based mechanisms could be identified in that period. The first was the distribution of lands to the war veterans in the framework of the peace accords at the end of the 1980s and early part of the 1990s. Twenty-manzana plots of land in the high zone of the area of study formerly belonging to the lumber company and to another farm at the base of Musún Hill were distributed to both beneficiaries from the zone and those from outside. This top-down, arbitrary distribution of rights by the State contradicted the local rights-legitimation routines and as a consequence the foundation of these land rights was quite weak in practice. This aspect, combined with the fact that many beneficiaries of this distribution were unable to initiate a land and cattle accumulation process, in particular due to a lack of access to financial capital, led the majority of them to quickly sell their rights. Those who were not from the zone returned to their regions of origin, while those from the zone migrated further east. The only beneficiaries who were able to conserve their rights and even enlarge their farms by buying out those who were selling were from the same families that had succeeded in developing a preferential position before the war.

The second rights-based access mechanism is inheritance. In general, inheritances were not made effective upon the death of the parents, but rather were a gradual process that began when the children reached adult age and needed to begin their own productive activity. Unlike the previous mechanism of transfer of rights by the State, inheritance was one of the local routines to legitimate rights, and the norm in the zone was that all sons and daughters of the family had a right to the parents' land. In practice, however, what was transferred to each heir varied significantly according to sex. In general, daughters did not receive land, but rather payment (in cash or kind, for example in cows) equivalent to the purchase of their rights, thus permitting them to contribute to the creation of a new home. The sons, in contrast, received land, cattle and part of

the farm's infrastructures.[42] Furthermore, depending on the size of the parents' farm, the capital they possessed and the family's composition, the inheritance could be shared out in various ways, each of which had repercussions on the capacity of the sons to implement production systems that allowed them to benefit from the land and remain in the zone:

- On the larger cattle ranches belonging to 'patron cattle ranchers' who had accumulated important capital—both monetary and in land, cattle or infrastructure—one of the sons generally ended up with the parents' farm and part of the herd. The parents bought land for the other male children in the same or neighbouring zones and gave them another part of the herd so they could implement the same production system as their parents.
- In some cattle ranches that had accumulated less capital (in general the farms of the 'Client cattle ranchers' type of the previous period), the same process could play out as in the first case, although it was much less frequent and what was generally observed was a splitting up of the parents' farm among several sons. Each son thus began his own accumulation process within farms smaller than their parents', to achieve the level that eventually characterised their parents' farm. The majority, however, did not succeed and had to sell their rights (usually to one of the brothers) and migrate east.
- The smaller farms could also be transferred in parts or as a whole (in general these belonged to the 'client farmer'). If the transfer was made in parts, the process was the same as for the 'client cattle ranchers'. If the transfer was done as a whole, one son ended up with the parents' farm. In this case, lacking the family capital with which to buy a farm for the other sons, they, like their sisters, received a sort of cash compensation that corresponded to the purchase of their rights by the brother who stayed with the farm. Some decided to use that money to migrate east and buy land there, and others remained in the zone as landless peasants and wage workers.

[42] Nonetheless, as can be seen in other works about gender conflicts in rural Nicaragua (Flores, 2015), these processes can be far from egalitarian. The amount women receive as inheritance depends on each family and not on the predetermined value of the land.

The third mechanism corresponded to land purchases, mainly fostered by the arrival in the zone of new migrants coming from areas to the west. These were young farm families that came with diverse levels of capital, having sold their farms in their regions of origin to buy larger areas in regions where the land was cheaper.

Finally, the fourth mechanism was the appearance of renting as a form of accessing land for brief periods of a single agricultural cycle (little by little that mechanism would become concentrated in the high zone and only for planting of beans). This mechanism gradually complemented the sharecropping and tenant farming systems already existing with the clientelist systems.

As in the previous periods, these rights-based access mechanisms interacted with structural and relational access mechanisms. Access to capital, already identified in the period prior to the war, continued to play a key role, as did the clientelist relationships that intensified via the introduction of a multiplicity of new services the patron provided to his clients, among which transport (generally only these families had a pick-up truck) and the sale of non-agricultural products in small shops, generally on credit. In addition, other access mechanisms that we present below acquired more and more importance in this period.

Insertion in the markets

This period saw an intensification of the farmers' market insertion. In a context of transformation of the forested area into agricultural land and a reduction of the fallow periods, being able to buy inputs (fertilisers, herbicides and seeds) became key to counteract the reduction of yields due to soil degradation (for example, the drop in the milk yield is one litre per cow per day since 1990 and the drop in the bean yield is 5 quintals per *manzana* since the 1970s, according to the historical interviews implemented). In addition to access to the inputs market, producers also gradually began to insert themselves into different value chains. Nonetheless, not all types of producers incorporated themselves into the same value chains or in the same modalities, a fact that influenced their capacity to benefit from the land. Table 5.1 shows

the variations in prices that could be obtained, according to the market to which one has access, for three key products in the zone of study: dairy, beef and cacao.[43]

Table 3.1: Price variations according to the markets to which the producers have access

Value Chains	Type of product	To whom one sells	Implications regarding sales price[44]	Factors that influence incorporation into the chains
Dairy products	Fresh milk	Collection centres	US$0.34 per litre of milk	Milk quantity and quality according to the requisites of the milk collection centres; and/or proximity to the collection centres; and/or participation in a cooperative of farmers producing milk
	Fresh milk	Intermediaries (producers who then resell to collection centres)	US$0.32 per litre of milk	
	Cuajada (rennet cheese)	Direct sale in the communities	Equivalent to US$0.20 per litre of milk	
Beef	Steers (3 years old, 350 kg)	Slaughterhouse Managua/Tipitapa	US$550-600 per animal	Amount of pasture sufficient to fatten a sufficient quantity of animals (lorry); and/or possibility of paying-owning a truck to take the animals to the slaughterhouse
	Steers (1-2 years old, 150-200 kg)	Local intermediary (producers who fatten cattle)	US$250-300 per animal	
Cacao	Organic cacao beans in mucilage	Collection centres of cacao cooperatives	Around US$100 per dry quintal	Proximity to cacao collection centres; and/or participation in projects (financial and technical support for installing or renovating a plantation) and/or participation in cacao cooperative
	Traditional dry cacao	Local merchants	Around US$75 per dry quintal	

Source: translated from Merlet et al. (2015, p. 211)

[43] For more detailed analysis of the cacao and red beans value chains, see Bastiaensen et al.(2015).
[44] Prices in effect in 2013.

Access to development projects and to credits

The end of the war of the 1980s brought important changes in the national context: a weakening of the State's capacity to implement public policies and an alignment with neo-liberal economic policies (Kinloch-Tijerino, 2012). Alongside this weakening of the State was a growth of local development interventions aimed at reducing poverty and implemented by national and foreign NGOs and by micro-finance institutions financed by international cooperation (Rocha, 2011). Access to these development projects and programmes soon became a determining factor, especially to access capital to finance production, but also to insert oneself into value chains that permit accessing preferential market conditions (for example, the case of cacao) and technical assistance. Two types of specific development interventions seem to have played an important role in initiating certain trajectories of the producers: the credit provided by micro-finance institutions to the larger producers to buy cattle and land (see e.g., Crucifix, 2015) and the development projects of some NGOs to promote cacao as an income-generating activity and develop a chain more favourable to small and medium producers (e.g., Martínez Arróliga, Collado Solís, & Romero López, 2015).

The implementation of a new type of peasant organisation: cacao and dairy cooperatives

Two producer cooperatives currently have members in the area of study. One is a dairy cooperative created in 2002. It has a milk collection centre in Río Blanco and a milk collection route that passes by the zone; it sells milk to the national dairy industry and also shares a milk collection centre in the area with another company. The other is a cacao cooperative based in Matiguás created in 2000. In recent years it has installed two collection centres in the zone and buys cacao in mucilage from the producers for the international organic market. Selling their products to these cooperatives permits the member-producers to insert themselves preferentially into the milk and cacao markets of greater value and receive a higher price for their products (see Table 3.1).

Labour relations

The differentiation of the production systems led to the development of systems that needed an increasing labour force beyond the family labour force available on the farms.

Wage labour, whether temporary or permanent, became crucial to the capacity of both employers and workers to benefit from the land.

In fact, within this period we witnessed an increase in the category of landless peasants or those with very little land who ended up becoming permanent employees on the largest cattle ranches. These are peasants with no capital who migrated from western regions or are sons of small farmers or cattle-raisers who could not generate enough revenue from their farms after the inheritance process described above. To assure the availability of their workers, the employers in the central zone close to the highway and in the low zone let them work a small plot to grow staple food for their own consumption, which gives them access to land and on occasions a wage as well. While in the high zone, landless wage labourers use their income to rent small plots to grow red beans for market.

The development of interdependent services among producers of different types

We have identified two types of arrangements that strengthen the interdependence among producers. On the one hand, producers who normally cannot sell their production in the pasteurised dairy and beef value chains because they are far from the highway, do not have the contacts or do not produce sufficient quantities, hammer out arrangements to access these value chains with the larger cattle ranchers who do have direct connections with them. The latter serve as intermediaries, buying milk and steers from the other producers of the zone and reselling them to the milk collection centre or to the slaughterhouse together with their own production. This allows small cattle raisers to be inserted into certain value chains that otherwise would be inaccessible to them, and the larger cattle raisers strengthen their position in those same value chains by capturing a part of the value added generated by those other producers. This intermediation, however, also implies that the producers without direct access to the markets are paid lower prices than those who do have access (see for example Table 3.1 for the difference in price for a litre of milk).

The system of sharecropping cattle is also key in the rural differentiation. It is an arrangement between a rancher with a lot of cattle, well inserted into the beef and pasteurised milk chains, and another with few cattle relative to the pasture area he has

available, with little capital to buy cattle but in a process of increasing his herd. To free space on his farm to fatten steers without abandoning milk production, the large rancher gives the smaller heifers for a year. The latter keeps them on his farm until they have their first calf when they are about three years old. During that period, he is responsible for the care of the animals, and with the birth of the first calf he returns the cows to their owner and keeps the calves. This allows the smaller farmer to keep increasing his herd without having to buy animals and allows the large rancher to recover a milk-producing cow without having to be responsible for it over its long non-productive period.

The larger cattle ranchers who survived the war and are found in the central zone or near the highway benefit most from the interaction among all these mechanisms. Their dominant position as patrons before the war, their capacity to recover from it, their location near the highway, and consequently their easy access to markets, development projects and credits all allow them to strengthen their dominant position in the zone even more and to strengthen their ability to control the access of other farmers through the interdependence services descried above. As such, the development projects implemented in the area and the expansion of the microfinance sector usually ended up benefiting those richer producers despite their narratives of poverty reduction. They thus manage to expand their own farms and buy land in the zone to transfer to their sons in inheritance. This generates a large demand for land in the area by these producers, who pressure the smaller producers to sell their properties to them, especially when they suffer some crisis such as illness or a death, or during the inheritance processes. This pressure impedes the installation of new farmers in the medium term and also makes it difficult for small farmers to hold on to their lands. In fact, it is observed that the new migrants who come into the area with capital have to set themselves up in areas with less pressure on the land, i.e., in the zones furthest from the highway. Although it is also observed that many lands in those zones are transferred to the migrants and larger cattle ranchers, a greater capacity of the smaller producers to maintain control of their lands is also observed there.

Altogether this has led to a differentiation of farmers into six different types (see Annex 3.1 for details):

1. ‘Large-scale cattle ranchers’: they hold between 300 and 615 *manzanas*, are located above all in the central zone and produce milk for the pasteurised dairy value chain, three-year-old steers for the slaughterhouse, staple food, garden products and in some cases cacao.
2. ‘Medium-scale cattle ranchers’: they have 80 to 215 *manzanas*, are located in the low zone and produce milk for the pasteurised dairy value chain, year-and-a-half-old steers for sale to intermediaries, staple food and garden products.
3. ‘Medium-scale cacao and cattle producers’: they have between 45 and 75 *manzanas*, are located in the central and high zones and produce milk and curd cheese for self-consumption and local sale to intermediaries, staple food, year-and-a-half-old steers for sale to intermediaries, and agro-forestry organic cacao that they sell in mucilage to the cooperative and garden products.
4. ‘Small-scale cacao and cattle producers’: they have between 14 and 45 *manzanas*, are located in the high zone and produce milk for self-consumption and curd cheese for local sale, staple foods, cacao (in two modalities: organic agro-forestry sold in mucilage to the cooperative or traditional sold dry to local merchants), calves and garden products (including poultry and pigs).
5. ‘Small-scale cacao producers’: They have between 5 and 10 *manzanas*, are located in all the zones and produce staple food, garden products and cacao (in two modalities: organic agro-forestry sold in mucilage to the cooperative or traditional sold dry to local merchants).
6. ‘Landless farmers’: in addition to their garden, they may have access to a couple of rented or borrowed *manzanas*, are located in all zones and produce basic grains and garden products (including poultry and pigs).

During the workshops to elaborate community maps in two communities of the area of study, community members were able to identify all farms’ boundaries and areas within each community. In a context of lack of reliable and updated statistical official data on the agrarian structure, this allows a rough estimate of the weight of each one of these types of farmers within the overall agrarian structure (at least for the types that own land and can be located within the maps). In these two communities, as shown in Table 3.2 below, larger farmers (’large-scale cattle ranchers’ and ‘medium-scale cattle

ranchers') who only represent 21% of the total of farmers in the area (excluding landless farmers who we were not able to quantify) occupy 69% of the total area. On the other hand, smaller-scale farmers ('medium-scale cacao and cattle producers,' 'small-scale cacao and cattle producers' and 'small-scale cacao producers') who represent the majority of the farms (79% of the total number of farms) occupy only 31% of the land.

Table 3.2: Rough estimate of the agrarian structure in two communities of the area of study

	Large- and medium-scale cattle ranchers*		**Others****	
	Number	Area (Mza)	Number	Area (Mza)
Community 1 (Central Zone)	10	2070	20	455
Community 2 (High Zone)	2	220	24	553
TOTAL	**12**	**2290**	**44**	**1008**
%	**21% *** **	**69%**	**79% *** **	**31%**

* 'Large-scale cattle ranchers' and 'Medium -sale cattle ranchers'

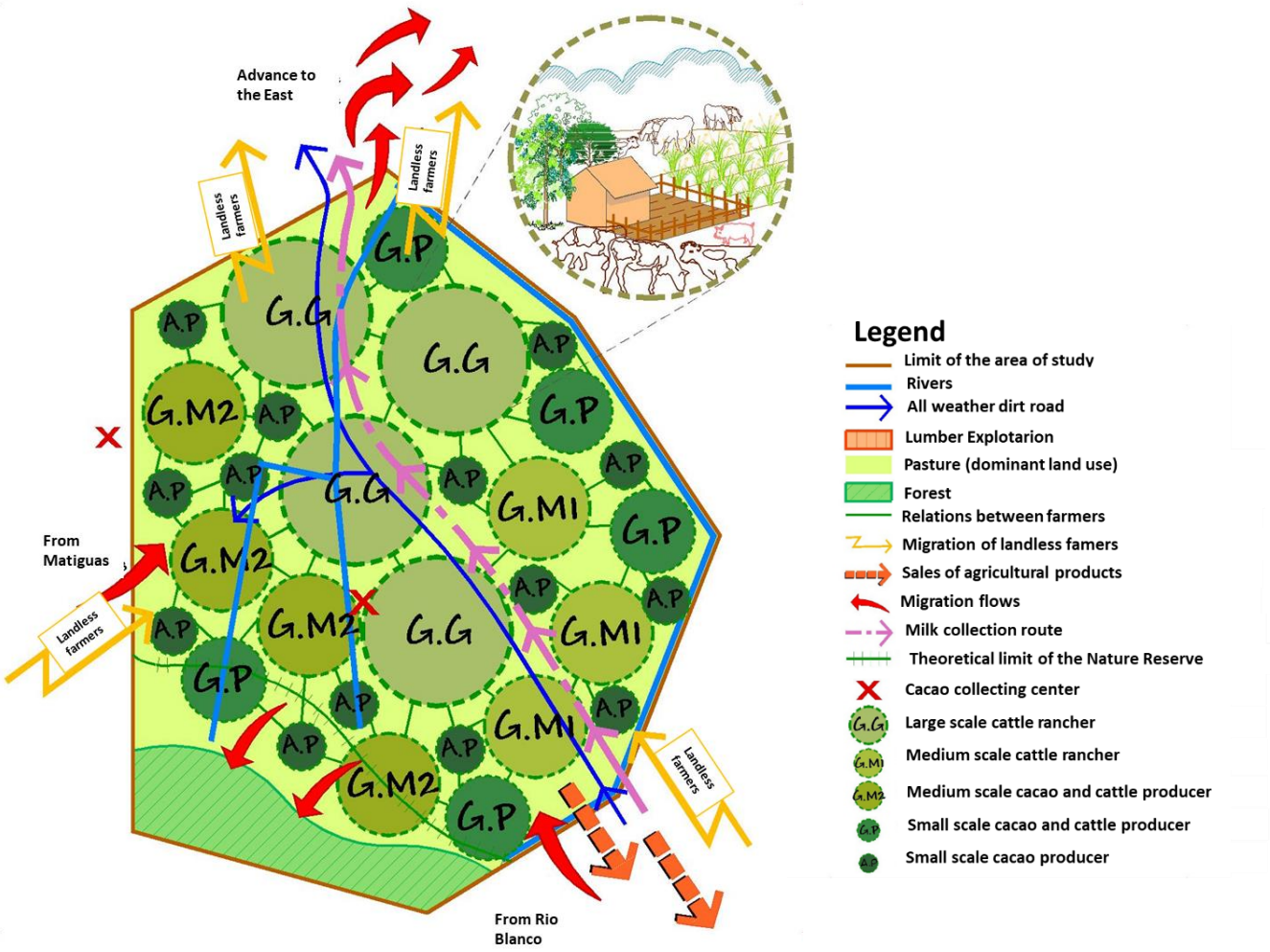
** 'Medium-scale cacao and cattle producers', 'Small-scale cacao and cattle producers' and 'Small-scale cacao producers'.

***This percentage has to be taken with caution as we were not able to quantify the number of landless farmers during the participatory mapping exercises.

Source: Authors' preparation based on the maps drawn up by inhabitants of the communities on 21/05/2013 and 23/05/2013).

The situation of the territory today is presented in Figure 3.5.

Figure 3. 5: The agrarian system today



Source: translated from Merlet et al (2015, p. 214)

5. FARMERS' TRAJECTORIES AND EMERGENCE OF DEVELOPMENT PATHWAYS

5.1 THE EMERGENCE OF A DOMINANT CATTLE-BASED DEVELOPMENT PATHWAY

As introduced in Chapter 2, a development pathway is a concrete social-institutional setting (i.e., interrelated rules, norms, social structure and power relations) that together with a set of shared ideas, influences the individual and collective actions undertaken by the actors, in particular with respect to specific economic activities. This opens or closes opportunities to implement certain individual livelihood trajectories, and at the same time these actors' trajectories shape to some degree this institutional and cultural context and the shared ideas that characterise it.

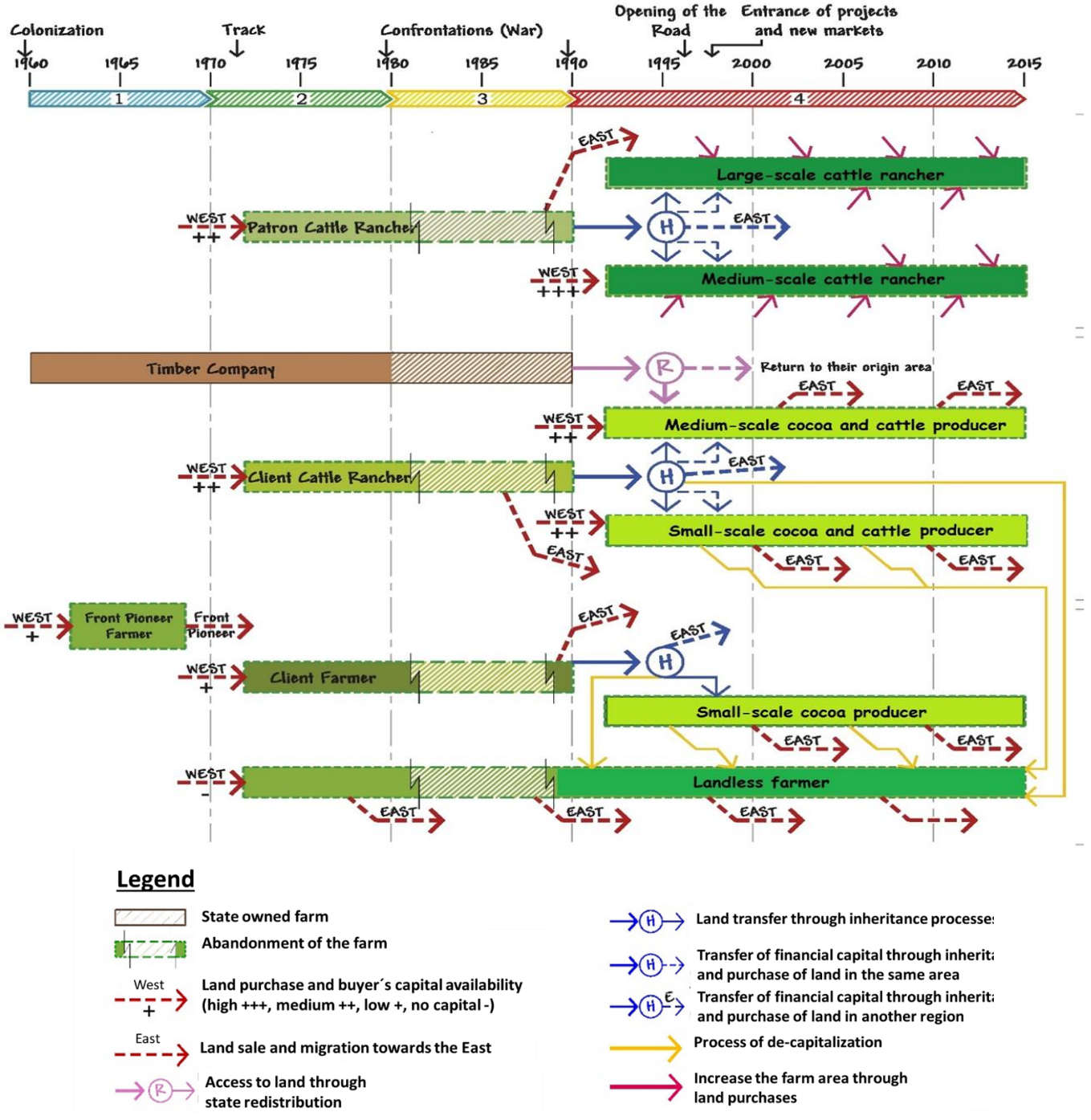
In Chapter 1, I have shown the importance of livestock expansion in shaping the dynamics of agrarian change in the Nicaraguan agrarian agricultural frontier, especially with respect to land use change and deforestation. I have also demonstrated how this expansion was related to several interrelated elements among which the following stand out:

- a shared vision within the society that forested areas are a reserve of unproductive land available for the expansion of agricultural production
- favourable state policies that encourage the migration of farmers to the agricultural frontier
- the long-term insertion of Nicaraguan agriculture within international markets
- important public investments in road and electrical networks aiming at facilitating access to markets and preserving dairy products

These are elements of the broader social-institutional and cultural context that define the features of both rights-based and relational and structural access mechanisms that explain what farmers can do. Through the historical analysis of access mechanisms implemented above, we can approach how this context has actually opened or closed farmers' opportunities to be able to implement concrete livelihood strategies. What this analysis brings to light is the emergence of some of these trajectories for different types of farmers in a specific concrete small territory within the broader setting in which they

are embedded. These trajectories are shown in Figure 3.6 below. As explained above, they characterise an agrarian system where the productive, social (mainly related to the establishment of patron-client relations), market and land-use change dynamics are highly shaped by the development of livestock production. Moreover, the numerous relations between farmer types and with other actors (cooperatives, public institutions, actors of the different chains, etc.) that we have identified in the previous section demonstrate that the majority of the productive and social dynamics are connected with livestock production. Taking these elements as a whole draws the contours of what appears to be a cattle-based dominant development pathway in the area of study.

Figure 3.6: Evolutionary patterns of the types of producers



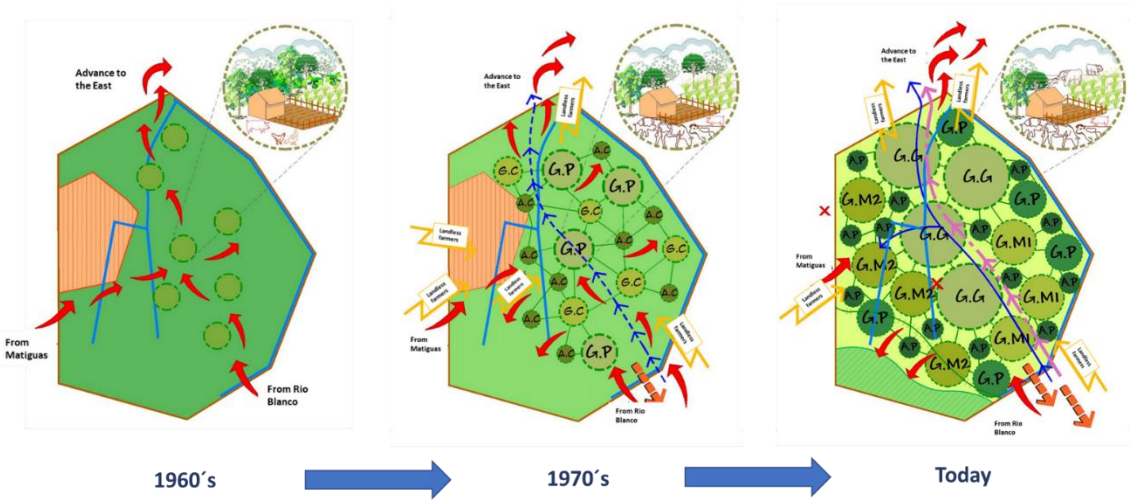
Source: adapted and translated from Merlet et al. (2015, p. 216)

5.2 THE OUTCOMES OF THE DOMINANT CATTLE-BASED DEVELOPMENT PATHWAY

5.2.1.A NATURE'S MATRIX DOMINATED BY PASTURES

Figure 3.7 shows the evolution of the agrarian system in a schematic way. The evolution of the background from dark to light green corresponds to land use change from an area dominated by forest to one dominated by pasture related to a concentration of land with larger and larger farms specialised in livestock production. An area of pristine forest remains in the south-west of the area of study, but we have not been able to identify any relevant relation between this area and the production systems of the different farmer types in the area.

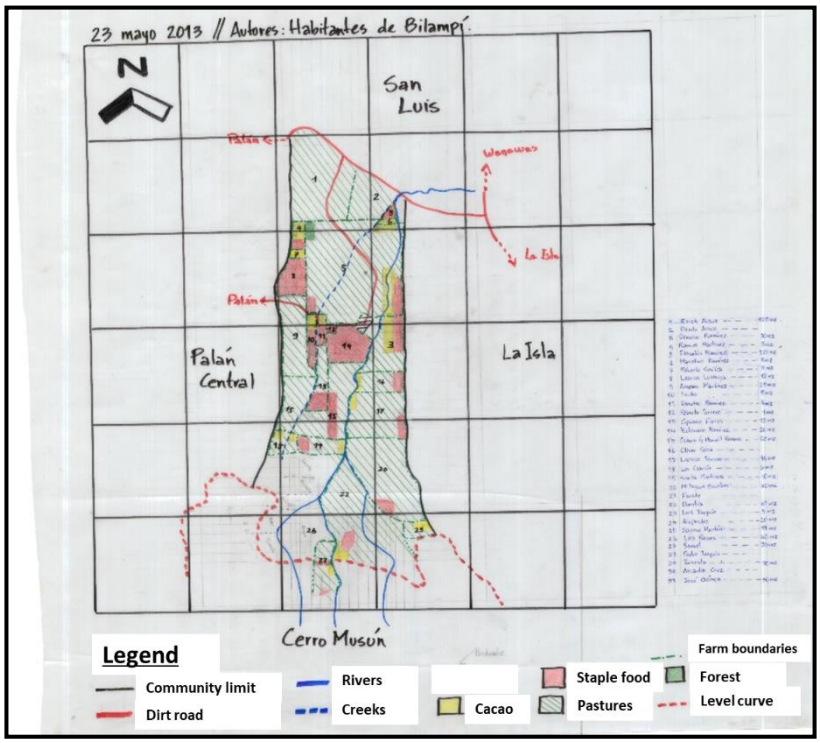
Figure 3.7: The evolution of the agrarian system

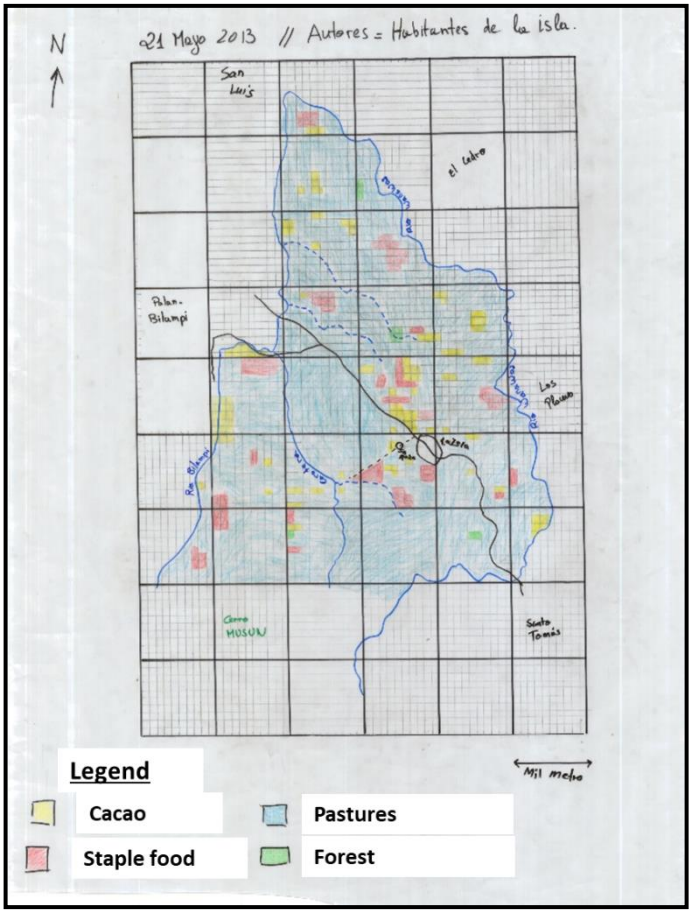


Source: Author's own elaboration.

Figure 3.8, below, gives a better view of current land use patterns in the area of study through the land-use maps prepared by community members in two communities of the area of study. It shows a landscape with little forest areas remaining (in green in booth maps) and a predominance of pastures (in hatched green in the map on the top and in blue in the map on the bottom) with some limited patches of plots for the production of staple food (in red) and cacao (in yellow).

Figure 3.8: Land use maps in two communities of the area of study





Source: Maps drawn up by inhabitants of the communities on 21/05/2013 and 23/05/2013.

The patchwork of land uses that characterise the current Nature's matrix in the area of study is therefore dominated by large farms covered with pastures and a very low level of diversification in land use, especially with very little remaining forested patches of land and a small number of plots for other agricultural uses. As described in the previous section, this is related to a specialisation of the production systems in livestock production and an increase in the use of chemical inputs. In environmental terms, this is quite far from the elements described in Chapter 2 that characterise a good-quality matrix, i.e., diversified patchworks of pristine forested areas and agricultural areas with diverse and complex production systems based on agro-ecological principles.

5.2.2. AN AGRARIAN SYSTEM WITH INEQUITABLE OUTCOMES BETWEEN FARMERS' TYPES

Each type of farmer described above participates in the dominant cattle-based development pathway and the historical evolutionary patterns of each one of them are intrinsically linked with the emergence of this dominant pathway and its subsequent dynamics of change. However, not all types of farmers play the same role within this dominant pathway and, conversely, the pathway's outcomes are not equal for all farmers.

Land concentration and specialisation in livestock production

The interactive dynamics of the different farmer types described above for the study area appear to be shaped to a large extent by the evolutionary pattern initiated by the 'patron cattle ranchers' of the 1970s and the features of the productive and social relations they have maintained in time with the other types through the numerous relational access mechanisms identified in the previous section. The outcome of the trajectory followed by these farmers are the 'large- and medium-scale cattle ranchers' of today. While some of the farmers belonging to these two latter categories might have arrived in the area from western regions to buy land in the 1990s and 2000s, most of them are children of families that settled in the 1970s and received the land through inheritance processes. They generally set up their farms in the central and low zones and from the beginning they had access to relatively important financial capital and cattle. Socially speaking, these types have always been the patrons within the clientelist

relations that I have described above and they have held a power position within the rural communities. After the initial access to the land through inheritance or purchase, all these farmers succeeded in buying neighbouring farms to expand their own and to specialise their production system in livestock. Today, more than 90% of their farms are covered with pastureland and 80% of their income is related to cattle production[45] (whether through the sale of dairy products or steers). Within the dominant development pathway, they have been able to profit from a set of interrelated access mechanisms which is relatively more favourable than those characterising other types (see Table 5.3).

Table 3.3: Relational and structural access mechanisms of the 'large-' and 'medium-scale cattle ranchers'

Type	Large-scale cattle rancher	Medium-scale cattle rancher
Relational and Structural Mechanisms	Access to financial capital at the time of settling	
	Role of patron in local clientelist relations	
	Good insertion in markets; sale of milk through cooperatives; direct sale of cattle to slaughterhouses	Good insertion in pasteurised milk value chain
	Access to development projects and credit due to nearness to the highway and to his position as leader in the community.	Good access to credit
	Access through relations with other farmers: he buys milk and calves from medium-scale cattle ranchers and medium-scale cacao-growing cattle ranchers; gives cattle over to medium-scale cacao-growing cattle ranchers through sharecropping arrangements; employs small-scale cacao and cattle producers temporarily and landless peasants on a permanent basis.	Access through relations with other farmers: sells steers to large-scale cattle ranchers for fattening; employs small-scale cacao and cattle producers temporarily and landless peasants on a permanent basis.

Source: translated from Merlet et al. (2015, p. 218)

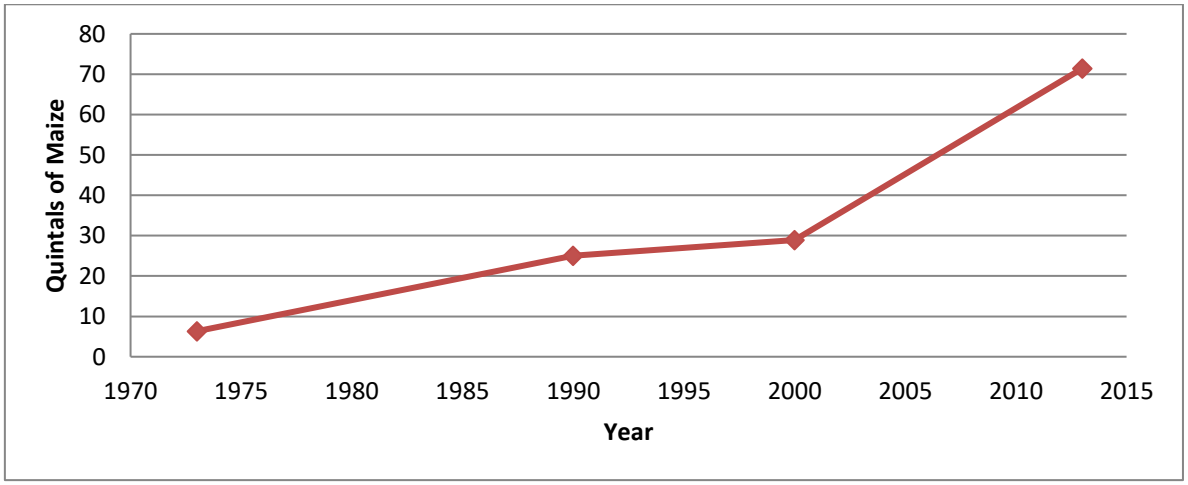
Access to wage labour is a crucial relational access mechanism on which those farmers rely. They find this labour force within the types that hold smaller amounts of land, the 'small-scale cacao and cattle producers' and 'small-scale cacao producers' for temporal labour and within the 'landless farmers' type for permanent labour. For 'landless farmers' the income received when working for large- and medium-scale cattle ranchers

[45] According to the models constructed through the Agrarian Diagnosis exercise (see Annex 3.1)

needs to be completed with a small yard (with the raising of hens and fattening of pigs) which represents between 55% and 60% of their total income.[46] Without these wage workers, large- and medium-scale cattle ranchers would not be able to implement their cattle-based production systems on such large areas of land. This work force comes from two sources: i) families that moved into the area at different moments of history, including currently, without financial capital and whose main strategy is to find employment opportunities and, ii) the children and grandchildren of the families that came with very little capital in the 1970s or afterward and ended up without land after an inheritance process. These families only have a small amount of land on which they have a house and yard, but in general can produce staple food (essentially red-beans) on small plots they rent or borrow for brief periods.

Altogether, large- and medium-scale cattle ranchers are the only types able to buy land to expand their farms or set up their sons without having to fragment their farms in a context of drastic increases in the relative-value of land in the past 40 years (see Figure 3.9)

Figure 3.9: Value of a manzana of land in quintals of maize (taking as a reference the post-harvest price of maize



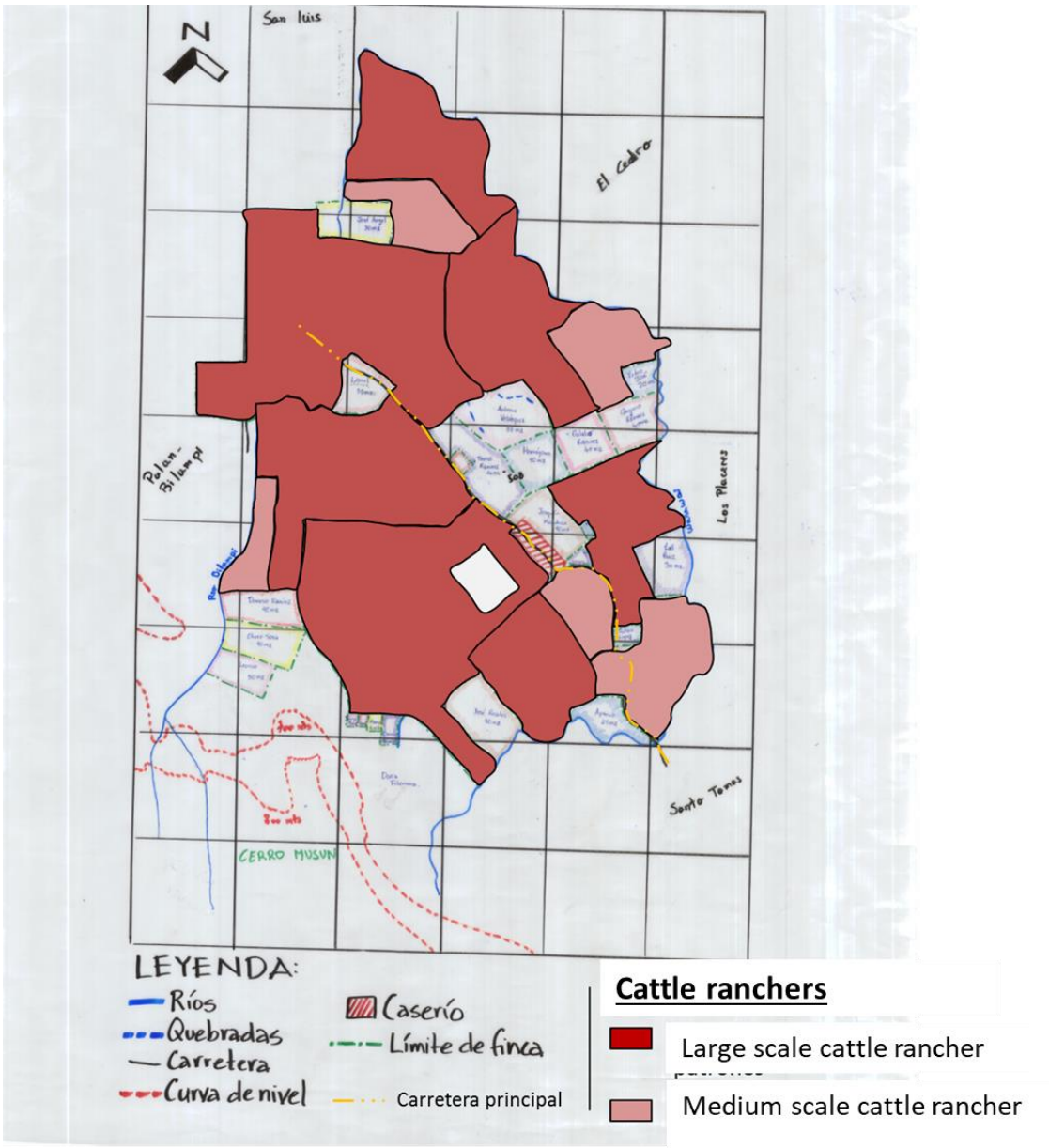
Source: translated from Merlet et al. (2015, p. 218)

Altogether, this results in a situation where, although relatively few, these farmers concentrate most of the land, as presented in Table 3.2 above in the text and also

[46] According to the models constructed through the Agrarian Diagnosis exercise (see Annex 3.1).

illustrated in Figure 3.10 which represents land distribution in one community of the study area.

Figure 3.10: Land covered by large- and medium-scale cattle ranchers in one community of the central zone



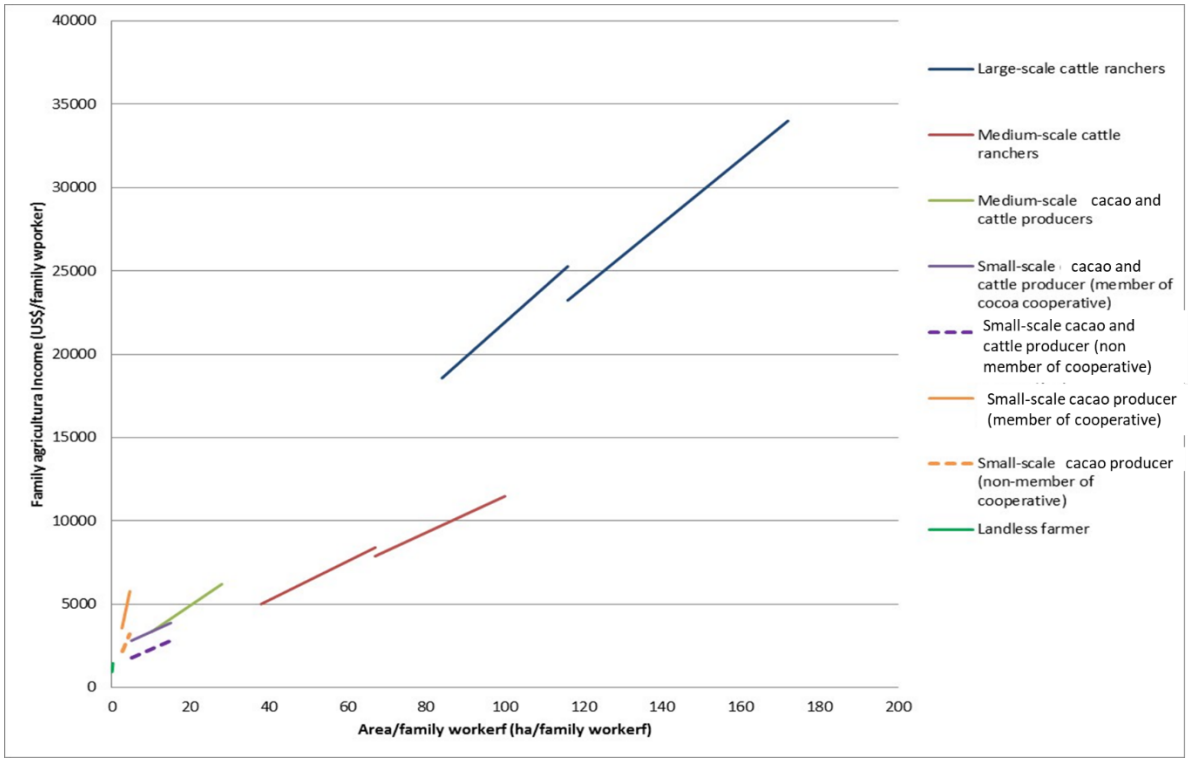
Source: Author's preparation based on the map drawn up by inhabitants of the community 22/05/2013).

Inequality and the necessity to migrate

In addition to the land concentration illustrated above, the evolutionary patterns presented previously led to the existence of producers who, based on different sets of access mechanisms, have a different capacity to benefit from the land.

First, agricultural incomes obtained through the production systems implemented by each type of producer are very unequal. Figure 3.11 shows income variations among the types of farmers, in which the large-scale cattle ranchers are the ones who achieve the highest family agricultural income per *manzana* and family worker.

Figure 3.11: Agricultural income obtained by each type of farmer



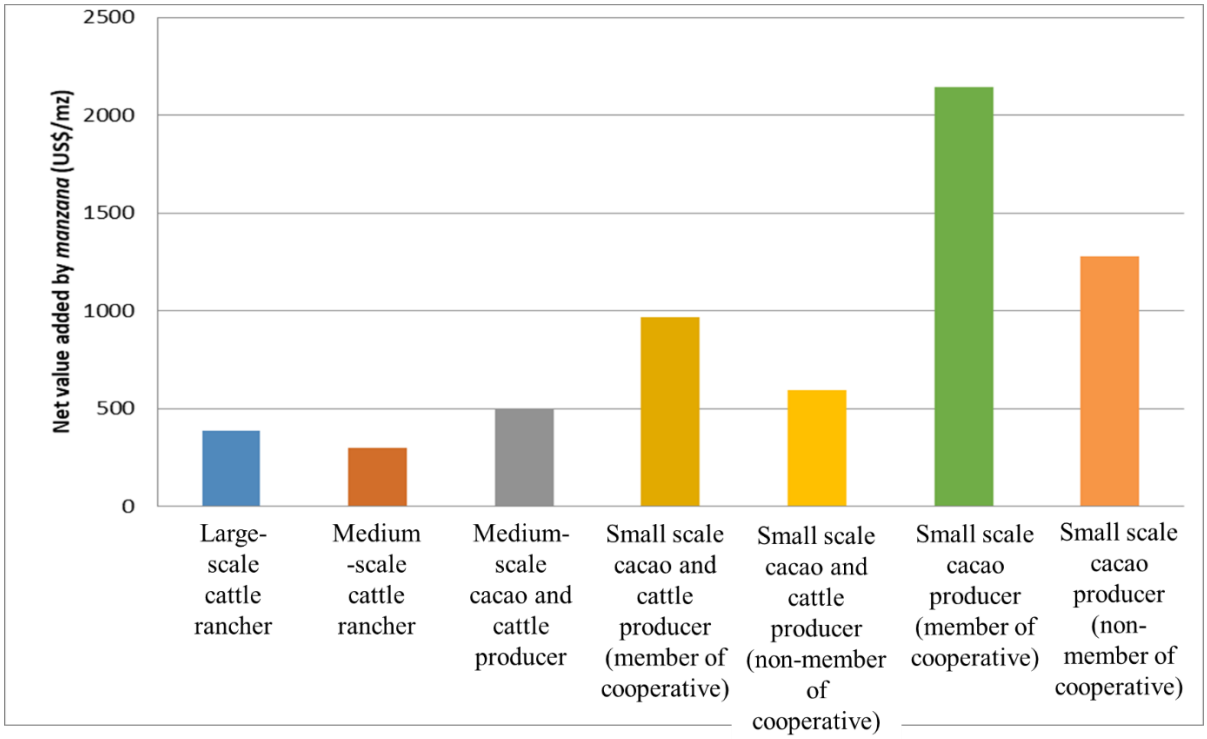
Source: translated from Merlet et al. (2015, p. 221)[47].

With land concentration increasing in the area, land is becoming a more and more rare resource; it is therefore important to link these results to the efficiency of the production systems implemented by each type with respect to the land resource. For this we can analyse land productivity, i.e., the wealth created per *manzana* of land for each system (see Figure 3.12).[48]

[47] This graphic is based on the models prepared in the agrarian assessment process. It was decided to present the annual income/manzana/family worker in order to compare the types with each other, as not all types are characterised by the same amount of family labour (a family worker corresponds to an adult family member who works full time on the farm). Each segment has as its limits the minimum and maximum land managed by each type, which is directly dependent on the technical features of each production system. When two segments by type are represented (large- and medium-scale cattle ranchers), it implies that we have identified sub-models within each type.

[48] A more complete analysis would involve examining the productive efficiency having to do with other key resources (like labour or available capital), but given that our main focus is on the land, we limited ourselves to what relates to this resource.

Figure 3.12: Net added value by manzana obtained by each producer type



Source: adapted and translated from Merlet et al. (2015, p. 221) [49].

The data in Figure 3.12 show that the production systems based on cacao production, particularly when sold through cooperatives, create the greatest value added per *manzana*. Nonetheless, as we have shown before, the types that implement these production systems are not the ones that obtain the greatest benefit from the assets in terms of family agricultural income. In addition, the land concentration process among 'large-scale cattle ranchers' and 'medium-scale cattle ranchers' shows that the land market in the zone is skewed toward these two types of producers who, paradoxically, are characterised by the lower value added created per *manzana*. As De Janvry et al. (2001) point out, this indicates that the area's land market is far from perfect given that the producers who obtain the greatest financial benefit from the land resource should also theoretically be the ones who can offer more for a *manzana* of land. This reality shows that imperfections exist in other markets (in particular the capital market) and that other elements beyond merely economic ones make up the value of land. Both elements—the imperfections in the other markets and the fact that other values than merely economic ones exist—could be directly related to the differences in the access

[49] According to the models constructed through the Agrarian Diagnosis exercise (see Annex 3.1).

mechanisms among the producer types. For example, we have demonstrated in the previous section that the preferential access to credit by the large- and medium-scale cattle ranchers, which plays an important role in land purchases, has been central in the evolutionary pattern undertaken by these types. At the same time, we have demonstrated that this privileged access to credit is due to other factors such as closeness to the highway, access to development projects and good insertion in the milk and cattle markets. In the end, credit tends to follow those producers who are deemed to be less risky, more solvent, i.e., large- and medium-scale cattle ranchers, illustrating the mutually reinforcing nature of these different components, and indicating the relative power of these farmers and how this power plays out in the creation of inequality. With respect to the other values land has, and in line with De Janvry et al. (2001), we can underscore the social status and social capital obtained when one possesses land and comes to be considered a patron within the clientelist relations that characterise the area or study. We have also demonstrated the importance of land as a savings and capital reserve fund, essentially when it comes to inheritance processes (only in farms with a large amount of land is a distribution of capital achieved that permits various male children to maintain the same production system as their parents).

Second, it is important to assess the outcomes of the dominant cattle-based development pathway in the context of agricultural frontier expansion in which the area of study is embedded. As explained in Chapter 1, the Nicaraguan agricultural frontier is a tropical forested frontier, which is now coming to an end. The 'end' of the frontier is related to the fact that, nowadays, there are very few remaining forested areas in the country and that these areas are threatened by the continued migration of farmers towards those areas. Not only has this negative environmental consequence been related to the loss of forest cover, but it has also led to often violent conflicts between incoming populations and indigenous populations that have owned and lived in these forested territories for generations (Bataillon, 2016; Salinas Maldonado, 2014). In this context, it is important to pay attention to the capacity of each farmer type to set up production systems that allow them to remain in the area with their family generating sufficient family income as well as an accumulation process over time. The evolutionary patterns of farmer types identified before give us interesting insights in this regard, as

they allow us to identify what farmer types are more inclined to migrate and under what conditions each type manages to remain in the area or not. We identified three categories of producers that at some point migrate east:

- Youths who do not receive enough capital or land in the inheritance process to become agricultural producers within the zone (usually children of 'small-scale cacao and cattle producers' or 'small-scale cacao producers' and to some degree 'medium-scale cacao and cattle producers')
- Youths who receive capital from their parents to become independent in other areas to the east (only sons of 'large and medium-scale cattle ranchers)
- Farmers who implement a production system in the zone but do not succeed in accumulating enough capital (in land or money) or obtaining enough income and decide to sell to migrate east (at the end of the war they were usually from any of the types, but in the past 20 years they are usually 'small-scale cacao and cattle producers', 'small-scale cacao producers' and to a certain degree 'medium-scale cacao and cattle producers').

It is interesting to note that all producer types may migrate at a certain point along their trajectory, but migration does not always have the same cause or consequences with respect to the maintenance of certain production systems in the zone. In the case of the 'large- and medium-scale cattle ranchers', only some children migrate in the wake of the inheritance process. The majority remain in the zone, whether buying lands to implement the same production system as their parents or continuing with the family farm. This contrasts with what happens with other types of producers, for whom migration usually occurs after a sale of land in the zone to buy in another zone further east. The land for sale is generally bought by the 'large- and medium-scale cattle ranchers' to expand their farms or by families with a lot of capital who set themselves up in the zone after coming from western regions of the country. There is in fact a very dynamic land market, whose buyers are almost always the same: the larger cattle ranchers.

5.2.3.PROCESSES OF DEPEASANTISATION

Drawing on the insights presented in Chapter 2, it is crucial to assess to what extent the dominant cattle-based development pathway identified above opens or closes opportunities for the implementation of more (or less) peasant-like individual farmers' trajectories according to van der Ploeg's analytical framework to analyse the evolution of the peasantries (van der Ploeg, 2009). As a reminder, Van der Ploeg argues that agricultural production can be divided in three main categories: peasant farming, entrepreneurial farming, and corporate farming. He also proposes a comprehensive description of what peasant farming entails and suggests that the study of agrarian dynamics should comprise the analysis of historical processes of de-peasantisation and/or re-peasantisation that accompanies the historical evolution of farming in specific contexts. The analysis implemented above provides relevant insights about these tendencies and, through the identification of access mechanisms, brings light to the processes that lie behind them.

To start with, it is important to underscore that the production systems identified above in the area of study are all family based. As such, they differ substantially from corporate farming systems and must be assessed within the continuum existing between peasant and entrepreneurial modes of farming. Table 3.13, below, already presented in Chapter 2, presents the main features of each one of these modes of farming.

Figure 3.13: Main differences between peasant an entrepreneurial modes of farming

Peasant mode	Entrepreneurial mode
Building upon and internalizing nature; co-production and co-evolution are central	Disconnecting from nature; 'artificial' modes of farming
Distancing from markets on the input side; differentiation on the output side (low degree of commoditization)	High market dependency; high degree of commoditization
Centrality of craft and skill-oriented technologies	Centrality of entrepreneurship and mechanical technologies
Ongoing intensification based on quantity and quality of labour	Scale enlargement as the dominant trajectory; intensity is a function of technology
Multifunctional	Specialized
Continuity of past, present and future	Ruptures between past, present and future
Increasing social wealth	Containing and redistributing social wealth

Source: van der Ploeg (2009, p. 114)

From the analysis above, I argue that the evolution processes of the agrarian system as a whole and the evolutionary patterns of farmer types described for the area of study demonstrate a clear tendency towards a de-peasantisation process. First, by their very nature, the processes that characterise agricultural frontier regions represent a clear rupture between past, present and future. Not only the system as a whole suffers a drastic change moving from a forested area towards an agricultural one, but, also, production systems in the frontier are evolving continuously together with the changes of land use patterns. Moreover, contrary to regions where agricultural production exists for generations and where farmers have been able to slowly establish production systems adapted to specific local biophysical conditions (e.g., through peasant-based seed selection processes), the current production systems in the area of study are highly shaped by the knowledge and skills that farm families brought with them from their regions of origin, in western parts of the country with different biophysical conditions. As such, these systems appear to be poorly adapted to local biophysical conditions and, as explained above, their evolution in time gives rise to a poor-quality Nature's matrix, in terms of environmental features. Furthermore, the evolution of the dominant production systems in terms of land occupation, i.e., those implemented by large- and medium-scale cattle ranchers, is characterised by a high level of specialisation in cattle production, little diversification in land uses and an increasing use of chemical inputs to offset the decrease in soil fertility due to insufficient fallow time and insufficient transfers of fertility between cultivated and pasture plots. In addition, far from processes of intensification in labour and locally rooted knowledge and skills that characterise more peasant-like modes of farming, the historical evolution of those dominant systems is based on an intensification in land and financial capital (i.e., systems that require more and more land and financial capital). Finally, I have also demonstrated that the evolutionary patterns of all types of farmers imply an ever-increasing market dependency. This market dependency is multi-fold as all farmers of the area rely on markets not only to have access to products ranging from food to chemical inputs and veterinary products, but also to sell their production within international value chains (cacao, meat and dairy products).

5.3. THE EXISTENCE OF SUBALTERN DEVELOPMENT PATHWAY AROUND CACAO PRODUCTION

As shown by the evolutionary pattern of farmer types above, the reintroduction of cacao after the 1990s has triggered new dynamics in the area of study, which had a huge influence on the differentiation of farmer types, mainly for those farmers with smaller farms who were not specialised in cattle production. This has allowed for the differentiation of three types of farmers whose production relies to a large extent on the production of cacao and the emergence of new actors related to the cacao value chain for the international market (e.g., cacao cooperatives, development NGOs supporting the development of cacao). These are the 'medium-scale cacao and cattle producers', 'small-scale cacao and cattle producers', and 'small-scale cacao producers'. For these types, cacao represents between 50% and 55% of the income generated on the farm, with important differences according to the cacao chain in which they manage to insert themselves (if they sell their cacao not to the cooperative collection centres but rather to local merchants, the cacao only represents around 30% of their total income).[50] Cacao production is nevertheless very labour dependent during the whole year, essentially for the harvest which happens every one or two weeks during the year. For the farmer types based on cacao production, labour is only family-based, which represent a huge limit for the expansion of cacao plantations within the production systems they implement.

The historical origin of these types varies: they can be children or grandchildren of families that came in the 1970s,[51] those that received land in the early 1990s during the distribution of lands to war veterans, or those that migrated there later in the 1990s. Unlike the large- and medium-scale cattle ranchers, these three types of cacao growers had a smaller amount of start-up financial capital and few cattle, and generally settled further from the highway due to the pressure exercised by the large- and medium-scale cattle ranchers on the lands neighbouring their farms. Small-scale cacao producers in particular had no cattle at the time they settled there. With respect to the relational and

[50] According to the models constructed through the Agrarian Diagnosis exercise (see Annex 3.1).
[51] Except for the 'medium-scale cacao and cattle producers' who inherit the farms the same way as the 'large- and medium-scale cattle rancher' types do, in these cases the farms were taken over by one of the sons when the others emigranted in search of work or remained to work on the largest farms.

structural access mechanisms, these three types are characterised by a deficient insertion in the milk and meat markets (although the 'medium-scale cacao and cattle producers sell *cuajada* locally and sell animals for fattening to middlemen) and by a variable insertion in the cacao markets (those closer to the highways and the collection centres sell to the cooperatives' collection centres and also have access to projects and credit for cacao; the others have to insert themselves into the traditional cacao chain). They are also tied to large- and medium-scale cattle ranchers as the clients in the clientelist relations described above and can participate in sharecropping arrangements with them with respect to cattle production.

The development of production systems based on cacao could represent a real alternative development pathway within the dominant cattle-based development pathway within the Nicaraguan agricultural frontier. In particular, it appears to have the potential to open opportunities for the development of more peasant-like modes of farming (using Van der Ploeg's terminology). Although cacao growing is highly market-dependant, it also implies the establishment of production systems that are more diversified, more labour intensive and often less dependent on external inputs (especially when it is produced organically). Moreover, the development of cacao farms can have a positive impact on the quality of the Nature's matrix through the diversification of land uses and the increase of forest cover, at least in the plots covered with cacao plantations.

5.4. LOOKING FORWARD: THE POSSIBLE FUTURE EVOLUTIONS OF CURRENT DEVELOPMENT PATHWAYS

The historical evolutionary dynamics of the territory as a whole, and of the different farmer types in particular, illustrate a trend toward a cattle specialisation within the territory, a concentration of land in the hands of cattle ranchers and an expulsion of certain actors from the zone. In fact, the farmers who dominate the cattle pathway are the ones who stick with it the best. As for the cacao growers, while it would seem that the production of cacao—particularly when inserted in the chains of the cooperatives—manages to create a valid alternative to resist the unbalanced outcomes of the dominant pathway, it is not yet clear whether the alternative development pathway they are shaping will actually change the territorial dynamics as a whole in the medium and long

term; in other words, the question remains to know if the children of today's cacao growers will be able to remain in the area implementing viable production systems after inheritance processes result in the division of their parents' farms.

In line with my focus on complexity, I think it is impossible to predict the future dynamics of the territory and its actors. This uncertainty partly obeys the fact that the relationship between access mechanisms, territorial dynamics, evolutionary patterns of farmer types and individual trajectories is not one-way. Just as the access mechanisms shape the dynamics of agrarian change, the change processes, in turn, also shape the access mechanisms, favouring evolutions different from the ones that have existed up to now. For example, the land concentrating and expelling dynamic tends to weaken certain relational mechanisms based on the relations between farmer types which could open spaces for the rise of other development pathways, such as the cacao-based pathway introduced above. We can illustrate this with three specific situations.

The first has to do with the livestock sharecropping arrangements based on clientelist relations. The territorial dynamic we have described has, as a consequence, the migration toward more eastern zones of farmers who were the recipients of heifers within these sharecropping arrangements. The departure of these farmers could represent a risk that jeopardises the ability of large- and medium-scale cattle ranchers to maintain their production systems in the future. Indeed, for these production systems to work, these farmers need to free up space on their farms for fattening steers. Until now these farmers have been able to cope with that risk, maintaining the sharecropping arrangements with the emigrating recipients by sending their heifers outside the area of study to the new farm in which those recipients settle, i.e., eastward, within younger agricultural frontier regions. This eastward migration of the heifers provided under the sharecropping system extends the clientelist relations to a far greater geographic scale. But, with the ´end´ of the agricultural frontier, it is increasingly difficult for farmers to settle in eastern regions.

The second has to do with the labour relations in the zone. The growth of the ´large- and medium-scale cattle ranchers´ in the area implies a growing or at least constant need for an external labour force. As we mentioned before, this labour comes from the

farmers with little or no land. For them, unless wage levels rise, it is crucial to gain access to small plots of land through loans, sharecropping or renting arrangements in order to remain in the zone. Nonetheless, the pressure on the land imposed by the 'large- and medium-scale cattle ranchers' in order to increase the size of their land and privilege pastures over other soil uses has significantly restricted the capacity of farmers with little or no land to obtain it through sharecropping, renting or borrowing. In fact, renting arrangements only persist today in the high zone, where an absentee landlord rents a 20-*manzana* farm in small plots, and borrowed or sharecropped land is only practiced in some of the larger cattle ranches that have not yet transformed their entire area into pasture. This has obliged certain patrons who do not have areas for sharecropping or lending to increase the remuneration of their wage workers to compensate for those workers' drop in income from agriculture.

The third has to do with access to markets. The development of the cacao value chain in the zone, particularly the farmers' organisational process around a cooperative and the installing of community collection centres permitted the emergence of a development pathway that favoured small and medium growers. Unlike access to the pasteurised milk chain, however, access to the preferential cacao chain has few barriers, such that any producer (whether or not a cooperative member) can sell his product to the cooperative's collection centres. This has stimulated some 'large- and medium-scale cattle ranchers' to also start producing cacao. Access to the cacao market thus ceased being an access mechanism that favoured poor farmers, but the consequences of this remain to be seen, in particular in the face of the labour market shortage commented on above.

The dynamics that could emerge from these changes are unpredictable. Nonetheless, we argue that by making explicit and analysing this bi-directional relationship between access mechanisms and development dynamics, be they individual or collective, we will be able to understand the consequences of the development policies and interventions proposed or established in the dominant development patterns.

6. CONCLUSION

In this chapter I have illustrated some of the historical evolutions that occurred in a small agricultural region within the Nicaraguan agricultural frontier and have been able to identify both some characteristics of the development pathways and of the individual trajectories followed by farmers that shape the region's dynamics. These evolutionary tendencies identified have favoured the emergence of a dominant development pathway related to cattle breeding which entails de-peasantisation processes. Indeed, it is characterised by the establishment of land-intensive production systems that create little value added per unit of land and generate social inequality and environmental deterioration due to their participation in the continued advance of agricultural activities in the forested areas, both locally and at the broader level of the whole Nicaraguan agricultural frontier. I have also shown, however, that, despite the strength of this dominant pathway, there is still space for the emergence of alternative production systems that distance themselves from the productive and social relations of the dominant pathway. These alternatives are mainly related to cacao growing; they correspond to more peasant-like modes of farming and have the potential to generate a positive impact on the quality of the Nature's matrix. We can say that the farmer types involved are indeed struggling for the emergence and strengthening of an alternative development pathway.

Nonetheless, the analysis of the historical access mechanisms in the territory has shown that these pathways—and the economic activities they involve—occur in a socio-institutional context that is not very favourable. This causes adverse insertion conditions for the producers who are part of such an alternative pathway with respect to the dominant cattle ranchers. Despite the fact that the strengthening of a cacao-based development pathway could be more inclusive, equitable and sustainable territorial development, neither the public policies nor the development interventions implemented by NGOs have been able to make it a real alternative to the dominant cattle-based development pathway (see for instance Bastiaensen et al. (2015)).

It is thus fundamental to *make visible* not only the maintenance but also the potential of this alternative development pathway. This chapter is an attempt to do so by

specifically emphasising the aspects concerning access to land. Nonetheless, more knowledge still needs to be created about the integration of components having to do with institutionality, power relations and the social sphere—not only the economic-productive one—as parts of the dynamic that condition the evolution of the existing development pathways.

In addition to making visible the potential of this alternative pathway, it also seems necessary for practitioners and policy-makers to improve the socio-institutional conditions in which it could be strengthened. For that, it is necessary to work in challenging the elements that allow for the maintenance of the dominant pathway at the expense of alternative ones, both at local and national or international levels. A way forward could be to work on trying to shape the set of access mechanisms that characterise the ability to profit from the land in different ways, and directly influence the individual evolutionary patterns in the territory. This involves centring the development interventions and public policies on processes that could actually strengthen some access mechanisms over others. It is vital that the development organisations and decision-making authorities in the public sphere design proposals that are more integral and more consistent with the territory's potentialities and restrictions. Knowing and understanding how all these access mechanisms are linked and mutually influence each other to generate the evolutions of the territory as a whole and the trajectories undertaken by the families is therefore crucial to designing interventions that favour one development pathway over another.

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ANNEXES

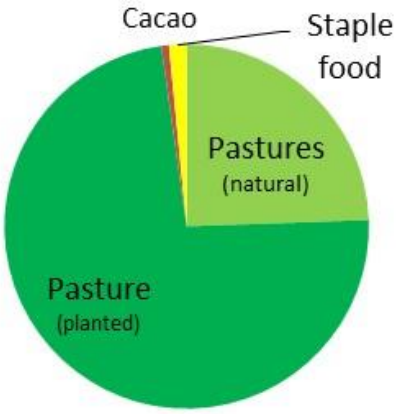
Annex 3.1. Farmers'types nowadays in the area of study

Large-scale cattle rancher
Subtype 1

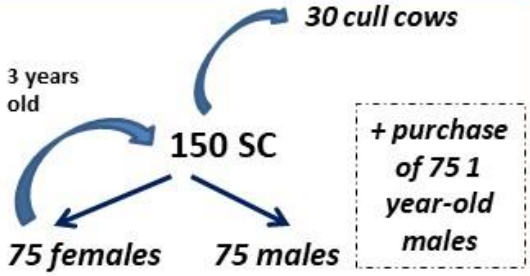
- **Area = 415 to 615 Mza**
- **2,5 family workers**
- **100 to 150 suckler cows**

- **Location: mainly Central zone**
- **Cowshed (capacity : 150 SC)**
- **1 pickup + 4 horses**
- **5 to 8 permanent workers**

For 615 Mza:



10 Mza Staple food
4-5 Mza cacao
600 Mza pastures
(75 % planted)



- Calving interval = 18 months
- Average milk productivity = 4 L/SC/day
- Animal load:

Milk producing herd = 0,71 SC / Mza
Meat producing herd= 1.4 head of cattle / Mza

- Milk sold within pasteurized value chain (0,34US$/L)
- Young bulls sold to slaughterhouses (3 years,350 kg)

- Purchase milk and calves to other farmers
- Sells directly to pasteurized milk plant and slaughterhouses
- Member of Milk cooperatives
- Own local stores and deliver services to other famers

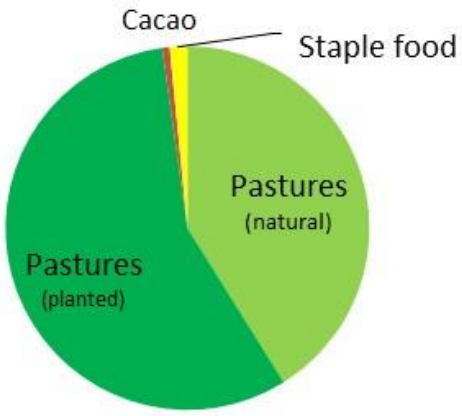
- **NVA / worker = 9400 US$ /worker**
- **NVA / Mza = 385 US$/Mza**
- **NVA / SC = 780 US$/SC**
- **FAI / FW = 36600 US$/FW**

Large-scale cattle rancher
Subtype 2

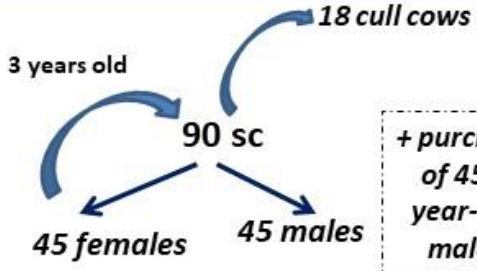
- **Area = 300 to 415 Mza**
- **2,5 family workers**
- **70 to 100 suckler cows**

- **Location: mainly Central zone**
- **Cowshed (capacity: 100 SC)**
- **4 horses**
- **3 to 5 permament workers**

For 370 Mza:



10 Mza Staple food
4-5 Mza cacao
355 Mza pastures
(75 % planted)



- Calving interval = 18 months
- Average milk productivity = 4 L/SC/day
- Animal load:

Milk producing herd = 0,71 sc / Mza
Meat producing herd= 1.4 head of cattle / Mza

- Milk sold within pasteurized value chain (0,34US$/L)
- Young bulls sold to slaughterhouses (3 years,350 kg)

- Purchase milk and calves to other farmers
- Sells directly to pasteurized milk plant and slaughterhouses
- Member of Milk cooperatives
- Own local stores

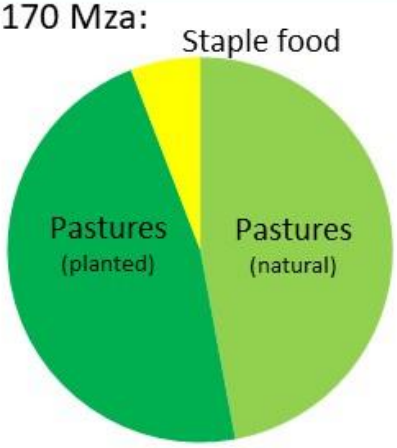
- **NVA / worker = 9630 US$ /worker**
- **NVA/ Mza = 415 US$/Mza**
- **NVA / SC = 800 US$/SC**
- **FAI / FW = 23000US$/FW**

Medium-scale cattle rancher
Subtype 1

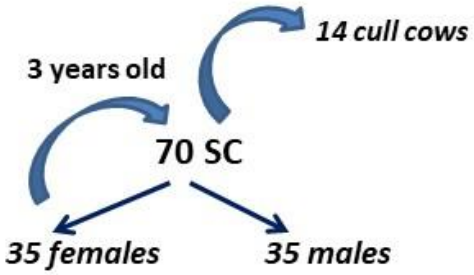
- **Area = 140 to 215 Mza**
- **1,5 family workers**
- **55 to 85 suckler cows**

- **Location: Central and low zone**
- **Cowshed (capacity: 80 SC)**
- **3 horses**
- **2 to 5 permanent workers**

For 170 Mza:



10 Mza Staple food
160 Mza Pastures
(50 % planted)



(sold between and 1 and 2 years old)

- Calving Interval = 18 months
- Average milk productivity = 3,7 L/SC/day
- Animal load= 0,85 SC/Mza
- Milk sold within pasteurized value chain (0,32US$/L)
- Young bulls sold to Large-scale cattle ranchers (150-250 kg)

- Milk sold directly to pasteurized milk plant
- Young bulls sold to large-scale cattle ranchers
- Fatten pigs

- **NVA / worker = 5040 US$/worker**
- **NVA / Mza = 300 US$/Mza**
- **NVA / SC = 360 US$/SC**

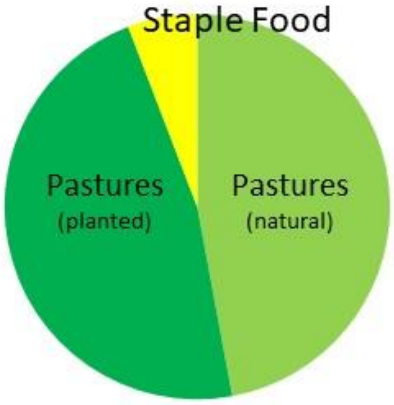
- **FAI / FW = 9330 US$/FW**

Medium-scale cattle rancher
Subtype 2

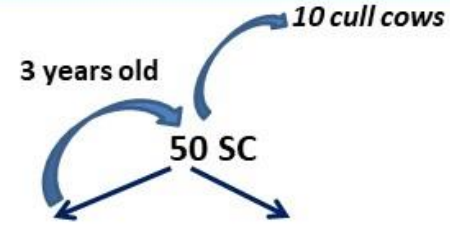
- **Area = 80 to 140 Mza**
- **1,5 family workers**
- **30 to 55 suckler cows**

- **Location: Central and low zone**
- **Cowshed (capacity: 50 SC)**
- **3 horses**
- **1 to 2 permanent workers**

For 130 Mza:



10 Mza Staple food
120 Mza Pastures
(50 % planted)



- Calving Interval = 18 months
- Average milk productivity = 3,7 L/SC/day
- Animal load= 0,85 SC/Mza
- Milk sold within pasteurized value chain (0,32US$/L)
- Young bulls sold to Large-scale cattle ranchers (150-250 kg)

- Milk sold directly to pasteurized milk plant
- Young bulls sold to large-scale cattle ranchers
- Fatten pigs

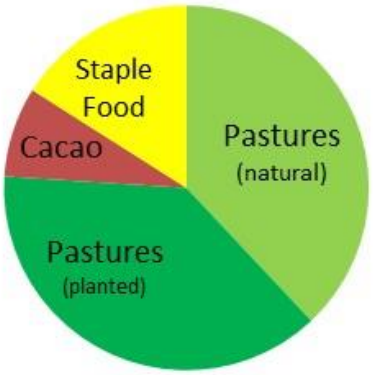
- **NVA / worker = 3640 US$/worker**
- **NVA / Mza = 286 US$/ Mza**
- **NVA /SC = 360 US$/SC**

- **FAI / FW = 7400 US$/FW**

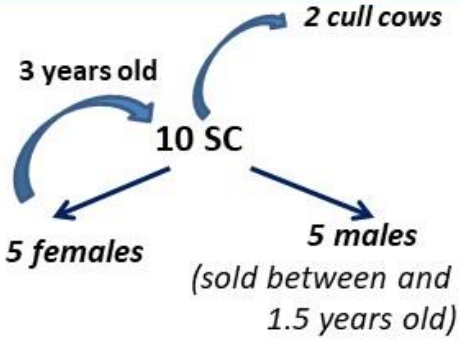
Medium-scale cacao and cattle producer

- **Area = 44 to 78 ha**
- **2 family workers**
- **10 to 28 Suckler cows**
- **Location: High zone**
- **Only manual tools**
- **Cowshed (capacity: 30 SC)**
- **1 horse and 1 mule**

For 35 Mza:



6 Mza Staple food
3 Mza Cacao
26 Mza Pastures



- Calving Interval = 18 months
- Average milk productivity = 3,7 L/SC/day
- Animal load= 0,7 SC/Mza
- Milk sold to large-scale cattle ranchers (0,32US$/L)
- Young bulls sold to Large-scale cattle ranchers (150-250 kg)

- Cacao sold in mucilage to cooperatives
- Fatten pigs and grow chicken
- Diversified garden (mango, orange, avocado, coffee, etc...)

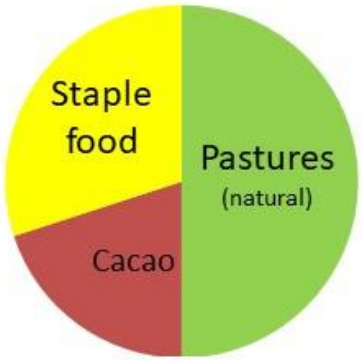
- **NVA / worker = 4350 US$/worker**
- **NVA / Mza = 500 US$/Mza**
- **FAI / FW = 3590 US$/FW**

Small-scale cacao and cattle producer
(member of cacao cooperative)

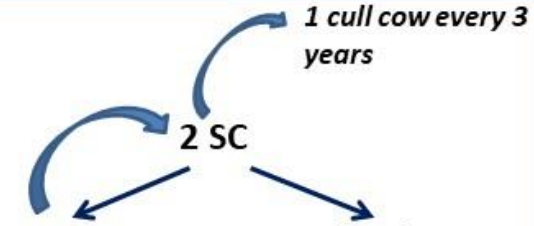
- **Area = 14 to 45 Mza**
- **2 family workers**
- **2 to 10 suckler cows**

- **Location: High zone**
- **Only manual tools**
- **1 horse and 1 mule**

For 14 Mza



4 Mza Staple food
3 Mza cacao
7 Mza Pastures (planted)



- Calving Interval = 18 months
- Average milk productivity = 5 L/SC/day
- Animal load= 0,6 SC/Mza
- Milk transformed in curd cheese self consumed or sold locally (equivalent 0,20 US$/L)
- Young bulls sold to Large-scale cattle ranchers (150Kg)

- Cacao sold in mucilage to cooperatives
- Fatten pigs and grow chicken to sell eggs locally
- Diversified garden (mango, orange, avocado, coffee, etc...)

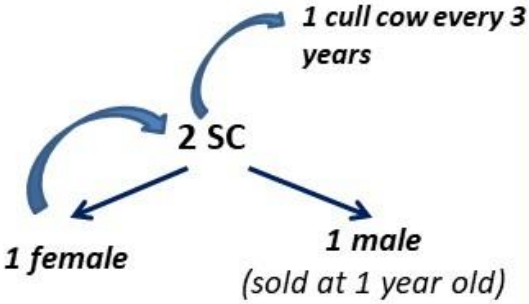
- **NVA / worker = 3600 US$/worker**
- **FAI / FW = 3180 US$/FW**
- **MVA / Mza = 1143 US$/Mza**

Small-scale cacao and cattle producer
(non-member of cacao cooperative)

- **Area = 14 to 45 Mza**
- **2 family workers**
- **2 to 10 suckler cows**
- **Location: High zone**
- **Only manual tools**
- **1 horse and 1 mule**

For 14 Mza:

5 Mza Staple food
2 Mza Cacao
7 Mza Pastures (natural)



- Calving Interval = 18 months
- Average milk productivity = 5 L/SC/day
- Animal load= 0,6 SC/Mza
- Milk transformed in curd cheese self consumed or sold locally (equivalent 0,20 US$/L)
- Young bulls sold to Large-scale cattle ranchers (150Kg)

- Cacao sold sold dry to local merchants
- Fatten pigs and grow chicken to sell eggs locally
- Diversified garden (mango, orange, avocado, coffee, etc...)

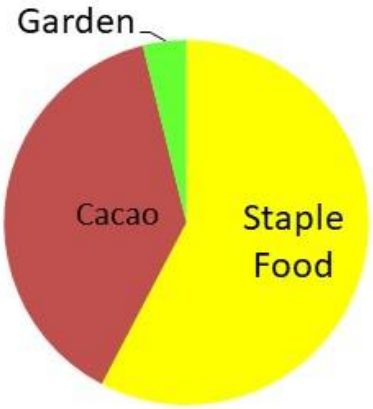
- **NVA / worker= 2400 US$/worker**
- **NVA / Mza = 757 US$/ha**
- **FAI / FW = 2150 US$/FW**

Small-scale cacao producer
(member of cacao cooperative)

- **Area = 5 to 10 Mza**
- **1,5 family workers**
- **No cattle**
- **Grow chicken and pigs**

- **Location: all zones**
- **Only manual tools**
- **1 Mule**

For 7 Mza



4 Mza staple food (+ 0.75 Mza rented for red beans)
3 Mza Cacao ha de cacao
0,25 Mza Garden

- Cacao sold in mucilage to cooperatives
- Fatten pigs and grow chicken to sell eggs locally
- Diversified garden (mango, orange, avocado, coffee, etc...)

- **NVA / worker = 3800 US$/worker**
- **FAI / FW = 3480 US$/FW**
- **NVA / Mza = 2328 US$/Mza**

Small-scale cacao producer
(non-member of cacao cooperative)

- **Area = 5 to 10 Mza**
- **1,5 family workers**
- **No cattle**
- **Grow chicken and pigs**

- **Location: all zones**
- **Only manual tools**
- **1 Mule**

For 7 Mza

4 Mza Staple food (+0.75 Mza rented for red beans))
2 mza de cacao
0,7 Mza Garden

- Cacao sold sold dry to local merchants
- Fatten pigs and grow chicken to sell eggs locally
- Diversified garden (mango, orange, avocado, coffee, etc...)

- **NVA / worker = 2380 US$/worker**
- **VAN / Mza= 1457 US$/Mza**
- **FAI/ FW = 2280 US$/FW**

CHAPTER 4

CAN FINANCIAL INCENTIVES CHANGE FARMERS' MOTIVATIONS? AN AGRARIAN SYSTEM APPROACH TO DEVELOPMENT PATHWAYS AT THE NICARAGUAN AGRICULTURAL FRONTIER

Note: This chapter has been published as: Van Hecken, G., Merlet, P., Lindtner, M., & Bastiaensen, J. (2019). Can Financial Incentives Change Farmers' Motivations? An Agrarian System Approach to Development Pathways at the Nicaraguan Agricultural Frontier. Ecological Economics, 156, 519–529. https://doi.org/10.1016/j.ecolecon.2016.12.030

For the elaboration of this paper, the fieldwork related with the agrarian diagnosis resulting in the current farmers´ typology and its historical evolution as well as the technical-economic calculations were mainly realised by Mara Lindner in the scope of her Master Thesis dissertation. I was Mara Lindner´s supervisor and, as such, realised numerous stays in the field to participate in the data collection process and I actively participated in the implementation of the corresponding analysis. With respect to the specific work presented in this paper, I was responsible for the sections that present the Agrarian System´s approach and its results and those that link the inputs of the empirical work with the discussion about financial incentives (which included reworking part of the raw data). These contributions were directly inspired from the theoretical framework developed for the PhD. As this paper was part of a special issue on ´Crowing-out or crowding-in? Behavioural and ethical responses to economic incentives for conservation´, Gert Van Hecken, as the first author specialised in Payment for Ecosystem Services (PES), was responsible of framing the analysis within the broader debate around PES. I also actively participated in the writing process.

Some parts of the original paper have been altered to fit within the PhD dissertation broad design.

1. INTRODUCTION

Conditional payments to incentivise land users to adopt environment-friendly practices are found to be a very attractive idea as witnessed by the skyrocketing amount of both pilot projects and scholarly articles on PES (Schomers & Matzdorf, 2013; Wunder, 2015). Especially in agricultural contexts, direct payments are deemed to be more efficient and effective than alternative top-down or indirect approaches (Ferraro & Kiss, 2002; Wunder, 2005). Since the participants are often poor farmers in the Global South, PES schemes also tend to be hailed as attractive win-win scenarios, conserving nature while alleviating poverty (Muradian et al., 2013; Pagiola, Arcenas, & Platais, 2005). Empirical evidence shows, however, that the presumed advantages of PES are not unequivocal. A growing number of studies underline the unpredictable outcomes of PES and point to ambiguous results both in terms of environmental and social outcomes (e.g., Adhikari & Agrawal, 2013; Pattanayak, Wunder, & Ferraro, 2010). These findings are also reflected in a body of critical literature warning of potentially detrimental social and ecological effects of interventions rooted in overly simplistic, apolitical and techno-economic (conceptual) frameworks (Büscher, 2014; Van Hecken, Bastiaensen, & Windey, 2015; Nicolás Kosoy & Corbera, 2010; McAfee, 1999).

The episteme underpinning much PES advocacy is based on technocratic notions of human-environment relationships as manageable systems which can be altered in predictable ways by capitalising on a universal economic rationality underpinning the actors' motivations (Van Hecken & Bastiaensen, 2010a). Recent studies suggest that non-financial incentives – agricultural extension support, information sharing or social pressure – can be more potent motivations in land stewardship schemes than payments, and that payment schemes do not necessarily enhance economic efficiency and sustainability of conservation activities (Hayes, 2012; Van Hecken & Bastiaensen, 2010b; Narloch, Pascual, & Drucker, 2012; Rode, Gómez-Baggethun, & Krause, 2015). The effects of payments on environmental behaviour depend on a variety of factors including the characteristics of the payment agreement, local notions of justice, and the psychological, cultural, and social embeddedness of the desired behaviour (Gneezy & Rustichini, 2000; Van Hecken, Bastiaensen, & Vásquez, 2012; Martin, Gross-Camp, Kebede, McGuire, & Munyarukaza, 2014; Muradian et al., 2013). Payments will

inevitably interact with intrinsic motivations and historically institutionalised logic and practices, undermining (crowding-out) or reinforcing (crowding-in) more environmentally beneficial attitudes and behaviour (Rode et al., 2015).

Empirical evidence about the interactions of monetary and non- monetary incentives, and corresponding institutional arrangements, and their sustained effect on the governance of ecosystems is gradually emerging (Ezzine-de-Blas, Corbera, & Lapeyre, 2019; Rode et al., 2015). The initial research has been rooted mainly in experimental economics and the use of framed field experiments (Bowles, 2008; Cardenas, Stranlund, & Willis, 2000; Kits, Adamowicz, & Boxall, 2014; Narloch et al., 2012). While these approaches generate valuable insights into the dynamics of decision-making, one of the drawbacks is that these studies assume that people's behaviour in artificial and simplified experiments actually reflects their behaviour in the much more complex, varied and repeated interactions in the real world. Since the argument of crowding-in or crowding-out builds precisely on the possibility of a change of perceptions and motivations, and thus unstable preferences and choices over time and across institutional arrangements, the external validity of these approaches might be in jeopardy.

Current research on motivation-crowding builds on conceptual frameworks such as the Self-Determination Theory (Ezzine-de-Blas et al., 2019), which links individual psychological processes to external incentives, assuming that particular individual motives result in particular actions. While these theories recognise that motivations are socially constructed[52] and thereby offer interesting insights into the influence of institutional contexts on personal motivations, they offer only limited methodological-conceptual tools to understand the nature of these interactions. Thus, the unequal effects of structural or institutional constraints on individual agency are often overlooked. Understanding the differential behavioural outcomes of particular incentive structures therefore requires attention to social inequalities, differential room for manoeuvre and the diversity of livelihoods (Cleaver, 2005; Milne & Adams, 2012)

[52] That is they interact with what Ezzine-de-Blas et al. (2019) have called the 'inter- personal context', including the institutional context and cultural values.

precisely because the various positions from which actors become involved in decision-making processes not only affect their motives but also their scope for action (Cote & Nightingale, 2012). Hence it is crucial to understand that institutions carry different meanings as well as diverse enabling or constraining factors for different actors (Leach, Mearns, & Scoones, 1999).

In order to understand how people react to the introduction of new institutional frameworks our analysis at the individual level must include an understanding of the dynamic and recursive relationship between the micro-level (individual decision-making concerning land use change) and the meso-level (interactive socio-institutional dynamics in specific territories). Understanding the effects of motivation- crowding, the sustainability of pro-environmental behaviour, and the socially-situated dynamics of human agency thus means that we should adopt an historical and socially-informed approach to the emergent socio-ecological dynamics in particular territorial contexts. In this article we offer a conceptual-methodological approach for assessing the inter-actions between the individual dimensions of motivation-crowding and the personal and interpersonal contexts in which these are embedded and from which they emerge.

In line with recent literature (e.g., Fazey et al., 2016; Leach, Scoones, & Stirling, 2010), this article adopts a pathways approach, but goes beyond its current metaphorical use by developing a more operational approach to rural territorial pathways (Bastiaensen et al., 2015). We also explore how the use of an agrarian system approach (Cochet, 2012; Dufumier, 1996; Mazoyer & Roudart, 2006) can help us in the analysis of such pathways, allowing for a more meaningful and comprehensive understanding of the dynamic and reflexive interactions between institutional structure and individual agency. We illustrate the usefulness of our approach with empirical findings from a review of the historical evolution of agrarian dynamics at an agricultural frontier in Nicaragua where a PES project has recently been implemented. The article is structured as follows. In Section 2 we discuss the epistemological basis and methodological implications of the agrarian system approach, and demonstrate how it allows to reflexively relate different types of farmers' individual ‘livelihood trajectories’ to broader collective ‘development pathways’. In Section 3 we illustrate the potential of this conceptual-methodological approach through an interpretation of the territorial dynamics and farmers' motivations

in the Nicaraguan agricultural frontier. Finally, in Section 4 we show how these findings allow us to more meaningfully reflect upon the implications of PES and other conservation and development interventions in terms of their potential impact on farmers' motivations and land use practices.

2. UNRAVELLING SOCIAL-ECOLOGICAL COMPLEXITIES IN RURAL TERRITORIES THROUGH THE 'AGRARIAN SYSTEM' CONCEPT

2.1. DEVELOPMENT PATHWAYS AND LIVELIHOOD TRAJECTORIES

Rural territories are complex dynamic systems resulting from the interaction of natural and human processes giving rise to particular physical landscapes shaped and bounded by people's actions, perceptions, ideas and aspirations (Rizzo et al., 2013; Setten, 2004). Human and natural aspects are intertwined and continually coevolve (e.g., Folke, Hahn, Olsson, & Norberg, 2005). It is pointless to analyse the social and the natural separately precisely because the dynamics of the system only exist in their interaction (Van Hecken, Bastiaensen, & Windey, 2015; Hukkinen, 2014). As rural territories have been co-produced by human activity, their present state depends on historical trajectories and on choices at critical junctures in the past (Liu et al., 2007). The historical and multi-dimensional reconstruction of the evolution of social-ecological systems therefore must receive sufficient attention in order to understand the current status of the latter and thus avoid 'snapshot' appraisals of rural reality (Leach et al., 2010). From this perspective economic interactions among human beings take place within specific historical and agroecological conditions, and lead to the emergence of development pathways around social mobilisation projects that generate and condition the desirability and viability of individual trajectories (Bastiaensen et al., 2015; Scoones & Wolmer, 2002). A development pathway emerges via the creation and maintenance of a set of shared ideas, observed regularities or livelihood patterns among particular social groups (Bastiaensen et al., 2015; de Haan & Zoomers, 2005). A specific pathway reflects culturally and historically shaped practices about 'the right way of doing things' (Cleaver, 2012) which circulate within social networks and give rise to specific 'rules', leading to particular relational patterns. These pathways influence a person's agency and opportunities, and thus enable or constrain the implementation of distinct individual livelihood trajectories (Bastiaensen et al., 2015). In particular, territorial development pathways will determine how different actors access resources, i.e., their 'ability to benefit from things' (Ribot & Peluso, 2003, p. 153). In the process of gaining and maintaining access there will be winners and losers, depending on actors' ability to sway others to their own views through the use of power, resources, knowledge and voice.

None of these pathways are cut in stone; they open and close dynamically. Despite the presence of situated, differentiated and constrained agency, households and individuals are constantly interpreting, testing and developing ideas; reproducing, reworking, contesting and renegotiating rules of the game as well as maintaining or changing their social networks throughout their livelihood trajectories. Through their successes and failures they continuously co-construct the human territories they belong to and impact the processes that define those territories' pathways. In so doing they realise their potential to change the development pathways and open opportunities for implementing future trajectories. From a conservation and development intervention perspective, this reflects a critical need to understand the differential effects on specific actors that ensue from the emergence of specific development pathways and, based on that understanding, inform debates as to which actors should be engaged in which ways.

2.2. THE AGRARIAN SYSTEM CONCEPT

A useful theoretical-methodological approach for unravelling the multi-scale complexities of rural realities, their dynamics of change and resulting development pathways, and which explicitly focuses on farmers' practices and motivations at different levels, is the agrarian system concept as developed within the 'comparative agriculture' approach (Cochet, 2011, 2012; Dufumier, 1996; Mazoyer & Roudart, 2006). Contrary to more traditional agronomic studies which often limit their focus to the farm level, the agrarian system approach begins the analysis of rural dynamics at the landscape level where the aggregated consequences of individually implemented farm practices ultimately unfold (Rizzo et al., 2013).

Although the agrarian system concept has been described in different ways,[53] we follow Cochet (2012) in arguing that:

> ´(…) the agrarian system encompasses first of all the mode of exploitation of a given environment. This mode of exploitation includes: (1) the characteristics of one or several agroecosystems; (2) a modus operandi, which itself is characterized by the farmers' technical heritage (tools, knowledge, practices, know-how that have evolved over time); (3) the way the environment has been trans- formed by man over time; (4) the resulting landscape; (5) the relationships

[53] We refer to Jouve (1988) and Cochet (2012) for an extensive overview of these different conceptualizations

> between the different agroecosystems that make up the environment; and (6) soil fertility renewal mechanisms. The agrarian system also includes the social relations of production and trade that have led to its implementation and development (particularly the conditions influencing access to resources) as well as the conditions affecting the distribution of resulting value added. It includes a limited number of production systems, the mechanisms that differentiate these systems, and their respective trajectories. Finally, it includes the characteristics of the specialization and social division of labour, within each sector, and the economic, social and political conditions—particularly relative pricing systems—that influence the farmers' integration in global markets.´ (ibid. 2012, p. 130)

One of the main premises underlying this approach is that at every moment in history, farmers always have reasons to do what they do (Cochet, Devienne, & Dufumier, 2007). In order to analyse rural territories, it is then key not only to identify farmers' practices but also to understand what multiple motivations lie at the core of these actions. Within this approach, it is argued that producers' actions are not merely motivated by dimensions of economic rationality such as maximisation of production, income or profit; management of risk, cross-generational capital creation, etc., nor that they can be unequivocally explained by mere reference to culture or traditions. Farmers' agency is also shaped by an evolving hybrid set of cognitive (e.g., knowledge, worldviews), material (e.g., natural resources availability, animal species, plant varieties, soil fertility), and social factors (e.g., institutions, power structure, social relations) (Cochet, 2011). Human behaviour is thus often rational, but not always conscious, intentional or strategic; rather, deeply habituated ‘on the basis of long experience with what seems to work’ (Hiedanpaa & Bromley, 2014, p. 182). Thus, motivations are, to a great extent, shaped by the institutional, cultural, historical and power contexts and thus less consciously determined than often suggested. This is also in line with our conceptualisation of evolving territories as the result of interplay between collective development pathways and individual trajectories.

As an entry point the agrarian system approach builds on the concept of ‘production systems’, which represent the farm level where agricultural practices are implemented (Brossier, 1987; Cochet, 2012). Production systems are however more than a simple sum of farm-level practices; they are embedded in interrelated social, ecological, and technical elements that together shape and simultaneously feed back into these practices. It is the combination of different production systems that crystallises into an

agrarian system. In this way the 'comparative agriculture approach makes it possible to zoom in and zoom out on different levels of analysis, and move frequently from one scale of analysis to another' (Cochet, 2012, p. 133). The process of zooming in is a mental tool that allows us to better understand a complex reality, and should always be accompanied by a zooming out process, that situates concrete agricultural practices in a broader reality beyond the plot or farm level, i.e., in the broader socio-institutional, geographic and cultural contexts in which they are embedded. The analysis of these interactions does not only help us to explain what farmers do, but also elicits the reasons or motivations behind certain actions, as well as the aggregated consequences that follow in terms of territorial dynamics (Cochet, 2012) and the feedback into what farmers are able and motivated to do. The continuous analytical switching among scales is one of the major strengths of the agarian system approach even though its application in practice is challenging.

2.3. METHODOLOGICAL COMPONENTS

In order to assess agrarian systems dynamics, the 'comparative agriculture' approach has developed the 'agrarian diagnosis' methodological package (Apollin & Eberhardt, 1999; Cochet, 2011). This diagnosis is based on substantial fieldwork and uses a combination of methods including landscape transect assessments,[54] participant observations and semi- structured open interviews. It consists of three general stages: a bio- physical landscape analysis, an historical analysis and a technical-economic analysis. These stages are neither linear nor independent of each other; they are implemented in an iterative way, stimulating the researcher to continuously move back and forth between them.

The landscape analysis aims to identify physical and human patterns and map coherent geographical spaces that are characterised by similar management practices and use of natural resources. This allows the researcher to discover the relationship between agricultural practices and ecological conditions. The historical analysis aims at identifying and assessing the trajectories followed by different types of farmers in terms

[54] Transect assessment is a method in which the researcher walks through the territory in order to identify and analyse ecological land use patterns, environmental characteristics (e.g., type of soil, slopes, water system), and human infrastructures (e.g., types of human settlement, roads).

of their changing production systems. Through detailed interviews with farmers, it relates the past processes of social and technical differentiation to broader socio-institutional changes (e.g., changing public policies, price relations, demography and migration). Together the landscape and historical analyses allow the researcher to construct a contextual typology of interacting local production systems. Finally, the technical-economic analysis enables a detailed understanding of the production systems typology in terms of agricultural practices and their economic results, as well as how these practices shape and are shaped by the changing social-ecological context. This last analysis is informed by in depth case studies for each type of production system, and results in a technical-economic model for each.[55] This in turn facilitates the calculation of socio-economic indicators such as the agricultural income for family farms, internal rate of return and return on capital for entrepreneurial farms, as well as land and labour productivity.

The agrarian system approach thus locates current observed practices in an historical pattern of change, and as such can help us assess how practices have evolved over time, the conditions that have spurred certain changes, and further changes likely in the future (Cochet, 2011; Cochet et al., 2007). One major limitation of this approach is that the methodological package is largely oriented towards analysis of the more technical and economic aspects underlying decision-making and processes of social differentiation, partially disregarding the contextualisation of beliefs, needs, and aspirations in relation to power and institutions. However, by emphasising the influence of structural elements in shaping individual and collective action, it engages with power issues at a political economy level. Moreover, the diagnostic results can feed in to a broader analytical process by incorporating other methods thus allowing us to more comprehensively reflect on the social and relational factors influencing rural dynamics.

[55] In order to build these models, a range of technical and economic data is gathered in the field, that can be subdivided in three categories: (1) Agronomical practices, necessary tools, labour needs and availability, farm infrastructure, etc.; (2) Production system out- comes – e.g., yields, type and quantity of products for sale, for own consumption or for re-use within the system; (3) Economic analysis, e.g., market prices for inputs and outputs, cash flows, depreciation of material, taxes and subsidies, etc

3. PAYING FARMERS AT THE NICARAGUAN AGRICULTURAL FRONTIER

Our case-study to illustrate the potential of the agrarian system approach for interpreting the complex relationships between development pathways and livelihood trajectories is located in the buffer zone of the Indio-Maíz Biological Reserve in south-eastern Nicaragua, specifically in the Manola forest-edge community[56] in Río San Juan Province near the border with Costa Rica. The reserve was established in 1990 and is one of the biggest protected areas in Nicaragua with a surface of 264,000 ha. It is part of the Mesoamerican Biological Corridor and is home to a variety of endangered species (Ministerio del Ambiente y los Recursos Naturales (MARENA), 2015). Even as a strictly protected area, with no human activity legally allowed, complex socio-political and economic dynamics have resulted in the agricultural frontier steadily moving from the established buffer zone into the reserve. A long history of immigration and extensive cattle raising make it one of the country's most intensive agricultural pioneer fronts (Nygren, 2004).

Alarmed by the detrimental ecological consequences of deforestation in this area, the response of the Nicaraguan government has mainly been restricted to the establishment of the reserve, and subsequent attempts to promote a settled population in the buffer zone through the legalisation of settlers' land rights (Larson, 2010; Nygren, 2000). Due to its remoteness and the limited willingness and ability of the state to halt further invasion into the reserve, the region saw a growing presence of conservation and development NGOs in the 1990s taking an increasingly active role to defend Río San Juan's tropical forests (Nygren, 2000). While initially most NGOs were largely guided by conservationist approaches that 'appeared totally insensitive to the realities of peasant livelihood needs (…) by the late 1990s, however, the conservation organisations appeared to understand that peasants must have clear benefits in order to support their projects' (Larson, 2010, p. 60).

One of the peasant-oriented organisations that experienced this evolution is Conservación con Desarrollo (CcD). This environmental NGO was founded in 1990 and

[56] In order to protect the identity of all participants, we have changed the names of all communities and actors involved in this study.

is rooted in the Río San Juan region. It aims to halt environmental degradation mainly through projects involving community development and raising awareness. Since its creation the NGO has experimented with interventions ranging from projects focused on environmental education and agricultural diversification to the promotion of alternative income-generating activities such as ecotourism. A remaining concern the NGO has is that their interventions have offered only limited livelihood alternatives for local people, and therefore have not succeeded in halting deforestation.

3.1. PROJECT DESCRIPTION

In 2006 CcD launched a PES programme, funded and co-designed by a European conservation NGO. In this programme the NGO pays farmers in the buffer zone of the Indio-Maíz for protecting parts of the remaining forests on their farms. The main objective is to create a monetary value for standing forests and thus generate additional income that would inhibit further farmer migration into the reserve. Only farm households legally possessing and willing to enrol a minimum forest area of 10 ha are eligible to sign a five-year contract with the NGO. The maximum size of eligible forests per household is 100 ha. Farmers receive an annual payment of USD 28.5 per hectare of protected forest. Since the NGO considers these payments to be low, farmers are free to choose the plots of forest they wish to include, and are not obliged to preserve all their forests. Forests under contract must be left undisturbed. Participants are also responsible for preventing other inhabitants from extracting (fire)wood and poaching wildlife. The programme is funded by the European NGO through the sale of forest protection certificates to the public in Europe.

In the 2006–2009 pilot phase, 13 contracts were signed, covering a total of 280 ha of forest. A self-assessment in 2010 concluded that the programme lacked a long-term vision and questioned farmers' future willingness to protect the forests once the payments ended. Consequently, in 2012 an adapted second five-year phase was initiated, aiming to include an additional 60 farmer households by 2016, covering a total forest area of 2000 ha. The contract now requires previous and new participants to design sustainable farm management plans – e.g., based on agroforestry systems,

ecotourism, or the production of cacao or *raicilla*[57] – and to use the payments to implement these plans. This would 'buy time for the forests by putting an economic value on them, meanwhile helping farmers to implement sustainable land use practices that generate alternative incomes in the long term' (interview project coordinator, 17/11/2014). The alternative incomes should lower the pressure on forests once payments end. In order to assist farmers CcD organises collective workshops on agroecological and sustainable production and offers on-farm technical assistance. Due to budget constraints, at the time of our research (2014– 2015) only 14 families had enrolled, covering a total forest area of 468 ha. Most of the current participants were chosen on the basis of previously established relationships with the local NGO. Table 4.1 shows the main characteristics of the participating households. The contracts were signed for a period of five years and almost all participants decided to enrol all the forests on their farm in the project.

[57] This is a plant used to extract emetine, a substance used in the pharmaceutical industry.

Table 4.1: Land characteristics of farm households (hh) participating in the pes scheme (n=14)

Farm HH*	Production System**	Total area (ha)	Forest area under contract (ha)	Forest area not under contract (ha)	Cultivation area (ha)	Pasture area (ha)	Access to other farm?	Investment plan	Implementation investment plan
1	**2**	128.94	100.00	22.00	2.94	4.00	yes	pigs	failed
2 (P)	**2b**	44.77	30.14	0	5.90	8.73	yes	pigs	failed
3	**2b**	37.38	18.93	0	3.69	14.76	yes	livestock	failed
4	**2b**	45.49	29.32	0	6.19	9.98	yes	livestock	medium
5 (P)	**2b**	33.10	12.08	0	5.80	15.22	yes	livestock	good
6 (P)	**2b**	43.27	28.20	2.44	9.09	3.54	yes	cacao	medium
7 (P)	**2**	39.46	28.20	4.81	6.45	0	yes	pigs	failed
8	**1**	33.64	21.72	0	11.92	0	no	*raicilla*	good
9	**2**	219.49	100.00	28.57	29.86	61.06	no	livestock	n.a.
10 (P)	**2b**	34.16	22.37	0	1.98	9.81	yes	livestock	medium
11	**4**	49.70	29.15	0	4.17	16.38	yes	*raicilla*	good
12	**4**	27.29	11.00	0	5.95	10.34	no	livestock	n.a.
13	**1**	20.05	13.26	0	3.88	2.91	no	clothes sale	n.a.
14 (P)	**2**	39.80	23.95	0	7.70	8.15	yes	livestock	n.a.
	Total	**796.50**	**468.30**	**57.80**	**105.50**	**164.90**			
	Mean	**56.90**	**33.50**	**4.10**	**7.50**	**11.80**			

* Households indicated with 'P' have also participated in the 2006-2009 pilot phase

** Production systems: 1 = Multiple crops / 2 = Multiple crops and livestock / 2b = Adapted multiple crops and livestock (with off-farm labour) /3 = Multiple crops and livestock with temporary employees / 4 = Specialised in livestock with temporary employees

Source: authors' own elaboration on the basis of project data base and field data

Three years into the second phase of the programme and confronted with limited future funding, the NGO has started a series of internal reflection processes on the effectiveness and potential unforeseen long-term consequences of its intervention. One of the main concerns expressed by the organisation is that the hoped-for adoption of sustainable practices seems to be largely absent in reality or has failed to generate the expected alternative income. Even more worrisome is that some participants seem to be using project payments to invest in cattle-related activities, undermining the long-term objectives. The project staff fear that the financial incentives provided to farmers are ineffective in promoting 'environment-friendly' behaviour and might even generate perverse effects in the long term, especially once payments cease. As we argued above constructing meaningful alternatives that might change the land use practices of local farmers requires a deeper understanding of the historical, socio-cultural and economic context of the local territory and its evolving development pathways: we have assessed these using an agrarian diagnosis.

3.2. FIELD RESEARCH METHODS

The agrarian diagnosis focused on one of the communities involved in the PES programme, located at the edge of the Indio-Maíz reserve. It was conducted by the third author during a 4.5 month research stay in the field (April–August 2014), in which the steps described in 2.3 were carried out. Sixty-six local inhabitants were interviewed, some of them on several occasions. Additionally, eight transect walks and 38 farm visits were undertaken to obtain a detailed overview of the landscape and the specific production systems and land use practices. Focus group discussions on the history of the study area were conducted with inhabitants who have lived longest in the region. Finally, participant observation and informal talks offered the possibility of elaborating on the information obtained from the qualitative interviews.

Between November 2013 and June 2015, the first three authors also carried out more specific research on the PES intervention. They conducted several interviews and focus groups with project staff from the local NGO, organised workshops with project staff and participants, and performed ten on-farm in-depth interviews with project participants. As per the interactive pathways framework, the interviews and focus

groups mainly focused on the motivations, opportunities, and constraints for participants vis-à-vis the PES project and its different components, and on farmers' long-term perspectives in terms of land use changes and future plans.

3.3. ASSESSING AGRARIAN DYNAMICS AND DEFORESTATION IN RÍO SAN JUAN

3.3.1. THE DOMINANT CATTLE-BASED DEVELOPMENT PATHWAY IN RÍO SAN JUAN[58]

Although the extraction of timber and non-timber products in Rio San Juan started well over a century ago, the colonisation process rapidly accelerated about 60 years ago with the appropriation of large areas of land for cattle raising by the authoritarian ruler Somoza and his associates (Larson, 2001; Rabella, 2004). This process was accompanied by state and multilateral policies to promote meat exports (mainly to the US), including the construction of roads and processing infrastructure. Attracted by the abundant presence of valuable timber species, various private companies were given logging rights to the forests (see also Nygren, 2004). In the 1950s the Nicaraguan government also conceived of this region as one of the escape valves for growing social discontent caused by increasing land concentration in the hands of large export-oriented cotton and cattle producers in the Pacific region (Larson, 2010). As a result, the government initiated a process of state-led agricultural colonisation (Ibid), a process which was amplified by the complementary spontaneous migration of peasants. Land 'improvement' (*mejoras*) through forest clearing was the basis for obtaining de facto land rights and led to the gradual conversion of forests into agricultural land (Larson, 2010; Nygren, 2000).

Colonisation of primary forests was temporarily halted by the guerrilla war of the 1980s when many peasants fled to Costa Rica or were evacuated to government resettlement areas. Despite the existence of strict regulations on permitted land uses in the buffer zone of the newly created reserve, the deforestation process picked up pace rapidly after the 1990 peace agreements when land owners returned to reclaim their land. In addition, the new government compensated demobilised soldiers with tracts of land in this region (Nygren, 2000). Hundreds of new migrants coming from more established

[58] This section is primarily based on our 'agrarian diagnosis' triangulated with/complemented by existing literature focussing on the same study area.

cattle-raising regions arrived. Between 1989 and 1995 at least 17 new communities totalling more than 1500 families were formed in the buffer zone (Larson, 2010). During this same period government policies to promote cattle-related exports resumed, now also including massive investments in dairy processing. This contributed to rising milk and cheese prices, while meat prices hit historic highs due to higher international demand and the trade connection of Nicaraguan cattle production with Mexican beef production for the US (Bastiaensen, Marchetti, Mendoza, & Pérez, 2013). At the same time, due to the arrival of a German chocolate manufacturer, cacao production for export led to expansion and transformation of the infrastructure for collection and processing thereby increasing demand and local prices for this traditional but relatively ignored crop.

Currently pioneers mostly arrive from 'old frontier' areas overrun by pasture, and often repeat their (grand)parents' pattern of converting forest to pasture as a way of improving their livelihood. Many peasants participate in a two-step migration process in which they eventually convert their land into pasture and, if they do not manage to establish a large cattle farm, sell it to wealthier livestock farmers thus giving rise to a domino effect in which land ownership is steadily concentrated into the hands of a few better-off cattle ranchers who replace an initial wave of small-scale farmers (Maldidier, 2004; Nygren, 2000). The latter are pushed and pulled ever more towards and inside the agricultural frontier, consolidating the dominant socially exclusionary and environmentally destructive pathway of cattle-driven development.

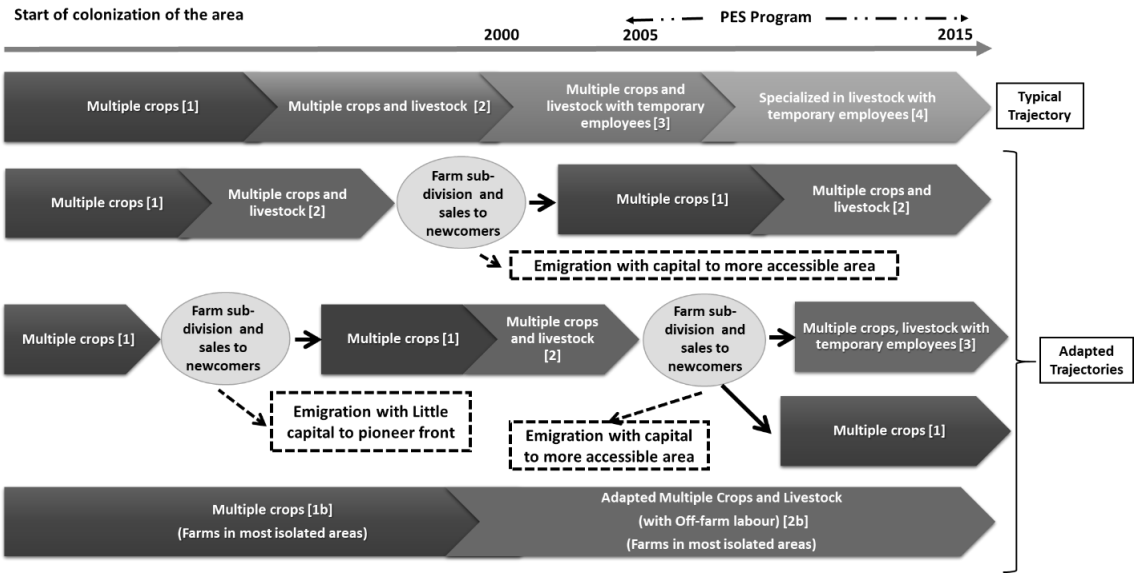
3.3.2 AGRARIAN CHANGE IN MANOLA

Our diagnosis of the dynamics in Manola, a community which comprises about 80 families, allows us to further zoom in on the main drivers underlying this livestock-based frontier advancement. Our research reveals how the first farms in Manola were established in the 1990s with the arrival of pioneer families who typically appropriated between 50 and 140 ha of virgin forest.[59] For poor farmers clearing forests is a way of obtaining fertile land using only their own labour. Given low capital availability and

[59] At that time the forested land in this area was considered to be free of rights. Any actor could freely take possession of any non-privately appropriated tract of land and secure de facto rights to it through clearing the borders of the area, building a house and clearing some forest plots for agricultural purposes.

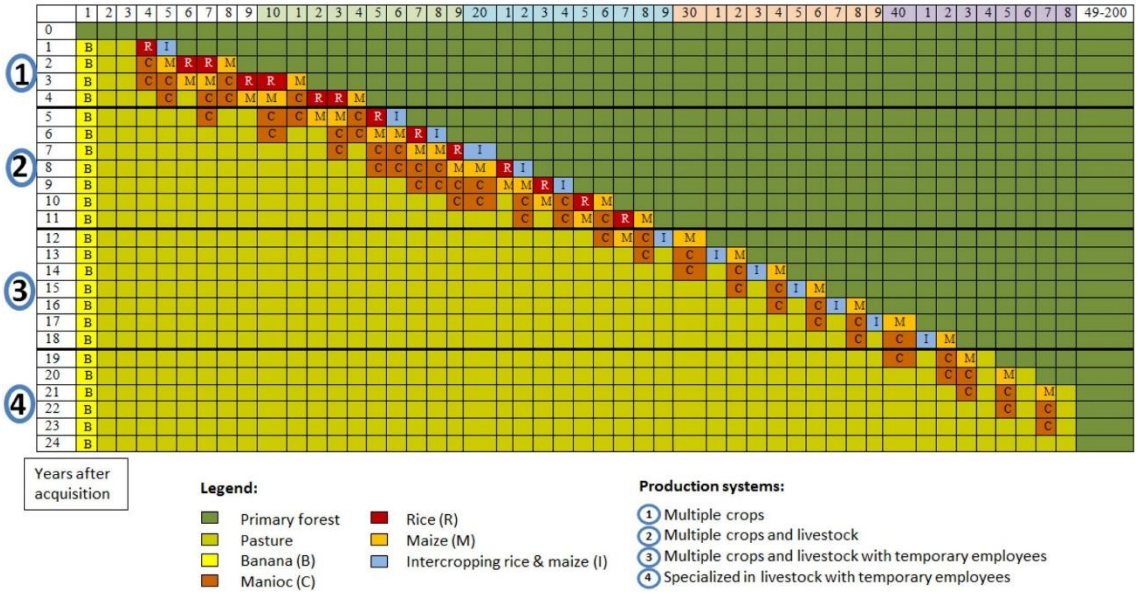
abundant land, slash-and-burn maximises labour cost-effectiveness, while ensuring food self-sufficiency (see also Maldidier, 2004). However, once the land has been cultivated for about three years, soil fertility rapidly declines while weed competition increases, resulting in diminishing crop yields. As restoring the soil's fertility would require a long fallow period (about 15–20 years), crop areas are then usually converted into pastures, while new plots of forest are cleared for crops thereby expanding the farm's agricultural area. These typical land use dynamics lead to gradually shifting production systems and related land use patterns at the farm and landscape level as is respectively shown diagrammatically in Figs. 4.1 and 4.2.

Figure 4.1: Evolution of coexisting production systems in the Indio-Maíz Biological Reserve buffer zone, Nicaragua 1990–2015



Source: authors' own elaboration.

Figure 4.2: Evolving farm production systems and land use changes in the Indio-Maíz Biological Reserve buffer zone, Nicaragua



Source: authors' own elaboration.

Figs. 4.1 and 4.2 show that once new settlers (multiple crop production system) manage to accumulate sufficient capital through casual off-farm wage-working and seasonal migration to Costa Rica (mainly during the coffee harvest), they usually start investing in cattle in order to exploit their growing pasture areas, leading to a multiple crops and livestock production system. As the herd size grows over time and demands more labour, farmers increasingly give up labour-intensive crop cultivation and further convert forest into pasture, usually by passing through a crop phase (multiple crops and livestock with temporary employees), eventually leading to a production system which is increasingly geared towards livestock specialisation. This sequence corresponds to the 'typical trajectory' in Fig. 4.1. In line with this, our interviews clearly indicate that farmers perceive forests as strategic land reserves for future agricultural and cattle production, possibly after bequeathing to their children. Apart from wood extraction for heating and construction, they report little benefit from forests. Therefore, although most farms in the Manola area are still covered by large tracts of forest (on average about 50% of total area), the specialisation in livestock will probably continue, resulting in an ever-increasing conversion of farms' forests into pasture, and eventually in the search for

additional land in neighbouring areas. These dynamics have also been observed in earlier-colonised neighbouring areas (Larson, 2010; Vérant, 2013).

Farmers' motivations to pursue cattle-based specialisation draw on a combination of factors, grounded in and, at the same time, grounding the dominant extensive cattle pathway. Firstly, our technical-economic analysis[60] shows that the relative abundance of 'idle' forested land and the lack of capital makes labour the main constraining production factor. Fig. 4.3a displays the monthly labour demand for each of the main production systems, together with the available on-farm family labour.[61] It clearly shows that for most production systems labour needs are close to or even surpass on-farm labour availability. It also shows that implementing cattle-based production implies hiring temporary workers, mainly employed for pasture maintenance. Farmers' limited access to financial capital reduces their capacity to hire non-family labour. Under current price conditions cattle production, even if representing the lowest output per unit of land, clearly offers the highest return per unit of labour (see Fig. 4.3b and c), making it an attractive production strategy for this area. Moreover, cattle are easy to move around and represent a means of saving that is easy to mobilise, especially in regions where markets are distant and difficult to access (Maldidier, 2004). As such, farmers tend to opt for production systems geared towards cattle, while limited labour and financial capital constrain the pace of land use conversion, which explains why we still observe a relative abundance of on-farm forests.

Secondly, as some farmers may climb the social ladder by becoming ranchers (production systems 3 and 4) and as no viable alternatives are currently envisaged, the ongoing transformation of land into pasture for cattle development is largely perceived – also by smaller farmers – as the desirable 'moral landscape' (Setten, 2004) offering a promising path towards the desired social identity of the successful, productive farmer. Despite an increasing local awareness of the detrimental ecological consequences of

[60] Calculations are based on the following basic principles (Apollin & Eberhardt, 1999; Dufumier, 1996): (1) Gross Product (GP) = Production ∗ Market Price (all products are valued at a local market price, or the equivalent purchase price in case of products for own consumption); (2) Value Added (VA) = GP − (yearly depreciation of machinery, tools and farm infrastructure) − (inputs costs); (3) Family Agricultural Income = VA − (payment of interest for financial capital) − (land rent) − (taxes) − (non-family labour costs) + subsidies (e.g., PES). For detailed calculations of all these indicators, please refer to Lindtner (2014)

[61] The graph displays the two most common levels of available labour equivalents in the area.

deforestation, peasant ideas of progress and development are still largely related to the conquest of the 'savage and unproductive' forest to make it arable and eventually to convert it into a large farm with pasture full of cattle (Van Hecken, Bastiaensen, & Huybrechs, 2015; see also Larson, 2010). Large cattle-breeders also manage a broad social network and hold preferential positions in a society where inherited vertical patron-client relations, based on control over land and capital/cattle, still largely prevail.

While the above sketched description of the typical evolution of farming systems might give the impression that they evolve in homogenous and unidirectional ways, in practice these changes occur at different paces and in complex manners, depending on specific differences between farmers. As shown in Fig. 4.1, this also means that a snapshot at a specific point in time reveals the co-existence of different production systems alongside each other, including but not limited to the four production systems presented in Fig. 4.2.[62] For example, our diagnosis reveals that a crucial element influencing a farm's pace of development relates to its degree of geographic isolation or accessibility and the influence this has in terms of labour availability (see adapted trajectories, Fig. 4.1). Families who arrived after the initial colonisation period were forced to appropriate land in the geographically less accessible areas of the area, with difficult access to local infrastructure (e.g., markets, schools). This often pressures part of the family – usually wife and children – to migrate to the urban municipal centre, thus increasing household expenses and further reducing available on-farm labour availability. This, in turn, means a constraint of the growth potential of the farm both in terms of herd size and cultivated area, usually also implying a slow-down in the rate of conversion of forests into agricultural/pasture land (see Fig. 4.1, bottom).

Other important factors that lead to divergence from the typical trajectory are related to differences in farmers' capital endowments, unexpected shocks (e.g., health problems leading to treatment funded by the sale of cattle), inheritance issues, and situations of local conflict (mostly related to land issues). These limiting events are often a substantial impediment to the capitalisation process, and in the most severe cases can

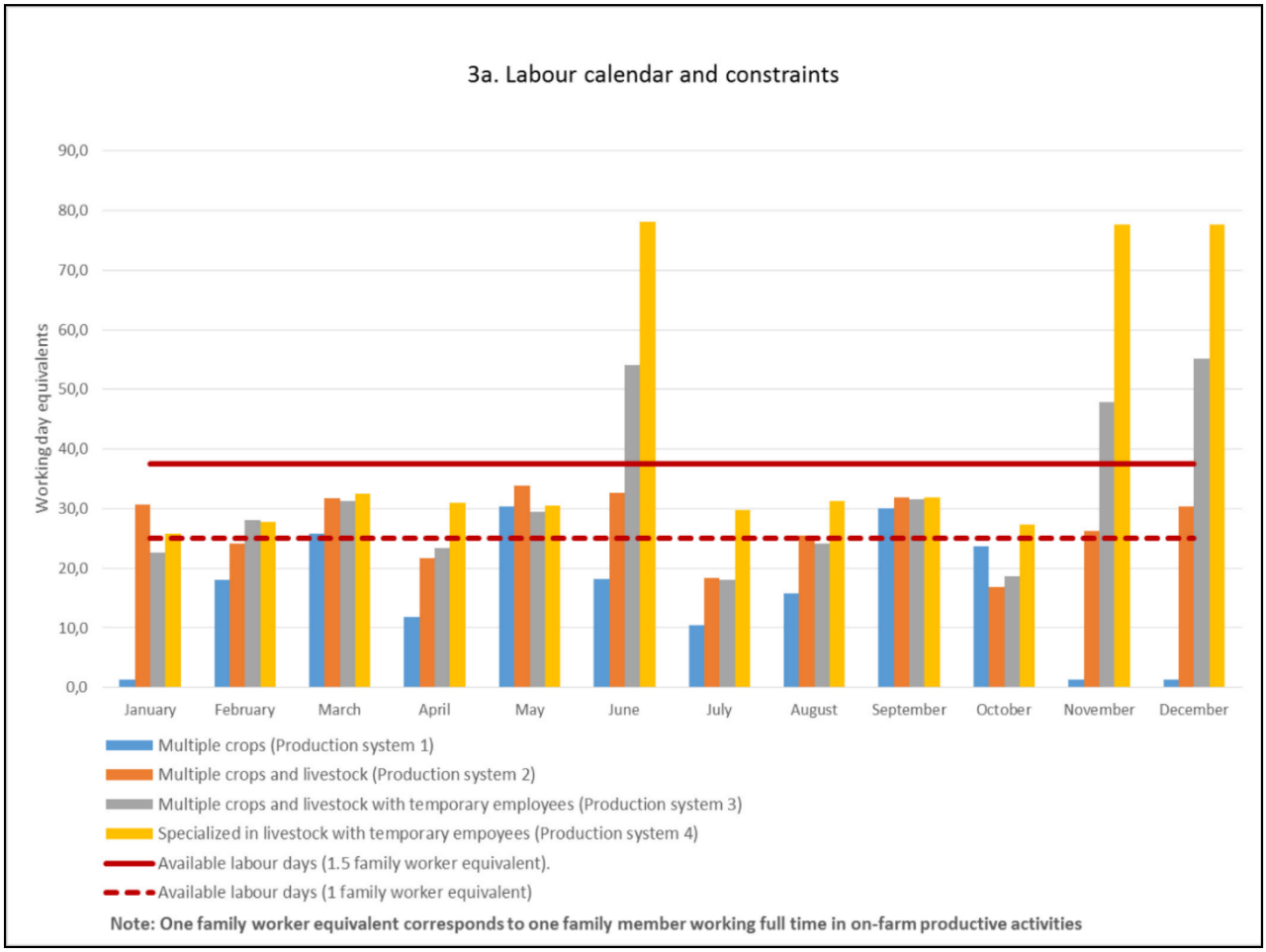
[62] In this article we only present the main historical trajectories. The original analysis provides a more detailed description of additional trajectories that can be found in the area (see Lindtner, 2014).

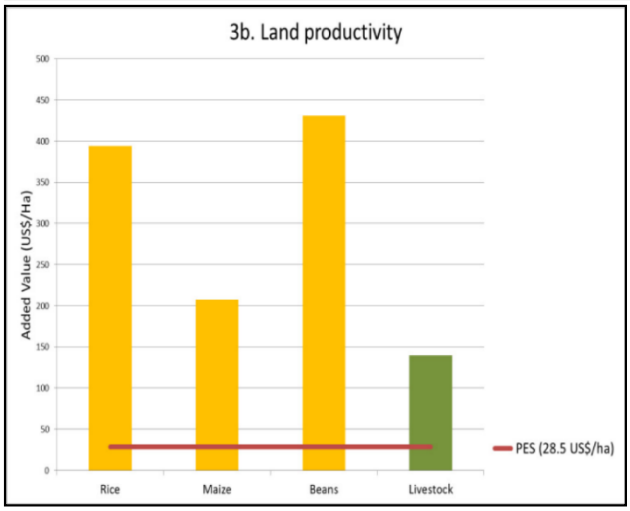
even result in the sale of the farm (cf. adapted trajectories, Fig. 4.1). As land systematically tends to be cheaper further into isolated regions of the agrarian frontier, there is always the temptation to sell a 'failed' farm in a more established zone to successful farmers and then start again by buying more, and cheaper, land. Currently in Manola this particular trajectory is mainly followed by younger farmers who, after having inherited a plot of land considered too small for establishing a sustainable farm, decide to sell and move into the frontier. Their original land is sold to local farmers wanting to expand or to newcomers from other regions who possess sufficient capital to buy several farms at once, thus allowing them to implement further livestock specialisation.

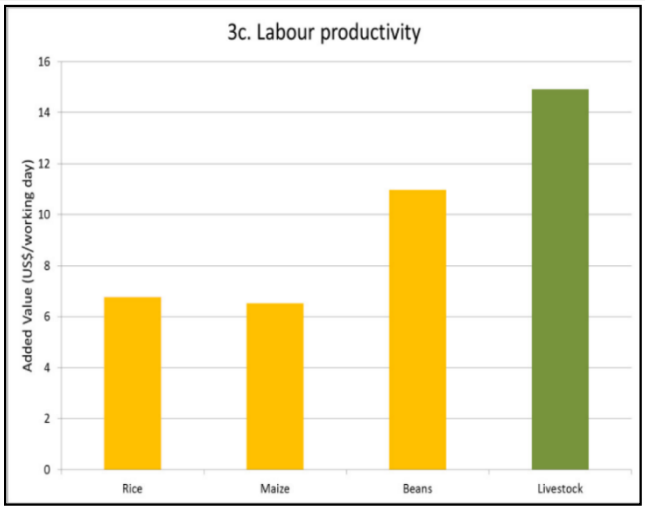
4. CAN FINANCIAL INCENTIVES FOR FOREST PROTECTION ALTER THE CATTLE-BASED DEVELOPMENT PATHWAY?

Our diagnosis shows that the territory is composed of different types of evolving farming systems that together crystallise into a dominant cattle-oriented territorial pathway. Our analysis clearly suggests that motivation is not merely an individual attribute but is socially instituted in this pathway which generates particular opportunities and constraints, as well as guiding ideas and habits that 'work' within, and are partially created by, these pathways. On the basis of these empirical insights, we now discuss whether the current intervention of forest-related financial incentives, aimed at the promotion of sustainable farm plans, offers any possibility of sustainably altering farmers' motivations and pro-environmental action in this context.

Figure 4. 3: Labour and land productivity, and labour constraints for production systems in the Indio-Maíz Biological Reserve buffer zone, Nicaragua







Source: Authors' own elaboration.

Three years into the second phase of the PES project we observe that so far all participants have maintained the forests under contract (see Table 4.1). This may give the impression that the project has been successful in promoting on-farm forest

protection. However, an assessment of the PES project against our diagnosis cautions against jumping to such conclusions. While we are aware that the performance of PES does not necessarily hinge on a complete coverage of the opportunity costs of economically more attractive land uses (Nicolas Kosoy, Martinez-Tuna, Muradian, & Martinez-Alier, 2007; Muradian, Corbera, Pascual, Kosoy, & May, 2010), our findings show that the project payment is particularly low as it only covers about 20% of the annual per hectare income created by the locally more attractive pasture alternative and less than 7% of the income generated by staple crops such as beans or rice (see Fig. 6.3b). From an economic perspective it is then unlikely that the current payment would be high enough to trigger long-term changes in farmers' land uses. This is also confirmed by our interviews in which all participants typically reported that:

> '[T]he amount they pay me is really insignificant; I'm grateful, but I feel we're doing them [the NGO] a favour. Producing beans or maize obviously would give me a much higher income. If they want to convince us to enrol our forests in a future project, they'll definitely have to pay us more.' (Interview with farmer, 18/07/2014.)

In light of this type of claim, it initially seems somewhat puzzling that farmers have participated in this project at all. In their answers all respondents refer to the importance of forests in providing water thus motivating them to protect strategically located on-farm forest patches. Also, the growing presence of conservation NGOs has generated new locally adopted discourses that stress the importance of forests for the provision of global goods such as clean air and biodiversity. Respondents typically stated that 'a community without forests would be ugly and unpleasant to live in', and would undermine the potential for developing ecotourism projects.

While these stated reasons are certainly credible, our agrarian system analysis allows us to go beyond common discourse and helps us explain why they are unlikely to translate into significant and long-lasting changes in farmer practices. Agrarian system enables us to assess remaining forest patches not as independent and disconnected elements but as part of broader pro- duction systems evolving within specific historical trajectories. As stated above, the current pace of deforestation in the area is mainly limited by labour and capital constraints. We also explained how the local NGO was predisposed to select participants on the basis of established relationships as well as a minimum requirement

of 10 ha of on-farm forest thus excluding farmers who recently arrived in the region and those who have small farms with the majority of their forest already transformed into fields for crops and pasture.

Relating Table 4.1 data to our analysis of agrarian change in Manola enables us to better understand the rationale behind the dynamics of forested plots within the PES project. Table 4.1 shows that many project participants (6 out of 14) belong to an 'adapted multiple crops and livestock production (with off-farm labour)' system. Farmers belonging to this production system are located in relatively isolated areas, are mainly constrained by limited labour availability and are therefore typically prevented from increasing their livestock in the near future. For these farmers it makes sense to include all on-farm forest plots under a fixed-term payment contract, potentially later continuing with livestock specialisation. A second group of farmers (6 out of 14) are those belonging to the 'multiple crops and livestock' or the 'specialised in livestock with temporary employees' production systems. Since participants were free to choose which plots and how much forest to enrol under the five- year contract, it is not surprising that these farmers did not include some forest plots - typically the ones adjacent to current production areas.[63] These farmers could continue their usual farming practices as described above, while temporarily 'protecting' forests that were not actually going to be disturbed, at least not in the foreseeable future (see Hartshorn, Ferraro, Spergel, & Sills, 2005 for similar findings in Costa Rica) Lastly, some project participants (2 out of 14) belong to the 'multiple crops' system. These farmers are characterised by a very low level of financial capital and the absence of cattle even if they have pasture. For diverse reasons – recent arrival to the region, inheritance issues – they have been stuck in the initial phase of the typical farm evolution and, thanks to seasonal international migration, have not been obliged to sell and permanently migrate towards the pioneer front. For these farmers, who lack the necessary financial capital to start the typical trajectory, it makes sense to put all their remaining forests under contract as a strategy to access financial capital. Overall participants chose to include

[63] This is often referred to as the 'self-selecting nature of voluntary participation' (see e.g. Wünscher, Engel, & Wunder, 2008, p. 822)

plots of forests that in the short term have almost no opportunity cost. This finding was confirmed in all our interviews where farmers typically stated that:

> 'I was going to protect these forests [under the PES contract] anyway. I have been protecting them for the past twenty years […] You really think that the little money they're offering me is the reason why I'm protecting these forests?' (Interview with farmer, 27/07/2014.)

As such, the current payments are unlikely to lead to much behavioural change. Respondents reported that they had used project payments to invest in practices that were very much part of their usual production strategies (Table 4.1). Families who cultivate staple crops used the payments to satisfy basic needs such as the purchase of medicines, sugar and staple foods. Only a few have been able to use the money to try alternative activities promoted via the NGO-supported sustainable management plans, such as the cultivation of *raicilla*. As shown in the Table, farmers practicing a livestock system have mainly used the money to invest in cattle-related expenditure such as fences, improving and expanding pastures, or additional cattle (7 of 14 farmer households). Payments alleviated some of the commonly experienced capital constraints and supported farmers in their endeavours towards aspirational livestock specialisation. These findings prompted the NGOs to critically reflect on the selection criteria for future participants (cf. selection bias), as well as to question their initial decontextualised technical assumptions about the need for and the possibility of intensified production in order to release pressure on the remaining forests. These assumptions are based on overly simplistic and erroneous ideas that attribute deforestation to farmers' cultural backwardness and their lack of technical know-how (see also Larson, 2010) rather than on an informed analysis of the multiple factors and motivations that underlie why farmers do what they do.

In summary, our case study suggests that the PES project alone is not enough to break with historically evolved practices, embedded in particular production logics and socio-cultural contexts. Instead of shifting farmers to alternative development pathways, in some cases payments paradoxically might even have stimulated and accelerated future deforestation. Indeed, the intervention did not challenge the conditioning factors of the current pathway that generate a strong economic and social rationale to continue

expanding cattle production. The rationale is founded in associated cultural views and habits such as moral landscape, social status of cattle ranchers, etc.

5. CONCLUSION

Territorial dynamics are more than the simple sum of individual decision-making processes implemented within independent farms. They are rather the result of the historically built rules and norms, social structure, culture and worldviews which characterise broader rural societies, and are supported by particular macro-economic policies and ensuing market and price structures. Throughout this article we have argued that research on the long-term impact of policy interventions on human behaviour should recognise that human motivation is socially constructed (Vatn & Vedeld, 2012). This does not deny the existence of strategic action, but rather suggests that individual motivation and actions are both constrained and enabled by the broader development pathways in which they are embedded. Understanding this dynamic interplay between agency and structure means that we should move beyond the purely bio-physical or economic considerations of human-environment challenges to encompass broader and often previously unacknowledged socio-institutional, political and knowledge- based dimensions of interventions (German, Ramisch, & Verma, 2010).

In line with Hiedanpää and Bromley (2014, p. 182), this is the fundamental reason why one should not expect a significant impact from the simple introduction of PES, since:

> 'Human behavior is deeply habituated – and for good reasons – on the basis of long experience with what seems to work (Ouellette & Wood, 1998). Only when confronted by startling doubt and surprise do individuals stop and reassess what they are doing – and why they are doing it (Bromley, 2006). This matter of deep habituation is fundamental to any supposition that scattered individuals out in remote areas can be easily dislodged by PES schemes from a life- time – perhaps of several generations of predecessors – of habituated behaviors with respect to their natural surroundings.´

Habits and motivations are not mere automatic unreflective reactions, nor just a matter of inherited cultural practices; they are contingent on or jointly determined by the structural features of the environment (Hiedanpaa & Bromley, 2014; Vatn & Vedeld, 2012). They are generated and sustained out of the perceived 'realities' in which they work. Logically, this implies that instituting new environmental habits means 'both the agent and the decision environment must be changed' (Hiedanpaa & Bromley, 2014, pp. 183–184). One cannot assume that offering fixed-term payments is sufficient to

promote a lasting change in structurally entrenched rationalities and habits nor that the challenge is reduced to finding the 'right' exchange prices for a PES mechanism to work.

Payments could however provide a spur for changing perspectives and rationalities and, if accompanied by broader structural changes, could become part of a change dynamic that redefines the emerging pathways in novel directions. Only if payments are sufficiently integrated within broader approaches that address the multiple causes of deforestation at different scales, could they possibly support changes in cognitive perceptions and farmer rationalities and 'crowd-in' new mental habits and motivations geared towards a changed culture of forestry (Geist & Lambin, 2002; Hiedanpaa & Bromley, 2014; Vatn & Vedeld, 2012). This would require socio-institutional transformations that enable the creation of new pathways with redefined opportunities and constraints, ranging from changes in relative prices through re-regulation of global value chains and national fiscal policies to more local initiatives related to the promotion of alternative strategies based on, for example, community-based ecotourism or cacao production.

We have shown that the agrarian system approach is a useful conceptual-methodological approach that can help us uncover and assess the emergence of particular development pathways and their consequent changed opportunities for individual livelihood trajectories at varied spatial- temporal scales. This approach paves the way for better-informed appraisals of the underlying reasons and motivations for why farmers do what they do. It also allows for deeper and more systematic reflection on the expected impact of interventions, such as PES, that attempt to change these motivations and habits. This should help us avoid one-size-fits-all panacea solutions by directing our attention to the particularities and the diversity within the local social framework as well as the wider social-institutional factors that underlie specific human-environment problems.

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CHAPTER 5

PLAYING BEFORE PAYING? A PES SIMULATION GAME FOR ASSESSING POWER INEQUALITIES AND MOTIVATIONS IN THE GOVERNANCE OF ECOSYSTEM SERVICES

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This paper was part of a broader action-research process implemented collaboratively between authors and the environmentalist NGO Conservación con Desarrollo. For the elaboration of this paper, I was the main person responsible for the design of the roleplaying gaming methodology and implemented the field work together with research assistant René Rodríguez-Fabilena. The analysis was conducted collaboratively between the authors. I also was mainly responsible for the writing.

Some parts of the original paper have been altered to fit within the broader design of the Ph.D. dissertation.

1. INTRODUCTION

Following the widespread adoption of the Ecosystem Services (ES) framework novel market-inspired instruments, such as PES, have gained increasing influence in international and national environmental policies (Engel, Pagiola, & Wunder, 2008; Schomers & Matzdorf, 2013; Wunder, 2015). These instruments assume that direct financial incentives to encourage management practices that will produce ES are an efficient and effective way to align individual interests with the common good (Ferraro & Simpson, 2002; Pagiola, Bishop, & Landell-Mills, 2002; Wunder, 2005). However, growing empirical evidence suggests that the behavioural changes with market-based conservation policies vary substantially, depending on the social context, local notions of justice, the psychological and cultural embeddedness of the desired behaviour and the type of incentives (e.g., individual or collective payments) (Agrawal et al., 2015; Kerr et al., 2012; Pascual et al., 2010; Salk et al., 2017; Travers et al., 2011; Van Hecken and Bastiaensen, 2010). More fundamentally, the increasing use of these instruments has also resulted in growing concerns about how they can conceal deep-seated power asymmetries, thus risking exacerbation of inequalities in access to and use of natural resources (Fairhead, Leach, & Scoones, 2012; Fletcher & Büscher, 2017; Kolinjivadi, Van Hecken, Rodríguez de Francisco, Pelenc, & Kosoy, 2017; McAfee, 2012; Muradian et al., 2013). An examination of PES and market-based instruments as emerging power-laden and relational phenomena is therefore necessary and should include how these schemes are constructed and negotiated between different actors with differentiated social positions, value frameworks and oppositional or collaborative relationships (Van Hecken, Bastiaensen, & Windey, 2015; Kolinjivadi, Van Hecken, Almeida, Dupras, & Kosoy, 2019; Mann, Loft, & Hansjürgens, 2015). Such analysis could also lead to a better informed integration of procedural and contextual equity concerns into the design of these instruments (Loft et al., 2017; McDermott, Mahanty, & Schreckenberg, 2013; Pascual et al., 2010). From a conceptual-methodological perspective, these issues pose a significant challenge in terms of developing tools that allow for meaningful exploration of the multiple ways in which involved actors mobilise differing rationalities to understand institutional settings for ES governance (Van Hecken et al., 2018).

In this article we present a methodological tool that (i) allows us to highlight different aspects of the struggles surrounding the local meanings and underlying social rationalities attributed to the ES framework; and that (ii) stimulates collaborative interpretation, learning and dialogue around institutional arrangements for ES governance. The development of such a tool requires adding a political — as opposed to a merely technical — perspective to ES analysis as well as a different view of scientific knowledge within the broader process of co-creation of shared 'actionable knowledge'. From this perspective changing behaviour towards sustainability not only requires a better understanding of 'knowledge encounters', in which different bodies of knowledge and meaning are competing with each other to make sense of complex reality (Buytaert et al., 2014), but also the engagement of academics and practitioners in a new way which will encompass diverse world views. It means supporting the co-creation of knowledge by working with residents, activists and social movements who are already imagining or making new worlds (Gibson-Graham, 2008). Inspired by the learning potential offered by simulation games[64] in natural resources management (Barreteau, Le Page, & Perez, 2007; Bots & van Daalen, 2007; Katsaliaki & Mustafee, 2015), we present a PES simulation game as an alternative for engaging with socio-political and motivational issues in ES governance. The game simulates farmers' decision-making processes and offers a forum to assess and interact with the motivational and socio-political dynamics triggered by ES governance interventions including PES.

Our PES simulation game is the product of a joint action-research process[65] by the authors and practitioners from the Nicaraguan environmental NGO '*Conservación con*

[64] The literature also often refers to 'Role Playing Games'. Conceptually there are differences between 'Role Playing Games' and 'Simulation Games'; while the former mainly focus on analysis of participants' behaviour (generally leaving leeway for participants to manoeuvre), the latter explicitly aim at reproducing real-life dynamics as closely as possible by simulating a simplified yet sufficiently reliable contextual reality. However, in the domain of natural resources management, the difference between the two types of games is quite indistinct (and often overlapping), leading to both terms often being used interchangeably.
[65] An action-research approach implies that researchers and practitioners reflect together on concrete experiences in order to co-construct knowledge and translate this knowledge into actions or intervention policies (Borda, 2006). This requires a commitment from researchers and practitioners to closely collaborate and to share responsibility, both in knowledge co-production and in the implementation of actions in the field.

Desarrollo'[66] (CcD). This ongoing collaborative process, which started in 2013, has mainly consisted of joint reflections on the implementation of different methodological approaches to assess and possibly redirect the conservation strategies CcD has been attempting during the past two decades (see also Chapter 4). It is within this process that a need for developing a PES simulation game surged. We realised that the more 'conventional' research methods initially used (e.g., observations, interviews, focus groups) did not sufficiently reflect the complexities of the decision-making processes of farmers regarding motivations for land use change and deforestation, nor how these are embedded in and shaped by local power-laden institutional arrangements. We also felt that these methods did not sufficiently stimulate necessary 'knowledge encounters' around possible changes. In contrast the implementation of the game brought important insights with respect to these issues. Firstly, it allowed practitioners and researchers (i) to more vividly envisage the constraints that farmers face in their everyday decision-making; (ii) to challenge simplistic assumptions about the reasons for farmer resistance to so-called 'pro-environmental' practices; and, more generally, (iii) to increase their empathetic relationship with farmers. Secondly, game sessions were used to trigger collective reflective processes on how power relations in rural Nicaragua are based on unequal, yet very common, patron-client relationships. Such reflections allowed for a more informed and nuanced analysis of the complex ways in which farmers' behaviour is influenced by external interventions. Thirdly, the analysis of game dynamics enabled us to jointly construct and discuss a tentative farmer typology that helped enhance engagement with different views on forests and natural resources, ultimately leading to the recognition of the need for more flexible and socially embedded ES intervention strategies.

In this article we first provide a brief overview of the use of simulation games for ES governance (Section 2). In Section 3 we then discuss the general design principles of our PES simulation game and underline the importance of debriefing sessions for turning the game experience into collective learning. Section 4 provides a specific PES simulation game example adapted to the local context of the Nicaraguan Agricultural Frontier.

[66] In order to protect the identity of all actors, we have changed the names of the communities, organizations, and individuals involved in this research.

Section 5 illustrates the game's potential in generating actionable knowledge by discussing some of the main dynamics and reflection processes triggered in the field. Finally, in Section 6 we conclude by reflecting on some of the main challenges and future avenues for tailoring this game to different ES governance contexts.

2. THE POTENTIAL OF SIMULATION GAMES FOR ES GOVERNANCE

Simulation games create an environment where participants enter a fictional situation and take decisions and act according to a set of rules and a particular narrative, while bringing in their own views and beliefs. Games can take many forms such as card games, board games or computer-based games. They usually involve several participants who develop strategies influenced by decisions taken by the rest of the participants – or by virtual agents generated within computer-based models – and by particular events. Though the purpose of games is usually entertainment, they are also increasingly used for research and education goals (Crookall, 2010). In socio-ecological research they represent an alternative methodology that prompts a range of social, political and behavioural responses and raises participants' awareness of environmental issues (Barreteau et al., 2007; Bots & van Daalen, 2007; Costanza et al., 2014; Katsaliaki & Mustafee, 2015; Villamor & van Noordwijk, 2011). Games have the potential to simulate in a simplified way the complexity of socio-ecological dynamics (e.g., Ansoms et al. (2015), Villamor and van Noordwijk (2011), Boisseau et al. (2004)) by temporarily creating a space for 'potential realities' (Barreteau et al., 2007, p. 187). Thus they provide imaginative entry points for thinking about and discussing existing and alternative practices with a diversity of actors involved in the complex process of environmental governance in real-life situations.

The type of knowledge that is generated through policy-oriented simulation games, and the way in which this knowledge is then mobilised to influence policymakers or practitioners, varies by approach. Generally games can either focus directly and explicitly on informing the design of ES-related interventions and policies through direct participation of relevant actors in the game, or they can take an indirect approach, in which the insights obtained are processed by researchers or other 'intermediaries' and used as inputs for recommendations to decision-makers (Barreteau et al., 2007; Bots & van Daalen, 2007). Games designed for multi-agent modelling research, for example, focus on the generation of mostly quantitative data on socio-ecological dynamics and individual actors' preferences and strategies. This data can then be an input for computer-based modelling for policy design (Bousquet et al., 2002; Campo, Bousquet, & Villanueva, 2010; Pak & Brieva, 2010). Simulation games are also increasingly used to

analyse cooperation or conflict dynamics in environmental governance settings (Anderies et al., 2011; Cardenas, Stranlund, & Willis, 2000; Narloch, Pascual, & Drucker, 2012; Reutemann, Engel, & Pareja, 2016; Rommel, 2015; Salk et al., 2017; Travers et al., 2011). This type of game focuses on the strategic interaction of multiple players by asking participants to make choices based on predefined payoff structures that mimic individual and collective trade-offs. The design and objectives usually measure key parameters and provide insights into the various equilibrium predictions or optimal solutions offered by institutional theories (Rommel, 2015). These modelling and experimental approaches have illuminated important aspects of motivation and decision-making.

When game designs allow for open communication and dialogue between participants (Cardenas et al., 2000; Salk et al., 2017; Travers et al., 2011; Villamor & van Noordwijk, 2011), the analysis of the discourses, conflicts and negotiation processes can lead to a profound understanding of the discursive struggles surrounding various value frameworks and the ways in which they are shaped by unequal power relations. Some games include a more creative dimension to these spaces for dialogue, and more explicitly use them as forums where actionable knowledge can be co-constructed by participants (Ansoms et al., 2015; Stefanska et al., 2011) simulates contemporary land dynamics in Africa, and offers a platform for participants to collectively reflect on 'the ways in which different social classes face both opportunities and constraints in securing their land rights in an extremely competitive environment' (ibid. 2015, p. 743). This more in-depth qualitative approach emphasises the importance of debriefing sessions in which participants (and facilitators) are encouraged 'to make a connection between experiences gained from playing the game and experiences in real-life situations' (Peters and Vissers, 2004, p. 70; see also Salk et al. (2017) and Stefanska et al. (2011)). Debriefing sessions allow new perspectives to emerge and create space to discuss how these insights might be relevant for actual future situations (Lederman, 1992; Peters & Vissers, 2004). The creation of such spaces for collective reflection, in which participants have the opportunity to jointly reflect, compare, analyse, and discuss different perspectives, is the very essence of the learning process of the 'PES simulation game' we have developed.

3. THE PES SIMULATION GAME

3.1. SETTING THE SCENE

The PES simulation game is not a ready-made, one-size-fits-all type of game. It has been designed taking into account the specific context of our action-research setting and needs. While the gaming platform and basic rules could serve as a basis for replication, it is important to underline that the game specificities are dynamic. The game should always be adapted to evolving contexts and, ideally, be part of a broader action-research process. The activities involved in designing and preparing a simulation game are learning processes in themselves, and are necessary to help better understand the real-life situation the simulation game refers to (Peters & Vissers, 2004). The preparation process is also an opportunity to address one of the most important simulation game challenges: striking a balance between approximating complex real-life situations and keeping the game sufficiently simple and fun. An unrealistic game design would generate few relevant insights, while one that mimics the full complexity of reality would be hard to play – and impossible to design (Ansoms et al., 2015). In seeking this balance explicit choices need to be made about which elements of real-life dynamics will be emphasised and which left out. During the design phase developers should sufficiently engage with the socio-ecological dynamics the game seeks to simulate. Necessary background can be obtained in different ways ranging from the use of secondary data from existing studies to conducting specific field work[67]. Key to the final design is prior analysis that allows for an informed and negotiated decision on the variables to be included in the game, and those elements to be simplified or left out altogether.

3.2. GENERAL GAME PRINCIPLES

The PES simulation game is a board game in which participants take up the roles of farmer households. The game is open ended which means there is no winner. The game is facilitated by at least two people. The first facilitator is the 'game master' who gives instructions to the participants and can intervene by asking questions aimed at a better sense of players' actions. The game master is required to have a detailed understanding

[67] Useful methodologies in this regard are Participatory/Rapid Rural Appraisals (Freudenberger, 1996; Paul, 2013), or the Agrarian Diagnosis methodological package (Apollin & Eberhardt, 1999; Cochet, 2011).

of both the game design and the way the simulation relates to real-life dynamics. The second facilitator is in charge of managing the cards (see below) and recording data about ongoing game dynamics for subsequent analysis. The type of data gathered (e.g., conversations, changes in land use, labour and land transactions), the social processes to focus on (e.g., power relations, gender relations, negotiations), and also the methods for recording the information (structured or free note taking; video or voice recording) will depend on the specific interests and practical conditions of the specific action-research process.

Before beginning the game, the facilitator explains the general principles and objectives to the participants, indicating that they are expected to develop the kind of farm they value or desire. The facilitator should not refer to maximising income or accumulating land as desired objectives, so as to avoid suggesting what farmers should value most when taking decisions. The playing board represents a physical space composed of a grid with each square representing 1 hectare of land. Within this grid different land uses are represented by different coloured square tokens (see Picture 5.1). At the outset each participant is randomly allotted a farm area on the board, a sum of initial financial capital (represented by printed bank notes), and an amount of yearly available family labour days (represented by labour cards). The initial farm size and corresponding land uses, as well as the financial capital and amount of labour each participant is initially endowed with, depend on the context and dynamics the game wishes to simulate and the objectives of the researchers. For example, they could be allotted unequally in order to simulate differences in social classes or farmer types. It is important, however, to note that the total available labour days for a particular participant is 'replenished' to its initial level at the start of each subsequent turn, i.e., the available labour days per year are fixed per participant.

The game proceeds through turns, each one corresponding to one agricultural year, in which participants are required to make choices within a limited set of productive options. During each turn three sequential steps are followed. Firstly, all participants receive the total amount of family labour days they possess yearly, and they are asked to hand in a fixed amount of labour days and financial capital to cover their yearly basic food needs. They are also asked to cover the maintenance costs of their current land

uses, which are calculated with the help of the game facilitators through the use of an input-output matrix (example in Table 5.2 in Section 4). Secondly, participants decide on the changes they wish to implement. This decision is constrained by the available land, financial capital, and labour days each participant still possesses after step 1. Based on the input-output matrix, participants hand in the required financial capital and labour days corresponding to these investments. Finally, at the end of the turn, each participant receives the financial returns corresponding to their land uses. Negotiations between participants are possible at any time. All types of deals (lending/borrowing money, selling land or labour, multilateral/bilateral deals, permanent/temporary agreements, etc.) are allowed, unless participants decide otherwise. There are no pre-defined rules about negotiations or conflict resolution; it is up to participants to collectively decide on measures to be taken in case of cheating, rule-breaking, etc.

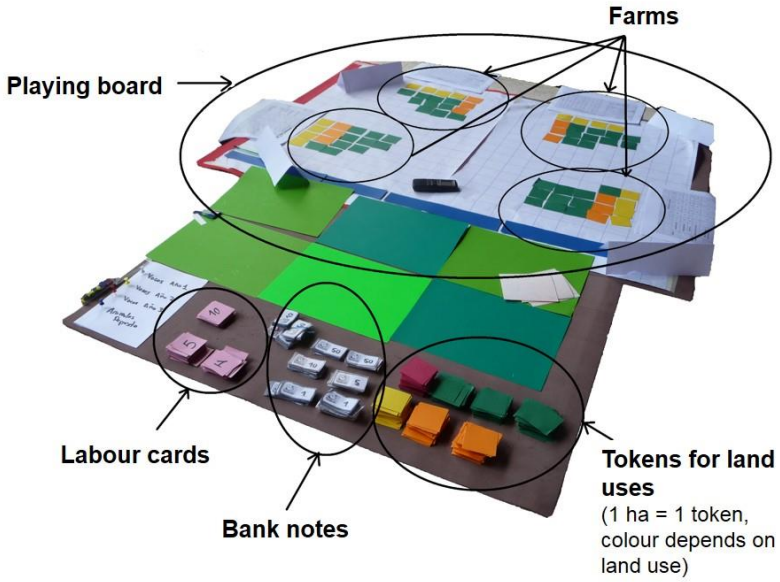
As the game advances, and different turns are being played, participants gradually become acquainted with the game dynamics. When the facilitators think all participants are sufficiently familiar with the game procedures, different types of events are gradually introduced. These events may (temporarily) alter relative inputs and returns or influence the perception of the participants in more indirect ways. A first type of event is an external conservation intervention which represents new institutional arrangements for governing the conservation or provision of ES. Such interventions can range from command-and-control approaches (e.g., demanding farmers protect parts of their remaining forests or instead face substantial fines), to individual or collective payments for voluntarily protecting/establishing particular land uses. The features of the interventions (e.g., the specific rules and duration, the scope in terms of targeting some or all participants, etc.) are context-specific and depend on the objectives and interests of the researchers and practitioners. These features should be collaboratively designed and can be elaborated between games (i.e., they could evolve based on feedback from previous games).

A second type of event is a ‘shock’, representing unexpected climatic or family events that affect either all or some of the participants. Such shocks alter participants’ assets and seek to assess the behavioural and perceptual changes that might be triggered under stress. For example, the sudden illness or death of a household member might

temporarily or permanently reduce the available labour and/or financial capital; droughts or hurricanes might negatively affect harvest and income; forest fires can affect the outcomes of the earlier-introduced conservation intervention. Researchers and practitioners should again discuss and carefully choose the nature and characteristics of the shocks they wish to simulate.

After ten to fifteen turns the facilitator ends the game and asks the players to participate in a debriefing session.

Figure 5.1: The PES simulation game playing board



The picture represents a game with four farmer household participants
Source: Authors' own elaboration.

3.3. STIMULATING COLLECTIVE LEARNING THROUGH DEBRIEFING

Learning from the game should not be limited to insights gained from playing or from observing interactions during the game, valuable as these are. Rather, the most crucial learning potential of the PES simulation game resides in the debriefing sessions. The game itself provides a setting in which exploration and experimentation can take place, but the debriefing session is where game experience is turned into learning (Crookall, 2010). In these sessions facilitators should assist participants to learn about perceptions by other players so that they gain a more complete picture of the game scenario, and better understand possible effects of their own actions (Peters & Vissers, 2004). These sessions are collective learning platforms where different perspectives can be

compared, where links to real-life situations can be established, and where alternative views can be openly discussed.

Our experience demonstrates that debriefing sessions can have high participation levels, are very enjoyable (for both participants and facilitators), provide many insights into the themes of inquiry, and can sometimes be even more engaging for participants than the game itself (see also Crookall (2010)). For this learning process to be most beneficial debriefing should be carefully set up, and can be facilitated by using general and specific guide questions (see Table 5.1). To prompt a collective discussion on particular aspects of interest facilitators can refer back to particular events, decisions, or discussions that took place during the game. Finally, debriefing sessions should not only be seen as part of one particular game but should be embedded in the broader action-research process, in which the game (and the corresponding debriefing session) is only one among other methodological and analytical entry points. Ideally debriefing should not be seen as a one-shot event, but as a cyclical iterative procedure that goes beyond particular game sessions (Peters & Vissers, 2004).

The discussions taking place during debriefing sessions are recorded by the game facilitator in the same way as the data collected during the implementation of the game (see above). Thus a substantial amount of information related to the specific interests of the broader action-research process is collected. Subsequently this information can be coded and analysed using a wide range of existing qualitative data analysis tools (e.g., NVivo or ATLAS.ti).

Table 5.1: Guide questions for debriefing in the PES simulation game

General guide questions*
● What major events and processes were observed while participating, and do they resemble real-life events and processes?
● Does this observed resemblance offer suggestions for action in real life, considering the course of events in the simulation game?
● Are these suggestions doable, desirable, and practical, in view of differences between the simulation game and real life and in view of expected reactions in real life?
Specific guide questions used in the PES simulation game
● Did you manage to create the farm you aspired to at the outset of the game? Why/Why not? To what extent is the imagined farm the same as your own farm?
● To what extent do the land use changes you observed during the game represent real-life experiences?
● Why did you decide to be part (or not) of the proposed intervention?
● Do you feel that the intervention rules were fair/unfair? Why/Why not?
● Does the intervention resemble actual interventions you have participated in?
● Would you have changed parts of the intervention rules? Why/why not? How would these changes have influenced your strategy?

* Taken from (Peters & Vissers, 2004, pp. 81–82)

Source: Authors' own elaboration.

4. AN EXAMPLE OF THE PES SIMULATION GAME IN THE NICARAGUAN AGRICULTURAL FRONTIER

4.1. RESEARCH CONTEXT

This section briefly illustrates the use of the PES simulation game through a discussion of context-specific rules developed as part of our broader action-research process. The PES simulation game was developed to offer entry points for the conservation NGO CcD to improve dialogue about farmers' perceptions and decision-making processes around current deforestation dynamics in the buffer zone of the Indio-Maíz Biological Reserve in Nicaragua. This reserve was established in 1990; at 264,000 ha it is one of the largest protected areas in Nicaragua. Although a strictly protected area with no human activity allowed, complex socio-political and economic dynamics have moved the agricultural frontier from the established buffer zone into the reserve (see Chapter 4). Alarmed by this detrimental dynamic, CcD has tried to defend the remaining tropical forests in this area. Since its creation in 1990 CcD has experimented with peasant-oriented conservation ranging from environmental education and agricultural diversification to the promotion of alternative income-generating activities such as ecotourism or cacao production. CcD is concerned that its interventions have offered only limited livelihood alternatives for local people, and thus have not succeeded in halting deforestation. In this context since 2013 we have partnered with CcD in a joint reflection process aimed at devising potential alternatives to change the regional environmentally and socially detrimental processes.

The design of our simulation game builds on key inputs from the above partnership. We have drawn upon the analysis of territorial dynamics (the historical evolution of social relations, land use patterns, technical-economic practices, etc.) from two Agrarian Diagnosis studies in the same area (Lindtner, 2014; Vérant, 2013)[68], with added data from interviews and focus groups with CcD staff and local farmers. These provided important insights into the main local social and land use change dynamics. We were able to trace current deforestation back to the early 1990s when farmer families,

[68] These diagnoses use landscape transect assessments, participant observations and semi-structured open interviews to identify agrarian change dynamics (changes in land use, production systems and farm types) and to construct technical-economic models for each farm type in the area.

originating from cattle-ranching regions in other parts of the country, started migrating to the Indio-Maíz Reserve where they appropriated large forest plots which were gradually transformed into agricultural areas and pastures. Via this history we identified evolving farming systems as well as the main motivations and institutional factors underpinning a continuous shift towards cattle production. The most important determinants were identified as access to non-family labour and financial capital, the existence of cultural stereotypes of desirable 'moral landscapes' (Setten, 2004) and desired social identities shaped by traditional ideas of progress and development as the conquest of the 'savage and unproductive' forest becoming cattle farms as the endpoint (see Chapter 4). While this cattle-based development pathway might seem unstoppable, our earlier research showed that over the past decade an increasing number of farmers have been trying to diversify their production by cultivating alternative crops such as cacao as an attractive 'green' alternative. This interest has been triggered by an expanding export market and by support from environmental NGOs, such as CcD. However, since initial investments in financial capital and labour for establishing and maintaining cacao are relatively high, uptake and production in the study area has been relatively slow (Merlet, Collado Solís, Lemoine, & Polvorosa Narváez, 2015; Vérant, 2013).

In 2006 CcD launched a PES programme in three rural communities of the Indio-Maíz' buffer zone comprising a total of 249 households. In the initial phase CcD paid 13 farmer households for protecting parts of the forests remaining on their farms. After a self-assessment in 2010 concluded that the programme lacked a long-term vision, a modified second five-year phase was initiated; farmers were also required to design sustainable farm management plans – e.g., based on agroforestry, ecotourism, or the production of cacao – and to use the payments for implementation. A second assessment in 2015-16 indicated that the anticipated adoption of sustainable practices failed to generate the expected alternative incomes, and that some participants used the payments to invest in cattle-related activities thus undermining the long-term objectives. This second assessment also questioned the logic of the programme and its apparent inability to trigger increased cooperation. This motivated the NGO to rather target groups of farmers through collective payments and contracts. Within this context CcD expressed

an interest in new participatory tools and approaches that would enable a deeper understanding of how farmers' decision-making is a product of the historical, socio-cultural and economic context of the locale, and that would permit cooperation in the creation, testing and discussion of new (or hitherto marginalised) alternative practices.

4.2. RULES OF THE PES SIMULATION GAME IN THE NICARAGUAN AGRICULTURAL FRONTIER

Based on analysis of the territorial dynamics and of the type of development and conservation interventions to be 'tested', we simulated the dynamics of newly-arrived farmers at the agricultural frontier. These immigrant farmers usually appropriate similar amounts of land but, depending on their individual history, there can be substantial differences in terms of available financial capital for further investments. At the outset of the game all participants were allotted an equal amount of land (10 ha of forested land, 4 ha for staple crops[69] and 3 ha of cleared land covered with pasture), and an equal 350 labour days. However, participants started with different amounts of financial capital (30,000 to 50,000 Nicaraguan Córdobas (NIO)[70]), roughly representing poor, middle, and richer farmers.

In each turn, participants first hand in the money and labour corresponding to their basic subsistence needs and to the maintenance of current land uses. Participants then decided which (combination of) investment(s) to undertake in their farms. Available options were:

1. **Invest in cattle**. Participants could buy one cow per hectare of available pasture. Upon reaching at least 4 ha of cattle pasture, their production system was upgraded from a basic breeding system to a specialised cattle-fattening system, implying a substantially higher financial return per animal.
2. **Clear forests**. Participants could cut down a maximum of 2 ha of forest per year[71] using slash-and-burn techniques. This decision meant that during the next two

[69] Staple crops are fixed at 4 ha for all players during the whole game. Staple crops do not result in annual financial returns but are used to cover households' basic food needs.
[70] 1 US$ = 30 NIO (January 2017).
[71] In this region cutting trees is a labour-intensive manual activity. This limits the area of forest that can be transformed into agricultural land to about 2 ha/year (see Chapter 4).

turns participants received returns corresponding to the temporary cultivation of staple crops on this area. After two turns these areas automatically turned into pasture.

3. **Plant cacao**. Participants could opt for converting pasture into cacao plantations.

These decisions have different labour needs and financial costs and returns, which are reflected in the game's input-output matrix (Table 5.2)[72].

Table 5.2: Input-output matrix: PES simulation game in the Nicaraguan agricultural frontier

		Cleared forest (per ha)	Cacao (per ha)	Cattle (< 4 cows) (per cow)	Specialised cattle (>= 4 cows) (per cow)
Initial single investment	NIO*	2,000	16,000	3,200	NA
	labour days	70	100	1	NA
Maintenance (yearly)	NIO	0	0	320	1,100
	labour days	0	40	5	15
Income (yearly)	NIO	10,000**	8,000	2,500	13,000

*NIO: Nicaraguan Córdoba (1 US $ = 30 NIO as of January 2017)

** The income from cleared forest only applies during two turns (corresponding to staple crops being temporarily cultivated on this cleared area). After two turns this area automatically transforms into pasture, generating zero income.

Source: Authors' own elaboration; calculations based on Lindtner (2014) and Vérant (2013)).

Two types of events were included in the PES simulation game. The first was a collective PES intervention, in line with *CcD's* current real-life initiative. On a voluntary basis interested farmer households were asked to sign a collective contract which stipulated that the signees were committing to, as a group, protect all remaining forest patches on their farms for a period of at least 3 turns. The contract also prohibited further expansion of cattle production within participating farms. As compensation, participating farmers

[72] These financial costs and returns correspond to actual values. Within these parameters the optimal economic strategy to follow is to specialise in cattle production. However, there are many constraints that hamper the implementation of such a strategy (e.g., labour constraints, limited access to capital). A more detailed discussion of these 'optimal' strategies is beyond the scope of this article, but can be found in Chapter 4.

were offered a 50% financial subsidy and 50% labour support for establishing cacao on their farms. Participating farmers were also offered assistance to improve production and commercialisation of cacao and staple crops, resulting in a 10 to 20% income increase for these crops. If any of the signees breached the contract at any point, benefits to all participating farmers would immediately cease.

Two turns after the collective PES contract was introduced, three types of shocks were randomly simulated: i) the unexpected death of a family member, resulting in the permanent loss of 75 labour days per annum; ii) a crop disease, causing a 50% income decrease for cacao and staple crops during that turn; and iii) an inheritance process, resulting in the permanent loss of half of the participant's current farm area. Per participant these shocks were attributed by rolling a dice.

Figure 5.2: PES simulation game played with farmers involved in the PES intervention of CcD in Indio-Maíz, Nicaragua

Source: Authors

5. REFLECTING ON ES INTERVENTIONS THROUGH THE USE OF THE GAME

From February 2016 to February 2017, we worked together with CCd´s staff on the design of the game and have played it on five occasions (see Picture 5.2). Each game lasted about four hours, including a debriefing session of about one hour. A total of 30 participants took part in the games at an average of six participants per game: 10 practitioners, 10 researchers from different institutes and 10 farmers living in CcD's intervention area. Sessions with practitioners and researchers were mainly aimed at providing a temporary virtual environment to experience and better understand some of the main constraints farmers experience when making livelihood choices (Section 5.1). Sessions with farmers were mainly aimed at an improved understanding of social relations and farmers' perceptions, motivations and decision-making in the context of land use change dynamics and project interventions (Sections 5.2 and 5.3). As such, within the broader action-research agenda we conceived of these games as new entry points for thinking about existing and alternative intervention policies. It is important to emphasise that up until now our work in this regard has mainly been focused on piloting and testing the game dynamics[73]. Therefore the discussion below offers a summary of only some of the many experiences this game might offer.

5.1. EXPERIENCING AND DISCUSSING FARMERS' CONSTRAINTS

The PES simulation game has proven to be a useful tool for researchers and practitioners to experience some of the many constraints and incentives that farmers face when making decisions. It allowed participants to take up the role of farmer households and feel first-hand how individual production decisions in the Nicaraguan agricultural frontier are constrained by the broader historical dynamics and processes in which farmers are embedded. By simulating the contextual dynamics in the study area all games played illustrated how investments in cattle quickly appeared to be the obvious option, encouraging most participants to pursue a cattle-based development pathway. Without exception all participants in all games we played decided at some point – but to different extents – to cut forest and increase pasture for cattle production.

[73] This also explains the relatively high proportion of researchers and practitioners as participants.

Interestingly this production strategy was not only dominant in sessions played by farmers but also in sessions with researchers or practitioners who initially often fiercely defended and argued for a 'pro-environmental' game strategy. For instance, in a game played with CcD staff one of the practitioners in the debriefing session said that he felt stressed and uncomfortable about being forced to take decisions that in real life he was, in fact, fighting against. Experiencing this stress helped the participant to view differently the assumed relevance and applicability of his NGO's conservation strategies. It made him realise why farmers usually stick to proven strategies in their own specific context, and that farmers' weak performance in environmental projects is influenced by many more prominent concerns beyond mere (un)willingness to contribute to the collective 'good' (Participant's comment, 30 September 2016): the concerns are mainly the result of historic rules and norms and socially-instituted ideas and habits around what seems to work in a specific context (Van Hecken et al., 2017). Another participant, who in real life was a practitioner promoting cacao projects, explained how she was convinced that her initial game strategy of investing in cacao would provide clear evidence of the potential benefits of a livelihood centred on this crop. However, the outcomes of such a strategy proved to be rather disappointing: it quickly led to financial problems, difficulties in covering basic food needs, and ultimately even a need to invest in cattle to be able to survive. During the debriefing session she explained that the experience made her realise how she and her colleagues might all too often gloss over the many daily constraints that farmers face when participating in a project that imposes a particular outside logic (Participant's comment, 30 September 2016).

While these observations might seem straightforward considering the context and the constraints imposed by the game, playing clearly offered a new interactive platform to personally experience and openly and critically discuss different lived experiences and perspectives on longstanding project assumptions and routines (e.g., uncertainty of project policies in case of unpredictable shocks, the often inflexible technocratic models imposed by projects, the perceived disrespectful behaviour of some project officials). These reflections also sparked broader discussions about often simplistic assumptions NGO staff hold regarding farmers' weak motivation or reluctant participation in different types of 'well-intended' projects, and how this mutual misunderstanding often leads to

frustration and distrust on both sides. The presence of practitioners as co-facilitators during the games played with farmer participants, for example, enabled the practitioners to enter into a constructive dialogue with them on how farmers' resistance to certain externally promoted activities/practices is often motivated by distrust due to previous experiences with 'questionable' interventions. This stimulated the NGO staff to start thinking more seriously about experimenting with alternative participatory methods and tools with empathy as a more central focus when approaching farmers in future projects. The discussions led to consensus among participants that being empathic was one of the most important characteristics a field practitioner should possess or further develop, even more so than their technical knowledge. The explicit recognition and discussion of these seemingly obvious issues was seen as a crucial but hitherto mostly neglected first step in constructing more meaningful and effective collaborative policies.

5.2. SOCIAL RELATIONS, POWER DIFFERENCES, AND ENVIRONMENTAL GOVERNANCE

Playing the PES simulation game also offered new entry points for discussing sensitive issues related to power differences in local communities, which, in turn, offered important inputs for thinking about the design of more equitable and effective ES governance interventions. This proved to be particularly relevant to our research as social relations in the Nicaraguan agricultural frontier are characterised by persistent vertical patron-client relations, one of the structural social underpinnings driving the dominant cattle-based development pathway (see Chapter 4). In these network constellations large-scale cattle ranchers ('patrons') usually secure access to both cheap labour and additional pasture by contracting neighbouring 'client' farmers or by engaging them in share-breeding systems[74]. Despite the unfavourable or even exploitative conditions these informal agreements usually entail for poorer farmers, the latter tend to accept them. One of the main reasons is that these unequal arrangements reach far beyond the cattle-related exchanges. They are considered as important coping

[74] In a share-breeding system, a large cattle rancher leases some of its animals to smaller farmers. The latter feed and take care of the animals on their farm and, in turn, are entitled to keep a portion of the generated products (milk and/or calves).

strategies for poorer farmers to deal with unexpected shocks or emergencies (e.g., sudden illness of a family member or a bad harvest), offering the opportunity to call upon patrons for e.g., short-term loans. While these social relations (and their social and environmental impacts) have been studied to some extent in the Nicaraguan context (Broegaard, 2005; Merlet et al., 2015), there is often an unwillingness by farmers to openly discuss them.

Playing the game with farmers has proven to be useful in assessing why these vertical, authoritative relations are so persistent and difficult to challenge. The game dynamics exposed two important characteristics of these relations. The first one is the apparently general perception among farmers that these relationships are overall 'helpful' and 'supportive' for both the patrons and the clients. Negotiations between richer participants, who had succeeded in establishing a cattle farm in the game, and poorer 'clients' struggling to cover their basic food needs were almost exclusively framed in terms of 'help', 'support', and 'favours': helping poor farmers with a loan, or conversely supporting cattle ranchers by selling them labour. The second characteristic is that patron-client relations are based on mutual trust. For example, when poorer participants urgently needed money, they would always prefer to borrow it from their 'richer' neighbours instead of turning to banks, for which they expressed a profound distrust[75]. In the debriefing sessions we urged participants to collectively reflect on these observed dynamics and corresponding discourses by referring back to particular events that had occurred during the game. This led to lively discussions on the unequal conditions imposed by powerful cattle ranchers, and deeper reflections on how the observed dynamics resemble real-life situations in their communities. These knowledge encounters proved to be crucial inputs for *CcD* as they allowed them to gain additional insights into the deeper social patterns and power relations underlying cattle-driven deforestation in the region. While these reflections have yet to translate into new intervention strategies, it is clear that the PES simulation game is a useful platform

[75] In most games participants assumed that the facilitators, who also managed the money transactions in the game, could be considered as a bank.

allowing for clear visualisation and acknowledgement of the deeper structural patterns, which could lead to ultimately challenging them.

5.3. VALUE FRAMEWORKS AND TARGETING IN INTERVENTIONS

Playing the PES simulation game has shed additional light on our previous finding that farmers in the region generally perceive forests as a dormant reserve of future productive land (see Chapter 4). From this perspective forests are largely considered as a short-term obstacle to development, only becoming economically valuable after being converted into agricultural plots. The game also uncovered further insights into this general farmer perception of forests, as well as in relation to the (P)ES interventions proposed in the game. Table 5.3 provides a rough illustrative typology of game participants, by considering three qualitative criteria: i) the pace of deforestation in the participant's farm; ii) the willingness to participate in the proposed PES project; and iii) the match between the proposed project rules and the participant's dominant production strategy.

Table 5. 3: Typology of game participants in relation to proposed PES project

Criteria / Group Type	Deforestation pace	Willingness to participate in PES project	Match between project rules and production strategies
Poor farmers	Low	High	High
Diversified farmers	Intermediate	Intermediate	Low
Specialised cattle ranchers	High	Low	Low

Source: Authors' own elaboration

'Poor farmers' were participants who typically started the game with little financial capital, and from early on struggled to cover their yearly basic food needs. From the outset these participants' capacity to invest in land use changes was very limited, resulting in less deforestation throughout the game. Unsurprisingly these participants were the most willing to participate in the proposed PES project. During the debriefing

sessions they explained that the project's requirement to leave forest undisturbed was not perceived as a significant production constraint in the short term. Furthermore, the labour and financial subsidies for cacao production offered by the project were considered as an attractive opportunity to start financial accumulation. 'Diversified farmers' and 'specialised cattle ranchers', on the other hand, were participants who typically started the game with a cattle-based development strategy. However, due to disparate financial constraints, not all of them succeeded in sustaining this strategy throughout the game. While specialised cattle ranchers were those who were able to fairly quickly transform their areas into pasture and upgrade their cattle system, diversified farmers were those who experienced more constraints, leading to slower deforestation and eventual diversification into both cattle and cacao production. To the specialised ranchers the proposed PES project was very unattractive as the commitment of conserving forest was much too costly compared to their very profitable livestock specialisation system. Diversified farmers were somewhat more willing to participate in the PES project but during the debriefing sessions they explained how they considered the proposed project rules to be quite unfavourable to their desired production strategy. One of the respondents said:

> 'In real life I would never participate in the proposed PES project. I just wouldn't be able to do so under the proposed conditions. I would only be able to participate if I would have already cleared enough forest in the previous years. It just doesn't make sense for us farmers who have barely started developing our farm. The contract would oblige us to leave all forests undisturbed and in turn would offer us cacao subsidies. But what's the use of these subsidies if I don't even have enough available agricultural land for planting cacao anyway?' (Participant comment, 30 September 2016).

The constructed typology in relation to the proposed project proved to be a very useful heuristic tool to collectively discuss the extent to which this particular proposal was acceptable, as well as illustrate when existing interventions' characteristics were (in)compatible with farmers' motivations and (long-term) strategies. It opened a platform to collectively analyse the heterogeneous nature of communities and, hence, to discuss the need for more flexible and socially-sensitive targeted strategies, while taking into account potential equity trade-offs for different types of farmers. These discussions, in turn, were important inputs for the broader action-research on CcD's ES governance interventions. For example, the organisation was inspired to initiate a

reflection process on determining *alternative values* for remaining forests. This represents an important paradigm shift for the organisation: whereas traditionally it always followed a 'don't-touch' or 'non-intervention' strategy for the remaining forests in the area, it now realises that in an agricultural frontier context such an approach may not be appropriate and might even be untenable. In order to encourage farmers to see forests as potentially valuable assets for their farm they should be allowed to integrate them into their production system by, for example, allowing different kinds of forest interventions such as shade-grown cacao production, ecotourism, agroforestry or silvopastoral systems.

6. CONCLUSION

The PES simulation game we have presented in this article aims to create a virtual platform where different actors engaged in ES governance are able to experience alternative realities and are encouraged to collectively explore and discuss them. Through discussion of the pilot games we have played in the Nicaraguan agricultural frontier we demonstrated some of the game's potential in terms of stimulating joint reflections and knowledge co-creation. By enabling practitioners to experience how farmers' motivations and decision-making processes are largely embedded in broader socio-institutional structures, we have shown how the game offers novel entry points for open discussion of alternative perspectives on commonly made assumptions. The game has also helped to more openly explore and debate how ES governance is to a large degree shaped and influenced by different values, interests, and power relations thus, for example, inspiring practitioners and researchers to think more carefully about the political dimensions and implications of different types of targeting strategies.

It is important to underline that we do not conceive the PES simulation game as an all-encompassing strategy to explore political and motivational dynamics in ES governance. The methodology has clear limitations and therefore needs to be used with care. One of the major limitations is that – ideally – the contextual design requires an in-depth understanding (and deliberative discussion) of real-life dynamics. In the absence of prior analyses of the study area, the construction of a meaningful and context-specific simulation platform will be a time-consuming process of contextual data collection and interpretation. This limits the meaningful use of the tool mostly to broader action-research processes which include a high level of stakeholder involvement and appropriation. This simulation game should be considered for use as part of a broader and iterative research process in which the co-creation of actionable knowledge starts before the contextual game design. As such, rather than offering a ready-made, predetermined design route, we recognise that there exists a multiplicity of ways to adapt the gaming platform we have presented in this article. In the spirit of action-research we encourage interested researchers and practitioners to further test and adapt the game in different contexts, and to share their additional insights with the

broader research-practitioner community, for example through the virtual forum we have created on https://pessimulationgame.wordpress.com/.

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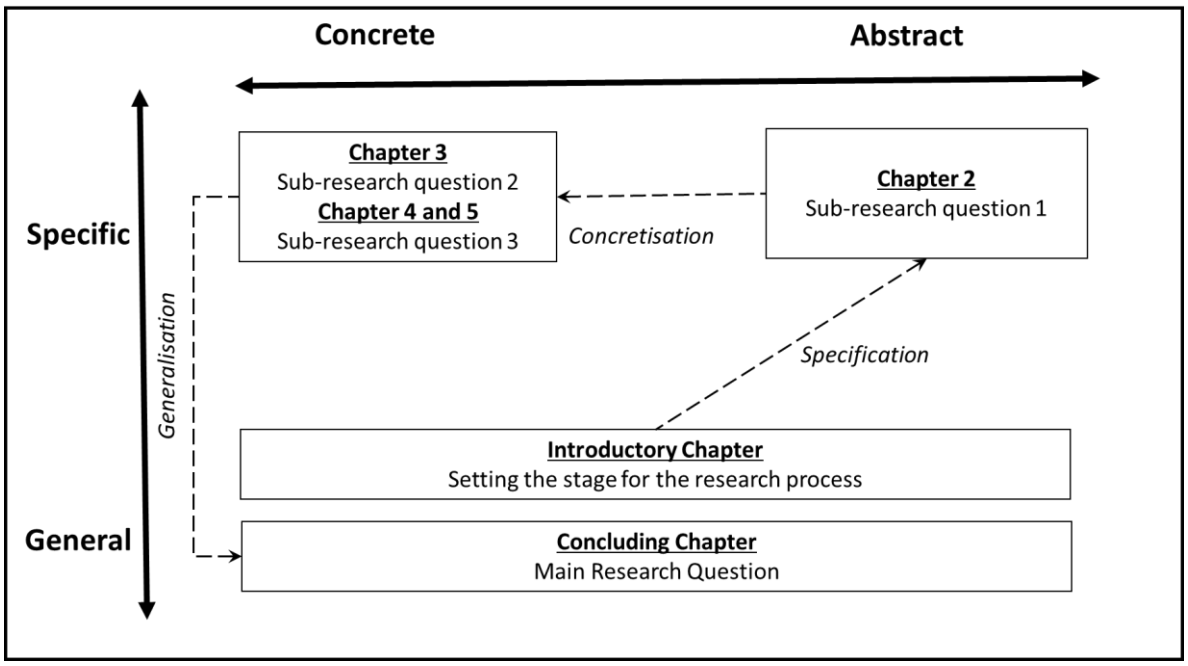
GENERAL CONCLUSION

This Ph.D. dissertation analyses the socio-ecological transformations related to agrarian change processes in the Nicaraguan agricultural frontier. As summarised in Figure 6.1 (already presented at the beginning of the dissertation), the study has covered all the dimensions that characterise social-science qualitative research processes.

Figure 6.1: Rationale of the dissertation



Source: author's own elaboration based on Lund (2014).

The research journey that the reader has travelled in this dissertation starts in Chapter 1 at the general level, where I set the stage for the whole research process. In this Chapter, I first introduce the concept of agricultural frontier, explaining that they are areas characterised by gradual changes from non-agricultural towards more agricultural landscapes related to the expansion of agricultural production. In the case of Nicaragua, where this research process is embedded, the agricultural frontier is characterised by a change from a tropical forest landscape towards a landscape dominated by livestock production. This expansion of livestock production, mainly cattle for international beef and milk markets, and the related deforestation that takes place in Nicaragua's agricultural frontier, are part of broader agrarian and environmental changes related to the emergence of a corporate food regime at the world level where production processes are more and more dependent on (global) market demands, specialized, disconnected from biophysical cycles at local and global levels and shaped by capitalist

and entrepreneurial rationales, being as such a core element of the global environmental crisis our world is facing (McMichael, 2009). Moving to the abstract dimension, I then explain how the evolution of agrarian structures in the Nicaraguan agricultural frontier resonates with broader debates around the role of agriculture in society and its relation to sustainable development, which I in turn relate to the debates around the Agrarian Question (Akram-Lodhi & Kay, 2010a, 2010b). The importance of the detrimental environmental consequences that take place in agricultural frontiers leads me to embed my research more specifically within the debates related to the Ecological Agrarian Question (Akram-Lodhi & Kay, 2010b). My understanding of the Ecological Agrarian Question follows Moore's idea to approach capitalism's development into the dominant system worldwide as a World Ecology where agriculture plays a key role in creating a surplus that can be appropriated and used to produce cheap food, in the sense of "more calories with less average labour-time in the commodity system" (Moore, 2015, p. 241). This leads me to embrace Moore's argument to challenge the dominant vision where 'nature' and 'society' are seen as two different overlapping and interrelated categories and to adopt the idea that, in order to analyse agrarian change processes we have to conceptualise that 'nature' and 'society' co-evolve constantly and are parts of a single whole, the '*oikeos*' (Moore, 2015). This implies developing an analytical framework to study agrarian change processes in agricultural frontiers that, rather than focusing mainly on the ecological impact of agricultural production, tries to deal explicitly with the ongoing reconfiguration of the '*oikeos*' as a whole.

In order to design this framework, following a movement of specification, I moved in Chapter 2 to the specific and abstract level of the research process. As such, in this chapter I try to offer elements to answer Sub-research question 1 **'How can agrarian change processes be analysed adopting an integrated nature-society approach?.** The first element of response to this question relies on the proposal to conceptualise rural landscapes as complex socio-ecological systems, in which the emergent dynamics of these systems as a whole are what define the agrarian change processes. Therefore, in order to analyse agrarian change in any concrete and specific situation, we must focus our attention on better understanding and analysing this process of emergence. I argue

that adopting the concept of 'development pathways' introduced by Bastiaensen et al. (Bastiaensen et al., 2015) helps to better understand this emergence. As defined in Chapter 2, a 'development pathway' is a concrete socio-institutional environment (i.e., a set of rules and regulations in interaction with specific social and power structures and biophysical setting) that, together with a set of sufficiently shared legitimating, actionable ideas, condition and inspire the individual and collective actions of the actors involved, in particular with respect to economic activities to be developed. This opens or closes opportunities to implement certain individual livelihood trajectories, which in turn shape the socio-institutional context and the shared ideas that characterise it. As such, adopting the concept of 'development pathways' permits a better assessment of the way actors' agency, both enabled and constrained by natural and social structural factors, participates in the emergence of the dynamics of complex socio-ecological systems and in the shaping of the Nature's matrix (Perfecto, Vandermeer, & Wright, 2009), i.e., the patchwork of land and natural resource uses, resulting from these emergent dynamics. Based on this conceptualisation of reality, I propose an analytical framework to investigate specific and concrete agrarian change processes that relies on the adoption of the Agrarian systems approach (Cochet, 2011, 2012) amended with a political definition of the peasantries inspired by the work of Van der Ploeg (2009) and a focus on the socio-institutional elements related to these change processes through an analysis of access mechanisms, as introduced by Ribot and Peluso in their Theory of Access (2003).

In Chapter 3, I move from the specific and abstract towards the specific and concrete level. Here, I apply the designed analytical framework in a small rural area in the Nicaraguan agricultural frontier in order to answer Sub-research question 2 **What are the main characteristics of the emerging dominant development pathways in the Nicaraguan agricultural frontier (i.e., the socio-ecological collective processes of change, the individual trajectories followed by farmers and their environmental and social outcomes)?** In this chapter, I analyse the processes of agrarian and landscape change using the combined lenses of the Agrarian systems approach and the Theory of access. This allows me to describe farmers' livelihood trajectories in the area together with land use change processes and to identify the main features of the dominant cattle-

based development pathway, which is shaping the emergent dynamics of the socio-ecological system as a whole in the Nicaraguan Agricultural frontier. In terms of agrarian change, I argue that these emergent dynamics result locally in de-peasantisation processes with negative social and environmental outcomes, very much in line with the establishment of the dominant corporate food regime and its consequences at the world level. However, my analysis also allows me to identify that, despite the dominance of this cattle-based development pathway, there is still manoeuvring room for actors to implement more peasant-like livelihood trajectories that deviate from these dominant dynamics and are part of a subaltern development pathway around cacao production.

In Chapters 4 and 5, I remain at the same specific and concrete level, but try to move from the identification of these dominant emergent dynamics towards a reflection on how to support the implementation of subaltern development pathways that could revert, or at least slow down, the de-peasantisation processes taking place in the Nicaraguan agricultural frontier. As such these chapters answer Sub-research question 3: **Within emerging dominant development pathways in the Nicaraguan agricultural frontier, how should we envisage and implement development policies and interventions that could promote more sustainable and inclusive pathways?** In order to bring insights in answer to this question, I focus on the example of a Payment for Ecosystem Services intervention implemented in the Nicaraguan agricultural frontier. This intervention allows me to analyse the interplay between farmers' agency and decision-making processes and the historically- built rules and norms, social structure, culture, world views and macro-economic structure that characterise the dominant cattle-based development pathway. I demonstrate that policy interventions that focus merely on trying to change farmers' behaviours at individual level without explicitly acknowledging the strength of these factors have little chance to be successful in changing the emergent dynamics of the system as a whole. Interventions' outcomes will indeed depend on the way the interventions interact with broader territorial dynamics and processes. Therefore, interventions must also try to influence those structural, socio-institutional and knowledge-related factors that shape the emergence of dominant development pathways in concrete-specific settings, escaping from blueprint types of designs. With respect to the design of policy interventions, this calls for the

development of processes based on an in-depth understanding (and deliberative discussion) of real-life dynamics in concrete-specific settings. Most importantly, it also calls for processes that explicitly and directly challenge the features of the dominant development pathways that impede the emergence and establishment of other pathways, as for instance incumbent power relations, knowledge creation processes and structural factors.

My research journey ends in this conclusion with an attempt to bring together the previous inputs in order to provide insights related to the main research questions: **What does an explicit focus on the complex interactions between nature and society contribute to the understanding of agrarian change processes within social-ecological systems in the Nicaraguan agricultural frontier, and, what insights can be derived to inform proposals for policies and interventions to promote more sustainable and inclusive collective development pathways?** Trying to answer this question takes me into the realm of action in relation to development policies and interventions. In line with the discussion introduced in Chapter 1 around the Ecological Agrarian Question, this question underscores that if we want to improve development practice, we need to challenge the dominant way of understanding and analysing socio-ecological dynamics and agrarian and landscape change processes in specific rural areas. The integrated nature-society approach and the related analytical framework I adopt in this dissertation, and which I applied to the case of rural areas in the Nicaraguan agricultural frontier, allowed me to identify co-evolution processes of nature and society and to relate them to specific agrarian and landscape change dynamics. In addition, this framework shows itself to be very effective in making explicit the influence of these historically-built collective and territorial changes in shaping farmers' individual livelihood trajectories, and, more broadly, in shaping the actions and decision-making processes of all involved actors, including development practitioners. Putting this in other words, the framework allows for reflection on actors' margin for manoeuvre within a specific context, i.e., the extent to which actors' agency is, at the same time, constrained and enabled by the structural factors that characterise these broad territorial processes of change.

In the case of the Nicaraguan agricultural frontier, I have demonstrated in this dissertation the existence of a dominant cattle-based development pathway that pushes farmers to adopt production systems geared towards the accumulation of land and cattle, based on specific macro-economic conditions (e.g., insertion within the international market, rising price of products), national policies (e.g., those directed towards supporting an agricultural production for international markets), and locally-defined social relations (based on patronage), power structure, and cognitive-motivational systems. This dominant pathway generates profits for a limited number of actors (at local level, those larger farmers able to accumulate land and cattle and acting as patrons within the patron-client relations that characterise the area.

At a broader level, those actors governing global meat and milk value chains also generate important negative social and environmental outcomes. Socially, they generate huge inequalities in the access to land and resources, and in the ability to generate family agricultural income. This results in an exclusionary process where smaller farmers are pushed to sell their land to wealthier producers and move further east in the agricultural frontier, fostering as such the advancement of the pioneer fronts and generating huge disputes over land with historical indigenous rights-holders, increasingly dispossessed of their land and forests, and sometimes leading to violent conflicts.

Environmentally, the implementation of this dominant cattle-based development pathway is related to detrimental global outcomes involving broad deforestation dynamics leading to the destruction of biodiversity stocks and a negative impact in terms of greenhouse gases absorption. It also results in negative local outcomes as it implies the implementation of production systems related to the establishment of a Nature's matrix dominated by pastures with little forest cover, which tends to exhaust water resources and soil fertility. This cattle-driven development pathway emerges as a kind of natural 'moral landscape' (Setten, 2004) that shapes the decisions and actions of all involved actors and appears as hegemonic. Actors involved are, therefore, locked within historically-evolved practices that are embedded in the production logics and socio-cultural and socio-ecological contexts that characterise the dominant development

pathway. As such, this leaves little space for alternative views and practices and for the emergence of more sustainable development pathways.

I have also demonstrated that development practitioners do not escape from the hegemony of this dominant cattle-driven development pathway. As shown with the example of the PES intervention analysed in this dissertation, it is very difficult for an intervention to generate changes that break away from the dynamics of the dominant pathway and, at the end, even well-intended interventions can be overruled by the dominant views and practices. If not enough care is put into seriously considering the way development interventions interact with the socio-institutional and socio-ecological processes of the dominant development pathways, the most worrisome thing will be that the same interventions that look to promote alternatives towards more sustainable practices could finish by supporting and strengthening the dominant detrimental dynamics they aim to challenge. As shown in this dissertation, this can happen with interventions that are insufficiently contextualised, draw on individualistic strategies and fail to acknowledge the interlacing between individual decision-making, strategies and practices and broader collective development pathway dynamics.

Therefore, if we are looking to achieve real transformations towards sustainability, it calls for a drastic change in the way issues are problematised and development interventions and policies are designed and implemented locally. Particularly, the results of my research imply a need to acknowledge that individual behavioural change is only possible and sustained if broader socio-economic, political and cultural transformations in the local development pathways are achieved. This in turn implies that the design and implementation of development interventions need first to draw upon a detailed understanding of the process by which a dominant development pathway emerges in order to identify the context-specific margin for manoeuvre of actors and the fissures in the hegemonic dynamics that could be harnessed to challenge those dominant pathways. Development interventions cannot therefore consist of the implementation of blueprint types of designs that would fit all time and space contexts. On the contrary, there is a need to be explicitly flexible in the design and implementation of those interventions and policies for them to be adapted to the specific and concrete development pathways in which they are embedded and that they try to challenge and

transform. Being aware of the hegemony of current detrimental dominant pathways also implies being modest in the design of often short-term development interventions, making explicit their limits in generating, by themselves, any drastic changes in the historically-built and sustained socio-ecological dynamics of change.

Moreover, acknowledging the importance of social structure, power relations and knowledge creation processes in the emergence of dominant pathways and the establishment of hegemonic ways of seeing reality and acting in it implies that development interventions and policies must move from simple apolitical and technical models, which often focus only on the individual level and are based on supposed superior (external) scientific knowledge towards the promotion of collective joint interpretation, decision-making and implementation processes that explicitly acknowledge different world views, power differences and social structure. This calls for the implementation of processes based on the creation of deliberative platforms where several actors can bring their views, perceptions and power in order to collectively negotiate and co-create a common understanding of the issues to be dealt with, the results expected and the strategies to implement. Finally, the recognition that the emergence of dominant pathways is also shaped by broader-level structural factors implies that development interventions and policies cannot simply stick to what they do and what they are at the local level. They need to be thought through and problematised taking into account the dominant world system in which they are embedded and, as a result, need to be part of broader strategies and alliances aimed at transforming those global structural factors.

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SAMENVATTING (SUMMARY IN DUTCH)

De aanhoudende transformatie van bossen in landbouwgrond, in wat bekend staat als ‘landbouwgrenzen’ (agrarian frontiers), wordt wereldwijd erkend als een belangrijk probleem. Enerzijds zijn de daarmee samenhangende veranderingen in landgebruik verantwoordelijk voor enorme transformaties in het biofysische milieu op lokaal en mondiaal niveau en spelen ze een cruciale rol in de huidige mondiale milieu- en klimaatcrisis. Anderzijds houden deze veranderingen in landgebruik in landbouwgrensgebieden verband met het ontstaan en de expansie van specifieke culturele en sociale landbouwsystemen, die hoofdzakelijk gericht zijn op producten voor de wereldmarkten (b.v. koffie, vlees en zuivel, soja en palmolie). Ze leiden vaak tot conflicten over de toe-eigening en het gebruik van hulpbronnen en tot grote ongelijkheden, zowel plaatselijk als tussen plaatselijke en externe actoren (m.n. door de nadelige integratie van kleinere boeren in mondiale waardeketens). De processen die zich afspelen in de beboste landbouwgrensgebieden brengen dus enorme uitdagingen met zich mee op het gebied van governance, ecologische en sociale duurzaamheid en rechtvaardigheid, zowel op lokaal als op mondiaal niveau.

Deze doctoraatsverhandeling draagt bij tot een beter begrip van deze processen en de daarmee samenhangende uitdagingen in beboste agrarische grensregio's. De nadruk ligt op het analyseren van de socio-ecologische transformaties gerelateerd aan agrarische veranderingsprocessen in de Nicaraguaanse agrarische grensgebieden. Het doel is om inzichten te verwerven die ontwikkelingspraktijken en -beleid beter kunnen informeren. In Nicaragua is de dynamiek van het terugdringen van de landbouwgrens een belangrijk onderdeel van de agrarische ontwikkeling met als rode draad een proces van specialisatie (in veeteelt en koffieproductie), concentratie van landeigendom en verdrijving van kleine boeren naar nog actieve pioniersfronten, en enorme ontbossingspercentages. Recent hebben nieuwe tendensen deze historische processen beïnvloed, zoals de toenemende aanwezigheid van de staat, de toenemende integratie van plaatselijke producenten in mondiale waardeketens, en de opkomst van nieuwe actoren (NGO's, particuliere agro-industriële investeerders en natuurbeschermingsorganisaties). Dit brengt veranderingen met zich mee in de praktijken en regels met betrekking tot de toegang tot en het gebruik van natuurlijke

hulpbronnen en de verdeling van de voordelen die eruit worden gehaald, terwijl er ook een nieuwe discursieve strijd ontstaat over de betekenis van duurzame ontwikkeling (met bijvoorbeeld spanningen tussen een klemtoon op natuurbehoud of duurzame agrarische productie).

Op basis van een literatuurstudie rond het thema van de 'ecologische agrarische kwestie' wordt in dit proefschrift gepleit voor een geïntegreerde natuur-samenleving benadering om de processen van socio-ecologische transformaties in landbouwgrensgebieden beter te begrijpen en te beschrijven. Dit impliceert dat afstand wordt genomen van benaderingen die natuur en maatschappij conceptualiseren als twee interactieve, maar losstaande categorieën. Daarentegen wordt het idee omarmd dat natuur en maatschappij deel uitmaken van eenzelfde ondeelbaar geheel. Concreet betekent dit dat we niet langer kijken naar hoe de menselijke samenleving omgaat met en invloed uitoefent op de natuur, maar dat we onze aandacht richten op de processen van co-evolutie van natuur en maatschappij als één geheel. Om dit te bereiken stelt het proefschrift een analytisch kader voor dat rurale landschappen conceptualiseert als complexe socio-ecologische systemen en dat zich richt op het beter begrijpen van de evoluerende dynamiek van dergelijke systemen, in het bijzonder het ontstaan van dominante ontwikkelingstrajecten met hun specifieke matrix van landgebruik. Binnen dit kader wordt bijzondere aandacht besteed aan de analyse van de sociaal-institutionele en relationele elementen die verband houden met deze veranderingsprocessen, teneinde de effectieve maneuvreerruimte voor de 'agency' van individuele en collectieve actoren en voor de implementatie van ontwikkelingsinterventies en -beleid beter te begrijpen.

Het empirische deel van het proefschrift past dit interpretatiekader toe in twee kleine regio's binnen de Nicaraguaanse landbouwgrens met een meervoudige doelstelling. Ten eerste tracht het de 'ontwikkelingstrajecten' die binnen de Nicaraguaanse landbouwgrens bestaan te identificeren en te karakteriseren. Om dit doel te bereiken concentreert het onderzoek zich op een kleine regio waar in de jaren zestig is begonnen met de transformatie van bosgebieden in landbouwgrond. De historische analyse van de dynamiek van de uitgevoerde sociaal-ecologische veranderingen omvat de analyse van de processen van zowel verandering in landgebruik als sociale differentiatie die in

de regio hebben plaatsgevonden. Alles tezamen toont zij het bestaan aan van een dominant, op vee gebaseerd ontwikkelingstraject dat gekenmerkt wordt door sociale ongelijkheden, machtsonevenwichtigheden en negatieve milieuresultaten. Ondanks de dominantie van dit op vee gebaseerde ontwikkelingspad toont de analyse echter ook aan dat er altijd alternatieve paden bestaan, met name een op boerenproductie gebaseerd ontwikkelingspad dat wordt gekenmerkt door gediversifieerde productiesystemen binnen het gezin waarin cacao een sleutelrol speelt.

Ten tweede tracht het proefschrift, voortbouwend op de inzichten over het bestaan van alternatieve ontwikkelingstrajecten die in sociaal en milieuopzicht duurzamer zouden kunnen zijn, een beter inzicht te krijgen in de speelruimte die er is voor het ontwerpen en uitvoeren van ontwikkelingsinterventies en -beleid die deze alternatieven zouden kunnen bevorderen. Vervolgens wordt een concrete ontwikkelingsinterventie aan de Nicaraguaanse landbouwgrens geanalyseerd. De interventie bestaat uit een betaling voor ecosysteemdiensten waarbij een lokale NGO voor natuurbehoud een betaling invoert voor boeren om hen te motiveren de resterende beboste gebieden op hun boerderijen niet te rooien. De nadruk van de studie ligt op de wisselwerking tussen de "agency" en de besluitvormingsprocessen van de boeren en de historisch gegroeide regels en normen, de sociale structuur, de cultuur, de wereldbeelden en de macro-economische structuur die kenmerkend zijn voor het dominante, op vee gebaseerde ontwikkelingstraject. Hierbij wordt getracht inzichten te verwerven in hoe interventies kunnen worden ontworpen en uitgevoerd die een verandering in de praktijken van de boeren kunnen bevorderen. De analyse toont aan hoe sterk het dominante ontwikkelingspad de beslissingen en handelingen van de actoren bepaalt, niet alleen voor wat de boeren betreft, maar ook voor de ontwikkelingswerkers en andere actoren. Als zodanig laat de analyse zien in hoeverre de betrokken actoren opgesloten zitten in historisch gegroeide praktijken die zijn ingebed in een bepaalde productielogica en een sociaal-culturele en sociaal-ecologische context die kenmerkend zijn voor het dominante ontwikkelingstraject. In die zin blijken de dominante, op vee gebaseerde ontwikkelingspaden sterk hegemonisch te zijn en laten ze maar weinig ruimte voor alternatieve zienswijzen en praktijken en voor het ontstaan van duurzamere alternatieve paden.

Deze doctorale studie stelt daarom dat er een drastische verandering moet komen in de manier waarop ontwikkelingsinterventies worden ontworpen en uitgevoerd en in de manier waarop problemen worden geproblematiseerd. Er wordt gepleit voor een meer diepgaande betrokkenheid bij de realiteit van lokale gebieden en hun actoren, om een realistischer beeld te krijgen van wat problemen en oplossingen zouden kunnen zijn. Dit betekent dat men zich niet langer moet laten leiden door blauwdrukontwerpen die in alle tijd- en ruimtecontexten passen, maar dat men in plaats daarvan expliciet flexibel moet zijn bij het ontwerpen en uitvoeren van die interventies en beleidsmaatregelen, zodat deze kunnen worden aangepast aan de specifieke en concrete ontwikkelingstrajecten waarin zij zijn ingebed en die zij trachten aan te vechten en te veranderen. Het impliceert ook dat wordt gedacht aan processen waarbij ontwikkelingsmaatregelen en -beleid worden geconstrueerd door de standpunten, percepties en macht van verschillende actoren in het debat te betrekken en zodoende via collectieve onderhandeling en co-creatie tot een gemeenschappelijk inzicht in en een gemeenschappelijke waardering van de te behandelen kwesties, de verhoopte resultaten en de toe te passen strategieën te komen. Ten slotte impliceert de erkenning dat het ontstaan van dominante trajecten ook wordt bepaald door structurele factoren op een breder (nationaal en globaal) niveau, dat ontwikkelingsmaatregelen en -beleid moeten worden doordacht en geproblematiseerd met expliciete inachtneming van deze factoren, en deel moeten gaan uitmaken van bredere strategieën en allianties die erop zijn gericht deze mondiale structurele elementen te transformeren.

CURRICULUM VITAE

Pierre Merlet holds an Engineer Degree in Agronomy with a Specialisation in Social Sciences and Rural Development from the Institute for Education and Research in Life Sciences, Agronomy, Food Technology and Environment of Paris-France (AgroParisTech) and an advanced Master of Globalisation and Development from the Institute of Development Policy of the University of Antwerp (IOB-UA). After his studies he worked for four years as a development practitioner in Nicaragua in development projects related to natural resources access and management.

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