EMERGENT CATTLE PRODUCTION CHAINS IN THE BRAZILIAN AMAZON: NATIONAL POLICIES VERSUS LOCAL REALITIES

By

Ritaumaria de Jesus Pereira

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Geography

2012

ABSTRACT

EMERGENT CATTLE PRODUCTION CHAINS IN THE BRAZILIAN AMAZON: NATIONAL POLICIES VERSUS LOCAL REALITIES

By

Ritaumaria de Jesus Pereira

Global environmental change is a pressing challenge for the 21st century, and scientists have identified tropical deforestation as one of the leading contributors to greenhouse gas (GHG) emissions. International concern for the environment is reflected in the many summits designed to bring together world leaders and civil society, such as Rio +20, as well as multinational programs like the United Nations Program to Reduce Emissions from Deforestation and Degradation (REDD+). Likewise, environmental concern is central to Brazil's policy arena, especially the nation's REDD+ program and policies that define new agrarian reform settlements, both calling for sustainable development. Finally, this environmental rhetoric is also repeated by the landless movements and is made explicit in the development plans created at the settlement level, which systematically outlines programs encouraging diversified production and environmental conservation. However, the reality is that the vast majority of settlers in the Amazon basin are engaged in the cattle economy as opposed to the green alternatives elaborated by policy. Consequently, there is an obvious disconnect between the environmental rhetoric in policies and the material practices of farmers living in the settlements. This is especially problematic because cattle is cited as the main driver of deforestation. So, not only are settlers not engaged in sustainable development as mandated by policy, they have become part of the global cattle economy and, as such, are implicated in tropical deforestation.

To understand this disconnect, and the social and environmental implications, this dissertation proposes three main tasks that (1) identify the main factors that motivate settlers to

invest in cattle as opposed to diversified activities proposed by policy; (2) examine how engagement in cattle has impacted smallholder well-being; and (3) identify how the insertion of settlers into the global cattle economy has impacted the contentious relationship between small- and largeholders in the Amazon and whether this has mitigated a contentious relationship between smallholders and large ranchers that has led to violent conflicts. To accomplish these objectives, research was conducted in the southeastern region of Pará State, an area that has a history of government-led colonization and development projects as well as entrenched social movement actions inspired to pressure the government to follow through on promises of agrarian reform and settlement formation. This area has also become the most important region in that state for cattle expansion. The research involved (1) interviews with households living in six selected Social Movement Organizations or SMO-led settlements, (2) key informant interviews with social movements, government officials, agronomists, and other settlers, and (3) regional data collection through available databases. Statistical and context analyses were performed to test a suite of related hypotheses. Overall, results show that 71% of settlers have cattle as their main economic activity, with most of them participating in calf production for large ranchers, and credit availability was shown as the main reason for the settlers' decisions regarding economic activities and land use. Finally, results show that the settlers who have cattle are experiencing a better life quality and access to durable goods. However, the evidence was not sufficient to show that involvement in the global cattle economy reduced the contentious relationship between settlers and largeholders that traditionally was intense given the struggle for land in the region.

To my mother Milvia Pereira, brother Jarbas Lima, and friend Karen Hudson,
for giving me support and for their patience with me during the last five years. All my love and gratitude to each of you.

AKNOWLEDGEMENTS

During the last five years I had full support from family and special friends who made me more adapted to the new experience. I apologize if someone is not mentioned because I am blessed enough to have always many people willing to help me and make me smile, even when the moment was difficult. First and foremost I thank my late grandfather (Maneca) who is not here to see what I have accomplished, but who is responsible for who I am. Also, I have to mention my mother (Milvia) and brother (Jarbas) for showing me how important it is to have a nice and supportive family and for understanding my absence on special dates of our family.

I also would like to thank all my committee members, Cynthia S. Simmons, Robert T. Walker, Bruce Wm. Pigozzi, and Mike Kaplowitz for their advice and patience during the entire process of my program. Cynthia S. Simmons was more than an advisor, she showed me how to better use my data and resources and guided me to have better results from my experience. Additionally, Cynthia Simmons became a friend who was always available to talk about all situations I have had in my life during this time. Robert Walker has guided me not only in the fieldwork we developed together but as a thinker during all my professional life. Bruce Pigozzi always made himself available when I needed him, and his guidance gave me confidence in the approach to my results. Mike Kaplowitz always had helpful considerations during my presentations that made my work more complete.

Special thanks to the Caldas family who helped me settle in this country and made my life a lot easier here in Michigan. Without you all it would not be possible. Thanks Marcellus, Martha, Amanda, Gabriel, and Lucas. Also special thanks to Eugenio and Norma Arima and to

Steve Aldrich for being part of my adaptation and academic progress. In this process of adaptation, I am also thankful to Teri Covington and Karen Hudson, who received me into their homes and, even with all the communication barriers, made me comfortable in my new place.

Some American families supported me during the time I was pursuing a Ph.D. degree, and I would like to say thanks to Mr. Henry Grayson and Mrs. Tina Grayson and their adorable children, Mr. Del Bacon and Mrs. Clara Bacon, Ms. Karen Allen and her children, and the late "Grampa" G. Albert Allen for receiving me as part of their families for several years for Christmas, Thanksgiving, and many other family celebrations.

Additionally, I have to thank my fellow graduate students who helped me to make myself at home as I was still learning English and adapting to the new life. Here I hope I won't forget anybody, as many of my colleagues who were special left a long time ago. Thanks to you all: Steve Aldrich, Ivan Ramirez, Peter Richards, Dante Vergara, Joel Gruley, Kristy Stanley, Jieun Lee, Cristina Leuca, Zeenat Karamchandni, Minting Ye, Mike Bigsby, Mike Luehmman, Meg Reed, Carolyn Fish, Courtney Galaher, Shaun Langley, Williams Castro, Yankuic Galvan, Dan Kowalski, Daniel Ddumba, Laura Johnson, and many other special people who made the work in the Geography building basement fun and productive during many days, nights, and weekends.

I cannot forget all the Brazilians who I met here and made my life happier and more comfortable, and I would like to mention some of them. Thanks to Marcellus and Martha Caldas, Eugenio and Norma Arima, Eraldo and Cleusa Matricardi, Vania Melo, Fernanda Paes, Angelica Santos, Margaret Francis, Williams Castro, Cristiane Araujo, Luis Araujo, Cristiane Pereira-Hicks, Amancio Souza, Tais Nayanne, Andressa Avila, Eliane Gomes, Caio Rachid, Polli Aguiar, and Roberta and Stella de Carvalho—just to cite a few Brazilians who left or just arrived to make life more enjoyable in this part of the world.

Not only Brazilians who had lived or still live here had supported me. Even far apart I always had support form special friends who were in Brazil cheering for me. Thanks to Lorenda Raiol, Katia Pereira, Samia Nunes, Simone Bauch, Euzi Inacio, Renata Santana, Bruno Dias, Maiara Nunes, Andrea Castro, Fatima Oliveira, Francisco Lima Filho, and many other friends who were always checking on me to make sure I was well.

I would like to express my gratitude to the wonderful staff from the Geography department; you all make our days special. Thanks to Sharon Ruggles, Claudia Brown, Wilson Ndovie, Judy Reginek, and Jim Brown. I would like to extend this thanks to all professors who overcame the barrier of communication and did a wonderful job in showing me how to keep up my progress. Special thanks to Joe Messina, Cynthia Simmons, Robert Walker, Bruce Pigozzi, Morris Thomas, and Sue Grady.

My gratitude is extended to the funding sources which enabled me to do the research, to participate in conferences, and to improve my ability to conduct data collection and present results. Thanks to the Geography department at MSU, the Graduate School at MSU, College of Social Science at MSU, Center for Latin American and Caribbean Studies (CLACS) at MSU, Inter-American Foundation (IAF), and Latin American and Caribbean Environmental Economics Program (LACEEP).

Without cooperation in the field, my work would not be done. First, I would like to thank all settlers who agreed to respond to my questionnaire and received me in their homes. Additionally, I thank Social Movement Organizations representatives, Government Offices, City of Marabá Cultural House (Ms. Augusta Luz), and Third Party Technical support which made all data used in this dissertation available. Also in Pará State, I would like to thank friends from Imazon for always having their door open for me, especially Paulo Barreto, who always provided

me data from the region. Mr. Ari and Mrs. Eunice gave me a home in Marabá and deserve all my gratitude as well. Mr. Raimundo Brito drove me around the settlements and, with Heloiza Andrade, Regiane, Jean Carlos and Maria Zelzuita, made my field team more efficient.

My sincere thanks to all of you for making this work possible. Even if I did not cite you here, I will make sure to let you know how important you were in the entire process of my studies at Michigan State University.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AgraFNP: Consultancy and Information in Agribusiness

ARPA: Programa Áreas Protegidas da Amazônia (Amazon Protected Areas Forest Conservation Program)

ATES: Assessoria Técnica, Social e Ambiental (Technical, Social and Environmental Assistance)

BASA: Banco da Amazonia (Amazon Bank)

CBD: Convention on Biological Diversity

CPT: Comissão Pastoral da Terra (Pastoral Land Commission)

CVRD: Companhia Vale do Rio Doce (Sweet River Valley Company)

DAP: Declaração de Aptidão do Produtor (Declaration of Competence of Producer)

EMATER: Empresa de Assistencia Técnica e Extensão Rural (Company of Technical Assistance and Rural Extension of Pará State)

EMBRAPA: Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Corporation)

FETRAF: Federação Nacional dos Trabalhadores e Trabalhadoras na Agricultura Familiar (National Federation of Workers in Family Agriculture)

FMD: Foot and Mouth Disease

FNO: Fundo Constitucional de Financiamento do Norte (Constitutional Financing Fund of the North)

FUNAI: Fundação Nacional do Índio (National Indian Foundation)

GEBAM: Grupo Executivo do Baixo Amazonas (Executive Group of Lower Amazon)

GETAT: Grupo Executivo de Terras do Araguaia / Tocantins (Executive Group of Lands of the Araguaia / Tocantins)

GHG: Gas de Efeito Estufa (Greenhouse Gases)

IBAMA: Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (Brazilian Institute of Environment and Natural Resources)

IBGE: Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics)

INCRA: Instituto Nacional de Colonização e Reforma Agrária (National Institute of Colonization and Agrarian Reform)

INCRA SR-27: Instituto Nacional de Colonização e Reforma Agrária, escritorio Sub-regional de Marabá (National Institute of Colonization and Agrarian Reform, Sub-Regional Office of Marabá)

INPE: Instituto Nacional de Pesquisas Espaciais (National Institute for Space Research)

IPND: I Plano Nacional de Desenvolvimento (First National Development Plan)

IIPND: II Plano Nacional de Desenvolvimento (Second National Development Plan)

MAB: Movimento dos Atingidos por Barragens (Movement of People Affected by Dams)

MAPA: Ministério da Agricultura, Pecuária e Abastecimento (Ministry of Agriculture, Livestock and Supply)

MDA: Ministério do Desenvolvimento Agrário (Ministry of Agrarian Development)

MIRAD: Ministério da Reforma e do Desenvolvimento Agrário (Ministry of Agrarian Reform and Development)

MMA: Ministério do Meio Ambiente (Ministry of Environment)

MPF: Ministério Público Federal (Federal Public Prosecution Service)

MST: Movimento dos Trabalhadores Rurais Sem Terra (Rural Landless Workers' Movement)

NGO: Non-Governmental Organization

OIE: World Organization for Animal Health (formerly known as Office International des Epizooties)

PA: Projeto de Assentamento (Settlement Project)

PA Resident: A settler who is already recognized by government as a land beneficiary

PAC 2: Segundo Programa de Aceleração do Crescimento (Second Growth Acceleration Program)

PAC: Programa de Aceleração do Crescimento (Growth Acceleration Program)

PDA: Plano de Desenvolvimento do Assentamento (Settlement Development Plan)

PGC: Programa Grande Carajás (Grande Carajas Programme)

PGCA: Programa Grande Carajás Agrícola (Grande Carajas Programme for Agriculture)

PIC: Projeto Integrado de Colonização (Integrated Colonization Project)

PIN: Plano de Integração Nacional (National Integration Program)

PNEFA: Plano Nacional de Erradicação da Febre Aftosa (National Plan for Eradication of Foot and Mouth Disease)

PNN: Programa Nossa Natureza (Our Nature Program)

POLOAMAZONIA: Programa de Pólos Agropecuários e Agrominerais da Amazônia (Program of Agricultural, Livestock and Mining Poles in Amazonia)

PPA: Plano Plurianual (Multiannual Plan)

PP-G7: Programa Piloto para Proteção das Florestas Tropicais do Brasil (Pilot Program to Conserve Brazilian Rainforest)

PRNA: Plano Nacional de Reforma Agrária (National Plan of Agrarian Reform)

PRONAF: Programa Nacional de Fortalecimento da Agricultura Familiar (Program to Support Family Farming)

RB: Registro do Beneficiário (Registry of Beneficiary)

REDD: Reducing Emissions from Deforestation and Degradation

SMOs: Social Movement Organizations

SNUC: Sistema Nacional de Unidades de Conservação (National System of Conservation Units)

SPVEA: Superintendência do Plano de Valorização Econômica da Amazônia (Superintendence of Economic Recovery Plan of the Amazon)

STR: Sindicato dos Trabalhadores Rurais (Syndicate of Rural Workers)

SUDAM: Superintendência de Desenvolvimento da Amazônia (Superintendence for the Development of Amazonia)

SUFRAMA: Superintendência da Zona Franca de Manaus (Superintendence of the Manaus Free-Trade Zone)

CHAPTER 1. BACKGROUND

Global environmental change is a pressing challenge for the 21st century, and scientists have identified tropical deforestation as one of the leading contributors to greenhouse gas (GHG) emissions. Recognition that environmental change is a global concern is reflected in the many international summits designed to bringing together world leaders to commit to a unified solution, most recently the Rio + 20 meetings in Brazil in June 2012. As an important strategy to mitigate global climate change, the United Nations created the Program to Reduce Emissions from Deforestation and Degradation (REDD+), providing financial incentives for nations to engage in sustainable development programs and efforts to reforest previous deforested and degraded lands. In response, Brazil's REDD+ program calls for sustainable development at the local level to curb deforestation and enhance diversified agricultural production practices that promote sustainable development. Government policies addressing agrarian reform settlements, and the myriad of landless movements that advocate agroecology to ensure food security and environmental conservation through investments in credits and programs, advocate that diversified and sustainable production and the use of techniques to improve productivity without additions to deforestation are part of efficient policies to redistribute land to the poor and to reduce forest loss. Nevertheless, the vast majority of smallholders, who are part of a structured program of agrarian reform in the Brazilian Amazon, are also engaged in livestock production, an activity broadly known as the main culprit of deforestation. It has been observed that even those who live in agrarian reform settlements led by Social Movement Organizations (SMOs) that explicitly reject market engagement and use the rhetoric of land redistribution as a solution to encourage diversified production through family farming are, in fact, actively engaged in the well-established global cattle economy in the Brazilian Amazon.

Evidently, a disconnect between policy and practice exists, with government policy and local development plans created by SMOs leaders calling for sustainable development, while settlement residents are engaging in cattle. In this dissertation, I empirically demonstrate this disconnect by comparing government policies for the creation of agrarian reform settlements and the actual development plans (PDA) as elaborated at the settlement scale with the material practices of settlers living in agrarian reform settlements. The goal of this research is to understand why and how settlers, who are part of settlement projects (*Projetos de Assentamentos*; PAs), are engaged in the expanding global cattle economy, and to explore the positive and negative implications for improvements in their social welfare.

To gauge the social and environmental implications of the global cattle economy in the Brazilian Amazon, it is necessary to address the history of Amazonian development and its intended and unintended outcomes. Since the 1960s, the Brazilian government has advanced a series of comprehensive plans designed to integrate the Amazon region with Brazil's economic and political core. The diverse reasons for these efforts included the geopolitical need to populate the Amazon frontier to ensure Brazil's sovereign territory, to increase economic growth through agroindustrial development, and to enhance social welfare and alleviate dire poverty in other parts of the country by providing land to the poor (Simmons, 2002). The main strategies of early development involved the construction of vast highway networks to integrate and make accessible the region, the distribution of subsidies and fiscal incentives to attract capital investment, and an elaborate colonization plan to promote orderly in-migration through provision of land and necessary infrastructure to support the population and encourage agronomic development.

A review of the Amazonian development history reveals that government motivation and subsequent policy vacillated greatly between national desire for economic growth supporting private capital interests and populist demand for land and opportunity. An accounting of development outcomes from more than 50 years—since the 1960s until today—of concerted development efforts presents mixed results. On the one hand, Brazil's economy is thriving and agroindustry in Amazonia is an important factor, especially in terms of the cattle sector that is today one of the most productive regions. In fact, the Amazon cattle economy has developed as the premier provider to global beef markets, and this expansion resulted from an increase of pasture (Walker *et al*., 2009). Development plans were also successful at integrating the region. Whereas the environmental costs have been high, according to Chomitz and Thomas (2000), Andersen *et al.* (2002), and Margulis (2004) most of the deforested areas (around 85%) take place within 50 km of roads. However, informal roads also expanded as a consequence of official roads and as a result of the consolidation of settlements and the presence of gold miners, logging, and ranching activities (Veríssimo *et al*., 1995; Mertens *et al*., 2002; Barreto *et al.*, 2006). As an example of the influence of formal roads in the expansion of unofficial roads, Barreto *et al.* (2006) observed that around 82% of all unofficial roads were opened within 50 km of official roads.

Government efforts for developing the region have successfully populated the region, thereby protecting Brazil's claim to this territory. Between the 1960s and 2010, the population of Amazonia increased from 4 million to more than 24 million (IBGE, 2010); and most were attracted to the region in response to the colonization programs, which aimed to promote land distribution. Nevertheless, this colonization has been far from orderly, and relative land scarcity became a reality in that part of Brazil. Additionally, land concentration in Brazil has historically

been replicated in all territories, mainly in the north and northeast, as part of a heritage of exploration that started during Portuguese domination. According to Ney and Hoffman (2009), in 2007 almost 60 million hectares of land were owned by 1% of a group of wealthy ranchers, while 4.4 million hectares were owned by small farmers. Land became the main factor responsible for the huge income disparities in agriculture, which consequently forces unemployment and increases poverty in the cities (Ney and Hoffman, 2009). This situation forces the landless to move to the emerging frontier boom towns, and this is responsible for the accumulation of 72% of people in Amazonian urban areas in 2010. According to Celentano and Veríssimo (2007b), only 24% of the adult population had formal employment in the Amazon, and this situation leaves the unemployed landless vulnerable to the multitude of landless movements mobilizing for land occupation.

Indeed, an additional unintended outcome of development has been land conflict. Land speculation and use of areas for cattle expansion generated relative land scarcity, taking large swaths of accessible land for the new roads and making it unavailable for small farmer settlements. This enflamed land conflict in the region and generated demands for action on the part of the landless and their advocates, who engage in contentious actions to pressure the government to follow through on agrarian reform promises. Despite promises of land distribution, not all in-migrants (attracted by government or spontaneous migrants) received land and that left many to experience relative land scarcity and consequently conflicts. State-led agrarian reform ended with economic stagnation in the 1980s and with national and international concern for tropical deforestation. People who arrived in the Amazon, with or without government support, experienced lack of access to infrastructure and were under the absence of a long-term plan for settling and promoting welfare.

This situation became visible through the quantity of landless represented by increasingly vocal Social Movement Organizations (SMOs), such as the Rural Landless Workers' Movement (MST), established in the Amazon as well as in other parts of Brazil. The SMOs started to organize at the national level, arguing for agrarian reform actions. Those actions consisted of large-scale land occupations of farms that were claimed as unproductive or under illegal use. Since the late 1980s, SMOs gained national publicity organizing people in the struggle for equal rights in accessing land, for better working conditions, and for salaries in the field. Many SMOs, such as the Rural Landless Workers' Movement **(**MST), Syndicate of Rural Workers (STR), National Federation of Workers in Family Agriculture (FETRAF), and Pastoral Land Commission (CPT) have been active in mobilizing the landless and their advocates. They typically engage in contentious politics involving a collection of actions referred to as *direct action land reform* (DALR), which includes protests, marches, and the infamous occupation of public or private land and government offices. These actions are designed to bring public and media attention to the demands of the landless and to force more actions to expropriate land and create new settlements. The SMOs bring together a mass of people, most with an agricultural activities origin and who—because of migration or displacement—did not find any opportunity to continue as smallholders in their local areas of origin. The action that brings together people without land, struggling for land through land occupation is known as *direct action land reform* (DALR) (Simmons *et al*., 2007; Aldrich, 2009).

1.1 *New Rural World*: Land Reform Settlements

Actions of SMOs resulted in the creation of the *Ministry of Agrarian Development* in the late 1990s, and as part of this new ministry, the *New Rural World* program was launched with the objective of promoting agrarian reform and access to conditions to enhance family farming

agriculture through land and credit distribution, technical support, and infrastructure investments (Reforma Agrária, 1997). However, as the landless had relative concerns for the environment and food security, those settlements which were and are created under the *New Rural World* program have the challenge of following environmental rules and providing for food security of new settlers and their families. To follow those rules, settlers were hostile to large farms that did not fulfill the social function of land defined in a land statute (or *estatuto da terra)* in 1964, which were to (1) promote the welfare of those who work the land, (2) maintain satisfactory levels of productivity, (3) ensure the conservation of natural resources, and (4) follow labor laws, not subjecting their employees to situations similar to slavery (Branco, 1964; Estatuto da Terra, Law 4,504/1964). Environmental concerns are explicitly included in many of the SMOs' social and political agendas, and the main focus, after settlement is established, is to direct attention to diversified production engaged with agroecology concepts and family farming activities. With this expectation of engagement in diversified production, settlements are expected to ensure food security and sustainable development for new settlers through government credits, technical support, and SMOs intervention (Altieri, 2010; Lima, 2010; Simmons *et al*., 2010).

1.2 Enduring Cattle Economy

In this dissertation, all people interviewed are part of formal settlements created by INCRA under the *New Rural World* program and are also defined as *settlers* in the remainder of this dissertation who are receiving credits for habitation, establishment of initial production for self-consumption, and agricultural production. Initial credits are for development of a system of family farming with the objective of promoting food security, meaning that more than producing for subsistence the family workforce is also used for enhancing participation of this particular group of producers (settlers) into the local market.

Despite all the concerns about bringing in new settlers to be involved in family farming through diversification, apparently well-established cattle chains are driving settlers to open new areas for pasture and replicate monoculture in agrarian reform areas. Among settlers in agrarian reform settlements, the availability of credit for livestock provided at the time of settlement creation, together with fast economic returns and an increasing market for beef, are the main drivers of expansion of the cattle economy within settlements (Arima *et al.*, 2005; Walker *et al.,* 2009).

Traditionally, largeholders have been observed as the main actors in the cattle economy and the prime culprits to deforestation. However, Brandão and Souza (2006) emphasized that settlers are also participating in deforestation, showing that settlement areas were responsible for 15% of deforestation in the Amazon up to 2004, with an annual rate of 1.8% between 1997 and 2004. That rate was four times higher than the average in the Amazon in the same period, corroborating the importance of settlers as contributors of deforestation. For Brandão and Souza (2006), this participation of settlers in deforestation rates is correlated to access to credit, which is made available after a settlement's formation. Le Tourneau and Bursztyn (2010) added that deforestation in settlement areas is also derived from lack of access to technology and infrastructure, forcing settlers to pursue a more efficient strategy in the short term, which is translated into selling wood remaining in lots and opening areas to be converted into pasture. Participation of smallholders in new areas opened to pasture can be translated into their participation in the cattle economy, driving settlers to be responsible for 25% of all herds in Pará State, showing that those areas created with government support have become essential for maintenance and expansion of cattle ranching (Heredia *et al.,* 2001).

1.3 Research Motivation

Obviously, a disconnect exists between policy and practice, with government policy and local development plans created by SMOs leaders calling for sustainable development and promotion of agroecological practices, while settlers are in fact producing cattle and consequently participating in the deforestation rates. This is problematic for a variety of reasons. Most notable at this time is the potential environmental impact. Just within the past few years, the international community, the Brazilian government, and Pará State have initiated programs to reduce degradation and deforestation (i.e., UN-REDD) and have recognized the negative role played by ranching and the importance of involving the region's residents in sustainable development activities (see http://www.un.redd.org and http://www.reddsocioambiental.org.br).

If these environmental concerns are important, meriting investments of time and money, then understanding the economic reality, opportunities, and limitations within settlements must be assessed. This allows for identification of barriers to sustainable development and, in turn, potential incentives, training, and infrastructure necessary to promote green alternatives. This directly defines the overarching goals of the current dissertation, which are to (1) understand why and how settlers are engaged in an expanding cattle economy, (2) explore the positive and negative implications for settlers' well-being, and (3) examine how a production system that integrates cattle activities between settlers and largeholders may mitigate the traditionally contentious relationships between these actors in the region. Finally, this research goes beyond an examination of the way things are currently in the region and identifies potential barriers to green alternatives, or agroecology, with the aim of highlighting policy implications. In summary, these goals are translated in the hypotheses shown in Table 1, and to make it easier in the

reminder of this dissertation, this table also indicates where each hypothesis can be found in the text.

Table 1. Summary of Hypotheses and Methods Used in this Dissertation

Hypothesis	Methods	Chapter Results Can Be Found
(H1) Smallholders' involvement in the cattle economy will increase when data from 2006 and 2011 are compared.	Same settlers were interviewed in 2006 and 2011 and questions such as: (1) How many animals do you have? (2) What is pasture size in your lot? (3) What is your property size? (4) How many years did you attend school? were asked both times.	Chapter 8, section 8.2.1
(H2) Settlers are motivated to invest in cattle by factors such as availability of credit, lot size and household economic and social characteristics.	Data collected in 2011 was used to perform a logistic regression where ownership of cattle was the dependent variable and (1) pasture size. (2) lot size. (3) availability of credit for cattle. (4) availability of credit for other activities. (5) dependency ratio. (6) work sold in other properties. (7) age of household. (8) involvement in green alternatives. (9) education level, and (10) time on property were explanatory variables.	Chapter 8 section 8.2.2
(H3) Involvement in cattle economy will affect settlers' well-being when data from 2006 and 2011 are put together.	Possession of a specific set of durable goods was used as an indicator of wealth. Questions from 2006 and 2011 data collection were designed to provide information about acquirement of durable goods, such as refrigerator, TV, motorcycle, etc.	Chapter 8 section 8.3.1

1.4 Research Objectives

The research goals identified above translate into the following objectives:

Objective 1. Identify the main factors that motivate settlers to invest in cattle as opposed to agroforestry or other green activities proposed by policy.

Understanding the motivation of individual settlers should provide insight into the disconnect between policy and practice. The predominant theory is that settlers are economically rational and are thus responding to market forces that recently indicated that cattle represent low risk and high economic payoff in comparison to other activities (Mertens *et al.,* 2002; Walker *et al*., 2009). Another plausible explanation is that settlers are influenced by government credit and subsidies (Hecht, 1985; Browder, 1988; Arima *et al*., 2005). Although policy encourages investment in sustainable development through diversification of production, the reality is that much credit and technical training is limited to livestock, so settlers may not have the means or know-how to engage in alternative activities (INCRA, 2009; Gonçalves and Fernandes, N.D.). Finally, motivation may stem from the traditional *cattle culture* in which land and animals afford prestige and emulate the settlers' wealthier ranching neighbors, or largeholders (Hecht, 1993; Walker *et al.,* 2009).

Objective 2. Examine how engagement in cattle has impacted settlers' well-being.

The cattle sector is one of the most economically productive in the region, and the expectation is that settlers involved in these activities would experience improvements in their well-being. However, a shift away from diversified production to one specialized in cattle may leave settlers vulnerable to volatile market forces and, consequently, food insecurity when prices are low (Hecht, 1982; Collins, 1986). For example, recent outbreaks of *foot and mouth disease* (FMD[1]) in two Brazilian states in 2005 affected the region, triggering closure of the international

[1] Foot and Mouth Disease (FMD), or Hoof and Mouth Disease, is caused by a virus. According to the World Organization for Animal Health (OIE), all domesticated and wild cloven-hoofed animals are susceptible to this disease. FMD is a contagious disease that causes important economic losses.

market with little warning, an event that left those investing in cattle in a dire situation of uncertainty and economic crisis (Nepstad *et al.*, 2005; Silva and Miranda, 2006).

Objective 3. Identify how the insertion of settlers into the global cattle economy has impacted the contentious relationship between small- (or settlers) and largeholders in the region and whether this has mitigated violent land conflict.

Traditionally, the vertical nature of ranching in the region required large tracts of land to be productive and to generate a few jobs, as largeholders have acted in all links in the production chain, being responsible for animals from birth to slaughter. However, because of environmental law enforcement, the presence of government, and market demand, those farmers found settlers as the main providers of calves (horizontal) (Arima *et al.,* 2005). Given its extensive nature, cattle production has long been linked to land accumulation (Walker and Homma, 1996). The landless had little prospect for work or access to land; and consequently, they engaged in contentious struggles for land with largeholders, often resulting in violent conflict (Gurr, 1971; Huntington, 1971; Homer-Dixon, 1999; Simmons, 2004).

Cattle density has thus been positively associated with land conflicts between settlers and largeholders in the Brazilian Amazon (Simmons, 2004). However, because of development programs by the government, including the investment of billions of dollars in road construction and efforts to eradicate diseases that impact livestock, the region has become one of the most productive regions integrated with the global economy. Now, settlers and largeholders have an incentive to cooperate in the effort to meet global beef demands and thus profit accordingly. Consequently, the expectation is that the new horizontal production system, which made room for participation of settlers into the cattle economy, would mitigate contentious relationships and violent conflict.

Once the objectives above are addressed, it will be possible to identify the factors that influence settlers in southern Pará, Brazil, in their economic decision making. With this insight and in-depth understanding of the current structural and institutional reality in the region, barriers to green alternatives are expected to be identified and, upon that, policy recommendations emphasizing sustainable development provided. The theoretical framework to develop this research borrows concepts from political ecology, environmental justice, and household models to explain changes over time in settlement areas, land use decisions, and variables used in statistical analysis and in contextual discussions.

The methodology of this research fuses quantitative and qualitative analysis, with inputs of both primary and secondary data. During the period from January to April 2011, household primary data surveys were performed in six settlements (Appendix A) in southeastern Pará state, an Amazonian region that represented the gateway to the Brazilian Amazon development and, as such, was made accessible through three highways and a railroad line. This region has experienced a disproportionate share of population growth, is the leading cattle-producing region, and consequently has experienced land struggles and subsequent conflict as the two groups of actors fight for accessible land. In addition to primary information collected at the settlement level, surveys of key informants were conducted to add context to the history of land conflicts and economic changes in the region. Finally, secondary data was collected from several archives located in the local cultural museum and from government representatives who are in charge of creating new settlements and of distribution of credits (i.e., INCRA, EMATER, and BASA).

To address the objectives above, this dissertation is divided into 11 chapters. **Chapter 2** describes the history of economic development and environmental policy. The development

process described in this chapter focuses on post-World War II efforts, outlining each of the key development plans promoted by the government to develop Amazonia with a mix of large investments in road infrastructure, fiscal incentives to attract investments, and attraction of people through land distribution and colonization projects. In **Chapter 3,** agrarian reform efforts are examined beginning with the failure of state-led colonization projects to the SMOs-led agrarian reform (DLAR), culminating in the mobilization of SMOs in the late 1980s and a variety of new efforts for agrarian reform and new projects for settlement formation and credit distribution. The specific government project since the 1990s, *Novo Mundo Rural*, will be described in order to explain how credits are distributed and how it affects settlers' decisions to be engaged in the global cattle market. **Chapter 4** describes the history of cattle expansion and changes in its economy, highlighting factors that made the study area a prosperous cattle producer and intended supplier of the global beef market. Specifically, I will discuss the evolving cattle landscape from a vertical and contentious production system to one that is horizontal and integrated with local small farmers (in this dissertation, settlers who are part of agrarian reform projects).

Chapters 3 and 4 bring together the history of Amazonian development that led to rapid population growth and consequently growing demand for land distribution, at the same time it laid the necessary foundation for a globalized cattle economy, the unintended occurrence was growing land conflicts. These factors initiated the main focus of this dissertation research, the settlements, which are marked by the need of development of a program of agrarian reform through establishment of better land distribution and promotion of sustainable activities.

Chapter 5 identifies a conceptual framework, borrowing from political ecology, household models, and environmental justice theories. This framework, in turn, influences the

key variables and modeling approach used in this dissertation. **Chapter 6** includes explanations about research design and methodologies used to acquire information for the statistical and contextual analysis. **Chapter 7** provides an economic and political history of the study area and a brief description of each settlement visited. This chapter also includes a brief discussion about limitations to data collection. **Chapter 8** characterizes the research findings concerned with characteristics of household production and impacts on their well-being. In this chapter, statistical analysis is shown to identify changes in production and family characteristics in the period between 2006 and 2011 and also key factors influencing settlers to opt for cattle as opposed to alternative activities. In addition, it considers information on wealth, income sources, and education level. **Chapter 9** reviews results from the contextual analysis concerned with the role of credit in the settler's economic decision. It also analyzes production costs for alternative products to assess whether settlers made economically rational decisions when they started cattle production, meaning that settlers understood this activity as the best to maximize profit. Additionally, a brief contextual analysis of soils from where settlements were created is considered. **Chapter 10** concerns contextual analysis of current and perceived conflicts in the region. Finally, **Chapter 11** contains the conclusions and policy implications of this dissertation research.

SECTION 1. THE POLICY FOUNDATIONS: ECONOMIC DEVELOPMENT, AGRARIAN REFORM AND GLOBALIZING CATTLE ECONOMY

This section is separated into three chapters (**2, 3, and 4)** that provide the policy foundations that support this dissertation's research. The vacillating economic development policies led to positive and negative outcomes. The positive outcomes involve successful investments in infrastructure and expansion of economic activities, which laid the foundation for a global cattle economy. The negative outcomes entail fast population growth, deforestation, land concentration, and subsequent social conflicts. In response to growing land conflict, the government created the *New Rural World*, a program focused on dealing with the contention through settlement creation and distribution of land and credits to landless groups. At the same time, government and SMOs started to create programs aimed to balance environmental development.

In order to understand the disconnect between environmental rhetoric and actual practices on the ground, a review of development plans, creation of settlements, and expansion of the cattle economy are explained in detail in the following chapters. In fact, this dissertation shows that not only large ranchers are connected to the global cattle economy, and not all people who are part of SMOs and agrarian reform programs are engaged in agroecology or family farming as stated by Brazilian agrarian reform policies. After these three explanatory chapters, my main goal is to understand why this disconnect is happening and how it is affecting settlers' welfare.

CHAPTER 2: DEVELOPMENT AND ENVIRONMENT IN THE BRAZILIAN AMAZON: FROM THE UNINHABITED FOREST TO PASTURE

2.1 Introduction

Development plans promoted by the government were essential for social and economic changes in the Brazilian Amazon since the 1960s. A set of investments in infrastructure, fiscal incentives, and colonization projects were primary policy initiatives that led to the current scenario found in the Amazon. To understand changes that occurred since the first Amazon development plan and its effects in the current scenario, this chapter provides an overview of shifting economic, social, and environmental motivations and policies.

Development programs were created in the 1960s to integrate the Amazon in an effort to populate the region and secure Brazilian borders, reduce migration to areas most industrialized, attract investments to the region, and connect the region to other parts of Brazil. The result of vacillating policies has produced both intended and unintended outcomes. Successful intended outcomes included accelerated economic growth, specifically the global cattle market, the integration of Amazonia to other parts of Brazil through thousands of kilometers of roads built over the last decades, and finally, the populating of the region by attracting directly and indirectly millions of people. The most unexpected outcomes are costs to the environment and the landless poor. To receive economic growth and mass population growth, deforestation rates exploded; and the problem of land scarcity and the related conflicts was replicated in the region. This chapter provides a detailed overview of development with a focus on programs initiated in post-World War II and summarizes key development outcomes

2.2 Colonial and Post-Colonial Development

Between 1616, when the first landfall was made by Portuguese explorers in the northern region of Brazil, and the 1950s, the Brazilian Amazon's role was limited when it came to the country's economy. During this period the Amazon provided drugs, indigenous slaves, rubber (*Hevea brasiliensis*), and Brazil nuts (*Bertholletia excelsa);* nevertheless, there was not a significant economic connection to the rest of the country (Mahar, 1989; Barbosa, 2000; Andersen *et al.,* 2002; Simmons, 2002). Economic cycles in the Amazon are divided into several boom-and-bust cycles dependent on resource extractions (including rubber, Brazil nuts, diamonds, and gold mining) and, later, logging and cattle ranching. The division of economic booms in cycles does not mean that each cycle happened in separate time intervals; in fact, booms occurred concurrently and complemented each other (Santos, 1980).

The rubber boom in the Amazon was experienced from 1827 until 1912, when Asiatic rubber production exceeded Amazonian production and Brazilian participation in the world market became negligible after international prices of rubber dropped substantially (Santos, 1980; Assis, 2007). During the rubber crisis, many conflicts started between rubber tappers and consumers; and in Marabá (where this dissertation research is focused), many stores were looted, generating a constant state of fear and insecurity in the region (Assis, 2007). As a result, many people fled the area and moved into new forested areas in search of land (as *grileiros*, or land grabbers) or new opportunities such as wildcat gold mining (Assis, 2007).

After the rubber cycle, commercial exploration of the Brazil nut in the late nineteenth and early twentieth centuries provided a valuable export to the United States and Europe. In Pará State, mainly in the south, that production became essential to the local economy; however, because of the seasonality of that nut, it was always developed concomitant with other economic

activities, such as gold and diamond mining (Assis, 2007). From July to December, mining was the predominant activity given that the rivers were at their lowest levels, facilitating excavation. These economic cycles affected population growth; and many people, after finding forest with several quantities of nut trees, grabbed a piece of land and established a permanent presence in the region (Mendras, 1978; Guerra, 2001; Assis, 2007).

Those migrants attracted to the region as a result of these economic activities, later moved farther into forest areas and cleared land for development of agriculture and cattle ranching for self-consumption. In addition, animals were brought to areas inside the forest to give support on the transportation of nuts collected in the region (Assis, 2007). Pastureland started to be opened near rivers and during the wet season. However, because of the lack of land ownership, a professional system of paddock divisions and fences was not in place. Investments started to become more systematic to enhance cattle expansion in the early 1950s when a law recognized land use and provided long-term leases known as *aforamento perpétuo*[2] (Velho, 1981; Assis, 2007). Formation of pasture areas became the assurance that the area would continue to be leased as a productive one (Assis, 2007). Long-term leases became the reason for land delimitation and exacerbated conflicts among those who wanted to expand their properties by *grabbing* the land of their neighbors. Despite land abundance, it became a disputed good, and nut producers started to invest more in pasture and cattle to demonstrate productive use. Economic gains from the Brazil nut were invested in cattle activity, *forcing* farmers to add more pieces of land to their areas and making the problem of land concentration in the region more noticeable (Assis, 2007).

[2] *Aforamento perpétuo* was a long-term lease given by state government to landholders who used areas where the nut polygon was. Those areas were intended for a particular use, initially extractive in nature (Aldrich, 2009).

2.3 Developing Amazonia

Due to the period of the rubber boom, early government efforts to develop Amazonia focused on trying to revitalize rubber production with little success. As early as the 1946 constitution, the government called for a comprehensive plan to develop the region. In the 1950s, when the federal government established its first comprehensive plan, the initial step was the definition of the Legal Brazilian Amazon, followed by the creation of several government programs charged with attracting people and investments to the region (Almeida, 1982). During the following decades, new development programs were established, and the result of this was (and still is) the attraction of people, investments, and deforestation. Given national and international concern for Amazonian deforestation in the late 1980s, environmental and development programs became linked, and therefore contemporary discussions of development must consider environmental policy. For ease of discussion, this development history is divided into three periods: (1) early development efforts, (2) the era under military government, and (3) post-democratic reform, which necessitates consideration of environmental policy (Table 2).

Table 2. Periods and Development Plans Classification

Period	Development Programs
Early Development Efforts (1943-1963)	Legal territories are created in the Amazon March to the west PVEA
Era of Military Government (1964-1985)	SPVEA Operação Amazônia National Integration Program (PIN) POLOAMAZONIA POLONOROESTE
Post-Democratic Reform (1985- current)	National Program of Agrarian Reform (PNRA) Pilot program to conserve Brazilian rainforest (PP-G7) Multiannual programs

Prior to describing the different development plans and their outcomes for the Amazon since the 1950s, it is essential to mention that the current Legal Brazilian Amazon (*Amazônia Legal*) definition embraces more than the extension of the Amazon biome, including parts of savanna and wetland biomes (Figure 1). The Brazilian Amazon limits were defined in 1953 (amendment 1.806 of 01.06.1953), and this decision brought together states with similar economic, political, and social characteristics (Lentini *et al.,* 2005). After changes in the definition in 1953 and 1966 (amendment 5.173 of 10.27.1966), three new states were added in 1988 (Federal Constitution of 10.05.1988): two from federative territories (Roraima and Amapá) and one from the division of Goiás State (Tocantins). Currently, nine states are in this region: Acre, Amapá, Amazonas, Pará, Rondônia, Roraima, Tocantins, Mato Grosso, and most of Maranhão State (at 44^{o} west meridian) (Lentini *et al*., 2005; May *et al.,* 2011).

Those changes made the Brazilian Amazon account for 61% of Brazil's total size, with 5,217,423 km^2 (Andersen *et al.,* 2002; May *et al.,* 2011). On the other hand, the Amazon biome

extends through nine countries in South America (Brazil, Bolivia, Peru, Colombia, Venezuela, Guiana, Surinam, Equador, and French Guiana), and accounts for approximately 7 million km^2 (Figure 1). For this dissertation, the concept of the Brazilian Amazon, instituted initially in 1953 and changed in 1966 and 1988, will be used in the discussions, analysis, and explanations.

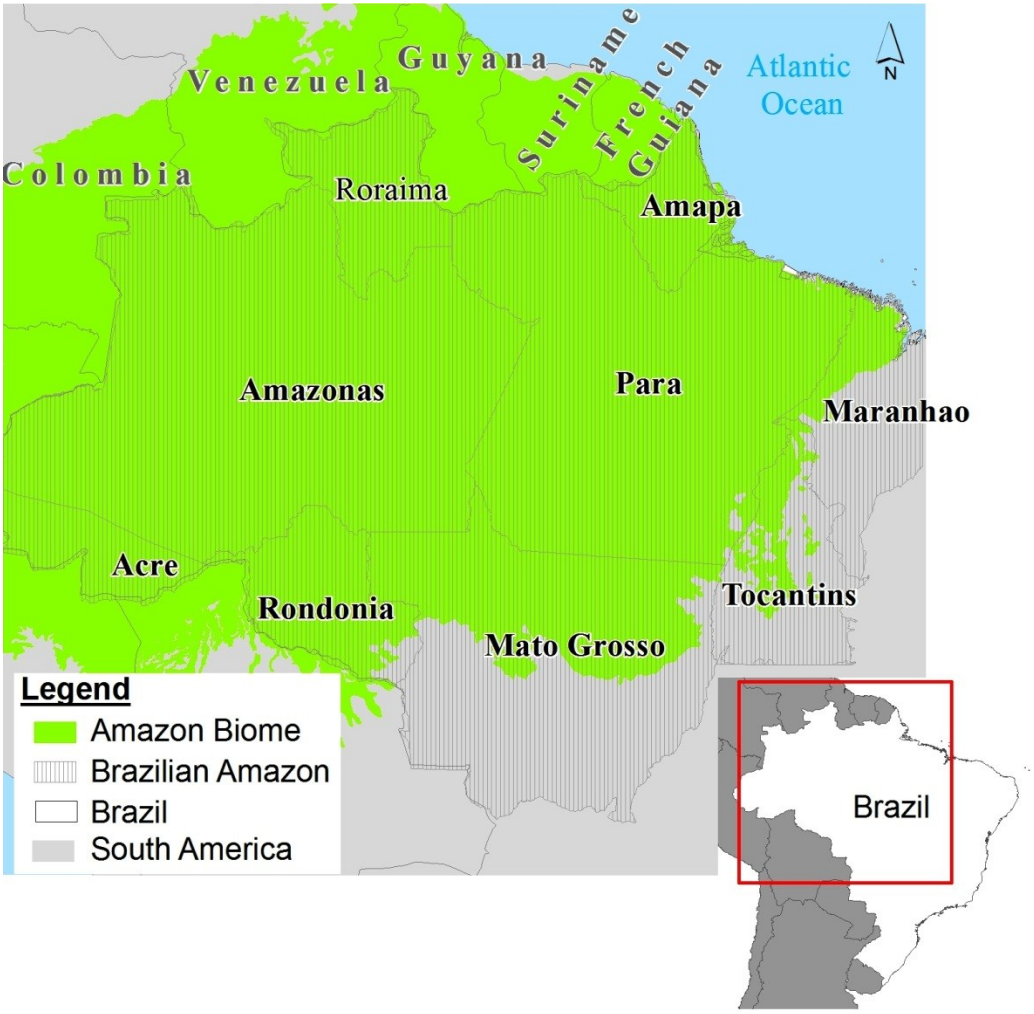


Figure 1. Amazon Biome and Brazilian Amazon: Localization in Brazil.

(For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.)

2.4 Early Development Efforts

Since the Getúlio Vargas government (1930-1945 and 1951-1954), a series of actions were started to make government present in the Brazilian Amazon. In 1943, legal territories were created in the Amazon—a strategy to apply new policies and develop government actions to develop the region (Miranda, 2001; Assis, 2007). During his first term (1930-1945), President Vargas kept efforts focused on strategies of population occupation, while during his second term (1951-1954) most efforts were focused on the creation of conditions to attract capital investments (Hecht and Cockburn, 1989; Browder and Godfrey, 1997). Actions to populate the center of Brazil started in 1943, when *March to the West* (marcha para o oeste) was encouraged. At that time, the main goals were to populate areas between the Araguaia and Xingu Rivers in the center and western parts of Brazil (Fernandes, 1999; Assis, 2007). To turn this program into a reality, 151,000 ha of land in the Araguaia valley was distributed in 3,000 ha plots to migrants from the Brazilian southeast (Fernandes, 1999).

In 1946, a P*lan of Economic Recovery of Amazon* (Plano de Valorização Econômica da Amazônia; PVEA) was created, and the goal was to use 3% of the total national budget during 20 years to develop the region; however, most of that budget was never used in the region (Trecanni, 2001). Only in 1953, when the Brazilian Amazon boundary was politically and economically redefined, did several government programs to attract people and investments to the region get momentum. The PVEA was redefined, making room for the *Superintendence of Economic Recovery Plan of the Amazon* (Superintendência do Plano de Valorização Econômica da Amazônia, or SPVEA); and the main goals at that time were to promote local development through livestock and agriculture production and to integrate the Amazon to the national economy (Moran, 1981; Assis, 2007). In addition, plans were made for the creation of a rural

population nucleus, research to stimulate family farming production, and construction of roads connecting the Amazon to southern Brazil (Assis, 2007). The PVEA was the first policy mechanism created by the government addressed exclusively to the region, and this early plan focused on local industrialization and extractive industries. At that moment, the region was still isolated and underdeveloped (Moran, 1981; Schmink and Wood, 1992).

Despite all efforts to bring attention to the Amazon, a small proportion of the SPVEA funds (which came from federal, state, and municipal taxes) were invested in the Amazon, and much went to the building of the new Brazilian capital, Brasília. High rates of inflation diminished the actual budget available, making the initial execution of this plan difficult (Cavalcanti, 1967; Moran, 1981). The main result of this program consisted in the building of the BR-010 highway (or Belém-Brasília highway) connecting the Amazon to the center of Brazil where the new capital was being built. The construction of a new connection to the center of Brazil was so important that the president of the executive commission of highway Belém-Brasília (RODOBRÁS), Waldir Bouhid, wrote in his SPVEA report in 1958 that

> *The construction of Brasília as a new capital, would not be complete for its historical start, in 1960, if the trunk road, which connects to the north of Brazil, would not have been finalized*, *simultaneously* (Brasil/SPVEA, 1958).

As a result of that accomplishment, SPVEA creators were invited to join the *special program goals* (programa de metas extraordinárias) of President Juscelino Kubitschek (1956-1961):

> *…fitting to honor the people of the Amazon, who contributed to the portion of the work most notably historical, the boldness with which is already and will persist in clearing the compact equatorial forest*, the *most difficult stretch, where advances the Belém-Brasília highway*, a distance of *550 kilometers (km) within the forest* (Brasil/SPVEA, 1958, p. 16-17).

For the first time in history, the Amazon region was freed from a dependence on river transportation routes (Andersen *et al.,* 2002). The 1950s ended with several groups of former Brazil nut collectors and rubber tappers established as farmers working on small pieces of land and living in small communities. Those small farmers practiced subsistence agriculture, extractive activities, and opened areas to start small livestock activities (Almeida, 1982). On the other hand, large farmers attracted from the southeastern region were starting to occupy more areas, expanding their farms, and finding in their way those small farmers already settled around their properties, causing conflict situations (Assis, 2007).

2.5 The Era of Development Projects under Military Government

Even with all attention directed to the Amazon, more than a decade later the Brazilian government was still trying to create a plan that could be a promise of development for the region. Under the military government, which started in 1964 and made strong the idea of boundaries protection, the SPVEA was *remodeled* in 1966 as part of *Operação Amazônia*, and its name was changed to *Superintendence for the Amazonia's Development* (Superintendência de Desenvolvimento da Amazônia; SUDAM[3]). The SUDAM was created to distribute special fiscal and financial incentives to attract private (national or international) and public investments (Ciccantell, 1999).

In 1967, the *Superintendence of the Manaus Free-Trade Zone* (Superintendência da Zona Franca de Manaus; SUFRAMA) was created in an effort to integrate western Amazonia through

[3] Created in 1966, the Superintendence for the Development of Amazonia (Superintendência Para o Desenvolvimento da Amazônia) was the primary agency in charge of development incentives in the Brazilian Amazon. Large cattle ranching projects figured as a preference in this plan. Many large farms in Mato Grosso and Pará were benefited by this agency (Sudam, 1976; Mahar, 1989; Andersen *et al.,* 2002).

creation of an industrial center with tax exemption. During this decade, the main arguments for those development projects were (1) to protect the Brazilian frontier, and as part of this, the public good was emphasized in programs that were better defined by the government with the slogan *bringing men without land to land without men*; (2) to bring economic benefits to the country through distribution of land, agricultural credit, and technical support to the new settlers; and (3) to protect Brazilian borders from invasion by adjoining countries (Kleinpenning, 1977, 1979; Fearnside, 1984; Hecht and Cockburn, 1989).

The 1970s started with a promise from the government to build 15,000 km of roads in the Amazon, with 3,300 km of those as part of the Transamazon Highway (BR-230)—a road planned to connect the northeastern and northern regions as part of the *National Integration Program* (Plano de Integração Nacional; PIN). The Transamazon Highway was also the first connection by land to a major Amazonian city, Belém (Browder and Godfrey, 1997). Government planned to populate the region through distribution of land along new roads (BR-230) to colonization projects. At that moment, they planned to settle around 100,000 families as part of PIN. In summary, the goal of PIN was (1) to push the economic frontier toward the Amazon limits; (2) to integrate the strategy of Amazon occupation with development of the northeastern region as well; (3) to create conditions to incorporate people who were not economically productive; (4) to establish a foundation to develop agriculture in an unproductive area; (5) to guide migration of northeasterners to the new agricultural frontier; and (6) to assure government support to the region through promotion of self-production (Brasil, 1970).

As part of that ambitious plan, the Brazilian government intensified its presence in the Amazon with construction of roads *(Tranzamazônica, Cuiabá-Santarém, and Perimetral Norte)*, colonization projects as part of the *Integrated Colonization Project* (Projeto Integrado de

Colonização; PIC), distribution of unoccupied areas, and the installation of agroindustries (Serra and Fernandez, 2004). At that moment, the main strategy of PIN was focused on the development of roads associated with small farmers' settlement to assure labor to extractive industry, to expand food production, and also to protect the frontier through occupation (Simmons, 2002). To do so, a 100-km tract of land on each side of all federal highways built in the Brazilian Amazon was designated to be under federal jurisdiction, and 10 km of each tract of land was automatically transferred to the *National Institute of Colonization and Agrarian Reform* (Instituto Nacional de Colonização e Reforma Agrária; INCRA) to be used in settlement projects (IDESP, 1996; Simmons, 2002). At that point, INCRA had the challenge to deal with the distribution of land; and the main goal was to have administrative responsibility for settlement creations in the newly colonized areas adjacent to the new roads (Simmons, 2002). However, according to Simmons (2002), despite the facts that the focus was to provide land to small farmers and that more than 34,000 km^2 of land was designated to that group, there was also a land market between INCRA and large cattle ranches during the 1970s—and up to 17,000 km^2 were sold to this second group.

As part of PIC and under the INCRA action, *agrovilas* were planned in an area located between Altamira and Itaituba on the BR-230, such that a set of 48 or 64 lots, with 100 ha and a house would be distributed to peasants attracted to the region. Each *agrovila* had to have an elementary school, an ecumenical church, and a health facility. A group of *agrovilas,* or *agrópolis,* were part of the program to be around a nucleus of urban services, such as banks, post office, public telephones, and high school. However, only one *agrópole* was established in the BR-230 during development of the program, and currently this is the municipality of Brasil Novo. A group of *agrópolis* were intended to be installed to constitute the *rurópolis*, and again,

only one *rurópolis* was established during that program, currently Presidente Medici County (Rabello and Ferreira, N.D.).

Because of the slow pace of planned colonization, within a few short years two new governmental plans took priority in the Amazon with the objective to develop megaprojects, such as investments in infrastructure: the *First National Development Plan* (I Plano Nacional de Desenvolvimento; IPND), from 1972 until 1974, and the *Second National Development Plan* (II Plano Nacional de Desenvolvimento; IIPND), from 1974 until 1979. The IPND focused on projects of national integration, such as transportation, export corridors, and telecommunications. This program also included a plan to promote economic growth through fiscal incentives, such as tax exemptions and subsidized credit for land distribution, agricultural development, and in-migration promotion (Simmons, 2002). The IIPND was devoted to basic industries (such as steel and petrochemical) and to construction of development centers in the Brazilian Amazon, with the objective of concentrating on investments in infrastructure (SUDAM, 1976; Mahar, 1979; Hall, 1987; Browder, 1988; Santana *et al.*, 1997; Simmons, 2002). As a result of those efforts in the 1970s, the *Program of Agricultural, Livestock and Mining Poles in Amazonia* (Programa de Pólos Agropecuários e Agrominerais da Amazônia; POLOAMAZONIA) was created in 1974. This program aimed to concentrate resources to stimulate migration toward selected areas inside the Amazon through attraction of capital by a wide range of actions to generate subsidies and tax incentives (Simmons, 2002).

In 1980, as a result of a decline of investments in cattle ranching, government attention in the Amazon shifted toward investments in mineral extraction, and the *Grande Carajás Program (*Programa Grande Carajás; PGC) was established to promote large-scale, capital-extensive, and export-oriented mineral extraction (Simmons, 2002). Areas in Pará, Goiás, and Maranhão were

designated to this program (PGC), corresponding to 11% of all Brazilian territory (Hall, 1989; Simmons, 2002). The PGC also had a component directed to increase agricultural production (the Programa Grande Carajás Agrícola; PGCA), and this component was focused in reversing the trends regarding land concentration. However, there was bias concerning investments in large-scale areas; and at the end of the 1980s, more than 50% of the area designated to this program was concentrated in the hands of < 1% of land owners (Hall, 1987, 1989; Simmons, 2002). In the 1980s, 70% of all newly formed pasture were located on farms larger than 1,000 ha, and the *superintendence for the development of Amazonia* (SUDAM) had approved ranches with more than eight million hectares—each farm having, on average, 24,000 ha (Andersen *et al.,* 2002). The expansion of cattle ranching in the Brazilian Amazon between 1974 and 1980 followed a higher average than in Brazil as a whole. During that period, the Brazilian Amazon experienced an increase in its herd of 9% per year, while all Brazil experienced only a 4% increase per year. Despite this higher expansion rate, the Amazon only held 9% of the total Brazilian herd, and in the 1980s, it was only 12%.

Since the 1960s, the population of the Amazon increased from around 4 million to more than 24 million in 2010 (IBGE, 2002, 2010), and many of those people migrated to the region after the promise of a better life quality through land distribution. After years of changes in the development plans, not all in-migrants received a piece of land; and in areas such as southern Pará State, not only land attracted people but also the spread of information of the existence of a deposit of gold, in areas such as *Serra Pelada*, located in the Curionópolis municipality. Serra Pelada became the largest gold mining area in the world when it registered around 100,000 men working in the area around river banks. At that time, the location of Serra Pelada could only be

reached by small planes or by foot. According to *Time* magazine, 8 September 1980, Serra Pelada was described as

> *… a scene that could belong to an outlandish biblical epic movie or a sinister labor camp. It is neither. Serra Pelada (Bald Mountain), 270 miles south of the mouth of the Amazon River, is the site of one of the biggest gold rushes in modern Brazilian history*.

In addition, many wildcat miners left Serra Pelada and went in search for land to settle. At the same time, large tracts of land were allocated to agroindustrial activities, especially ranching, which was most sought after along the new road network. This increased demand for accessible land, and the decreased availability that was created has been referred to as *relative land scarcity* in the region—and a contentious landscape ripe for violent land conflict increased as these disparate actors struggled for the same land. Pará State, particularly in the 1980s, experienced a peak of murders related to land conflicts, responsible for 35% of Brazilian murder occurrences. Land concentration trigged the increase in land conflicts, and as result, in the 1980s the *Special Ministry for Land Affairs* (Ministério Extraordinário para Assuntos Fundiários), the *Executive Groups of Lands of the Araguaia / Tocantins* (Grupos Executivos de Terras do Araguaia / Tocantins; GETAT) and the *Executive Groups of the Lower Amazon* (Baixo Amazonas; GEBAM) were created to implement a program to mitigate land conflicts.

In 1982, the POLONOROESTE was created as a special plan intended to develop the states of Mato Grosso and Rondônia. This program aimed to promote population growth in those states through the paving of BR-364 (Cuiabá-Porto Velho highway) and through the expansion of infrastructure, agriculture sectors, rural incomes, and social welfare (Serra and Fernandez, 2004). The World Bank financed this plan with USD 1.5 billion, and the Cuiabá-Porto Velho road (BR-364) was paved, connecting the capitals of Rondônia and Mato Grosso (Millikan, 1992). In addition to POLONOROESTE, more colonization projects and land regulation, health

protection, and indigenous and environmental defense programs were established (Mindlin, 1991; Hagemann, 1994). After the BR-364 was paved, the official rate of arrival of migrants in Rondônia exceeded official projections. In 1980, there were around 490,000 people living in that state, and by 1986, the official number was almost 1.2 million people (Milikan, 1992). According to IBGE (2008), in 2000 there were 1.4 million people living in Rondônia, equating to an increase of 185% between 1980 and 2000. According to Lentini *et al.* (2005), between the 1970s and early 2000s, the Amazon population experienced a growth of more than 150%. In Brazil, in the same period, the population increase was 42%.

2.6 Development and Environment Policy in the New Democratic Era

The year 1985 had political importance to Brazil, at that time the military government gave way to democracy and new economic actions to develop the Amazonia were initiated. The *National Plan of Agrarian Reform* (Plano Nacional de Reforma Agrária; PNRA) was created in 1985 by the *Ministry of Agrarian Reform and Development* (Ministério da Reforma e do Desenvolvimento Agrário; MIRAD), as part of INCRA actions. The main goal of PNRA was to settle 1.4 million families between 1985 and 1989. However, at the end of that period, less than 90,000 families received land through that program (Cardoso, 1997; INCRA, 2011a).

In 1988, a new constitution was promulgated, and it marked a decisive step toward the formulation of environmental policy. For the first time in Brazilian history, a constitution had an entire chapter dedicated to the environment, giving to the government and society the responsibility for its preservation and conservation (IBAMA, 2011). The Brazilian president created *Our Nature Program* (Programa Nossa Natureza; PNN) and the *Brazilian Environmental Agency* (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis; IBAMA) with the purpose of establishing broad policies and local actions toward environmental protection

(IBAMA, 2011). The PNN did not have expressive results, but it was a step in adopting environmental development concepts, and it brought national attention to environmental issues. In June of 1992, the United Nations Conference on Environment and Development was held in Rio de Janeiro, which was attended by 170 nations. The Rio-92 had three main objectives: (1) to identify strategies for regional and global actions related to important and current environmental issues; (2) to examine the environmental situation of the world and changes after the Stockholm conference; and (3) to examine strategies to promote sustainable development and poverty eradication in developing countries.

As result of Rio-92, and driven by international repercussions of discussions raised at the World Conference on the Environment, the *Brazilian Ministry of Environment* (Ministério do Meio Ambiente; MMA) was created—an institution with the power and structure to guide environmental policy in Brazil (Barbanti, 1998; IBAMA, 2011). Additionally, the *pilot program to conserve the Brazilian rainforest* (Programa Piloto para Proteção das Florestas Tropicais do Brasil; PP-G7) was approved with the cooperation of Germany, Netherlands, Italy, France, Japan, Canada, the United Kingdom, and the United States. In addition to the European Commission and the Brazilian government (World Bank, 2009), PP-G7 was then launched with the main goal of enhancing better use of the environmental benefits of rainforests through the implementation of leading projects to reduce deforestation rates in Brazil (World Bank, 2009). Broadly, that program aimed to protect biodiversity, to reduce the emission of carbon, to promote quality of life of the local population, and to build international cooperation in global environmental questions (Ministry of the Environment/ World Bank, 2000).

During the presidential campaign in the 1990s, environmental questions became part of government discussions. A continuous plan of government was established, and in 1998, the

multiannual plan (plano plurianual; PPA) was launched in decree 2.829 of 10.29.1998 (Table 3). The multiannual plan has a set of actions, investments, and goals to be followed by federal, state, and municipal governments during four years, always starting in the second year of each government term and ending in the first year of the next term (Cardoso, 1998; Executive Decree #2,829). Table 3 provides a list of each PPA up to the most recent.

Table 3. Multiannual Plans Developed and Planned Between 1996 and 2015

Period	Plan Name	President	Main Efforts toward Amazon
1996-1999	*Brasil em Ação*	Fernando H. Cardoso	Pavement of roads (BR-364, BR-163, and BR-174)
2000-2003	*Avança Brasil*	Fernando H. Cardoso	Enhance transportation through Araguaia, Tocantins, and Madeira Rivers; Investment in transport corridors
2004-2007	*Brasil de Todos*	Lula	Energy and transportation
2008-2011	*Desenvolvimento com inclusão social e educação de qualidade*	Lula	Many efforts were directed to the Growth Acceleration Program (PAC) and to income distribution through cash transfer programs
2012-2015	*Brasil sem Miséria*	Dilma Rousseff	Focused on poverty reduction and continuity of PAC

Since the first term of Fernando Henrique Cardoso in 1995, several plans were in place to pave roads and to construct dams, locks, railways, waterways, pipelines, and roads in the Brazilian Amazon, all of them part of PPA *Brasil em Ação* (1996-1999) and PPA *Avança Brasil* (2000-2003) (Brasil, 2003). Both programs aimed to connect the Amazon to the productive space that was rising in the rest of Brazil and also to include the region in the integration policy to be connected to South America. The *Brasil em Ação* program concentrated its efforts mainly in the paving of BR-364, connecting Brasília to Rio Branco, capital of Acre; BR-163, connecting Cuiabá, capital of Mato Grosso, to Santarém, in Pará State; and BR-174, connecting Manaus, capital of Amazonas, to Boa Vista, capital of Roraima (Figure 2). In addition to those efforts, *Brasil em Ação* also aimed to connect the region through river transportation in the Araguaia, Tocantins, and Madeira Rivers (ABrasil, 2001). *Avança Brasil* continued efforts started in the previous program, and its plan mainly concentrated on the transportation corridors connecting south and southeast Brazilian regions to the Amazon. In that program, the plan was to invest USD 40 billion to build and pave around 7.5 thousand kilometers of roads (Laurance *et al*., 2004).

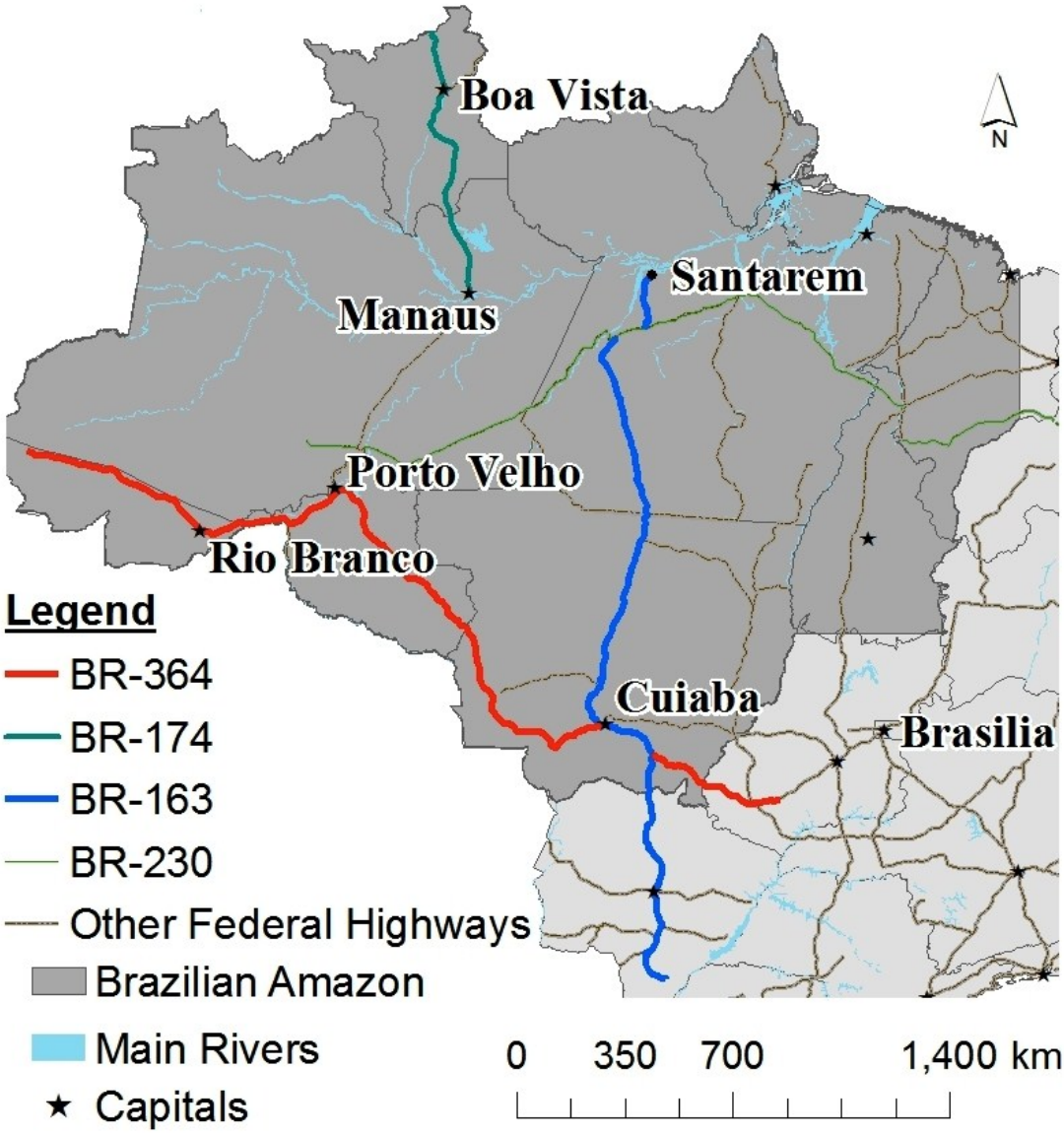


Figure 2. Roads Focused on Brasil em Ação Program.

According to Nepstad *et al.* (2000), Arima and Veríssimo (2004), and Théry (2005), the *Avança Brasil* plan, alone, could generate negative impacts (deforestation) on the order of more than 187,000 km^2 along the roads. Despite all the studies concerned about negative impacts of development projects in the Amazon, many plans would be kept in the next government terms lead by President Luís Inácio Lula da Silva (2003-2006 and 2007-2010). Much like Fernando Henrique Cardoso's terms (1995-1998 and 1999-2002), Luís Inácio Lula da Silva discussed a

public policy to reinforce the discourse around sustainable development and the conservation of forest resources and to intensify the use of the deforested areas to enlarge agriculture and cattle ranching in the Amazon. Almost USD 25 billion was to be invested in the Amazon region until 2010 in projects directed to logistic, energy, social and urban sectors. For example, in Rondônia State, most of the attention had been paid to the building of two dams on the Madeira River (Santo Antonio, 3150 Megawatts [MW] and Jirau, 3300 MW). The discussions about creation of those dams started in 2003; and to construct them, it would be necessary to inundate 217 km^2 and move 10,000 families from traditional communities to other locations (MAB, 2008). According to Cinccantell (1999), the construction of dams and reservoirs represents the most dramatic and destructive impact in the Brazilian Amazon and its traditional communities. Construction of the Tucuruí (1984), Balbina (1989), and Samuel (1988) dams required the relocation of almost 40,000 people (indigenous and nonindigenous) to areas far from rivers and ecosystems where they used to produce crops for subsistence (Cinccantell, 1999). Despite discussions around the impacts of development plans in the local landscape and communities, projects to build new dams, locks, and waterways and to pave roads continue to be the focus in the *Brasil de Todos* plan (Brazil of All, 2004-2007) and in the *Programa de Desenvolvimento com Inclusão Social e Educação de Qualidade* (Program of Development with Social Inclusion and Education Quality, 2008-2011), which focused mainly on the *Programa de Aceleração do Crescimento* – PAC (Growth Acceleration Program – 2007-2010), both during Lula da Silva's term (Plano Brasil, 2011).

The next president elected, Dilma Rousseff (2011-2014) represented the continuation of Lula da Silva's program, as she was from his party (*Workers' Party, PT*) and received Lula's support during the electoral campaign. During President Roussef's term, the multiannual plan is

focused on the promise of poverty reduction (Programa Brasil sem Miséria, 2012-2015). However, much attention has been given to the second *Growth Acceleration Program* (PAC2, 2011-2014), which estimated a total investment of more than USD 742.57 billion, of which USD 47.5[4] billion will be used until 2014 and the remaining after that period. The sectors that have the most attention of PAC2 are energy, housing for the poor, development of cities, organization of communities, access to water and light for all, and transportion. Energy seems to be the most important investment of PAC2, and an investment total of USD 539.6 billion is estimated for the energy sector (Brasil, 2012). Accounting for unfinished dams from previous programs and planning for new ones are part of the big investments in the Amazon: the construction of more than 20 dams is being considered within the following years, with estimated costs of about USD 28 billion (Brasil, 2012) (Figure 3).

[4] For this dissertation, the currency exchange rate of 18 July 2012: 1 US$ = 2.02 Brazilian R$ was used.

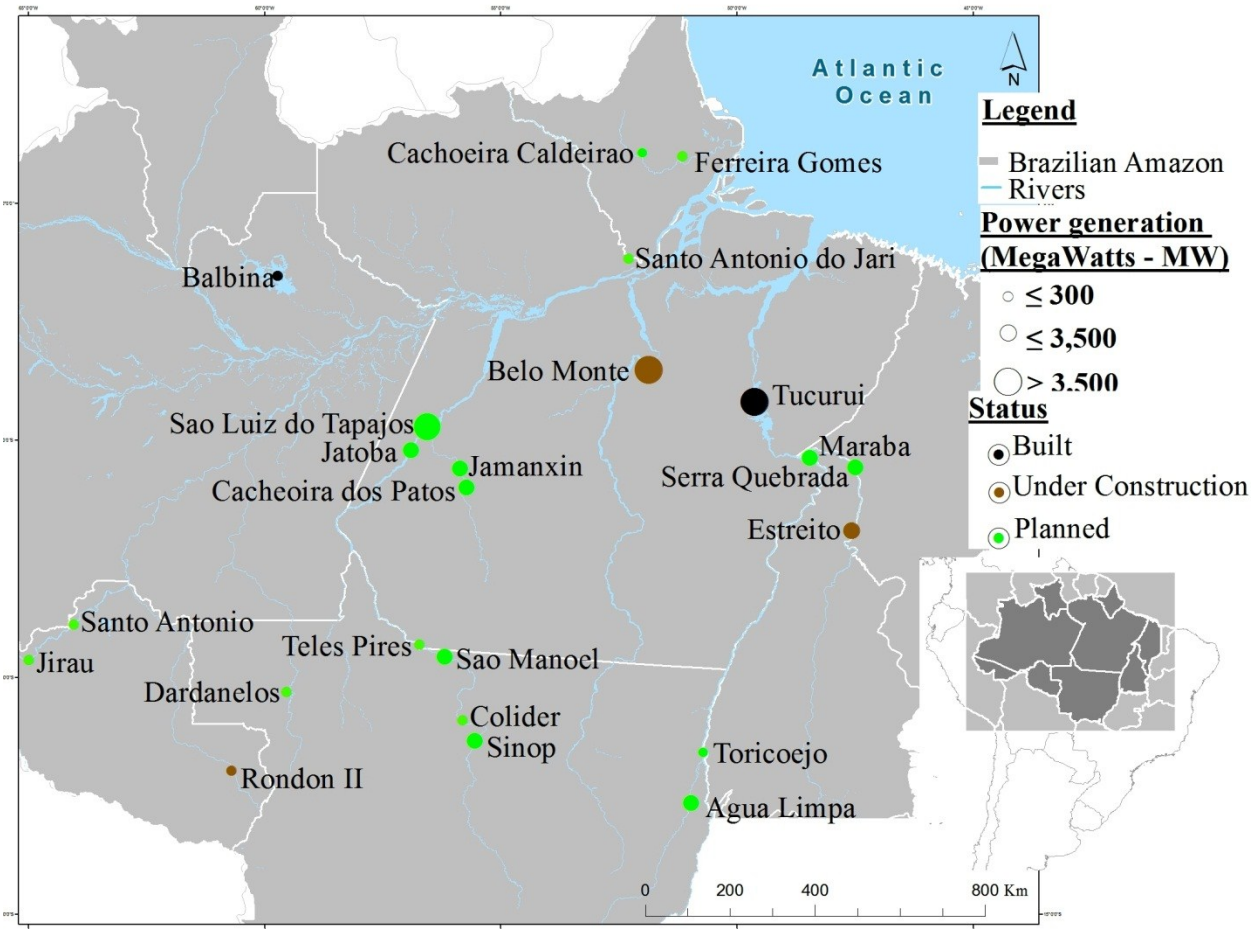


Figure 3. Planned and Built Dams in the Brazilian Amazon.

2.7 Development Outcomes

A review of Amazonian development history reveals that government motivation and subsequent policy vacillated greatly between a national desire for economic growth supporting private capital interests and a populist demand for land and opportunity. The main goals were to expand economic growth into the vast frontier; integrate and populate the Amazon with the remainder of Brazil, and remedy populist discontent in the country at large through orderly settlement. An accounting of development outcomes from more than 60 years of concerted development efforts presents mixed results, both positive and negative, with intended and

unintended outcomes. On the one hand, the region has been settled, and the economy has expanded given vast infrastructure projects including roads, canals, and energy development. On the other hand, the costs have been high with massive deforestation at 20% and rising land conflicts. In the discussion that follows, these intended and unintended outcomes will be elaborated.

2.7.1 Intended Outcomes

Planned integration and economic growth of Amazonia have been successful with the construction of thousands of kilometers of roads that integrated the region to other parts of Brazil, motivating migration of thousands of people to populate and protect borders of region, and through development of agroindustrial sectors (mainly mining and cattle). The federal highway system in the Amazon added more than 55,000 km of road between the 1960s and 1990s, connecting the region to the rest of Brazil and reducing transportation time and costs, making possible investment on industries in the region (Walker *et al*., 2009). According to Walker *et al. (*2009), in 1995 from São Paulo (the most industrialized Brazilian city) to the Amazon, around 50 hours of ground transportation was used, one-third less than was used in 1968. Indeed, reduced transportation costs are one of the many factors contributing to the success of the region's cattle economy (Margulis, 2004; Walker *et al.,* 2009). In a region where lack of population was discussed as a problem, there are now more than 24 million people living there, in contrast with 7 million people who lived there in the early 1970s. However, even though expanded roads and population growth were expected, the most visible expansion resulting from development efforts are reflected in the growth of agroindustrial sectors, mainly cattle and mining.

During the last decade, Amazon became an important provider of beef to big cities in the region, Brazil, and overseas. In fact, currently Pará state plays an important role on the export of live animals to Lebanon and Venezuela and beef parts to China, additionally; mining is also an important activity, attracting people and investments to the region. This expansion of mining exports was an expected outcome of programs developed by the government such as POLOAMAZONIA. Currently, Pará State is the second largest Brazilian exporter of iron ore, and in that state is the largest mining company in the world, the Companhia Vale do Rio Doce (CVRD). That company owns Carajás mine, located in southern Pará, which is considered the largest iron ore mine in the world, with an estimated annual capacity of iron ore production of 110 million tons (Poloni, 2010).

Even with all the new industries, roads, and exploration of natural resources, the Amazonian GDP represents only around 8% of Brazil's total (Celentano and Veríssimo, 2007a). Participation of the Amazon region in the GDP is slowly increasing: during the 1960s, it stagnated at around 4% of Brazilian GDP, in the 1970s this represented around 3%, in the 1980s it represented up to 6%, and it reached 7% in the early 1990s. However, by the end of that decade, it was back to 6%; and during the first decade of the twenty-first century, it reached 8%. Between 2000 and 2008, Amazon GDP increased more than 7%, while total national GDP increased < 5% (Figure 4). Even with improvements in the Amazonian GDP, it is clear that the highest numbers are still concentrated in southern and southeastern Brazil. Among the Amazonian states, Pará, Mato Grosso, and Amazonas accounted for 64% of total GDP (Figure 5).

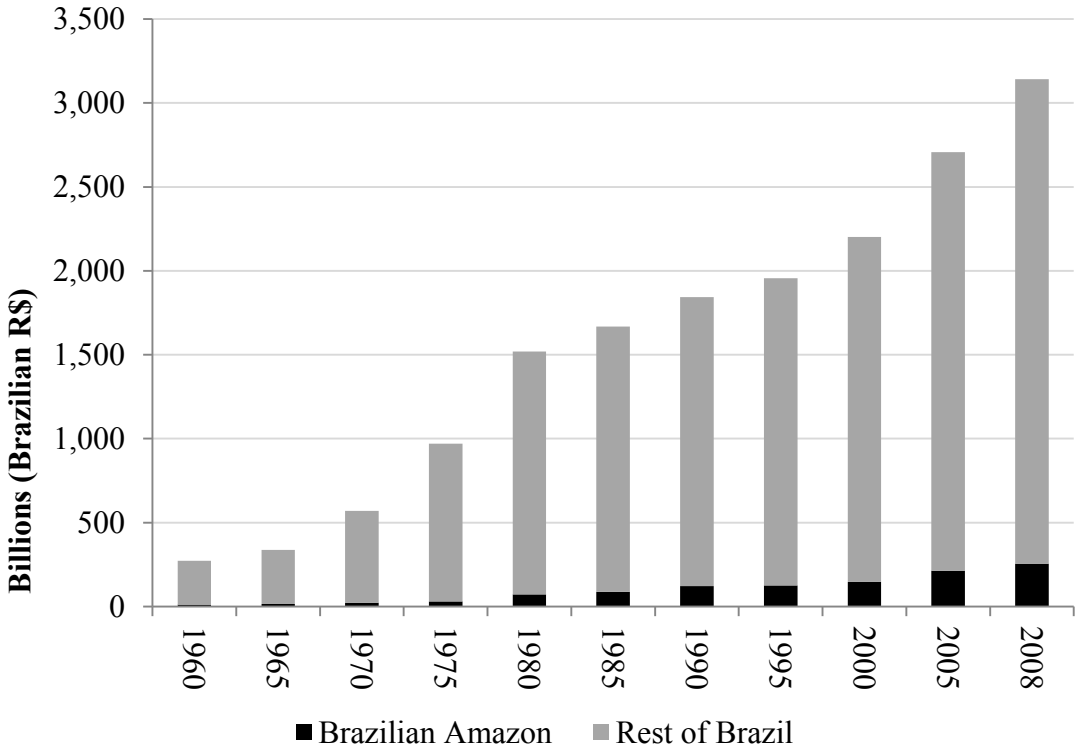


Figure 4. Brazilian and Amazonian GDP between 1960 and 2008, in Brazilian R$ billions[5].
(Source: Ipeadata (2011), produced by the author.)

[5] The figure was produced using deflated current prices provided by IPEADATA (2011).

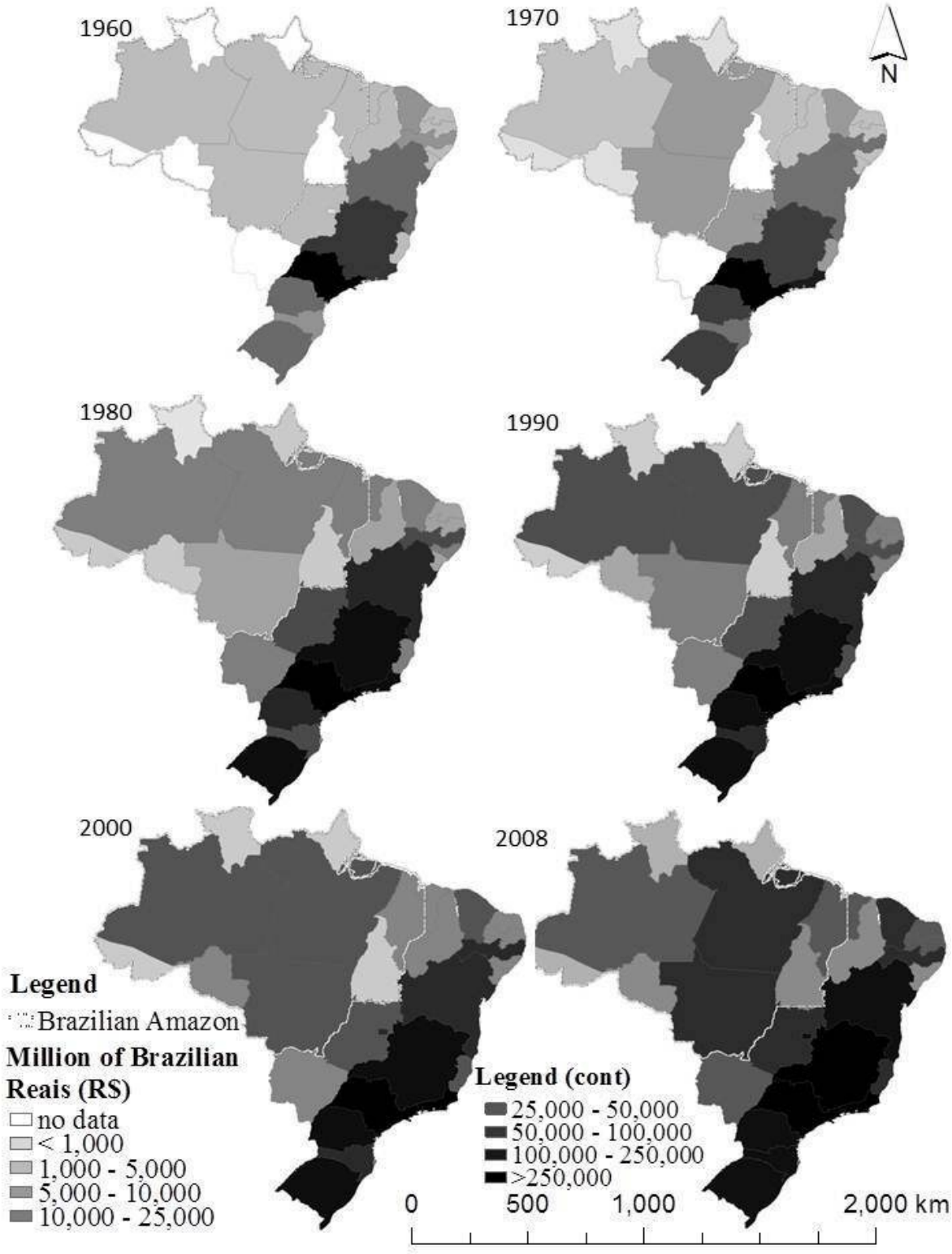


Figure 5. Brazilian GDP Per State Between 1960 and 2008.
(Source: Ipeadata (2011), produced by the author.)

2.7.1.1 Impacts on Population Growth

Starting in the late nineteenth century, population changes around the Amazon happened initially because of exploitation of natural resources such as rubber, gold, diamonds, and timber (Browder and Godfrey, 1997). Those extractive activities favored population aggregation near major Amazonian rivers, from where extracted products were sent to market. Currently, reasons for migration are related to programs of economic integration led by government, affecting the distribution of population in rural and urban areas. The highest rates of migration into the region had been observed in colonization areas around the southern part of Pará State and along BR-364 from Porto Velho to Vilhena in Rondônia State (Browder and Godfrey, 1997). New road corridors provided inland migration to new areas of settlements, changing the urbanization pattern predominant in the Amazon until then. Indeed, megadevelopment projects started during the military government and continued in subsequent years, promoting massive migrations to the region. Unfortunately, much of this was spontaneous colonization and more people moved into the region than were awarded with a piece of land (Becker, 1990; Browder and Godfrey, 1997).

An important geopolitical goal of development was to populate the vast frontier, and on this account it was a success. Between 1970 and 2010, the Amazonian population increased threefold, expanding from 7 million to 24 million people. In 1970, around 7 million people were living in the Amazon, and by 2000 this number was over 20 million, with only 31% of this total living in rural areas. By 2010, more than 24 million people lived in the Amazon area, with 28% settled in rural areas (Table 5) (IBGE, 2008, 2011). Looking at changes that occurred in rural and urban populations between 1970 and 2010, it is observed that urban population increased from 37% of the total to more than 73%. This is a result of a rural exodus that includes several reasons, including decline of productivity in the lots, lack of good access to markets during the

rainy season, and absence of schools. It is common for people to sell their lots and go to live in nearby urban areas, experiencing precarious conditions of emergent favelas (CPT, personal contact, April 2011).

Table 4. Population Growth in Rural and Urban Areas in the Brazilian Amazon Between 1970 and 2010

Year	Total	Urban		Rural	
		#	%	#	%
1970	6,931,759	2,587,816	37.33	4,343,943	62.67
1980	10,785,453	4,945,290	45.85	5,840,163	54.15
1991	15,904,162	8,899,434	55.96	7,004,728	44.04
2000	19,878,779	13,716,153	69.00	6,162,626	31.00
2010	24,074,677	17,471,216	72.57	6,603,461	27.43

Source: IBGE, Censo Demográfico

2.7.2 UNINTENDED DEVELOPMENT OUTCOMES

2.7.2.1 Land Scarcity and Conflicts

Disordered immigration, relative land scarcity, and poorly developed projects fueled land conflicts across Amazonia. In fact, Simmons (2004) illustrates that land scarcity in the regional scale, which in this dissertation is located in southeastern Pará, is an outcome of a large tract of land held by ranchers, in-migration of smallholders, and environmental concerns in the form of conservation and indigenous units' creation. All those factors are the result of Brazilian government programs intended to promote economic and social development that, instead of curbing the problem of land scarcity in other parts of Brazil due to land concentration, replicated

this in the Amazon when limited tracts of land were made accessible by new government roads and much effort was made to attract industries and investments (Simmons, 2004). In fact, land concentration has persisted historically in Brazil, as indicated by the Gini-coefficient of 0.836 in 1967 and of 0.854 in 2006 (Simmons, 2004; IBGE, 2009). The Gini-coefficient is an index that estimates fairness of resources distribution; it varies from 0, meaning complete equality, to 1, or complete inequality. In numbers, according to IBGE (2009), the 2006 Gini-coefficient revealed that in two decades this index did not experience any significant change, and properties with more than 1,000 ha occupied 44% (or 147 million ha), held by 47,000 farmers, or 0.5% of all Brazilian agricultural establishments; while properties with less than 10 ha hold around 2% of the total area (or 8 million ha), held by more than 2 million owners, or 26% of all establishments (Table 5). According to Simmons (2004), this concentration index shows a historic concentration of land in Brazil, and Amazonian states had a Gini-coefficient of 0.871 in 1998, with Pará State (in the same year) having an index of 0.889.

Table 5. Classification of Rural Properties in Brazil According to Size in Hectares, 1985-2006

Year	Groups of Total Area (ha)	Number of Establishments		Area (ha)	
		#	%	#	%
1985	< 10	3,064,822	27.82	9,986,637	2.66
	10 ≤ x < 100	7,385,502	67.03	69,565,161	18.55
	100 ≤ x < 1000	517,431	4.70	131,432,667	35.06
	≥ 1000	50,411	0.46	163,940,667	43.73
	Total	**11,018,166**	**100**	**374,925,132**	**100**
1995	< 10	2,402,374	26.24	7,882,194	2.23
	10 ≤ x < 100	6,235,348	68.09	62,693,585	17.73
	100 ≤ x < 1000	469,964	5.13	123,541,517	34.94
	≥ 1000	49,358	0.54	159,493,949	45.10
	Total	**9,157,044**	**100**	**353,611,245**	**100**
2006	< 10	2,477,071	26.44	7,798,607	2.36
	10 ≤ x < 100	6,420,225	68.53	62,893,091	19.06
	100 ≤ x < 1000	424,906	4.54	112,696,478	34.16
	≥ 1000	46,911	0.50	146,553,218	44.42
	Total	**9,369,113**	**100**	**329,941,394**	**100**

Source: IBGE/Censo Agropecuário, 2009.

Land concentration in general is cited as a cause of land conflict, and in Brazil the numbers show that between 1991 and 1998, 376 people were murdered because of the struggle for land (CPT, 2003; Simmons, 2005).Three-quarters of all land-related deaths were concentrated in the Amazon, most in Pará State (Simmons, 2004). Recent statistics show that the state of Pará has perpetuated its reputation as the notorious badlands when, between 1994 and 2010, only that state accounted for more than 600 murders, or 38%, related to the land struggle in all Brazilian territory (Sauer, 2005).

Governmental policies were responsible for the intensification of land conflicts, as those who did not receive a piece of land through government programs or could not stay on a lot due to lack of assistance started to be part of the struggles to remain on squatted lands or could not depend on large farmers to have jobs (Guerra, 2001; Assis, 2007). Those struggles demanded that the landless organize themselves into groups. Initially, those groups were organized by the Catholic Church; and later, people started to join associations and syndicates.

The land conflict in southern Pará has been divided into two phases: the Luta Posseira (LP) and Direct Action Land Reform (DALR). The LP refers to the unorganized and isolated conflicts between the landless and the large ranchers and their *gunmen*, and it is marked by high mortality rates on the part of the landless. Except for the Catholic Church, during this early phase there was little social movement involvement aside from the rural syndicates linked with colonization policy and under military rules (Assis, 1997). In 1980, GETAT was created to reduce agrarian conflicts between those who wanted possession of land within *castanhais* and those who wanted better land distribution (Hall, 1991b; Miranda, 2001). To reduce conflicts, the first GETAT action was to identify public and private land available, to expropriate land from those who did not have title, and finally, to redistribute land to curb conflicts (Trecanni, 2001).

However, because GETAT distributed land in areas where indigenous people were settled, instead of curbing conflicts, it was responsible for the occurrence of new conflicts (Trecanni, 2001). According to Hall (1991b) and Assis (2007), during a period of influence of GETAT and PGC, Pará State was responsible for 35% of murders related to land conflicts in Brazil, with the peak happening in 1985 when 43% of all murders related to land conflicts happened in that state.

The violence and brutality of life for small farmers in the region attracted attention, and SMOs and human rights group descended on the region. According to Hébette (1997), only in the 1980s did rural leaders take power from the old syndicates and strengthen rural worker movements in the form of new syndicates. Those rural leaders then became strong voices against consolidation of *latifundios* in the region and for the struggles for better land distribution, marking the transition to the second phase of the struggle referred to as DALR. Those actions strengthened social movements in Brazil, which then reached southern Pará and other parts of the Amazon to consolidate the unions of rural workers and their demands for land. Between the late 1980s and early 1990s, the presence of SMOs (such as MST, CPT, and STR) in southern Pará advocated directly forcing actions of agrarian reform (DALR). Those forms of action mostly involved the occupation of public and private lands that were understood by SMOs as unproductive, as they did not satisfy the social function defined in the Land Statute of 1964 (Trecanni, 2001; Simmons 2002). The DALR actions were aimed to bring together groups of people with the common interest of having access to land and to fulfill the need for pressure for the legal promotion of land distribution.

The GETAT ended in 1987, and PNRA failed in its efforts to promote settlements through land distribution. Brazil was still experiencing the transition from military to democratic government, and despite efforts to promote land reform, land redistribution was overshadowed

by actions to curb high inflation and to reordering the country. INCRA remained without financial and operating conditions; and lack of immediate actions by the government fueled growing land conflicts, making violence common (Assis, 2007). To curb the violence, in 1988 the government expropriated 61 farms remaining from Brazil nut (*castanhais)* production to create new settlement areas. However, there were tens of thousands families in the region demanding land, organizing in camps around farms, and promoting DALR protest marches to bring attention to the situation of land scarcity that became a reality in the region. Despite growing poverty, expropriation of the *castanhais* instead benefited large farmers and promoted cattle ranching expansion, not solving the urgent problem of land scarcity (Assis, 2007). Stimulated by goals settled during the PGC, in the early 1980s investment in cattle ranching was a part of the actions to promote large-scale activities, along with export-oriented mineral extraction (Hall, 1991b; Simmons, 2002). Those actions resulted in establishment of old and new titled large properties; and as result of investments on a large scale, in 1986 farms smaller than 100 ha represented 11% of all land in use for agriculture, held by 70% of landholders (Hall, 1991a; Costa, 2000; Assis, 2007).

2.7.2.2 Deforestation

An additional unintended consequence of development successes, population growth, regional integration, and economic advance of the frontier has been increasing rates of deforestation. Not only growth of the national market affected this trend, but changes in export trends were linked mostly to the export market driven by the high profitability of the main economic activities, such as logging, livestock, and (more recently) agribusiness (Fearnside, 2003; Alencar *et al.,* 2004). Most deforestation happened along the so-called *arc of*

deforestation, an area that extends from southeast of Maranhão State to north of Tocantins, south of Pará, north of Mato Grosso, south of Amazonas, and east of Acre (Figure 6).

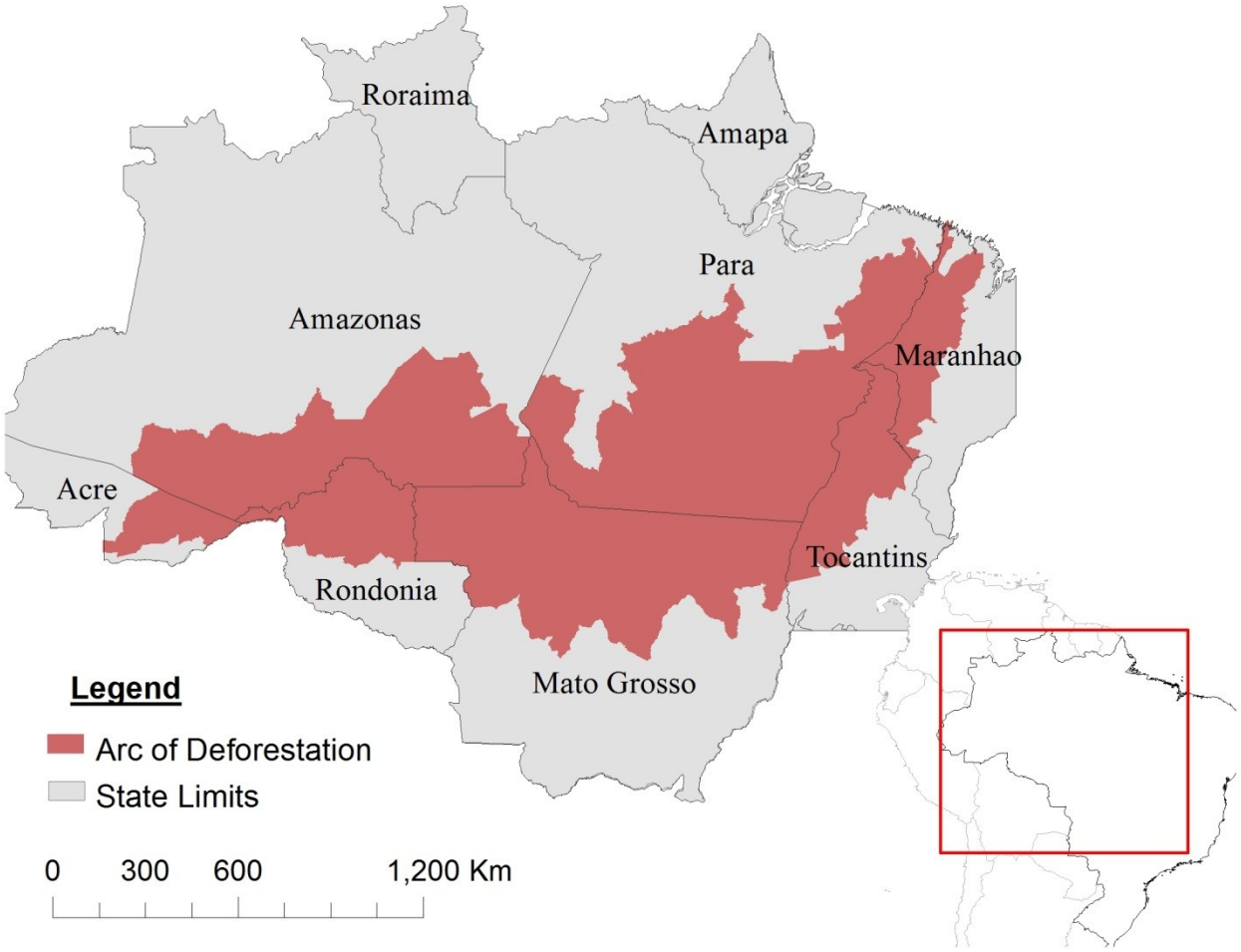
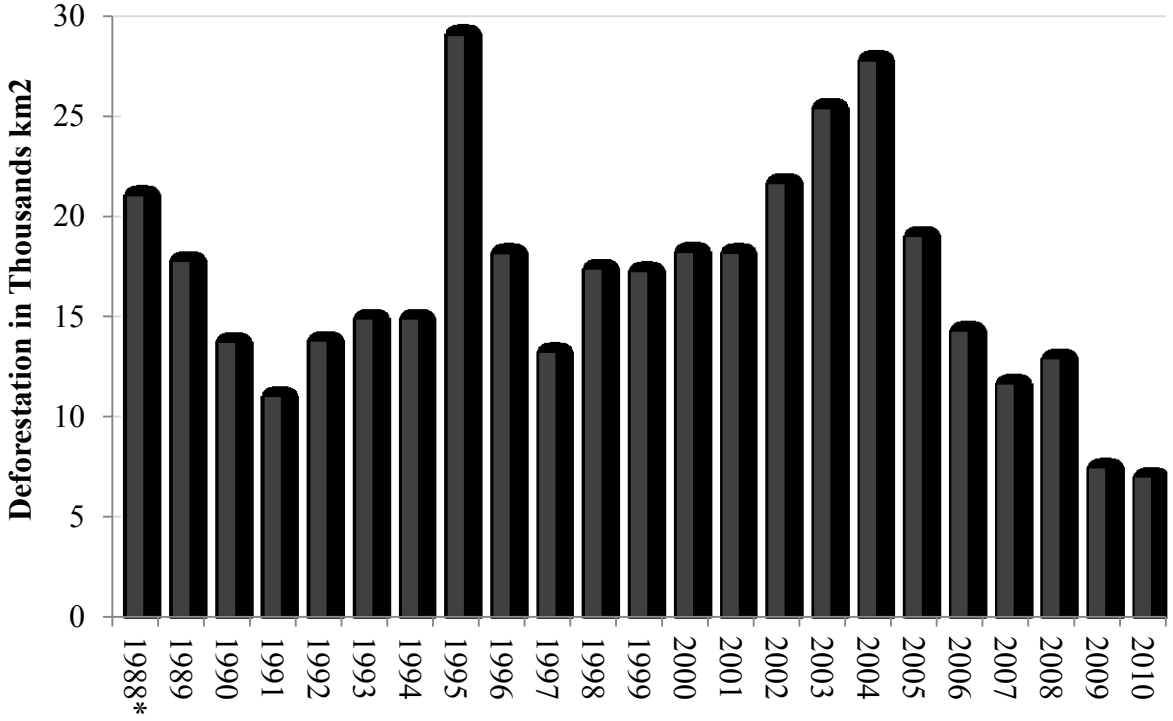


Figure 6. Geography of Deforested Area Known as *Arc of Deforestation*.

Specifically in the Brazilian Amazon, road construction and credit and fiscal subsidies to agriculture pushed the agricultural frontier into a northern direction; and the deforestation rates increased substantially until 2004, when new programs and international pressure were brought to the Amazon (Figure 7). Expansion of pasture areas has been indicated as the main cause of deforestation; and in the Amazon, it has been estimated that 80% of the deforested area is used as pastureland (Mahar, 1989; Andersen *et al*., 2002; Caldas *et al*., 2007; Walker *et al*., 2009). As a

result of decades of development, in the late 1980s the deforestation in the Brazilian Amazon had come to a critical level in Brazil.



* 1988 accounts for the yearly average deforestation from 1977 to 1988.

Figure 7. Forest Loss in the Brazilian Amazon, 1977-2010 (in thousand km^2).
(Source: Inpe, 2011.)

The annual deforestation rate in the Amazon during the 1990s increased from around 11,000 km^2 in 1991 to almost 15,000 km^2 in 1993, reaching a peak of 29,000 km^2 in 1995. Those deforestation rates forced the government to change forest protection laws, and a provisional effort (MP 1,511/96) was established in 1996 increasing the legal reserve from 50 to 80%, meaning that all property owners could use up to 20% of their land, keeping the remaining forest intact (Prioste *et al.,* 2009). In addition to increasing the legal reserve established by *Provisional Decree*, or Medida Provisória – MP 1,511/96, the expansion of the conversion of areas into tree farms was banned in agricultural areas that have areas already

deforested, abandoned, or underutilized (according to the supportability of the soil). Furthermore, it was determined that the use of native forest inside the Brazilian Amazon limits would be allowed only in the form of sustainable management. During the following years, MP 151/96 would experience modifications in an effort to reduce the required legal reserve area. As a result of successful contestation, holdings less than 100 ha where family farming was practiced were released from the legal obligation to reserve 80% of their property. In addition, ecological–economic zoning identified areas with low productivity in these areas that were allowed to reduce the legal reserve to 50%.

2.7.2.2a. Response – Creation of Conservation Units

In response to the loss of 20% of the forest during the last decades, more protected areas have been created, laws have become tougher on deforestation, and the government has become more involved in discussions about environmental issues. Since the late 1990s, establishment of protected areas as part of the strategy to meet conservation goals for Brazil through sustainable forest production was consolidated at the Convention on Biological Diversity (CBD) to manage land use, prevent illegal logging, protect areas with high biological value, and meet the demands of traditional populations. In 2003, *Amazon Protected Areas Forest Conservation Program* (Programa Áreas Protegidas da Amazônia; ARPA) was created; and between 2003 and 2010, conservation units increased in the Amazon to 47%, with peaks of conservation unit creation between 2003 and 2006 (40% of the total, newly created, protected areas happened in that period), equating to 2,197,485 km^2 or 44% of the Amazon territory (or 26% of the total Brazilian area) protected as state or federal areas or as indigenous land reserves (Figure 8) .

Those protected areas are under the responsibility of federal, state, or municipal offices and can also be classified in accordance to its use as (1) units of sustainable use, which are

designed to match the sustainable use of nature conservation with sustainable use of natural resources allowing planned and regulated direct economic exploitation; and (2) units of integral protection, which aims to conserve biodiversity through full preservation of the forest. A third classification for protected areas is (3) indigenous land (or *Terra Indígena*), which has national government protection through the *National Indian Foundation* (Fundação Nacional do Índio; FUNAI); however, those areas are not included with the official protection system (the *Sistema Nacional de Unidades de Conservação;* SNUC), and lately there has been increased human pressure in the form of logging, farming, and mining on those areas (Figure 9) (SNUC, 2000; Hall, 2011; Veríssimo *et al.,* 2011).

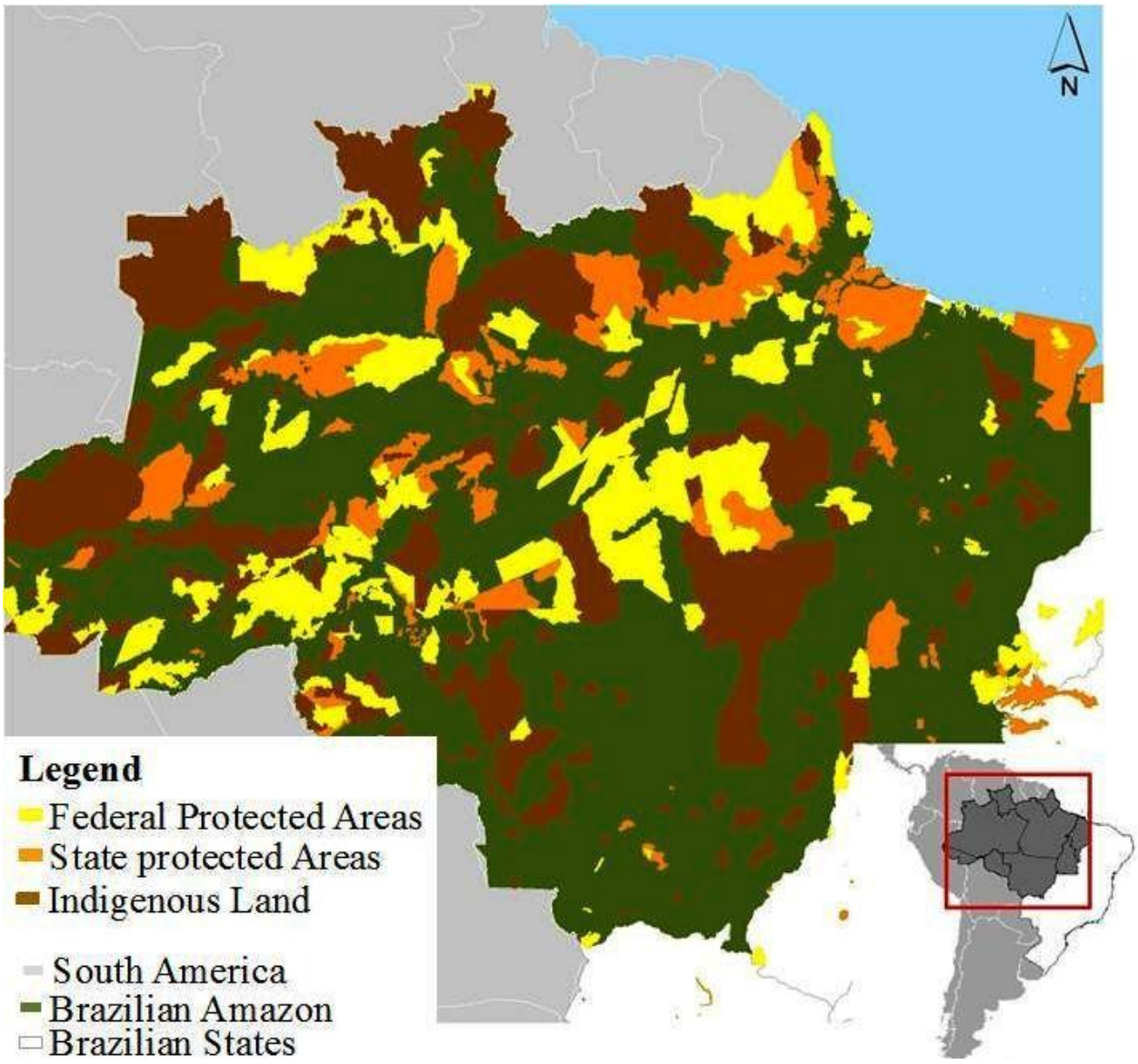


Figure 8. Areas in the Brazilian Amazon under Federal, State, or Municipal Protection.

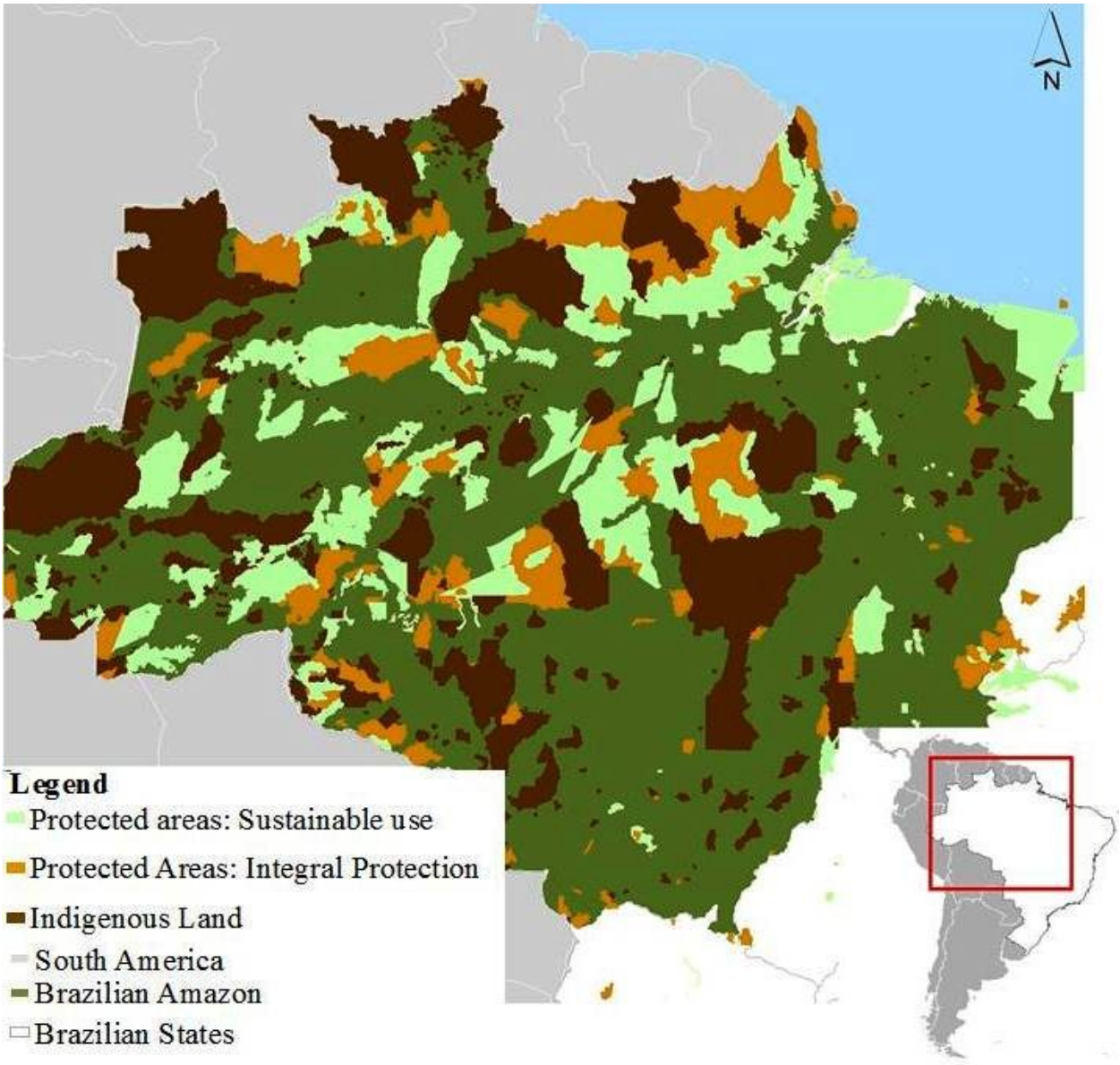


Figure 9. Protected Areas in the Amazon in Accordance to Their Use.

Protected areas play an important role in reducing deforestation and in mitigating the harmful influence of climate change through carbon sequestration. Protected areas have become effective in protecting species and ecosystems from human pressure (Bruner *et al.,* 2001). It is estimated that areas under protection in Latin America are responsible for retaining 27% of local

carbon stocks, where Amazonia is responsible for 40% of Latin America's total (Hall, 2011). As part of the results of the Amazon Region Protected Areas Forest Conservation Program (ARPA), it is expected that in the future the Brazilian Amazon, by itself, will be able to retain 4.6 billion tons of carbon, which can reduce annual carbon emissions by 1.1 billion tons until 2050 (WWF, 2008; Hall, 2011).

Deforestation in the Brazilian Amazon became an important concern in scientific discussions in the last decade because of emissions of greenhouse gases (GHG), which contribute to global warming (Hall, 2011). Currently, deforestation is responsible for 20% of the world's GHG emissions, and Brazil is responsible for 5% of all world emissions, of which 75% is the result of deforestation and land use change (UNFCCC, 2008; Hall, 2011). Lately, Brazil has implemented a more efficient plan to combat deforestation; and results, despite the fact that deforestation is still occurring at high rates, show that decreasing annual deforestation has been observed since 2005. As part of the effort to reduce deforestation, Brazil joined REDD+, a program to Reduce Emissions from Deforestation and Forest Degradation (REDD) through creation of a financial value for the carbon stored in forests and through funds that will provide incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development (UN-REDD, 2011). Deforestation and forest degradation caused by expansion of agriculture, pastureland, infrastructure development projects, destructive logging, and forest fires account for approximately 20% of global GHG emissions (UN-REDD, 2011).

The REDD initiatives include commitments of the developing countries to reduce greenhouse gas (GHG) emissions. In Brazil, the REDD program identifies a number of actions to reduce GHG emissions, including (1) a plan to prevent and control deforestation, and (2) a plan

to reduce carbon emissions from several economic sectors, including cattle ranching (Viana *et al*., 2010). To do so, nongovernmental organizations (NGOs) and government are working together to implement strategies to reduce deforestation rates over the decade. These plans include participation of Amazonian communities on prevention, monitoring, and control of illegal deforestation. At settlement and other small property levels, procedures to reduce deforestation start with a register of property, followed by sustainable agricultural practices that involve intercropping and pasture in same areas, divisions of paddocks to allow for rotation of animals, and development of alternatives to control fire on the properties. Those actions are intended to reduce degradation and deforestation caused by pastureland formation.

Over the past decade, Brazil has initiated a variety of programs to curb deforestation. In 2003, the *National Institute of Spatial Research* (Instituto Nacional de Pesquisas Espaciais; INPE) projected an increase in the deforestation of the Amazon between August 2001 and August 2002, showing that expected deforestation for that period would increase 40% when compared to the same period in the previous year. As a result of those estimates, a new government commission was created to (1) establish better land distribution in the municipalities in the so-called arc of deforestation (see Figure 6 in chapter 2) where the study region is located, (2) distribute credits to enhance sustainability and economic efficiency in areas already deforested, (3) invest in sustainable infrastructure, (4) generate jobs and income through management of reforestation, and (5) integrate all government sectors to monitor and supervise illegal deforestation in the deforestation arc (Casa Civil, 2004) .

In 2011 and 2012, new changes were proposed and voted to current forest code; and discussions are being raised about the effects of those changes, which include reduction of the legal reserve to 50% in states that hold more than 65% of their areas under environmental

reserves, reduction from 30 to 15 m of forest recovery for rivers with a width of 10 m, and areas under permanent preservation can be used for the planting of some crops such as cocoa and coffee. The main issues raised by environmentalists concerned with the newly proposed forest code is that this new action will forgive those who have already been deforesting for many years before the current law and that this new code will open opportunities for further unnecessary deforestation (Ellinger and Barreto, 2011).

In summary, responses to deforestation over the last five decades are reflected not only in the creation of new protected areas but also in local level actions to curb deforestation and promote sustainable development at the municipal level. These actions are directly linked to settlement areas, and today the actions are concentrated in good management of credits made available by government, meaning that credit incentives have to be directed for alternative production instead of cattle, an activity that despite its economic importance is the main cause of deforestation and unsustainable land use in the Amazon. Also, cattle ranching has, historically, been associated with a traditional contentious relationship between the large ranchers, who represent the main benefactor of unequal land distribution, and the landless, whose main goal is to access the unproductive land of the region. These landless are the concern of INCRA and Agrarian Reform programs. However, even with this history of contentious relationships, it seems that credits provided to settler developments are being invested in cattle and are creating a new relationship between large ranchers and settlers. This new trend is the main focus of this dissertation, as I aim to understand which factors are affecting settlers' decisions and how this new economy is affecting settlers' welfare. In the next two chapters I will perform in-depth analysis of the evolution of agrarian reform, through rural world programs and globalizing the

cattle economy to try to better clarify how the interactions between smallholders and cattle articulate.

CHAPTER 3: FROM STATE-LED COLONIZATION TO THE NEW RURAL WORLD: HISTORY OF LAND REFORM IN BRAZIL

3.1 Introduction

In this chapter, the history of agrarian reform policy is described, and my main focus is on the more contemporary *Novo Mundo Rural* and INCRA policies for creation of the PDA. Most of this discussion stems from data collected at the INCRA office in Marabá and from documents made available by the Agrarian Development Ministry (MDA). Not much has been written about this contemporary *Novo Mundo Rural,* and primary documents made available by INCRA during data collection were essential to building the contemporary history about land reform and policies involved. The overview of agrarian reform history here involves the explanation of PDA requirements, as it is stated as a policy document to be followed by each settlement. This is necessary as one of my main concerns is to understand the disconnect between policy and practice; and this document, the PDA, is essential in assessing the policy as to how economic activities are happening in the field and how this is not fitting the actual policy prescription.

3.2 The Beginning of Land Concentration in Brazil as Cause of Land Struggle

Since Brazil was occupied by Portugal, the trend to stimulate land concentration in Brazil has been strong. Initially to protect Brazilian borders from invasion from other European countries (such as Netherlands, France, and England), Portugal started a process of land distribution that consisted of distributing huge portions of land divided in the area explored by that country—which started on the coast and extended to the division line that limited actions

between Portugal and Spain—and that division that gave permission to those countries to explore Brazil was established in the *Tratado de Tordesilhas*[6] *(Treaty of Tordesillas)*. Large tracts of land were given to people loyal to the Portuguese kingdom, and the new land owners' commitment to Portugal was to protect Brazilian territory and to give one-sixth of their production to Portugal (Furtado, 1984). With Brazilian independence in 1822, it was hoped that land distribution would follow a better pattern; however, that did not happen. Land concentration remained strong through a process where those people with more economic resources took land under struggle. At that time, the *lei do mais forte (law of the jungle*) prevailed, and wealthier people were able to hire gunmen to ensure that land remained under their control (Furtado, 1984).

In the 1850s, government established what was called the First Land Code of Brazil, which enforced a relationship between state and landowners, gave to the government total control of unproductive land, and stated that some of those lands under government control would be made available to the poor (Medeiros, 2002; Simmons *et al.,* 2007). That was the first attempt to plan agrarian reform in Brazil; however, due to the political influence of large landowners, land control was kept under the possession of a few people in the countryside of Brazil. After that, in 1950 with the onset of industrialization in Brazil and a boom of people moving to poor urban areas, debate about the agrarian situation in Brazil resurfaced. At that time, the first *ligas camponesas* (peasant's leagues) arose; and in the future these would be countered by the imminent military government, resulting in land wars in Brazil that highlighted the deadly

---

[6] *Treaty of Tordesillas* (1494) consisted of an agreement between Portugal and Spain that divided the newest colonized countries out of Europe. The division had an imaginary demarcation line at 1,770 km east of Cape Verde Island. In practice, the lands that lay on the east side belonged to Portugal and on the west side to Spain, meaning that the newly discovered land on the east side of the Atlantic would be under the responsibility of Portugal (Carvalho, 1998). In Brazil, this vertical line crossed what today is Marajó Island in the north, passing through Araguaia and Tocantins Rivers, and arriving southeast and south of São Paulo, Paraná, and Santa Catarina States (Appendix F)

struggles in southern Pará State, where this dissertation research was conducted (Simmons *et al*., 2007).

3.3. History of Land Concentration and Land Struggle in the Amazon

Part of the agrarian reform purpose stated during the military government was developed as a form of colonization projects in the Amazon. The main objectives were to curb migration to industrialized areas and to promote development of the vast Amazon frontier. The first government-directed colonization project started in the 1970s was called the *Integrated Colonization Project* (or Projeto Integrado de Colonização; PIC), under the *National Integration Program (*Programa Nacional de Integração; PIN). During the first half of the 1970s, government actions in the Amazon were directed mainly to social integration and colonization projects in the Brazilian Amazon, which had been the main public goal during that time. On the other hand, lack of information about culture, climate, and soil conditions would drive colonization projects to failure.

Social incentives given as part of the government-directed colonization (*colonização dirigida*) included 100 ha of land, up to six months of minimum wage, access to credit at a 7% annual interest rate for starting a plantation of staple crops, as well as access to inputs, such as seeds and fertilizers (Moran, 1983; Andersen *et al*., 2002). At that time, the main target was the landless rural people from the Brazilian northeast. In addition to those incentives, promises were made for housing either near the main road or in the villages nearby the lots (known as *Agrovilas*), roads accessing nearby markets, access to schools and health services, and the guarantee of government participation in production sales (Kleinpenning, 1975; Moran, 1983, 1984; Mahar, 1989).

A high degree of government intervention was involved in this as the initial stage of development projects to all process at end of occupation, such as land and subsidies distribution (Moran, 1983). That colonization project was developed as a reasonable solution to the problem of land scarcity and rural out-migration predominant in northeastern Brazil; and the initial plan was to attract up to 100,000 families to the region (Wood and Wilson, 1984). However, by the mid-1970s, only 7% of the predicted quantity of families was part of the colonization program in the Transamazon highway, and the focus of settlement was shifted to Rondônia State (Moran, 1981; Kohlhepp, 2002).

With the policy of occupation, protection, and exploration of the Amazon through colonization projects, the idea of agrarian reform was reproduced as a social program for reducing landlessness in the northeast. However, lot abandonment by many settlers—who were attracted to forest areas in the middle of the Amazon without appropriate support—made the program unsuccessful, and many people started to move to the big cities around the settlement areas—those who decided to stay found themselves without any government support (Ianni, 1979; Oliveira, 1988). In general, high turnover rates were and still are explained not only by lack of technical support, but also because of environmental degradation, revealed in the decrease of soil quality and the lack of agricultural experience for crops adapted to the Amazon's climate and soils (Guedes *et al.,* 2010).

Despite the failure of colonization programs, the slogan used by the government to attract people to the region, *there is land for all in the Amazon,* was responsible for the high spontaneous migration toward the Amazon, establishing pioneer frontiers, which advanced deep into the forest (Kohlhepp, 2002). Spontaneous migration along with persistent land concentration would become, in the future, reasons for land conflicts and actions from which social movements

and new programs of settlement projects originated; and where established, they became the model that they are at the present time.

In Pará State, because of the high spontaneous in-migration, those PICs could not absorb all the people; and this induced violent land conflicts, which became customary in the region (Moran, 1983; Almeida, 1992). In fact, Pará State has replicated land scarcity patterns that occurred in other parts of the country (Almeida, 1992; McCracken *et al.,* 1999). This *relative* land scarcity has all too often triggered violent conflict between large ranchers on one side and the landless on the other—the vast majority of which is occurring in Amazonia (Simmons, 2004; Aldrich *et al.,* 2006). Pará State reported an estimated 1,425 land conflicts with more than 600 murders between 1994 and 2010, accounting for around 38% of the country's total land-conflict–related murders, giving to the region the reputation as Brazil's notorious *badlands* (Sauer, 2005; Simmons *et al.,* 2007; CPT, 2010).

Those problems, mainly related to lack of planning, drove state-led colonization programs to failure; and as a result, persistent rural poverty and growing land conflicts were enhanced. As a consequence of the increasing rates of land conflicts, in the 1980s SMOs started to organize at the national level, claiming the need for agrarian reform action. The SMOs gained prominence organizing people in the struggle for equal rights in the access to land, for better working conditions, and for salaries in the field. They created a strong structure to organize groups that aimed to use the struggle for land redistribution in Brazil (Reforma Agrária, 1997). Land concentration in the Amazon generated actions of SMOs to bring people together to demand better land distribution in the region. In fact, those movements were already acting in other parts of Brazil, and the continuous situation of land conflicts demanded that groups in the Amazon area be more organized.

A variety of SMOs (such as the Rural Landless Workers' Movement, MST; Syndicate of Rural Workers, STR; and Pastoral Land Commission, CPT) have been active bringing together landless people and encouraging direct action in the form of land occupation with the intention of forcing the government to follow through on agrarian reform promises. In recent years, and mainly in the Amazon region, those SMOs have incorporated environmental concerns with their social and political agendas, encouraging residents not to focus on monoculture production systems for markets but instead to engage in what they call *agroecology* and family farming, promoting diversified production so as to ensure food sovereignty and sustainable development that balances environmental and social needs (Altieri, 2010; Lima, 2010; Simmons *et al.,* 2010).

3.4. The New Era of Settlement Projects: The *New Rural World* Program

Because of the continuity of agrarian inequalities and violence, such as the massacre of 19 landless in Eldorado do Carajás in 1996, in 1999 a *Ministry of Agrarian Development (*Ministério do Desenvolvimento Agrário; MDA) was created and the *New Rural World Program* (Programa Novo Mundo Rural*)* was designed to promote agrarian reform and family farming agriculture through land and credit distribution, technical support, and infrastructure investments. Those were essential items for installing settlers on the land and to guarantee their sustainability and empowerment at the end of the program (Reforma Agrária, 1997). This program consisted of two steps: (1) to establish families in the settlements through concession of credit for installation (basic needs, such as food, tools for subsistence agriculture, and housing) and access to land; and (2) consolidation of settlements through provision of basic infrastructure such as roads, access to electricity and clean water, technical support, and continuous activities to guarantee sustainability and maintenance of settlement projects (Projetos de Assentamentos; PAs) in the long term (Abrasil, 2002).

In accordance with INCRA (2012), procedures for each type of settlement are under federal decree #69 of 2008, which outlined that those settlements are ruled within two groups of agrarian reform projects: (1) established by INCRA in the traditional approach named as *Settlement Projects* (Projetos de Assentamentos; PAs), or those with environmental differences created inside areas with environmental limitations, named *Extrativist Settlement Projects* (Projetos de assentamento extrativistas; PAE), *Sustainable Development Projects* (Projetos de Desenvolvimento Sustentável; PDS), and *Forest Settlement Projects* (Projeto de Assentamento Florestal; PAF); and (2) created by government offices recognized by INCRA, such as state offices. In this second group, settlements are created for displaced people owing to dam construction, relocation of populations living within state forests, indigenous land, and settlements for descendants of slaves known as *Quilombo*. In Brazil, there are almost 9,000 settlements defined in these groups, housing more than 920,000 families in all five regions of Brazil. Most of the settled families are in northern Brazil and in that region more than 50% of all settlements and settled families are in Pará State (Tables 6 and 7).

Table 6. Number of Settlements and Families Settled in Brazil

Region	Settlements #	Settlements %	Settled Families	Families %
Northeast	4,028	46	307,054	33
North	2,009	23	399,775	43
Center-west	1,210	14	137,507	15
South	809	9	36,009	4
Southeast	735	8	42,967	5
Total	8,791	100	923,312	100

Source: INCRA (2011).

Table 7. Number of Settlements and Families Settled in Pará and Other Northern States

State	Settlement #	Settlement %	Settled Families	Families %
Pará	1,053	52	227,495	57
Acre	148	7	31,261	8
Amazonas	142	7	52,068	13
Rondônia	194	10	37,094	9
Amapá	40	2	13,033	3
Roraima	66	3	15,652	4
Tocantins	366	18	23,172	6
Total North	2,009	100	399,775	100

Source: INCRA (2011).

For this dissertation, all settlements visited are classified as traditional settlement projects or PAs, and they are regulated by INCRA and its agrarian reform policies. From the moment of acceptance of a settler as a beneficiary of agrarian reform to the formation of a settlement, there are a set of rules to be followed (INCRA, 1997). For instance, land beneficiaries follow executive rule #45 of 2005 that states that to be accepted in the agrarian reform program a settler has to be one of the following: (1) landless; (2) squatter, employee, partner, or tenant but with monthly nonagricultural income not higher than three minimum wages; or (3) farmer whose property does not exceed a municipality rural module, or 70 ha, in the study area (MDA/INCRA, 2005).

Policy requires that PA residents (or settlers) first organize a settlement association with assistance from extension agents through the organization of *Technical, Social and Environmental Assistance* (Assessoria Técnica, Social e Ambiental, or ATES). The ATES, SMOs, and settlers develop a *Settlement Development Plan* (Plano de Desenvolvimento do Assentamento; PDA) that outlines the settlement-specific social, economic, and environmental strategies to promote sustainable development with rural economic livelihoods. According to the basic guidelines for the development plan of the settlement (PDA), details related to technical support procedures—as well as the analysis of social, economic, cultural, physiographic, and environmental characteristics—have to be included in the final document (Appendix B). Additionally, climate, soils, forest cover remaining, social condition of families, families' history, and local economy are all to be described in the PDA, with the objective to direct credits and actions toward production to consumption at local markets. Finally, an evaluation is made regarding the structure of the settlement as to where schools, transportation system, roads, and electricity systems will be installed. As important as production and logistic structure in the PDA, vegetation, slope, water resources, and environmental systems are evaluated in order to define the best productive activity to be developed in the PA.

Once the analyses required to create a PDA are done, a map and a report is attached to the PDA, indicating how much the area is degraded, if there is a legal reserve, and also if it is in accordance with environmental rules. If not in environmental compliance, an action plan for reallocation of the legal reserve is necessary. Once the PDA is ready and presented to INCRA, the government initiates the process for distributing resources for housing and infrastructure, as well as the myriad of programs aimed at expanding formal and technical education, improved incomes, and sustainable economic activities (see http://www.incra.gov.br/portal/).

The PDA has to involve settlers through participative activities to raise information about the relationship between settlers and agriculture. In fact, INCRA and the settlers' association have an important role when the development of a settlement is happening. However, between INCRA and the association, there is a third group consisting of technical supporters who are in charge of bringing together the points necessary to develop a PDA and showing production alternatives for the region. Additionally, this third party is responsible for elaborating methods for creation of the PDA, with the participation of the settler, consisting first of a questionnaire applied at the settler's level and meetings with leaders of the settlement. The questionnaire is created in accordance to INCRA, settlement representatives, and local study groups from local nongovernmental organizations (NGOs) or local university requests. The questionnaire, among other things, tries to understand each sampled family's production, economic activities, and behavior. The next step consists of reaching key informants (social movements, religious representatives) who contributed to the settlement creation (PDA of PA Canudos, 2004). With social, physical, and economic information about the area and the people, the results are provided in the PDA. The main objective of this assessment is to direct public policies to motivate settlers to engage in production for market and self-consumption in accordance with their past rural knowledge.

One interesting point of the PDA is that it includes a study showing the current agricultural activities and productivity in the region, comparing with the average productivity of each crop (i.e., rice, corn, cassava, beans, etc.) in other Brazilian areas where it is most productive. The PDA of PA Canudos, for example, shows that the main causes cited for the low agricultural productivity in the region was a dry season in several stages of the plantation or excess rain when the grain was ready to be harvested; poor soils; lack of access and use of

technology, including pesticides and seeds with better genetics; small areas for harvesting; and lack of machine use (PDA of PA Canudos, 2004).

After analysis, social, economic, and agronomic assessments are recommended in the PDA production systems that are more viable to the region. The technical support hired has a priority to follow each lot development and to recommend diversification of production at the settlement level. According to INCRA rules, any production can only be developed in each lot after PDA approval. Once PDA is created and approved by INCRA, access to benefits and basic infrastructure start to be developed as a priority to provide welfare through housing, tools, and basic production. The myriad of programs to assure that settlers have access to land and that they start to improve well-being consists of several kinds of credits with different values. An initial credit for installation became an important tool for strengthening settlement projects, and the value of each benefit has been redefined over the years in order to provide decent conditions of employment, production, and maintenance of rural families on each plot. The current values and types of credits were defined in 2005, and in 2008 two more credits were created that were intended to promote the inclusion and participation of women in a productive and dynamic economy, to contribute to gender equality in rural areas (women support), and to consolidate household food security and strengthen the process of production (through additional support). In 2009, because of environmental concerns raised in settlement areas, an extra decree was published by INCRA creating an environmental credit. This credit was intended to finance (for two years) development of agroforestry systems for the recovery of the legal reserve in settlements where it was necessary to reforest to reach the legal forest rules: 80% per property for the Amazon.

Currently, each family recognized as a land beneficiary by INCRA receives up to USD 22.8 thousand in credit that includes resources for initial support, housing building materials, production support, housing repair materials, rehabilitation of production, and environmental credits (Table 8). Each of those credits have specific objectives, such as meeting basic needs, strengthening productive activities, development of projects, and assistance in building housing units (INCRA, 2011b). In 2008, two new credit types were made available: women support and additional production support, with the objective of including women in the productive and economic activities, contributing then to gender equality in settlement areas and to strengthen food security and economic production. In addition to the above, there are other forms of credits intended to curb regional problems, such as dry land support for settlers in northeastern Brazil where drought is a problem (INCRA, 2011b).

Table 8. Types and Values of Credits Available Per Each Settled Family

Credit Definition	Value (USD)	Goals
Initial support	1,584	Meet basic needs
Women support	1,485	Promote gender equality through inclusion of women in production (animal, agricultural, artisanal).
House building materials	7,426	Assist in the construction of housing units on lots.
Support for production	1,584	Strengthen the production activities and develop land reform projects.
Additional support for production	1,584	To make production continuous.
Material for house repairs	Up to 3,960	To recover house units in the settlements in need of repairs and/or extension.
Credit for rehabilitation of production	Up to 2,970	To recover the ability of access to new loans, allowing the discharge contracted under previous programs.
Environmental credit	1,188	Fund the installation of an agro-forestry system to attend the legal reserve.
Dry-land credit	Up to 990	Meet needs of water security.

Source: INCRA (2011b) and Machado (2011).

The *New Rural World Program* used as its basis the Federal Constitution of 1988, which established that beneficiaries of the distribution of rural lands through agrarian reform programs

will receive land titles or land use concessions to make sure those who are awarded by government will have the legal right to explore the area. Land use concession is the first document issued to settlers to assure rights to access all credits through INCRA and other government programs (MDA/INCRA, 2005). If terms of land use are followed, after a period (usually 10 years) the permanent land title can be issued and the settler can pay for that document in 20 annual payments. In addition to access to land given through INCRA, there are rights and obligations that have to be followed by government and by settlers. Government has to provide access to land, technical support, infrastructure, and benefits to assure that the settler will be in a condition to feel truly connected to the land and self-sufficient. Settlers have to follow the established guidelines to promote sustainable land use and food security (Abrasil, 2002). To be designated as a PA, a set of rules must be followed by new settlers, such as land cannot be sold unless the settler pays for the land title after 10 years of living in those areas. Despite the establishment of a settlement that has as its final goal to create an independent group of producers, it was observed in the field that many settlers and even representatives of settlements say it is not in their interest to reach the last phase of a settlement (phase 7) because of the interruption of government support at that moment. The argument is that even after many years of access to credit, settlers are not ready to produce without government support (Personal Contact, MST representative, March 2011).

The settlement projects (PAS) are officially recognized by the government, with rights to credit for housing and agriculture. Creation of PAs follows steps divided in accordance with the objectives to the establishment of a consolidated settlement, with a capacity for agricultural production and access to infrastructure and credits, through access to land (Table 9). Each step for a creation of a settlement may take several years; and the main goal, when the last step (phase

8) is reached, is to have established a settlement where settlers are already connected to the market and are able to pursue credits and gains without government interference (IPEA, 2002).

Table 9. Phases and Actions of Settlement Creation

Phases of Creation	Definition / Actions
1	**Pre-Settlement Project (Pré-projeto de assentamento)** Farm is selected and indicated for expropriation or for acquisition through programs of land credit; settlers are pre-selected for projects.
2	**Settlement under creation (Assentamento em Criação)** Settlers are indicated to be registered as credit beneficiaries (registro de beneficiário; RB); land to settle people is already identified and being acquired through expropriation collection or acquisition.
3	**Settlement created (Assentamento Criado)** Land under INCRA property; settlers have permission to officially move to the lot; land use contract is signed between INCRA and settler.
4	**Settlement under installation (Assentamento em Instalação)** Creation of Settlement Development Plan (PDA); access to credits for installation support.
5	**Settlement under structuration (Assentamento em Estruturação)** Basic infrastructure installation.
6	**Settlement in consolidation (Assentamento em Consolidação)** Settlers already installed with access to basic infrastructure (roads, electricity, water, health, and school); access to Pronaf A; settlers receive provisory land title; families are already able to access other credits available, such as Pronaf A/C, B, C and AF.
7	**Settlement consolidated (Assentamento Consolidado)** More than half of total settlers already have land title; remaining areas are transferred to state and municipality responsibility.

Source: Ipea (2002) and Banco Central do Brasil (2010).

Despite the initial credits that are earned by all settled families, there are also other credits to be invested in production that can be earned through INCRA, and this involves banks.

The credit can be received by an individual or by a group of people. The most popular program in Brazil is the *Program to Support Family Farming* (Programa Nacional de Fortalecimento da Agricultura Familiar; PRONAF), which was created in 1995 with the objective of improving productive capacity and the welfare of those who work in the family farming system (Feijó, 2001; Mattei, 2005; Guanziroli, 2007). The notion of a credit designated to family farming was started because of the barriers that small farmers had to earn income only with the initial support from INCRA and also because bank debts were not viable to be paid by settlers without any guarantee (Guanziroli, 2007).

In order to enable settlers to improve production, PRONAF is supported by the government through INCRA, which pays down part of the debt, and is also supported by low interest rates from the banks. According to data collected at Banco da Amazônia (BASA) in Marabá, the main credit bank in the study area, each family receives up to USD 12,647 (which USD 882 of this is designated to technical support) from PRONAF A, which can be paid back in 10 years, with a 45% discount of the total value and 0.5% interest per year. The only guarantees the Bank requires is (1) a *declaration of competence of the producer* (Declaração de Aptidão do Produtor; DAP), which identifies farmers or their associations who are able to have access to credits through PRONAF A to expand production, and (2) income declaration, both of which are issued by INCRA. To be able to be part of the INCRA list, settlers have to be registered as a beneficiary in one settlement; at the field level, this registration is defined as a *Registry of Beneficiary* (Registro do Beneficiário, or simply RB). Once a settler is recognized as an RB and part of the debts granted are paid, they are eligible for access to other credits such as Pronaf A/C, B, C, or AF, which give access to higher loans and with different goals (Table 10).

Table 10. Pronaf Types, Beneficiaries and Goals

Pronaf Type	Beneficiaries	Goals
A	Settlers who are already participants of agrarian reform programs and living in a consolidated settlement (phase 6).	To invest in agriculture, livestock, and other activities related to production.
A/C	Same as Pronaf A, but people have to first apply and have a good use of previous credit and proof of commitment with production through success of investments of Pronaf A.	To invest in agriculture and livestock and other activities related to the lot production; or industrialization of production.
B (Rural Microfinance)	Settlers with annual total income up to USD 2,970.	Financing of agriculture, livestock, or processing activities. This can be earned individually or by groups.
C	Settlers who work in subsistence production with involvement of other family members who were settled by INCRA before 31 March 2008 and who did not use all credit with bonus before 30 June 2008.	Financing of costs before annual production of 2012/2013 years.
AF (Family Farming)	Family farmers with total annual income higher than USD 2,970 and lower than USD 54,455).	Financing in infrastructure for production and services related to agriculture and/or livestock in the lot.

Source: Banco central do Brasil (2010),

Broadly, policies stated in the *New Rural World* program state that settlers will be engaged in diversified agriculture funded by government through credits and technical support. However the history of changes in the cattle economy has affected the economic scenario in the

Amazon over the last decades, and even settlers are important actors in that economy. The process of expansion and changes in cattle economy and its integration to a globalized economy is explained in the chapters that follow. Again, the importance of these chapters are directed to the understanding of why settlers are involved in the cattle economy, even in small lots that are directed to engage family farming and diversified production.

CHAPTER 4. HISTORY OF CATTLE EXPANSION AND CHANGES IN ITS ECONOMY

In this chapter, I consider the history of the evolving cattle economy in the Brazilian Amazon. Findings related in this chapter are based on secondary data, as well as on field observations related to cattle economy and its expansion to northern Brazil. Additionally, I describe policies that made cattle expansion possible, and I conclude by examining the role that settlers may play with largeholders in an effort to understand their engagement, the role they play, and how settlers' current participation within the cattle chain is being developed.

4.1 Introduction of Cattle to the Amazon

Remote cattle activity started in the Brazilian Amazon in the seventeenth century during the Portuguese colonization when mariners brought the first group of animals to supply the demand for milk and animal labor (Veiga *et al*., 2004). Initially, cattle ranching was established in lands with natural pasture in Pará State, in the Santarém and Marajó Island areas, expanding later to the lower Amazonas (Teixeira, 1953; Veiga *et al*., 2004; Láu, 2006). According to Ianni (1978) and Faminow (1997), farmers specialized in cattle, raised animals, and sold them around the largest cities, using rivers to transport them to the farthest areas with the intention of supplying the Amazonian market, which was geographically isolated from the rest of the country. According to Faminow (1997), Amazonian cattle ranching started its expansion to feed the local population, as transportation costs were not attractive in driving the region to a position of supplier or demander of beef to or from other Brazilian regions.

4.2 Specialization of Cattle Economy During the Last Decades

Since the late 1990s, cattle ranching has expanded and become more specialized, and this increase was a starting point for several discussions about its viability in that region because of climate and soils conditions. On the one hand, some studies stated that this activity could not be economically viable without subsidies because of the poor soils in the Brazilian Amazon, which were not rich in nutrients, could not retain enough water, and also could suffer compaction effects very quickly, causing the degradation of the pasture in fewer years than other Brazilian regions (Hecht, 1985, 1993; Veiga *et al.,* 2004). Some authors, such as Serrão (1986) and Veiga *et al.* (2004), stated that poor soils were the cause of 25 million ha of planted pasture in that region being degraded in 1983. On the other hand, specialists have said that the productivity of cattle ranching in the region could indeed be higher than the most productive areas of Brazil because of the expansion of the activity in areas with intermediate precipitation indices, low land prices, subsidies, low transportation costs, and because of the use of wood, which was sold to pay the earlier costs of cattle ranching implementation (Margulis, 2004; Arima *et al*., 2005).

Regardless of early claims that ranching was not viable in Amazonia given the poor soils, the region's cattle economy has emerged as the premier supplier to global beef markets (Arima *et al.,* 2005; Walker *et al.,* 2009). In parallel, pasture increased from 0.7% of the total area in 1970 to 10% in the early twenty-first century, and herds increased more than nine-fold, from 8 million animals in 1974 to 77 million by 2010 (Margulis, 2004; Veiga *et al*., 2004; IBGE, 2011) (Figure 10). Comparing participation of Amazonian herds with the Brazilian, in 1974 the Amazon frontier held only 9% of the Brazilian total number of animals. This number increased to 12% in 1980, and reached 17% in 1990. In 2000, the Amazon represented 28% of the total,

and the first decade of the new century was marked with the region holding almost 37% of all Brazilian bovines.

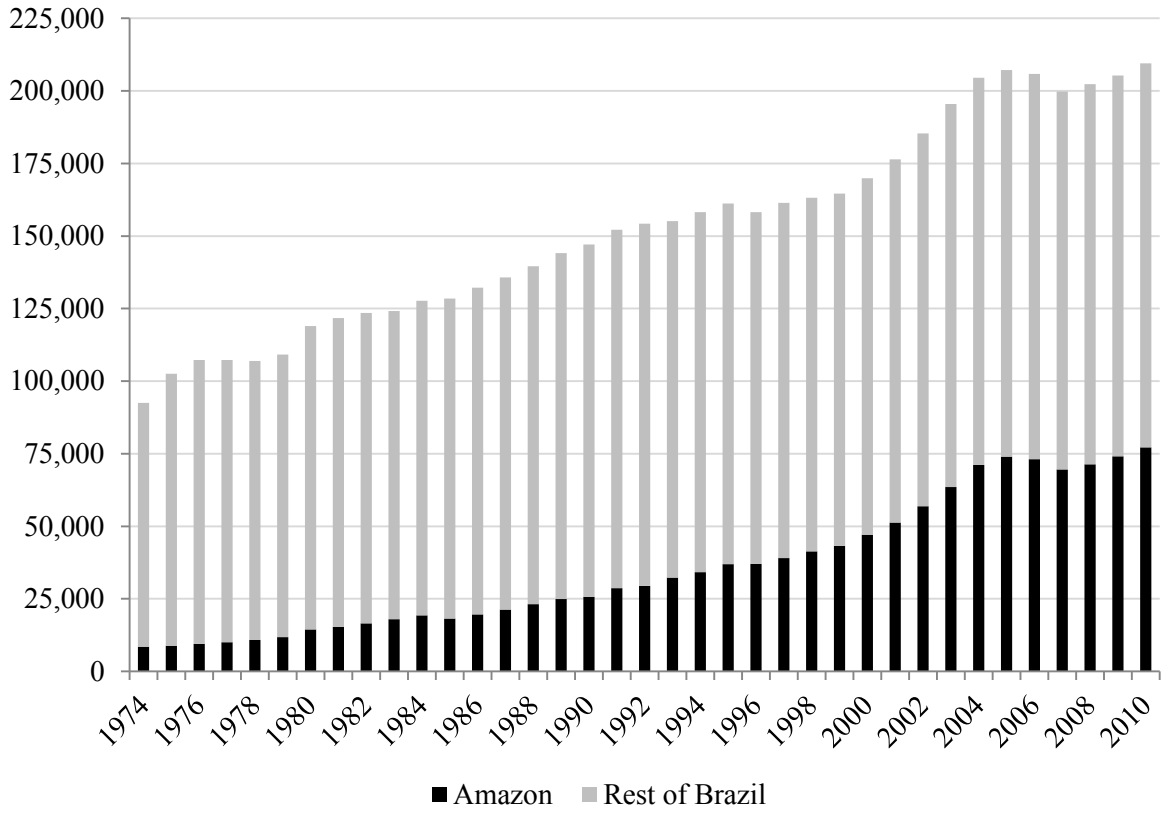


Figure 10. Evolution of Cattle Ranching (in thousand heads) in the Brazilian Amazon, 1974-2010.
Source: IBGE (2012). Pesquisa Pecuária Municipal.

The Brazilian plan to improve the Amazon condition brought actions to increase markets and expand commercialization. As a result, many industries have migrated to the region since the late 1990s. Roads are cited as the best facilitator to migration of slaughterhouses to the Brazilian Amazon (Arima *et al.,* 2005). During the last decade, many slaughterhouses moved to remote areas where, in the past, they were viewed as unproductive (Margulis, 2003; Arima *et al.,* 2005; Pereira and Barreto, 2008; Greenpeace, 2009). According to Santos *et al.* (2007), the quantity of

slaughterhouses installed in the Amazon increased from 13 in 1995 to 31 in 2006, 10 of those in Pará State. In 2012, the database from the *Ministry of Agriculture, Livestock and Supply* (Ministério da Agricultura, Pecuária e Abastecimento; MAPA) shows that there are 92 slaughterhouses in the Amazon, 15 of those in Pará (six of those owned by the largest protein processing group in the world, JBS). This last observation reveals a trend of concentration in the Amazon, with a small number of companies dominating beef processing and exports and controlling prices in the region, which is what attracted those large groups involved with animal slaughter and market (Santos *et al.,* 2007). In fact, when comparing prices of animals ready to be commercialized, it has been observed that better prices are paid in southeastern Brazil. In the northwestern part of the state of São Paulo, for example, an average of USD 3.29 was paid per kilogram of animal; while in Marabá, Pará, the most promising region of Pará State, this value was USD 2.93 per kilogram (Anualpec, 2006, 2011).

In the 1980s, Brazil experienced a cattle expansion rate of 2% per year. If only the Amazon frontier is considered, 6% of growth in the cattle herd per year was accomplished. In the 1990s, Brazilian herd growth was 1.5% per year; and the Amazon kept its growth almost constant at 6.3%. Between 2000 and 2007, the Brazilian bovine herd increased to a rate of 2.4% per year; and the Amazon states expanded their production to almost 6%. According to Pereira and Barreto (2005), if the Amazon participation were excluded from the Brazilian cattle expansion between 1990 and 2004, national expansion represented an average growth of only 0.7% per year. According to Barreto and Silva (2009) and Arima *et al.* (2005), this growth of cattle ranching in the Amazon with higher rates than in the rest of Brazil was favored by good rain distribution (which impacted pasture development), by subsidized credit, and by low price or free use of public land occupied illegally.

4.3 Causes of Cattle Expansion

Economic, structural, and seasonal factors affected cattle expansion in Brazil and the Amazon. Throughout the Brazilian Amazon, the expansion of livestock production was intimately linked to the expansion of roads, which resulted from development credits, favorable climatic conditions, production costs, and a variety of credits ranging from fiscal incentives to subsidized agricultural loans. Fiscal incentives directed to Amazon development provided agricultural expansion through subsidized credits that exceeded USD 40 million between 1969 and 1990 and stimulated investors to open land to ensure access to tax benefits (Hecht, 1985; Hecht and Cockburn, 1989; Barbosa, 2000; Helfand, 2001; Walker *et al.,* 2009). However, subsidies by themselves were not the only or main reason for cattle expansion. A range of actions during years of specialized cattle production in Brazil is responsible for the fast expansion. Other important factors affecting livestock production and expansion include classification of the region as free of FMD (which happened after many efforts from government through vaccination campaigns), strengthening of the department of animal health, animal tracking, and creation of regions (classified as cattle circuits). Movement of animals between those regions started to be monitored, and vaccination documentation started to be mandatory for those movements (Walker *et al.,* 2009). These actions resulted in the addition of 16 states into the free FMD zone between 1998 and 2010, including the states of Mato Grosso (2000), Tocantins (2001), Rondônia (2003), Acre (2005), and south-central Pará (2007)—all part of Brazilian Amazon territory (Figure 11).

The remaining portion of Pará State is expected to be included as an area free of FMD by MAPA in August 2012, which opens the international markets that do not require specific treatments to beef, known as countries with a general list (*lista geral*), which is a temporary list

created by MAPA in 1999 to allow slaughterhouses to export to countries that accept all the Brazilian legislation and make no extra demands. As soon as this step is reached, the World Organization for Animal Health (OIE) will start to analyze possibilities to recognize the entire state as free of FMD during the next meeting in May 2013, opening markets to the specific list *(lista específica)*, when Brazilian slaughterhouses are able to receive inspectors from importing countries. These importing countries demand requirements beyond those followed by *lista geral* to meet any item in the legislation or in order to control a disease that does not have (for example) traceability, hazard analysis and critical control points, search of specific pathogens, and control of waste and contaminants to conduct inspections. These requirements must be met before issuing authorization to export, for example, to Switzerland, USA, EU, Israel, South Africa, Singapore, Philippines, and Canada (Miranda, 2001; MAPA, 2012).

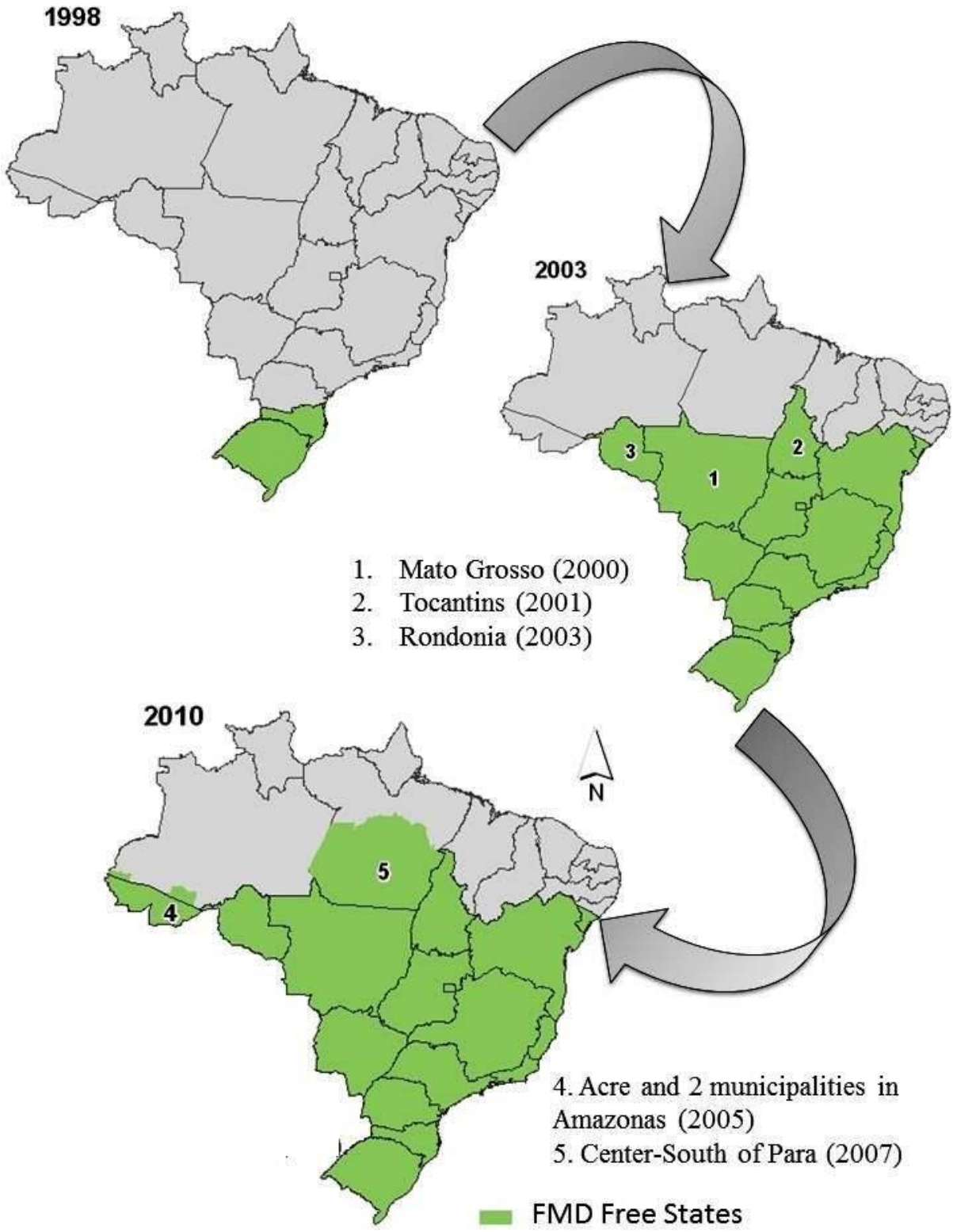


Figure 11. Evolution of FMD Status in the Brazilian States from 1998 to 2010.
Source: PNEFA (2008) and MAPA (2012).

Additional significant components impacting changes and expansion in cattle production in the Amazon are explained by reduction of transportation cost and time and by the increasing participation of Brazil in the global beef market[7] (Arima *et al.,* 2005; Salibury and Schmink, 2007; Walker *et al.,* 2009). According to Walker *et al.* (2009), because of the intervention of the military government in the 1960s to the end of the 1990s, the federal highway system in the Amazon was increased from 400 km to almost 57,000 km, affecting transportation costs and time. Walker *et al.* (2009) showed through GIS application that transportation time from Belém was reduced by more than 50 hours between 1968 and 1995, and this reduction in transportation time was spread through one-third of the Amazon geographical areas.

Walker *et al.* (2009) demystified the past affirmatives that ranching only developed in the Amazon because of the availability of subsidized credits and that in the absence of this intervention this activity was condemned to fail. In fact, through a combination of a new economic model, through *Plano Real* (started in 1994), and the control of Foot and Mouth Disease (FMD), cases of mad cow disease in Europe and investments in animals with better genetics have all impacted Brazilian exports. Brazilian exports provided products, including beef, at affordable prices across the world and affected the independence of production even in areas such as the Amazon. Actually, in 2008, it was shown that cattle herds increased 73% since *plano real* started, and only in 2007 did the exports of live animals improve 466% in the Amazon (Istoé, 2008).

[7] Since 2004, Brazil is the top beef exporter, with European Union (38%), Middle East (18%), and Russia (10%) as its main consumers (MDIC, 2005; Nepstad *et al.,* 2005).

4.4 Marching to the North

Since the 1990s, Brazilian production has increased and the global market has been opened to the products from that country. Farmers from southern Brazil, formerly producers of corn and coffee, started to invest in sugarcane to produce biofuel, and part of the agriculture and cattle ranching areas started to be pushed to regions where production costs were reduced, essentially to the Brazilian Amazon (Margulis, 2004; Veiga *et al.,* 2004). Despite increasing expansion of cattle activity in the Brazilian Amazon during the 1990s, until 2000 exports did not directly influence cattle expansion in the Brazilian Amazon.

Nevertheless, at the same time as Brazil expanded its participation in beef exports, the Amazon role was to supply the local demand and also the main exporter regions, located in southeastern Brazil (Walker *et al.,* 2009). According to Arima *et al.* (2005), in the early 2000s, 87% of the beef produced in the Brazilian Amazon was sold in other regions of Brazil. In 2005, Pereira and Barreto (2008) showed that 70% of Amazonian beef production was sold for consumption to São Paulo State, one of the top beef exporters by that year. Currently, this national demand for beef *in-natura* is still expanding, but now the Brazilian Amazon has increased its participation in the market overseas, which has jumped from 5% in 2000 to 28% in 2010 (MDIC, 2011). Walker *et al.* (2009) showed that, in 2006, the Amazon's participation in direct exports had reached countries in Latin America, European Union, Middle East, and Asia.

4.5 Cattle Ranching and its Connection to Deforestation

One of the most critical problems attributed to cattle ranching is loss of forest. The forest was opened to agriculture, but cattle were not significant before the 1960s. Since the late 1960s, many programs to promote Amazon integration into the rest of the country was being created;

and particularly, the IIPND wanted to promote cattle enterprises for beef export as a proxy of development (Barbosa, 2000). During the 1970s, colonists and corporate ranchers from the southeast region of Brazil and foreign enterprises benefited from investments in infrastructure and government subsidies (Walker *et al.,* 2009). Those new ranchers and entrepreneurs were attracted, in addition, by low land prices and by the generous tax rebates given by the Brazilian government.

According to Veiga *et al*. (2004), as of 1970, only 3% of the Amazon was deforested because of agriculture and cattle ranching; this number reached 10% by 2003. During the 1970s, more than 10 million ha of forest were thus converted to pasture. According to Hecht (1985), between 1966 and 1975, 38% of deforestation in the Brazilian Amazon occurred because of large-scale cattle ranching, while agriculture was responsible for 31% and highways for 27%. The main change in land use through the last 50 years was for expansion of pasture, which currently occupies around 80% of all deforested area (Margulis, 2004; Veiga *et al.*, 2004; Walker *et al.,* 2009).

As Faminow (1997) stated, cattle expansion increased the discussions about deforestation, and most of the forest clearance is more concentrated in areas where cattle are most developed: along the southwestern side (down from Acre to the northern part of Mato Grosso) and along the eastern side (from Pará to Tocantins). Other factors such as the new roads connecting the Amazon and the commodity prices in the international market also affected the deforestation rates in the region. Roads built in the Brazilian Amazon allowed cattle ranching to spread very quickly, and the deforestation peaks coincided with the high prices of commodities such as soy and beef (Barbosa, 2000; Veiga *et al.,* 2004; Nepstad, 2005).

4.5.1 Brazilian Actions to Deter Deforestation Related to Cattle Expansion

Despite the growing demand for beef, the government and often the beef industry itself acted to create barriers to deter animal expansion to newly deforested areas. The first barrier was created in 2001, when the legal reserve (or area that cannot be deforested) in the Amazon changed from 50 to 80% per lot, reducing the availability of land to expand cattle. Despite this law, only during the last five years has the government started to be present in the Amazon, mandating that laws are followed. An important factor to be added to the new deforestation law requirements is the demand from supermarkets, slaughterhouses, and importers, which started (jointly with the government) to track the properties that sell cattle to slaughterhouses. This action started after a report from Greenpeace (2009) was issued showing that different chains (such as leather, beef, and by-products) affected deforestation in the Brazilian Amazon. As a result of that report, which also addressed the cattle economy as the main emissary of GHG, farms were requested to not be part of new deforestation to convert areas to pasture. If a farm that will supply animals is part of new deforestation, the slaughterhouse can refuse to buy from that property. A farm's legal situation can be checked in a national integrated list, called *lista suja* (black list), which also includes properties where people are working in situations similar to slavery.

Reinforcing this initiative about the origin of beef in the Amazon, the *Federal Public Prosecution* (Ministério Público Federal*;* MPF) started, in 2009 with other inspection agencies, a campaign called *carne legal* (or legal beef) with the goal of educating the population about conscious consumption of beef products and the importance of knowing their origin. The main goal of this action is to reverse deforestation in the Amazon through a series of measures to monitor and punish farms and slaughterhouses that do not comply with land tenure and

environmental, social, and labor legislations (MPF, 2012). As part of this campaign, supermarkets were notified that, if they continued buying beef without checking the source, they would also be liable for environmental damage (MPF, 2012). The MPF website shows a list of those producers and slaughterhouses that are committed to this campaign; and in Belém, the Pará capital, it is possible to find those products with *origin certificate* in the main chains of grocery stores. It is clear that there is still no local demand for beef in accordance with its origin in local markets; but at the national and international levels, this seems a good start to curb deforestation and other problems associated with cattle ranching.

4.6 Cattle Expansion in Pará State

In southeastern Pará, where data for this dissertation was collected, colonization by small farmers has taken place since the late 1960s, with colonists being an expressive representation of land occupation and being responsible for one-third of forest loss (LASAT, 1998; Muchanata and Brown, 2003). Since that period, cattle ranching has been expanded to become an attractive economic activity. Today, southeastern Pará is one of the most economically productive regions for livestock (Arima *et al.,* 2005). The advantages of cattle ranching in the region are related to land rights and production and can be translated as (1) pasture as a means to secure land and increase its lot value; (2) pasture as a good way to secure income through rent; (3) cattle as an easier product to transport to market, not being tied to bad road conditions that are constant in that area; (4) the market for calves is well established; and (5) cash flows from milk and calf commercialization (Muchagata and Brown, 2003).

Those advantages made livestock in the state of Pará one of the most important economic activities, with 17.6 million animals in 2010, representing more than 8% of the total Brazilian herd. Although present throughout the territory of Pará, that total is heavily concentrated in the

southeastern part of the state, with approximately 64% of the actual total state (IBGE, 2012). In comparison, in 1974 Pará State was responsible for only 1.5% of the Brazilian herd, with 1.3 million animals on its pasture (Figure 12) (IBGE, 2012). In 51% of the municipalities located in that state, livestock is already the main economic activity, with emphasis on Marabá and its surrounding municipalities, where data collection for this dissertation was carried out.

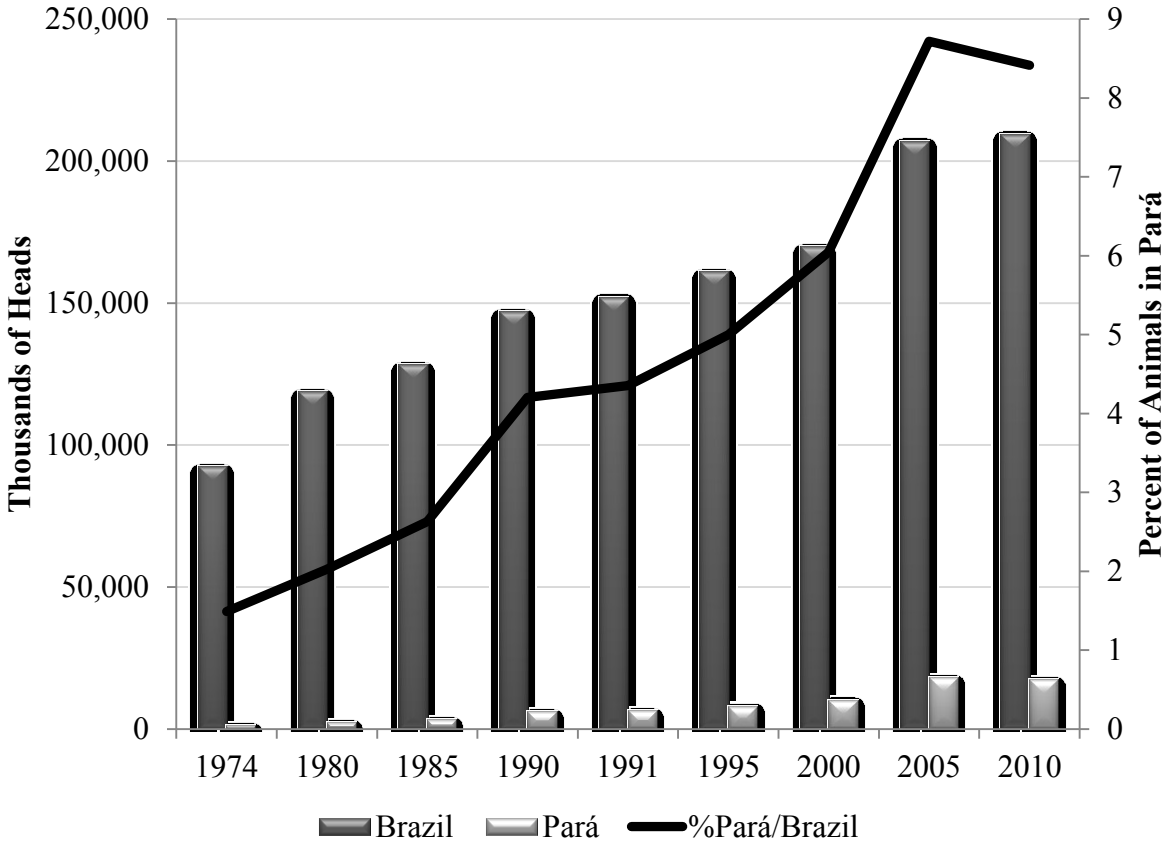


Figure 12. Evolution of Participation Livestock from Pará State in Brazil.
Source: IBGE – Pesquisa Pecuária Municipal

The expectation is that the market for beef will continue increasing and Pará will participate more in the international market. According to Angelken (2012) in a note issued by the secretary of communication of Pará, all state municipalities (144) can be recognized by the National Ministry of Agriculture, Livestock and Supply (MAPA) as free of FMD. The

expectation is that this action will happen by August 2012, and then the OIE can issue the international recognition in May 2013. If this happens, without changes in the settlement models and credit distribution, cattle ranching will become even more attractive to small producers. The projection of increasing participation of small producers in the cattle economy deserves more attention not only because of their participation in deforestation rates, but by their vulnerability if any case of FMD or other animal disease happens, which will cause a temporary loss of market for at least 6 months in any region within the radius of influence of the disease. Being settler owners of limited plots of land already converted to pasture, the concern is directed to their future as producers and dependents of the calf market.

4.7 Situating Settlers in the Global Cattle Economy

Increasing demand for beef and associated new deforestation rules contribute to the interaction between large- and smallholder (settlers) farmers during the earliest stages of production, which thus provides motivation for transitioning from a vertical production system to a horizontal one. Cattle ranching in the Amazon has traditionally been a vertically integrated activity with large enterprises performing each component of production, from calving and fattening operations to the slaughterhouse; while smallholders (and settlers) were specialized in dairy production (Arima and Uhl, 1996). Under a vertical integrated system, very little labor is necessary and not much interaction happened between small- and largeholders. That system breaks environmental and labor laws when large-scale ranching is always associated with deforestation and employment of workers in situations analogous to slavery, and this made land vulnerable to expropriation triggering contentious land conflicts between landless/growing SMOs and ranchers. Currently, however, the expectation is that a more benign and cooperative

spirit will emerge with the small- and large-holders given the need to interact in trade in order to enable the global cattle economy.

Currently, however, with the combination between the emerging global cattle economy and actions to curb deforestation related to the cattle economy, it has been observed in the field that largeholders have found it difficult to meet ever-increasing demands for beef and have instead turned to settlers to supply calves, a critical and relatively intensive component of the cattle production process. This trend is supported by recent ethnographic studies across the Amazon basin that has demonstrated that settlers are shifting from subsistence agriculture to a pasture-based farming system (Walker *et al.,* 2000; Walker, 2003; Browder *et al.,* 2008). Even traditional peoples who originally focused on extractive activities, such as the rubber tappers in the Chico Mendes reserve, have instead opted for cattle (Salisbury and Schmink, 2007).This confirms that, despite the majority of cattle and related deforestation being attributed to large-scale cattle ranches (largeholders with more than 5,000 animals), it is important to pay attention to those who have a small piece of land and are historically mobile agents of deforestation (Hecht and Cockburn, 1990; Almeida and Campari, 1995; Faminow, 1997; Walker *et al.,* 2000; Salisbury and Schmink, 2007).

At a settlement created with government support, shifting from subsistence agriculture to cattle ranching may be explained by the availability of credit and social programs that are provided to settlers when settlements are created, as well as by fast economic returns and increased global demand for beef (Arima *et al.,* 2005; Salibury and Schmink, 2007; Walker *et al.*, 2009). Despite the increasing participation of settlers in the cattle economy, their livestock system is distinct from a largeholder who is specialized in commercial production. In commercial production, animals are genetically specified to produce beef in a smaller period and

with better quality. Zebus (*Bos indicus)*, or animals with Indian origin, are focused on meat production and are quite resistant to heat—these are called beef cattle (*or gado de corte*). Dairy breeds are compounded by animals with European origin (*Bos Taurus),* or animals aimed for milk production, having an excellent daily production. Despite those specifications, there are those mixed animals, not pure in race, that are designated for both productions, milk and meat, that are most raised by settlers. Those mixed animals are most common in small farmers' lots for meeting better the dual needs of small producers (milk and calves). This last information was confirmed in the settlements and will be discussed ahead.

Within settlement areas, it is common to find settlers who started in animal production to have milk to feed the family and to sell for local microindustries specialized in production of byproducts. It is important to observe here that credits given for livestock production at the settlement level were originally meant to be directed to milk production. However, because of demand and perception of the mobility of animals, nonlabor investment, and diversity of production (milk and calves), settlers started to invest in selling or exchanging male calves and kept females on the farm as a guarantee of a future source of income and growth in the size of the herd.

In addition to the mentioned factors of attraction of small producers to the cattle economy, calf prices have become attractive to the local economy; and between 2005 and 2011, prices in southern Pará have increased on average from USD 137 per animal to USD 363 (Anualpec, 2006, 2011). On top of those perceptions, cattle among small producers are seen as a proxy of status and savings. Cattle are perceived as a liquid investment that can be sold immediately, and there are always *merchants* willing to buy calves in case of health problems or an unexpected economic crisis.

Historically, participation of largeholders in the cattle economy has been of interest, and facts at the ground level make this perception strong (Simon and Garagorry, 2005). For example, when a producer sells fattened animals to a slaughterhouse, usually those large companies only accept the purchase if the producer has enough animals to fill a truck that supports at least 18 live animals. Because smallholders do not have enough land to produce this quantity of animals at one time, the best way to participate in the market, found by large- and smallholders, is in the interaction of several small producers with a select group of large ranchers who live around the settlement area.

This interaction between large- and smallholders is responsible for the stagnation in production of subsistence crops in the Amazon (Simon and Garagorry, 2005). According to those authors, starting in 1989 crops such as beans *(Phaseolos vulgaris)*, cassava (*Manihot sculenta Crantz*), and coffee (*Coffea arabica* L.), which historically had their importance in that region, started to open space to more commercial productions such as soybeans (*Glycine Max)* and cattle ranching. Nevertheless, soybeans had its space more in northern Mato Grosso State, while cattle expanded toward the so-called arc of deforestation (Margulis, 2004).

A scenario described by Simon and Garagorry (2005) showed that in the Brazilian Amazon commercial agricultural development is being driven mainly by large-scale producers, while smallholders are finding it economically viable to replace forest and old crop lands with planted pasture. Walker *et al.* (1998), Poccard-Chapuis *et al.* (2001), and Vosti *et al.* (2003) attributed this gradual replacement of crops and forest lands to planted pasture in small-scale farms to a widespread process of p*ecuarização,* or expansion of cattle ranching economy toward the Amazon geographical limits. Participation of smallholders in the cattle economy has been perceived by Homma (1976) and Walker *et al.* (2000) when they made a comparison of cattle

herds and pasture clearance in areas owned by small producers (land < 100 ha). Homma (1976) found that smallholders living near the Transamazon highway in Altamira had an average herd size of 1.4 animals, distributed on 6.41 ha of pasture in 1975. This infers that there was 0.21 animal for each hectare of pasture. In the same region in 2000, Walker *et al.* found an average of 33 animals per property distributed in 37 ha of pasture land, meaning that there was 0.89 animal per each hectare of pasture. These numbers show that, over time, smallholders in the Amazon became more involved with the cattle economy, which as a consequence will drive more areas to be addressed as pasture. This behavior explains less areas being addressed to agriculture when studies from Homma (1976) and Walker *et al.* (2000) are compared. According to Homma (1976) the amount of land attributed to pasture was comparable to the amount used for agriculture, while Walker *et al. (*2000) found that only 9% of the total land used for pasture was designed for agriculture.

Given the environmental rhetoric discourse of INCRA policy for settlements and PDAs as elaborated by social movements, the expectation is that settlers would not be involved in the cattle economy. Nevertheless, data collected in the field show 71% of settlers involved in cattle. This participation of settlers in the cattle economy is problematic not only for increasing their contribution in the deforestation rates but also for exposing them to possible market crashes, which will leave no alternative for other production because of the settlers' reduced participation in agriculture. On the other hand, it is been said that a well-established economy may affect positively settlers' well-being, as that is an activity not dependent of seasonality and with a current well-established chain. However, in analyzing arguments for government investments in the creation of settlements, it is clear that investments in the cattle economy at the settlement level is only replicating all social and environmental problems that landless and SMOs struggle

against. Cattle ranching does not fulfill the need of promotion of sustainable activities, and government credits toward that activity are not reproducing the need of diversification as a solution for promotion of food security. In summary, policy and practice seem to be disconnected when settlers are being encouraged by government to invest in unsustainable practices. Nevertheless, in the section that follows, the research components show the main factors in the discussion as to why settlers are making this choice.

SECTION 2. CONCEPTUAL FRAMEWORK, METHODS AND DISCUSSION

As the history of development and its outcomes related to this dissertation topic are described in the previous three chapters, it is time to describe methods, study area, and results of this research. To do this, in the next 6 chapters I try to fit the history described in the previous chapters with data collected in the field. A conceptual framework brings together concepts of political ecology, household life cycle models, and environmental justice to justify variables used in the final analyses. Statistical and contextual analyses were performed with the objective of finding the main causes of settlers' economic behavior and social impacts. Questionnaires applied at the property level were essential to make comparisons in changes between previous data collection, in 2006, and the last one, in 2011. It was also essential to have access to government offices such as INCRA, EMATER, and BASA to understand policies as they are stated and practices as observed in the settlements, as well as to collect regional data related to soil conditions and production costs in the region. Last but not least, it was essential to have access to PDAs of two settlements to better understand all suggested economic activities and to compare with the final results shown in this dissertation.

CHAPTER 5: THEORIZING THE LOCAL ARTICULATION OF THE GLOBAL CATTLE ECONOMY IN AMAZONIA: POLITICAL ECOLOGY, HOUSEHOLD MODELS, AND ENVIRONMENTAL JUSTICE – A CONCEPTUAL FRAMEWORK

In the previous chapters, it has been shown how development efforts have affected social, political, and economic factors that have driven environmental change and influenced living conditions for the region's population since the onset of Amazonian development in the 1960s. Given the multidimensional nature of those changes in the Amazon and to address this dissertation's goals, the conceptual framework borrows from political ecology, recent theoretical work on household lifecycles, and concerns addressed by environmental justice.

There are many different definitions and concepts of political ecology, ranging from structuralist explanations of sociopolitical and economic factors causing environmental change to frameworks that engage power differentials, political action, and environmental policy critique. Theories employing household life cycle models likewise vary in structure and intent, providing foundations for evaluation of smallholders' decision-making regarding consumption, production, and labor allocation. Finally, environmental justice literature unites social and environmental demands in an attempt to advocate sustainable development. Land degradation, population growth, deforestation, and insertion of small producers into local and global markets as they are addressed in this dissertation are factors that can be applied to all three schools of thought used to develop a conceptual framework. In the discussion that follows, each school of thought is elaborated separately, and then a final theoretical framework is detailed that unites all three into a cohesive conceptual design that guides this research.

5.1 Political Ecology and Environmental Changes in the Brazilian Amazon

According to Neumann (2005), political ecology is a liberal political movement that appeared as a reaction against industrialization and modernity and defined the causes of environmental problems as stemming more from politics. Vayda and Walters (1999) stated that the influence of politics in affecting environmental change is related only to political decisions. Bryant (1992) defined the relative cause of environmental change as the conflict in excess to assess natural resources and political ramifications of nature variation as the major areas of inquiry in political ecology. Still after many discussions about the definition of political ecology, the most used is from Blaikie and Brookfield (1987) where it was stated that a combination of concerns of ecology associated to a broadly defined political economy would derive the dynamic dialectic between society and its effects on land-based resources. This dynamic permits interactions of scales, also defined as a chain of explanation, where individual *resources users* (in this dissertation, settlers) are linked to regional, national, and global political and economic outcomes (Blaikie, 1985; Hecht, 1985; Watts, 1987; Walker, 2003). In a seminal piece, Blaikie and Brookfield (1987) described political ecology under an approach to explain land degradation following what they refer to as *chain of explanation*. That chain linked historical events related to political and economic forces, such as credit policies affecting land use decision-making and consequently land degradation, and its consequences to degree of land management.

Historically, the discussion around political ecology was concerned with the scale, which surged because of the necessity to understand that what happens in local places is impacted by human environmental factors at different scales—often at exogenous levels (Brown and Purcell, 2004). The propensity in political ecology to think about wider scales, including political economy distinct from local culture and local ecology, has persisted. Contemporary, political

ecologists question how "the global political economy dictates local cultural and ecological processes, assuming that more decision-making authority transferred to the local scale would allow the forces of culture and ecology to resist those of political economy" (Brown and Purcell, 2004).

For this dissertation, the scale considers a case study in southeastern Pará (a state located in the Brazilian Amazon) and how development projects culminated in concerns that involve social, political, and economic processes that have been replicated in the region. These processes have been characterized by a sequence of irregular government planning and have yet to be explicitly interrogated in the understanding of Brazilian Amazon development processes such as industrialization, migration, governmental decision-making, and social movement resistance; and the environmental changes positioned on the rainforest have all impacted Amazonian development outcomes. Each of these processes have been continually rescaled by various political interests under pressure to advance their agendas and, in turn, have established a continuous process of interaction between political ecology concerns and Amazon development (Brown and Purcell, 2004).

From a human geography perspective, political ecology emerged as an understanding of how political processes and power inequalities influence the relationship between ecology and the economy (Peet and Watts, 2004). Robbins (2004) further elaborated an argument where degradation was directly related to environmental conflicts and social movements as a response to its linkage to poverty. Zimmerer (2010) added approaches related to contemporary environmentalism and political concerns to the concept of political ecology. At the heart is poverty, which is considered itself to be a proximate cause of environmental degradation (Guedes *et al.*, 2010). In fact, Robbins (2004) argued that poverty is not only a cause but also a

consequence of land degradation. Even though poverty is already inserted into the discussions about land degradation, not enough research has been conducted to detail income and its sources at the household level to confront the well-being of families living in settlement areas with environmental constraints (Barbieri and Bilsborrow, 2009; Guedes *et al.,* 2010). This lack of research about poverty can be explained by the level of disaggregation involved in income sources at the household level. For example, Barbieri and Bilsborrow (2009) cited that production for self-consumption is a source of income, but in the field, it is common to find people who do not count production for self-consumption as part of their monthly needs. Access to land *per se* should have a proxy value for reduction of poverty levels. Indeed, SMOs pursuing land reform are intended to, among other things, curb poverty and contribute to economic growth through access to land (Zimmerer and Basset, 2003).

In terms of the present topic for research here, government colonization programs and infrastructure projects led to rapid population growth and intended to reduce poverty through land distribution, which in turn became directly connected to land cover change and land conflicts. Political ecology has been employed in a variety of studies to examine contentious struggles for resources (Collier, 2000; Le Billon, 2001; Peet and Watts, 2004) and, specifically, land conflict in the study region (Simmons, 2004; Caldas *et al.*, 2007; Simmons *et al.,* 2007). Peluso and Watts (2001) have an edited volume that provides a number of conflict examples, including forest in Sierra Leone (Richards, 2001), ranching in Chiapas (Bobrow-Strain, 2001), oil in Nigeria (Watts, 2001), and peasants in Tanzania (Neumann, 2001). Political ecology has also been used to theorize land conflict in Amazonia and its connection to deforestation (Simmons *et al.*, 2007; Aldrich *et al.*, 2012). In general, conflicting government policies attracted capitalized agroindustry, among them and perhaps most notably cattle ranching, where ranchers

were lured with the promise of large tracts of land at the same time as the government was encouraging the resettlement of smallholders with the promise of access to land. The events brought both large ranchers and smallholder farmers into the region and laid the foundation for a new source of conflict, namely land scarcity (Simmons, 2004).

The situation of land scarcity triggered actions of SMOs to systematize groups and call for land reform, mainly in the third world, as SMOs' goals include curbing poverty and promoting equality (Zimmerer and Basset, 2003). In general, the various discussions about political ecology declare that all resources (cropland, water, forest, oil, etc.) are likely to be scarce and generate conflicts of any sort if it is not managed according to the concepts of sustainability. The base for developing the assumptions of political ecology is related to scarcity, which is often connected to three concerns: land degradation, population growth, and inequality of distribution of resources (Peluso and Watts, 2001; Basset and Zimmerer, 2003; Peet and Watts, 2004). In fact, these three concerns are present in the current position of cattle expansion in southern Pará, for example, where this study was conducted. Subsidies, land, and credit were distributed as a means to protect the national border and to make the area developed in the future. As a result of those actions, it opened the discussions about land degradation as part of high deforestation rates. From that moment, land started to be evaluated as a scarce resource, and the arrival of new people drove new occupations toward forested areas.

According to Hecht (2004), population and market are the dominant framework to explain forest loss. These two factors together are responsible for the changes in land use in southern Pará in the last decades. As cited before, facilities generated by the government (such as subsidies, roads, and land) built a perfect case study for the insertion of political ecology concepts into the region. Despite elaborate plans outlined by the government and SMOs to

promote sustainable development, the reality is that the programs are not working as originally planned, and a disconnection between policy and practice is precisely one of the primary issues amenable to a political ecology framework. In order to understand deforestation and to ultimately slow its pace or reverse the environmental damage, it is important to understand what the different agents (i.e., small farmers, ranchers, loggers, etc.) on the ground are actually doing and what motivates their land use decisions. Therefore, in line with political ecology theorization, the identification and examination of the *chain of explanation* is the necessary first step that this research performs.

5.2 Household Lifecycles and Economic Changes at the Settlement Level

Following the disconnect between policy and practice identified in this research, the framework in this dissertation considers household life cycles, with specific analysis of settlers' economic decisions, particularly their decision to invest in cattle as opposed to other alternative economic activities.

According to Walker *et al.* (2002), with the purpose of explaining the impact of new economic reality on smallholders and to adapt concepts of household life cycles to the current institutional environment of the Brazilian Amazon, the Chayanovian theory can be added to the household economy framework. In this new explanation, markets for inputs, outputs, and capital are included; and smallholders enter the greater economy by either hiring or selling their labor or selling their production outputs.

In the past, the Chayanovian model stated that smallholders did not sell or hire external labor and that they tried to maximize utility of production to meet family consumption needs (Chayanov, 1925; Thorner *et al.*, 1966; Ellis, 1993). From this perspective, production is defined as a ratio (c/w) of nonworkers (e.g., consumers, c) and workers (w) in a family nucleus.

Chayanov considered this ratio and its relationship to family structure (Chayanov, 1925; Thorner *et al.*, 1966; Ellis, 1993). This ratio accounted for the dependents in the family and varied according to the family life cycle. As more dependents enter the family and as more of the household's behavior follows a risk aversion action, the smallholders direct their production to make supplies available to the family.

Ellis (1993) and Barnum and Squire (1979) developed a model that contrasts with the Chayanovian model where markets exist for labor and where farm households can hire and sell labor (on-farm and off-farm employment) under a specified market wage. Smallholders have to choose between consuming their products or selling the production in order to purchase nonfarm consumption goods. At this moment, the household ignores risks; and this is related to the reduction of dependency experienced after years of settlement, i.e., children grew up and left or are now part of the workforce. The production function is related to farm production (output), which can be either commercialized or consumed. A utility function applied to this behavior is composed of three items: time for production of outputs and for leisure, production for consumption, and nonfarm goods acquired[8]. In summary, family and farm size, age and education of household head, and the history of the household in agriculture are essential variables in defining the dynamic of land use and engagement in markets (source of income).

For this dissertation, a model is specified borrowing variables developed by Chayanov (1925) and Barnum and Squire (1979) and adapted to the Amazon reality as Walker and Homma (1996), Pichón (1997), McCracken *et al*. (1999), Walker *et al.* (2002), and Vanwey *et al.* (2007) did previously. These studies will be essential in the development of a model to assess factors

[8] $U = f\ (T_z, C, M)$; where: T_z is time for production of outputs and for leisure; C is production for consumption; and M is nonfarm goods acquired (Ellis, 1993).

that influence smallholders to invest in cattle as opposed to other alternative activities. Those authors identified important key variables such as time on property, age of household, and property size to explain settlers' choice of cattle ranching. For this dissertation research, additional variables were included based on responses from the pilot survey conducted in 2010 by this author, in which an open-ended question queried the respondents on the main factors contributing to the settlers' decision to invest in cattle. A myriad of responses resulted, including abundance of credit for cattle and other activities and access to government subsidies to enhance education. Specific questions involving income sources, market options, and rationality of decisions were included in the final survey to elicit the prevailing factors underlying production decisions, which, in turn, were incorporated into the model and contextual analysis.

5.3. Environmental Justice as Justification for Land Distribution

Finally, all Social Movement Organizations (SMOs) demanding land redistribution through agrarian reform projects use the rhetoric of environmental justice to reduce social differences. According to Taylor (2000), environmental justice represents practical evidence of how environmental policies integrated with people's conduct direct the results related to negative impact on nature and on communities that are dependent on the surrounding environment. Environmental justice considers the first movement where human–human and human–nature relations are linked to a social lens that involves race, class, or gender. According to Walker (2009), the environmental justice discussion became recurrent when interaction between environment and social difference was debated. In Brazil, all government efforts that led to deforestation—land concentration and population growth—put together a mass of people who were not benefited and/or excluded and decided to resist the social differences through resistance and struggle; at that moment, rights were demanded for a massive group forgotten inside the

forest (Paiva, 2007). That group originated a campaign in the Amazon that included concepts of environmental justice in the form of promotion of equality and sovereignty through settlements within the forest. Those settlements had a special element regarding promotion of sustainability through family farming and promotion of alternative productions that included diversified production.

Environmental and social justices were, together, using concepts of food sovereignty through access of the right to produce on their own land (Ziegler, 2004; Rosset, 2009). It was also claimed that food security could be assured through access to productive land and participation in the local markets. However, land reforms failed when land beneficiaries ended up with no productive land and debts in remote locations with a precarious engagement with the local market (Sobhan, 1993; Rosset, 2009). In practice, this pursuit of land reform could generate a situation of environmental justice if *land reform from below* would be able to promote food security inside settlements and around local towns with crops produced locally (Leite *et al.,* 2004). Not only could food security benefit from *land reform from below,* but so could local diversity through extractive activities, intercropping, and involvement with small livestock; and also environmental justice, if fair access to environmental resources and information was being followed as it was conceptualized (Paiva, 2007).

The original concern of SMOs in the region was their claims for social justice through agrarian reform and sustainable development. With the growing national and international concern for the environment and greater knowledge of the implications of development on deforestation, environmental activists and movements made it an important agenda item. The challenge was to balance social and environmental needs, and to do this, sustainable development has been brought forward as the key strategy within the environmental justice

framework. Currently, there is a merging of concerns, at least rhetorically. Traditionally, movements interested in social justice have included an environmental agenda, and now, those traditionally environmental movements have added social development to their list of concerns. However, there is a growing critique that environmental justice has become a convenient guide to hide the real intent of these movements (Paiva, 2007).

Broadly, environmental justice became a movement of global scale addressed to bring discussions and actions against unequal economic development and environmental degradation. In Brazil, according to Wolford (2008), environmental justice is connected to agrarian problems triggered by a history of land concentration. In the Amazon, campaigns to promote environmental justice are closely linked to the debate to reduce deforestation and to build a political approach focused mainly on the preservation of biodiversity. To do so, according to Paiva (2007), it is emphasized that environmental justice can be reached through promotion of agrarian reform, reorganization of land use, and establishment of public policies that promote alternatives for promotion of better natural resource use and that demonstrate how the forest's resources are becoming exhausted. Additionally, those campaigns are focused on identifying and curbing sources of socioenvironmental conflicts in the Amazon (Paiva, 2007).

5.4 Combining Political Ecology, Household Life Cycle, and Environmental Justice

These schools of thought—political ecology, household life cycle, and environmental justice—influence my theoretical framework and the fusionist methodology I employ that combining qualitative and quantitative research informs the specification of a conceptual model to gauge smallholders' land use decisions and tests with a variety of data. More than a model of smallholder decision making, this research involves (1) results of policies affecting

environmental landscapes, (2) social and economic characteristics affecting household decisions, and (3) the struggle for equality and justice bringing together groups of landless demanding land to promote sovereignty. In this dissertation, the history of land occupation, policy prescription, and the farming system characteristics of settlers are considered with the purpose of understanding how and why settlers engage in cattle ranching instead of agroecology. To illustrate a chain of explanation, this dissertation framework borrows from a figure in Pichón (1997) and identifies key factors from the literature that influence land use decisions and, consequently, change. Together, the roots of these schools of thought are important in defining variables for a statistical model and a contextual foundation for qualitative analysis.

5.5 Specifying a Conceptual Model of Smallholder Decision Making

As Figure 13 shows, demographic and economic factors are included in the conceptual framework, such as socioeconomic characteristics of settlers and farming systems, institutional environment and technology, and land quality—all are essential for describing the decision of settlers in using their land. Those characteristics bring together borrowed variables and concepts from political ecology, household life cycle, and environmental justice. For example, from political ecology, this model borrows the interaction between human–environment through the relationship between income and land use decisions (farm-based decisions). From household life cycles, variables are proposed such as family and lot size, age, education of household head, and time on property that will directly affect factors of production allocated and production investment, as well as employment on-farm and off-farm and, consequently, income earned per property. Contemporary institutional environment and technology are added as a response to creation of settlements with (consequently) access to land, technical support access to credits, and labor markets. The pursuit of equality and sovereignty by the landless and SMOs, through

land distribution generates creation of settlements with the promise of promotion of less pressure on the local environment, bringing together the principles of environmental justice. In these new models of settlements, settlers' actions are shown to be directly linked to land use change and promotion of intensity of its use. Although institutional environment and technology and household characteristics are playing an essential function on land use decisions (farm-based activities), the natural resource base (such as soil quality and slope) has been added as a special factor to add to the dynamic proposed by this framework.

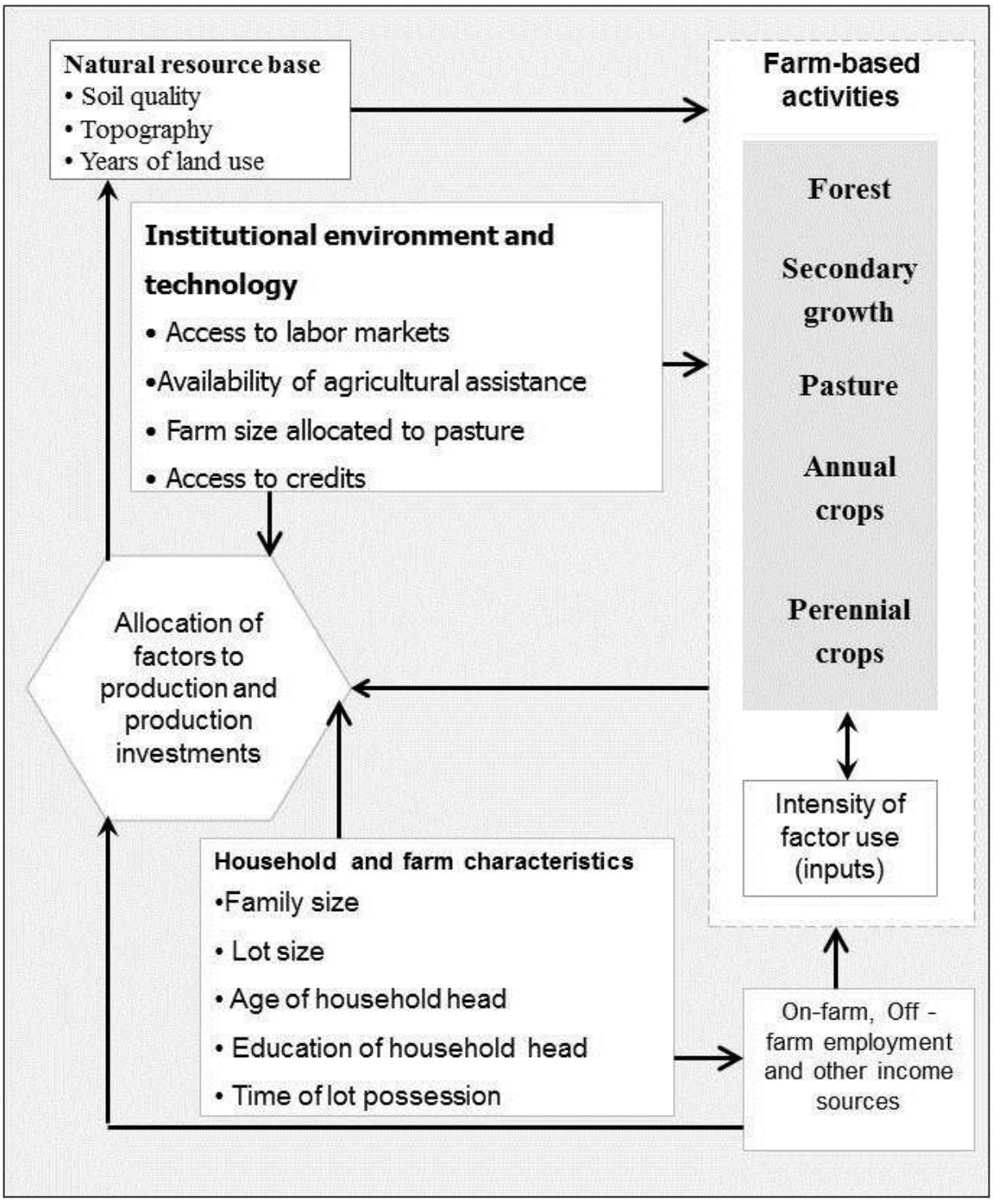


Figure 13. Conceptual Framework (adapted from Pichón, 1997).

The settlers and farm characteristics are present in this model, which includes the essential variables that drive the production decisions and the allocation of production factors and investments. The settlers' family structure (size and composition) have been used to define household land use behavior in the absence of markets (dependency ratio). Chayanovian theory thus proposes a model to analyze the household choice between leisure and income. Utility of household is thus a function of time allocated for income and leisure.

The influence of markets and settlers' participation in the cattle economy in this framework can be identified directly through the amount of land allocated to pasture as part of the farm-based activities. Three factors affect the decision of land use in this framework: natural resource base or land quality, institutional environment and technology, and the intensity of inputs used for production. As part of the natural resource base, soil quality has been discussed as a key factor in the decision of pasture formation. Institutional environment and technology will account for the participation of the government as a key element responsible in directing settlers toward a particular economic activity. The role of government can be evaluated by the access to credit and technical assistance. Besides government incentives, family structure will be important in the decision of land use given the role of farm and family size in deciding the amount of land to be designated for pasture formation.

Soil quality, topography, and the time that the land has been used for agriculture are important factors in showing how fragile natural resources exposed to markets may become over time. These characteristics will be affected by the quantity of factors allocated to improve production. Institutional environment and technology, settlers and farm characteristics, on-farm and off-farm employment and other benefits (such as credit and social programs), and farm-based activities will thus each be represented as a particular farm characteristic.

This conceptual framework is not a static model; and it borrows variables from studies developed by Walker and Homma (1996), Pichón (1997), McCracken *et al*. (1999), Walker *et al*. (2002), Aldrich *et al*. (2006), Caldas *et al*. (2007), and Vanwey *et al.* (2007) and adapted by inserting the PA resident as a producer and as an important agent in both global and local economies. This framework is opened to the insertion of variables included to meet the current reality of the case study, such as the role of government when it established the social programs that distribute resources (cash transfer); and such as the *bolsa-família*, a welfare program that provides an economic incentive for families to keep their children in school rather than on the farm as labor. Access to credit as part of the creation of settlements will be inserted in this new conceptual framework under other income sources. The main interest here is to define all income and its use (e.g., on-farm and off-farm employment, government credits to develop the settlement, social programs to distribute resources to poor people) and their allocation to cattle production, whether via intensified labor, technological, or other input use—which would theoretically diversify economic possibilities for settlers, as well as encourage participation in the cattle economy.

All changes experienced in the small farm system are constrained by time. Time is essential in redefining the dependency ratio, results of government efforts, market improvements, and soil degradation. I assume that these factors together are the most important in defining land use boundaries and, consequently, the reasons explaining the settlers' participation in the global economy. The consequences of settlers' participation in the cattle economy can be hypothesized as (1) settlers will increase their participation in the cattle economy with consequent decline of subsistence production; (2) settlers will be more vulnerable to a market crash; and (3) social relationships between settlers and largeholders will experience changes.

CHAPTER 6: RESEARCH DESIGN AND METHODS

6.1 Research Design

The broad goal of this study is to demonstrate how policy outlined in the *New Rural World* program and the regulations for creating settlements is far from practices at the settlement level. With this, I aim to understand settlers' production decisions, particularly their choice to engage in the cattle economy instead of environmentally beneficial alternative economic activities proposed by the SMOs and government policy and, in turn, the effects this choice has on their well-being. The motivation of this dissertation is to understand the disconnect between policy and practice and the fact that PA settlers are, in fact, part of the cattle economy, which has substantial consequences for the environment as well as increased economic vulnerability to settlers and their well-being. Those concerns, together with the need to identify barriers to sustainable development, makes up the main goals of this dissertation, which are to (1) understand why and how settlers are engaged in the expanding global cattle economy, (2) explore the positive and negative implications for their well-being, and (3) examine how a production system that integrates cattle activities between small- and largeholders may mitigate the traditionally contentious relationships between small- and largeholders in the region. The ultimate goal is to understand the current situation in the study region with the aim to identify potential barriers to green alternatives, or agroecology, which will provide valuable input to policy makers and to the efforts to support genuine sustainable development approaches in settlement areas within Amazonia.

These goals lead to the specification of the following objectives and related hypotheses to be examined by research. The first objective **(1)** is to identify the main factors motivating settlers to invest in cattle as opposed to agroforestry or other green activities proposed by policy. This

objective leads to two research hypotheses to be tested through statistical analyses. The first research hypothesis, **H1,** maintains that smallholder involvement in the cattle economy will increase when involvement in the cattle economy is compared between 2006 and 2011. The expectation is that, given the cattle market's new policy and demand, the economic rationale will lead to continued and increased involvement in cattle. The second research hypothesis, **H2,** argues that settlers are motivated to invest in cattle by factors described in the conceptual framework such as availability of credit, age of household, and time on property. These variables are derived from previous studies related to decision making of smallholders in that region (e.g., see Walker and Homma, 1996; Pichón, 1997; Walker *et al.*, 2000; Caldas *et al*., 2007) and will be explained in a logit model.

The second objective **(2)** of this study is to examine how engagement in cattle has impacted smallholder well-being. From this objective a third research hypothesis, **H3,** is derived**,** which maintains that involvement in the cattle economy will affect smallholders' well-being when data from 2006 and 2011 are compared. Given the importance of cattle from the region in national and international markets, the expectation from market openings, a well-established production chain, and a high demand for animals is that smallholders in the region will see improvements in well-being from 2006 to 2011.

Finally, objective three **(3)** aims to identify how the insertion of settlers into the global cattle economy has impacted the traditionally contentious relationship between settlers and largeholders in the region and whether this has mitigated violent land conflict. The expectation here is that contentious relationships related to land will decline as settlers and largeholders begin to cooperate in order to provide for the global beef demand. However, this is uncertain, given the continuous and increasing action of SMOs in the region to engage in land occupation

in order to force government to promote land reform and the attraction this has for more people to be part of the movement. Although a statistical analysis may be difficult, the changing dynamics of land conflict can be illuminated with a more qualitative approach combining household surveys, key informant interviews, and archival research at local museums and CPT archives.

Ultimately, an examination of the above objectives will provide valuable information that will allow for the assessment of whether settlers made informed and rational decisions and for the identification of barriers to green alternatives (such as soil quality) that will provide policy recommendations to support sustainable development in the region. To address the research objectives, this study involved multiple data and methods fusing qualitative and quantitative approaches, including (1) household surveys in six PA settlements; (2) key informant interviews with representatives of the community, SMOs, banks, and government offices responsible for settlement creation; and (3) collection of regional data from governmental databases, such as the Brazilian Institute of Geography and Statistics (IBGE), National Institute for Space Research (INPE), and Brazilian Agricultural Research Corporation (EMBRAPA) (Table 11). In terms of methodology, the PDA is an essential document to compare activities on the ground as opposed to activities stated by policy. Additionally, a panel data set was created using data collected by Simmons *et al.* in 2006 as a base with subsequent data collected at the same households by the author in 2011. Panel data was available, but it was not appropriate to do a panel regression because the original data was not collected with a second data collection in mind and also because data related to cattle rented and owned were not comparable. Those data collected in six settlements in both years aimed to understand economic activities and social welfare at the property level. Statistical analyses and hypotheses testing were performed with data from the

panel set and the secondary regional data. Finally, key informant interviews were gathered to understand both, the process of settlement creation and settlers' involvement in the cattle economy. Collection of regional data at government sources, such as soils types and production costs were used to provide resources for the contextual analyses that contribute to the general understanding of change dynamics between small- (or settlers) and largeholders, as well as insight into the barriers and potential policy implications to promote sustainable development in conformance with REDD+ at the settlement level.

Table 11. Quantity of Actors and Key Informant Interviews Conducted in 2011

Settlements (6)	Settlers (105)
Settlements Representatives (8)	Social Movements (4)
Technical Support (3)	Government (4)
Bank – Credit (1)	Others (4)

6.2 Panel Data Set – Sample Design

In 2006, research by Simmons *et al.* was designed to reach 20% of the lots in a select set of settlements in the states of Para and Rondônia. To achieve a good spatial representation within the settlement, each settlement was divided into quadrants; and inside each division, a random selection of households was followed. The random selection process consisted of a sampling of every third house on each road; if the person responsible for the chosen lot was not present, the next house was selected, and so on. The research, in 2006, was designed with the objective to

have covered lots from the entry point of the settlement (usually closer to roads and markets) through to the end of the settlement (farther from markets). The design proposed a good spatial representation of settlements, and different effects were experienced due to accessibility. A subsample of six settlements in southeastern Pará was derived from the 2006 field campaign and was used as a baseline for the creation of the panel data set to address the research objectives of this dissertation.

In 2011, 105 lots were revisited following the list of households provided by the 2006 survey, representing 65% of the original sample. This survey method was successful, and the expectation was that original settlers would be available for the follow-up sample. This expectation derives from a rule established that states, when a settlement is created, that land cannot be sold unless the householder pay for the land title, which cannot happen before 10 years. Usually, settlers do not buy the land title and keep the land in the same family. In fact, during my previous study conducted in 2010, I found cases where the person from 2006 died or moved to the city, but the family in the lot remains the same and the lot characteristics (land use, production, and market interaction) remained within the same family.

6.3 Research Methodology

With data collected following the process described above, this research involved two primary components: statistical analyses to address objectives 1 and 2 (hypotheses 1, 2, and 3) and contextual analyses to address objective 3—each to be discussed in turn.

6.3.1 Statistical Analyses

The first component of this research involves statistical analyses to address objectives 1 and 2 and hypotheses 1, 2, and 3.

For **OBJECTIVE ONE,** to identify the main factors motivating settlers to invest in cattle as opposed to agroforestry or other green activities proposed by policy and to test the two hypotheses, a series of statistical analyses were performed.

6.3.1.1 Paired Sample *T*-test: Means of Difference

To test **hypothesis 1** (**H1)** that PA resident involvement in the cattle economy will increase between T1 (2006) and T2 (2011), the panel data set and change indicators derived from key variables were essential. The years when data collection were performed are important because T1, 2006, corresponds to the year before southeastern Pará State received permission to export beef given eradication of hoof and mouth disease (FMD), and T2, 2011, data will reflect cattle expansion given new slaughterhouses and greater participation of Amazonia in total beef export, due to the opening of part of that state to beef export. To address this hypothesis, a series of questions from the surveys allowed for the identification of variables for both time periods (T1: 2006 and T2: 2011) and a comparison of change. Key questions from the household surveys (Appendix C) are as follows:

(a) $\boldsymbol{Y_c}$ **-** do you have cattle – n/y – 0/1;

(b) $\boldsymbol{X_p}$- what is the size of area used for pasture (in hectares);

(c) $\boldsymbol{X_s}$- what is your lot size (in hectares);

(d) $\boldsymbol{X_c}$ **-** did you receive credit for cattle – n/y – 0/1;

(e) $\boldsymbol{X_o}$ **-** did you receive credit for other activities – n/y – 0/1;

(f) $\boldsymbol{X_{DR}}$ **–** how many people live on the lot (quantity) and how old are they (years);

(g) $\boldsymbol{X_{ws}}$ **–** how many days per year you and family members sell work to other properties (days per year);

(h) $\boldsymbol{X_{y}}$ **–** how old is the household head (years);

(i) $\boldsymbol{X_{g}}$ **–** are you involved in any other alternative production than cattle – n/y – 0/1;

(j) $\boldsymbol{X_{edu}}$ – how many years did the household head go to school (years);

(l) $\boldsymbol{X_{t}}$ - how long have you been on this property (years).

These variables were selected as a result of preliminary analyses of statistical significance and consideration of multicollinearity. Correlation tests were run to confirm positive correlation on paired data that would make possible the use of the panel data set. In addition to tests with the statistical models, a pilot study conducted during the summer of 2010 with a subsample from the study region was essential to identify factors affecting household economic decisions. Given the predominant literature and recent research findings that show the expansion of the global cattle economy in the region and an increase in the involvement of small farmers in cattle ranching across the Amazon, the expectation is that the number of respondents identifying livestock as a prime activity would increase, thus **statistical analyses of the panel data** would allow a rejection of the null hypotheses that involvement in cattle activities would decrease. The expectation is that there will be an increase in each variable (quantity of animals, pasture size, and quantity of settlers investing in cattle as prime activity). Paired ***t*-tests** and χ^2 were performed to determine if the results are statistically significant and whether the null hypotheses can be rejected.

6.3.1.2. Regression Analyses

The second set of analyses was performed to better understand factors that influence the decision making of settlers. The second research hypothesis, **H2, maintains** that settlers are motivated to invest in cattle by factors described in the conceptual framework presented in chapter 5, such as availability of credit, age of household, and time on property. **Here, all variables are from data collected in 2011.** Two regression analyses were performed, including linear and logistic regressions. In both models, the variables specified were theoretically derived from key literature as discussed in chapter 5. The primary concern was not to create the strongest explanatory model, but to test the validity of each variable and thus the theories from which they are derived.

For **linear regression,** the first dependent variable was the number of cattle per household. This was problematic because field research revealed that the number of cattle per household did not consistently reflect the number of cattle owned by the household. In fact, many households rented their land, so the cattle did not belong to the settler. To further complicate the use of this indicator, there is concern that respondents did not consistently answer this question. In some cases, they responded by providing the number of cattle on their property, whether they owned them or not. In other cases, however, there is reason to believe that they underreported the cattle on their property, even that the land was rented. The same problem is presented with the use of hectares in pasture as the dependent variable; given the possibility of pasture rented, it is not clear that this variable would adequately indicate the degree of the settler's involvement in cattle. Those unexpected findings concerning the quantity of cattle owned and the area of pasture used in the property were understood as main factors deriving a not well-fit model.

Because of problems related above, a final **logistic regression** model was specified, identifying $\boldsymbol{cattle}$ as the dependent variable represented by a binary indicator (0/1) indicating whether settlers owned the cattle or not. This identification was possible after linear and logistic regressions were specified with data limited to the 2010 data set, when the survey was tested. For reasons explained earlier, a linear model did not fit well for either year. For **logistic regression** specified in 2010, independent variables were limited to indicators included, such as:

$\boldsymbol{Age}$: Age of household in years;

$\boldsymbol{Edu}$**:** Quantity of years the household went to school;

$\boldsymbol{Past}$**:** Quantity of hectares in each lot that are converted to pasture;

$\boldsymbol{Def}$**:** Quantity of hectares in each lot that was deforested since the household started to use the lot;

$\boldsymbol{Pple}$**:** Quantity of people living on each lot;

$\boldsymbol{Lsz}$**:** Lot size, in hectares;

$\boldsymbol{\varepsilon}$ **:** is the error term.

The expectation of those variables used in the tested sample from 2010 were that quantity of years household went to school, pasture area, deforested area, and lot size would have a positive relationship with cattle ownership (no/yes – 0/1). Age of household and quantity of people were expected to experience a negative relationship with the dependent variable (Table 12).

Table 12. Description of Variables Used in the Final Logistic Regression with Data Collected in 2010

Variable Name	Acronym	Unit	Expected Signal	Definition
Cattle	Cattle (0/1)	Dummy	Dependent Variable	=1 if settler has cattle ; =0 if not.
Age	Age_	years	(+/-)	Age of household at moment of interview.
Education	Edu	years	(+)	Quantity of years household went to school.
Pasture Size	Past	Hectares (ha)	(+)	Number of hectare per lot under pasture.
Deforested Area	Def	Hectares (ha)	(+)	Quantity of hectares deforested since household arrived on the lot.
People	Pple	Quantity (#)	(-)	Quantity of people living per lot.
Lot Size	Lot_Size	Hectares (ha)	(+)	Size total of lot (or lots) the settler owns.

The outcomes for the regression used with 2010 data showed that ***Past*** was the only variable with significance at that time (Table 13). Years of education and quantity of people living on the lot presented a relationship with the dependent variable different than expected.

However, these unexpected findings may be explained by the size of the sample I used, only 30; collected in a subsample of three settlements. Based on the regression using the data of 2010 and in the changes I perceived and the last field questionnaire test, I added variables that can be essential in the settlers' decision of owning cattle or not. The new variables included for 2011 data collection were related to prices and access to the several kinds of credits directed to cattle and other investments. Using regression with data from 2010, it was identified that those variables and model better fit the proposed study. Additionally, a suite of independent variables derived from the literature and described in chapter 5 were included as influential factors.

Table 13. Logistic Regression of Data Collected in 2010

	Dependent Variable: Cattle (dummy) n=30		
Independent Variables	**Coefficient**	**Standard Error**	**P> z**
Age	-0.0023	0.0077	0.765
Education	-0.0047	0.036	0.899
Pasture Size	0.0079	0.0040	**0.063*****
Deforested Area	0.0019	0.0092	0.835
People	0.0070	0.0258	0.788
Lot Size	0.0054	0.0091	0.559
Constant	0.5144	0.5490	0.354
Prob > χ^2 =	0.4722		
Log likelihood =	5.3666		
Pseudo R2 =	-0.008		

*Statistically significant at 1%; *** Statistically significant at 10%.

A **final logistic model** used in this dissertation uses as the dependent variable the response of settlers if they have or have not cattle on their property (=0, if settler does not have cattle, =1 if settler has cattle); and as independent variables: pasture area, property size, access of credits for cattle, access of credits for other activities, dependency ratio, employment (or work sold) off farm, age of household, involvement in green alternatives, and a variable that combined access to benefits and years of education of household, as a proxy for education. In the final logit model, a linear relationship is expected between dependent and independent variables as a result of the following equation:

$$Logit\ (cattle) = \beta_1 + \beta_2 Past\_Size + \beta_3 Lot\_Size + \beta_4 Cred\_cattle + \beta_5 Cred\_other + \beta_6 Dep\_Ratio + \beta_7 worksold + \beta_8 Age\_hh + \beta_9 Green\_Alt + \beta_{10} Eduproxy + \beta_{11} time\_lot + U_i \quad (1)$$

where

cattle is the dependent variable represented by a binary indicator (0/1) as to whether the resident has cattle or not.

This variable is a function of a variety of independent variables, such that,

Past_Size **,** is the total area used for pasture (in hectares);

Lot_Size **,** is the total size of the lot (or lots) the settler owns;

Cred_cattle*,* is the availability of credit for cattle;

Cred_other*,* is the availability of other credit;

Dep_Ratio **,** is the ratio of the number of consumers and workers per lot;

worksold **,** is number of days employed off-farm by lots' residents;

$\boldsymbol{Age\_hh}$ **,** is age of household head;

$\boldsymbol{Green\_Alt}$ **,** is involvement in green alternatives;

$\boldsymbol{Eduproxy}$ **,** is proxy of education of household times access to government benefits;

$\boldsymbol{time\_lot}$ **,** is time on the property; and

$\boldsymbol{\varepsilon}$ **,** is the error term.

This set of independent variables was chosen in accordance to previous studies conducted by Walker and Homma (1996), Pichón (1997), Walker *et al.* (2002), Caldas *et al.* (2007), Vanwey *et al*. (2007), Aldrich (2009), and Simmons *et al.* (2010). These variables are derived from theories developed by Chayanov (1925) in his seminal piece *Theory of Peasant Economy* and from new approaches established with market and development concepts. Those new approaches involving participation of *peasants* in the market shows that a new interaction through commercialization of labor (either selling or hiring) will affect small producers' choices of being part of the economy, acting in fact as suppliers and consumers of farm and nonfarm goods (Ellis, 1993; Barnum and Squire, 1979). As part of this particular change in the small producer's behavior, it was shown previously that most of the income is currently used to acquire goods at grocery stores.

As stated earlier, 80% of all deforested areas in the Brazilian Amazon are designated as pasture; and the system used there is extensive, where animals are fed only by grass and need large tracts of areas to be raised. The continuous variable **pasture size** is expected to interact with the dependent variable positively, meaning that the probability of having animals or being involved in cattle will be affected by the quantity of land pasture—the more land in pasture, the greater probability that the household is involved in the cattle economy. It is understood that the

size of land distributed to settlers is a limiting factor for sustainability of an activity only devoted to cattle expansion; however, the current system where settlers keep opening new plots of primary or secondary forest, or areas used initially for agriculture, will be affected by the availability of land to be opened in the short or long term. **Lot Size** is expected to affect the decision of investing in cattle in a positive way, and those who have more land available also will be more likely to be involved more intensively in that economy.

According to the *New Rural World*, the creation of a formal PA comes with a suite of benefits to ensure success, including financial incentives and credit to improve production and food security. It is not clear if only **credit for cattle** is available in the region, but the fact is that most of those who have cattle affirmed that the decision of investing in cattle was primarily affected by credit availability. A positive coefficient for this dummy variable is expected, meaning a positive correlation between the probability of involvement in the cattle economy and access to credit for cattle. Usually, the initial amount for each project is the same for all settlers, making it most useful to ask settlers if they had access or not to credits instead of the amount. **Credit for other activities**, where cited by government sectors and by a small group, is to be made available; and it is expected that this availability will affect the involvement with cattle negatively.

Dependency ratio is described by Chayanov (see Thorner *et al.*, 1925) as the ratio between the numbers of consumers and workers (C/W) per area. Consumers are all residents living on the lot. In this study, I used as workers all subjects older than 14 years old and younger than 65 years old. These numbers were used because of the time of school, and most settlers affirmed that it is easier to go to school until the end of eighth grade, which in Brazil happens when children are about 14 years old. The limit for the older people corresponds to the time they

usually start to receive a minimal wage as part of their rural retirement. As noted earlier, for men this retirement program is granted when they are 60 years old, and for women when they are 55 years old; however, because of the bureaucratic steps that have to be followed, I used 65 as a limit. Following the Chayanovian theory, time is expected to affect this variable, and the changes experienced will affect involvement with production. Those with more consumers need more land for subsistence or crop production; and the higher the dependency ratio, the lower the area addressed for other activities such as pasture. This said, the relationship between dependency ratio and investment in cattle is expected to show a negative connection—the higher the dependency ratio the decreased probability of involvement in the cattle economy.

Also cited as a proxy for time of investment on the farm is the importance of **work sold** off-farm in land use. Ellis (1993) stated that more time spent off-farm results in less time that will be used on-farm, thereby reducing investments in new areas to be used on-farm. However, this variable can have a dual effect on investments in an activity such as cattle, which demands less investment in labor. Analyzing one way, we can expect that less availability of work on-farm will reduce the dedication of investing in cattle; on other hand, if more income is made through labor sold off–farm, this extra gain can be allocated to improvements on farm, meaning that more investments in cattle can be expected.

Age of household has been cited as an important factor affecting changes in land use (Caldas *et al.,* 2007). The older the farmer, the lower the dependency ratio, and then the need to produce for self-consumption is less. Applying this theory for cattle activity, the minimal need of labor affects the decision of being engaged in this activity. The older the settler, the more involved he will be with cattle. However, again, this is a variable with dual association as it has been observed and said at the field level that cattle are the only consolidated chain in the study

area; and those newest settlers, in age and **time on the property**, will see this as a strong factor to invest in cattle to receive a faster return and keep production profitable.

Several efforts have been made to keep settlers engaged in **alternative production**. In the field, these efforts were translated into credits for cassava, coconut, and banana mostly. Understanding that settlers have a limited piece of land and that if they invest in activities other than cattle, their involvement with cattle is expected to be affected in a negative connection when comparisons between investments in other activities are compared with cattle involvement. In this model, involvement in alternative production is a dummy variable created after analysis of whether settlers were or were not involved in other activities (agriculture or small animals) addressed to market.

In the final model presented in this study, an interaction between level of education and access to government benefits, such as *bolsa-família*, to establish a **variable proxy of education** was used. This was defined after tests with variables were done, and an impact was observed in the level of education caused by access of benefits (collinearity). In fact, as explained in the previous chapters, when a settlement is created, education is also a part of government and SMO efforts, and much has been invested to reduce illiteracy rates. On the other hand, access to *bolsa-família* is the promise that children will be kept in school, and at many settlements, it means that teachers are hired to live in the surrounding areas. Adults also start to be part of education improvement goals in opposite shifts of the children who take classes. Improvements in education level are expected to bring settlers into being part of the economy more intensely, meaning that education and investment in cattle will be connected directly.

A summary of variables, their definition and expectations, as well as their summary statistics can be observed in Tables 14 and 15. The summary statistics in Table 14 shows that

71% of all settlers had cattle on their properties, pasture average size was 21 ha, and lot average size is 33 ha. Other interesting findings are seen in the summary statistics, showing that 75% of settlers received credit addressed for cattle, while only 31% mentioned they had received credit for other activity. These findings will be better explained in the statistical analysis results section.

Table 14. Description of Variables Used in the Final Logistic Regression with Data Collected in 2011

Variable Name	Acronym	Unit	Expected Signal	Definition
Cattle	Cattle (0/1)	Dummy	Dependent Variable	=1 if settler has cattle; =0 if not.
Pasture size	Past_Size	Hectares (ha)	(+)	Number of hectares per lot addressed to pasture.
Lot size	Lot_Size	Hectares (ha)	(+)	Size total of lot (or lots) the settler owns.
Credit for cattle	Cred_cattle	Dummy	(+)	=1 if received credit for investment in cattle, fence, and/or pasture; =0 if not.
Credit for other activities	Cred_other	Dummy	(-)	=1 if received credit for other agricultural activities; =0 if not.
Dependency ratio	Dep_Ratio	-	(-)	Ratio between number of consumers (all residents) and workers (those between 15 and 64 years old).
Work sold	Worksold	Days per year	(+/-)	Number of days sold off-farm by lot residents per year.
Age	Age_hh	Years	(+/-)	Age of household at time of interview.
Green alternatives	Green_Alt	Dummy	(-)	=1 if involved in any alternative production that does not need new areas to be opened in short term; =0 if not.
Education	Eduproxy	Years	(+)	Years of education of household times 1 (if received government benefits); Times 0, if did not receive benefits (=0)
Length on the property	Time_lot	Years	(+)	Time living on the property.
Constant	Cons		(+/-)	Is the value of a chance, in log, of settler owns cattle if all other variables are zero.

Table 15. Summary Statistics of Variables with Data Collected in 2011, *n*=105

Variable	Mean	Std. Dev.	Min	Max
Cattle	0.7115	0.4552	0	1
Past_Size	21.6442	11.9261	0	50
Lot_Size	33.6796	10.1732	8	50
Cred_Cattle	0.7596	0.4294	0	1
Cred_other	0.3173	0.4677	0	1
Dep_ratio	1.6262	0.7544	1	5
worksold	13.5243	42.8241	0	200
age_hh	52.7290	12.1768	19	78
green_alt	0.3173	0.4677	0	1
eduproxy	1.9712	2.7393	0	11
time_lot	11.7059	4.6980	3	25

Collinearity tests were ran in Stata 9.2 and showed that the logit model does not show high linear relationship among the independent variables. In the multicollinearity test ran in Stata, it tested the *variance inflation factor* (VIF). According to O'Brien (2007), a variable whose VIF presents value greater than 10 is indicative of multicollinearity problems; and in this model, as it can be observed in Table 16, there was no VIF greater than 1.33, with a mean VIF of 1.13. The tolerance of VIF results was tested as 1/VIF, which is used to measure degree of collinearity. Despite that collinearity was not found in this model, I recognize that **Endogeneity**

could be a problem; and to correct this, I understand that a two-stage model is necessary in next steps of data analysis.

Table 16. Collinearity Diagnostics for Logistic Model with Data Collected in 2011

Variable	VIF	Tolerance	R^2
Past_Size	1.33	0.7495	0.2505
Lot_Size	1.13	0.8818	0.1182
Cred_Cattle	1.06	0.9437	0.0563
Cred_other	1.13	0.8827	0.1173
Dep_ratio	1.05	0.9530	0.0470
worksold	1.05	0.9560	0.0440
age_hh	1.11	0.9013	0.0987
green_alt	1.26	0.7951	0.2049
eduproxy	1.05	0.9561	0.0439
time_lot	1.17	0.8544	0.1456
Mean VIF	**1.13**		

In addition to tests recognizing collinearity, it is important to cite that spatial contagious effects is an issue that was not investigated statistically because my settlements were not contiguous, which would make spatial regression across settlements problematic. However, I recognize that there are highly localized effects, which in fact were cited by settlers as an important reason for investing in cattle.

6.3.1.3 Impacts on Settlers' Well-Being

To address **OBJECTIVE TWO**—how engagement in cattle have impacted smallholder's well-being and to test the third research hypothesis, **H3,** that maintains involvement in a cattle economy will affect the settlers well-being, comparisons are made with data from T1 (2006) and T2 (2011). For this analysis, possession of a specific set of durable goods is used as an indicator of wealth, and thus well-being. The survey questions were designed to understand changes in acquiring durable goods. Given the importance of cattle from the region in national and international markets, the expectation is that smallholders in the region will experience improvements in wealth when 2006 and 2011 measures are compared. Because defined prices for wealth are not available in the region, the categorization of durable goods is an appropriate proxy for wealth (Junming, 1997; Morris *et al*., 2000; Caldas *et al*., 2007; Simmons *et al*., 2010). Following Walker *et al*. (2002), Caldas *et al*. (2007), and Simmons *et al*. (2010), a set of durable goods have been identified for the Amazon region, and questions as to whether the household owned each good at T0 (time of arrival), T1 (time of interview 2006), or T3 (time of interview 2011) were included in the surveys. First, each household was categorized into a wealth classification for each time period, as follows:

> **Category 1.** Poorest householders. No possession of durable goods.
>
> **Category 2.** Household possesses either a stove or a chainsaw and nothing else.
>
> **Category 3.** Households are in category 2 and also possess (i) a specific durable good dependent on electricity, such as TV, refrigerator, or radio; or (ii) a motorcycle.

Category 4. Households are in category 3 and also possess a motor vehicle.

A comparison was made between changes detected in the panel data set T1 (2006) and in T2 (2011), and variables were created in accordance to changes in the acquisition of durable goods, representing changes in wealth. Considering the categories explained above, settlers were included in one category for each time period, receiving values from 1 to 4 in accordance to their responses for T0, T1, and T2—with T0 being the moment of arrival in the settlement area. The *T*-tests were performed to assess whether changes were statistically significant overtime (from T0 to T1, T1 to T2, and T0 to T2).

In addition to improvements in well-being measured in terms of durable goods as a measure of wealth, analyses were done to assess improvements in terms of education level and income. To do so, education level, which is already included in the panel data set, is contextualized as an assessment to gauge improved well-being. In addition, source of income, and how this is used, is evaluated to shed new light on the realities of settlers as consumers. These assessments will be discussed in the contextual analysis to follow.

6.3.2 Contextual Analyses

The second component of this research involved **Contextual Analyses** and aimed to pursue answers related to **OBJECTIVE THREE**. Analyses used here involve informal interviews with settlements, government, banks, and NGO representatives, as well as systematic research conducted in the archives about land conflicts in the region. With this analysis, the goal is to develop a comprehensive understanding about changes in the relationship between small- and largeholders in the region and the role the cattle economy has had on this dynamic. In

addition, the contextual analysis was designed to entail a variety of analyses to provide an appropriate understanding necessary to assess (1) changes in the relationship between settlers and largeholders and local land conflict dynamics, (2) the rationality of settlers' decisions to invest in cattle, and (3) identification of barriers to green alternative production systems.

6.3.2.1 Globalization of Cattle and Implications for Land Conflicts

To gauge the connections between the globalization of cattle ranching and instances of land conflict, a set of questions related to **conflict history** in the region were performed with the 2011 survey. In addition, during fieldwork I identified largeholders who were buying cattle from settlers and conducted an informal survey to understand when they started this commercial relationship with settlers and how it has affected conflicts between settlers and largeholders. However, the relationship of those changes to the cattle market is uncertain because many SMO representatives were alerted that after creation of a settlement, a reduction of conflicts in the region is expected. This perception happens because, after creation of settlements, the former landless understand now that they have their own land and there is no reason for a largeholder to continue to struggle (CPT, personal contact, April 2011). When settlers are asked if there is conflict inside settlement areas, the response is negative; however SMOs understand that conflicts still exist but now on a different level—when settlers start conflicts among themselves for several reasons. Although analysis is difficult to conduct about the status of land conflicts in the region, mainly in already created settlements, I tried to show the dynamics of land conflict in the study with a qualitative approach, combining household surveys and key informant interviews.

6.3.2.2 Rationality of Decision

To assess the **profitability response**, secondary data was gathered to allow for a comparison of profitability based on prices for different commodity production costs. Important crops in the region were chosen, such as cassava and cupuaçu[9], for example. Such data was made available through personal contact with agronomists at *Amazon Bank* (Banco da Amazônia; BASA) and at the *Company of Technical Assistance and Rural Extension of Pará State* (Empresa de Assistência Técnica e Extensão Rural do Estado do Pará; EMATER-PA); and specific cattle data was acquired from the *Consultancy and Information in Agribusiness Company* (AgraFNP). To learn about proposed economic activities in each settlement, key informant interviews were conducted to assess the production chains for cattle and other agricultural activities with leaders inside each study area.

6. 3.2.3 Barrier to Sustainable Development

To gauge the response regarding **credit availability**, data and key informant interviews were collected on the types of credits and subsidies from the various government agencies in the region, including the *National Institute for Colonization and Agrarian Reform* (INCRA) and *Amazon Bank* (BASA). According to responses from the pilot study conducted in 2010, the expectation is that most credit is directed for cattle; however, it was not clear if there were incentives available to be invested in other activities.

[9] **Cupuaçu** (*Theobroma grandiflorum*) is a fruit from the same genus and family (*Malvaceae*) as cacao (Vasconcelos *et al.,* 1975). The cupuaçu tree can be found all over the Amazon region, on noninundated areas, being common mainly near existing or former settlements. The white pulp produced from this fruit is used for juices, desserts, and sweets. Pará is the largest producer of this fruit.

In addition, to investigate the claim that **poor soils** are to blame for activity, a geographic information system was constructed, including soil layers and settlement boundaries. This analysis will allow a direct comparison of soil classification at the settlement level. In addition, key informant interviews were conducted with local agronomists from the government and the settlements to provide a greater context for understanding soil quality and to confirm settlers' perceptions. In addition to that information, in the 2011 survey's respondents were asked to identify their reasons for choosing cattle and to rank their responses. Based on these responses, further analyses were performed to understand the reasons for their option for cattle.

The above steps were important for understanding why settlers are involved in the cattle economy as opposed to diversified activities. Additionally, this methodology used for data collection provided support to assess whether cattle indeed are economically rational and identified potential barriers to other economic activities, especially green alternatives proposed by the SMOs and supported in the government's policy rhetoric.

CHAPTER 7. STUDY REGION

To pursue the research objectives of this dissertation, the focus of research was on the southeastern region of Pará State, an area that has a deep history of government-led colonization and development projects, as well as a long involvement of social movement actions and settlement formation. In addition, that region has also become the most important in the state for cattle expansion. In the study area, more than 11,000 families are already settled and have access to the public credits system, including public and credit agency loans. The study area is already included in the *arc of deforestation*, a region characterized with the highest intensity of deforestation in the last decades. Additionally, data collected by Simmons in 2006 with the same settlers will permit an assessment of changes related to the involvement of settlers in the cattle economy.

The geography of southern Pará with amorphous boundaries has been debated (Simmons *et al*., 2007; Caldas, 2008). According to Kotscho (1981), the region can be defined as the area that has boundaries with Maranhão and Tocantins States and that became known as *Bico do Papagaio*, or Parrot's Beak, because of its similarity to a parrot's beak shape. Other authors, such as Schmink and Wood (1992) and Campos (2002) included all southeastern Pará in the definition. In this dissertation, I am using the definition of southern Pará as it was stated by Simmons *et al.* in 2007, where it includes municipalities that have boundaries with the neighboring states of Maranhão and Tocantins, east of the Xingu River, and below BR-230 (or the *Transamazon highway)*, as well as in areas west of the Araguaia River (Figure 14). This definition lies within the area that has experienced the highest rates of land contentions and had experienced economic, political, and social changes from efforts to develop the Brazilian Amazon (Simmons *et al.,* 2007).

Figure 14. Southern Pará, Brazil.

Southeastern Pará is marked by significant political and socioeconomic changes during the last six decades and represented the gateway to Amazonia development, resulting in high rates of in-migration and use of natural resources (Simmons *et al.,* 2007). In accordance with resource abundance theorists, the wealth of natural extractive forest products, minerals, and fertile land for agriculture in this region has always been characterized by resources-driven

conflict, especially over land. In the past, in-migrants and locals were dedicated to the collection of forest products like rubber and nuts, hunting, mining, and large pasture implementation for farmers and the production of food crops (Assis, 2007). Historically, southeastern Pará is characterized by distinct cycles such as rubber (1913-1920), brazil nuts (1920-1983), and gold (starting in 1960) (Barros, 1992).

Southern Pará is unique in its original forest cover with a rare ecology highly conducive to the production and harvesting of Brazil nuts, a product which once drove the local economy from the 1920s to the late 1940s before it was lost to the advance of forest loss (Castro *et al.,* 2004). The region also represents the forefront of development efforts since the early years and has thus experienced fast economic and population growth. Much of the forest is gone today, replaced by vast pasture lands. Finally, the region has a long history of contentious relationships between large landowners and the landless, which has resulted in violent struggles for land reform giving it the reputation as Brazil's badlands and attracting human rights activists and SMOs.

Research was conducted in six SMOs-led settlements in southeastern Pará State, created between 1987 and 2004 (Figure 15). The study area includes the counties of Marabá, São João do Araguaia, and Eldorado do Carajás, an area with more than 200,000 residents and almost 11,500 families settled in around 100 consolidated settlements. The municipalities are strategically located at the crossroads of three highways (BR-230, BR-222, and BR-155, formerly known as PA-150) and an operating rail network (or *estrada de ferro carajás)* owned by *Companhia Vale do Rio Doce* (CVRD), the world's largest mining company, and used to transport mineral products to the coast and passengers to São Luís, capital of Maranhão State.

Those study sites were chosen because the baseline data identifies settlers involved in cattle activities and provides information characterizing their socioeconomic conditions and productive activities. The 2006 data were the foundation for understanding changes between 2006 and 2011. I returned to the region in spring 2011 (January through April) to a selected sample of households from the Simmons project [2006, *National Science Foundation (NSF) – Geography and Regional Science - Project # 0522062*] and reapplied questionnaires to those agents who were part of the 2006 research, providing a 5-year panel data set for evaluation. A first version of the questionnaire was tested during summer 2010 in three settlements (Primeiro de Março, Castanhal Araras, and Alegria) in Marabá and São João do Araguaia Counties. Key questions were added after that preliminary test in order to reach the objectives of this dissertation.

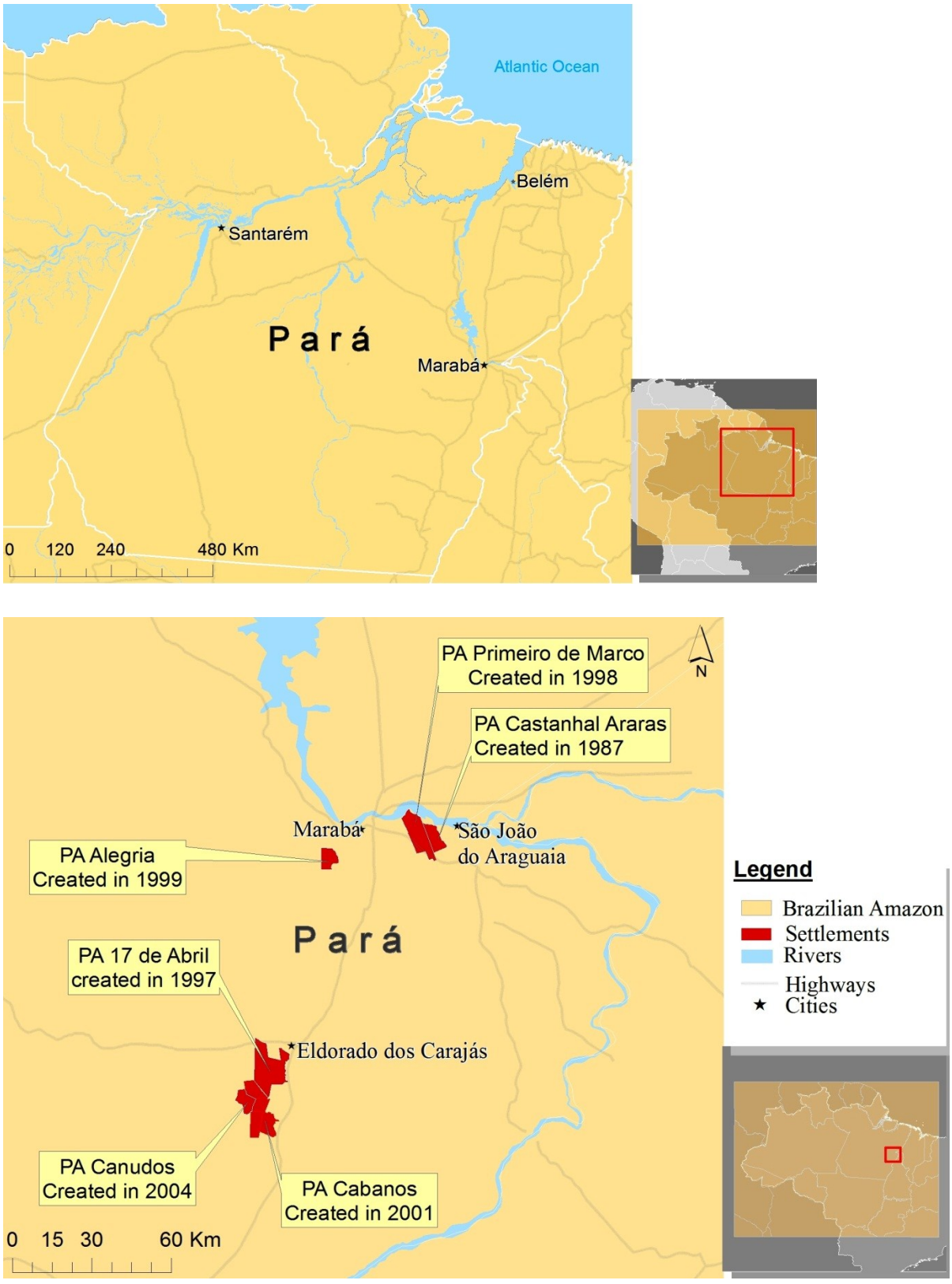


Figure 15. Study Area and Settlement Location in southeastern Pará.

7.1 Brief Description of Settlements

Those six settlements that are part of this study resulted from DALR actions and organizations in groups demanding land. Five of them were created in expropriated areas, while one (PA Canudos) resulted from the purchase of land held by INCRA. In this last, the typical participation of the former owner indicated to the landless that he was interested in living in the area and was open to negotiation to sell the farm for agrarian reform purposes. This participation of farmers happens when an interest is expressed in leaving the area, but with gains from selling land back to the government, even if areas were previously owned by the government and were taken illegally by farmers. The Landless Workers Movement (MST) then occupied the area and informed INCRA about that action. Although MST has been active in many land invasion activities, two out of six settlements evaluated in this dissertation did not have participation of the SMOs, meaning that a group of land grabbers, or *posseiros,* took the area and forced INCRA to recognize their occupations after many years of land use. Four remaining settlements resulted from DLAR organized by MST.

7.1.1 PA Castanhal Araras

The PA Castanhal Araras is the oldest settlement in the sample, created in 1987 within an area of more than 5,000 ha and where each of the 83 settled families received 50 ha of land. Castanhal Araras is 40 km from Marabá. This PA is the first one created in southeastern Pará and marked the start of the dissolution of those remaining areas known as *Polígonos dos Castanhais* (Almeida, 2009). The history of the creation of PA Castanhal Araras is marked by conflicts with indigenous people from Gavião ethnicity because, first, *occupation* happened in an area dedicated for indigenous when 22 land grabbers decided to occupy the area without a plan

of occupation. At the moment of invasion, land grabbers did not know they were inside an official indigenous reserve; and the landless people were able to camp in the area for around two years, until many other land grabbers heard about the camp and started to move to the region—still without a plan of occupation. That mass migration to indigenous areas resulted in conflicts between the landless and indigenous, and INCRA had to intervene at a certain point and find an alternative area to take those families camped to a new and official settlement area.

The area where the settlement was created now was expropriated and distributed by draw. The process of expropriation is one of the means of land acquisition; this happens when INCRA officials understand that a farm is eligible for expropriation either because the area is not productive or because it was acquired through illegal means. The INCRA officials then evaluate all construction and legal reserve to define the cost of property and assign a value that should be reimbursed to owners. After this process is done, the area is ready to be addressed for agrarian reform; and to make sure that the process of land distribution is fair; lots are divided and distributed by draw. After settlers from the PA Castanhal Araras received their lots, some settlers left while others who wanted to be closer to the village and schools exchanged lots with other settlers. After 24 years of settlement creation, this area is under pressure because it is part of a possible area of inundation for creation of the Marabá dam, which is included in PAC 2.

7.1.2 PA Primeiro de Março

The PA Primeiro de Março is strategically located on the BR-230 within São João do Araguaia County and only 16 km from Marabá, the main city in the region. Originally, actions to create that PA were **led by MST**; however, currently, because of disorder and disagreements among settlers, two SMOs are installed in the settlement (MST and FETRAF) resulting in one association and one cooperative that act separately when they need to demand action toward the

settlement and to benefit settlers. Created in 1998, PA Primeiro de Março was divided into pieces of land varying from 25 to 31 ha for each of 343 families. The structure of that settlement followed the village model along the highway; and settlers could choose if they wanted resources to build a house in the village nearby schools, health facilities, and roads or at the lot. This location had influence in the current dynamics of that settlement over the years. Many settlers already left the original lot; houses were sold or are for sale in the village. This was observed in the field when, from the list of people interviewed in 2006, 20% were not found because they sold their lots and left, and 33% were not known by the current settlers. In addition, at that PA, a reconcentration of land was observed with a farmer or even other settlers buying more than one lot in the area. The PA Castanhal Araras and PA Primeiro de Março share boundaries; and at some point in the field, separating one from another was confusing (Figure 16). Some lots in northern PA Primeiro de Março also will be affected by construction of the Marabá dam.

Figure 16. Lot Divisions at PA Primeiro de Março and PA Castanhal Araras.
Source: INCRA SR 27 (Marabá, personal contact, April 2011).

7.1.3 PA Alegria

PA Alegria was created in 1999 and has a particular history in its formation. A group of people living near the area for more than 20 years decided to camp on the farm because they understood that that farm was an unproductive one, therefore eligible for expropriation. At that moment, most of the landless had a small and simple house in the *Brejo do Meio* village. The former owner of an occupied farm had a document of *aforamento*; and at the time of occupation, the remaining forest in the area was primarily compounded by secondary growth. Settlers related that during the time they were camped, the former landowner sent henchmen to frighten the landless. The henchmen's actions included putting fire to the remaining vegetation nearby the

area the landless had built their plastic shacks. As a result of the struggle for that piece of land, the leader of the movement was killed outside the camp area.

Landless people camped in the farm then, used the burnt area to start to plant annual crops, and resisted until more people joined the first group. When violence became most common in the area, INCRA decided to intervene, expropriating area and accepting the 95 lot divisions that the landless people had already marked. This is a unique settlement formation as INCRA is responsible during settlement formation to divide lots into a similar size for each settler. However because their produce had already been planted and all of them agreed with their piece of land, INCRA decided to accept the lot division made by the landless (Figure 17). Because of this, there is no pattern in lot size; and in this dissertation, lot size inside that settlement varied from 8 to 50 ha. Currently, many settlers still keep their main activities, such as school and jobs at *Brejo do Meio* village, even after they have received all benefits from INCRA. Settlers argue that if they have children it is impossible to reach school during the rainy season and that the village is the only connection to grocery stores and transportation to Marabá.

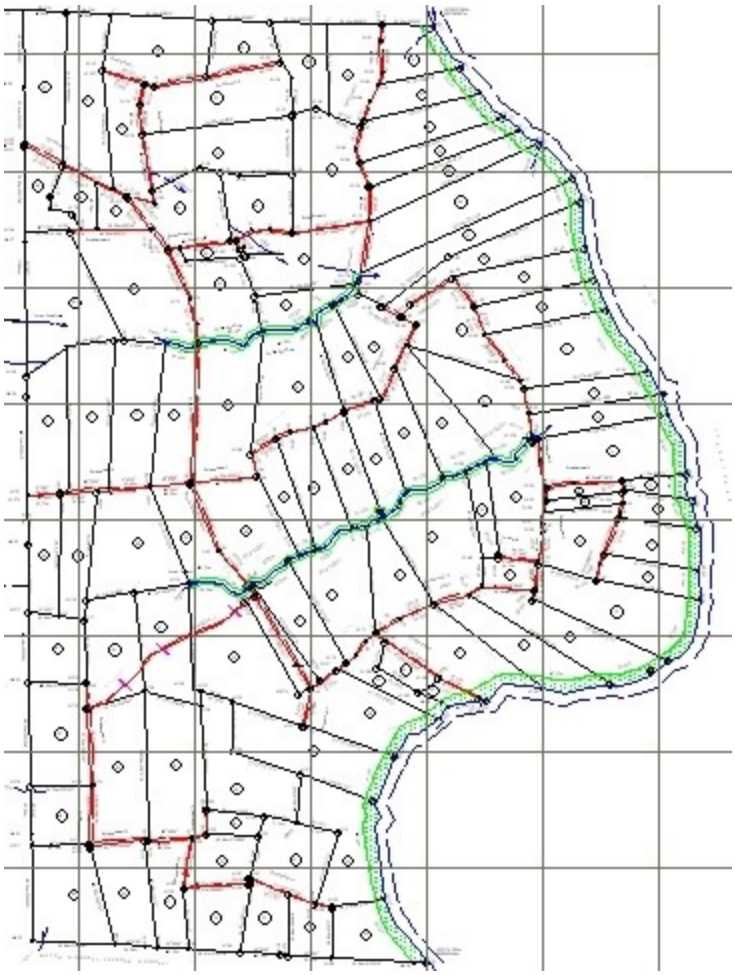


Figure 17. Lot Division at PA Alegria.
Source: INCRA SR 27 (Marabá, personal contact in April 2011).

7.1.4 PA 17 de Abril

The PA 17 de Abril started its history with 19 participants murdered and 69 mutilated during the expropriation demand of Macaxeira farm. One thousand five hundred landless people participated in a march organized by **MST** and blocked state highway PA-150 (now under federal appropriation and called BR-155) in Eldorado do Carajás in April of 1996. According to the landless, the protest started because INCRA did not follow previous agreements to reinforce the right of access to land, but the state governor sent military police to intervene resulting in the largest massacre of the landless existing in the region (Correio do Tocantins, 2011a). After the

massacre, all attention was directed to southeastern Pará, and INCRA created an office (SR-27) to deal with land invasions, expropriation, and all processes of settlement creation in southern Pará (Assis, 2007; Correio do Tocantins, 2011b). Currently, INCRA SR-27 is responsible for assistance to almost 500 settlements and almost 70,000 families distributed in 37 counties.

The PA 17 de Abril was created in 1997, with each of 689 families receiving 25 ha of land (Figure 18). The conditions of creation of that settlement made settlers more politically organized, and they received more attention from the government. One example of this last observation is that the school built in the settlement was created to be a resource in the region—a place where professors and staff who are hired by local government are settlers, and where relatives who live in the region and who (through **MST)** had the opportunity to finish their degree can return to the settlement to initiate a differential school where students learn the importance of land access, agricultural techniques, and political concepts to keep their actions for agrarian reform. In addition, PA 17 de Abril has the distinction of being organized with a village in the center, which works as a business center and as a place for meetings, discussions, and decisions.

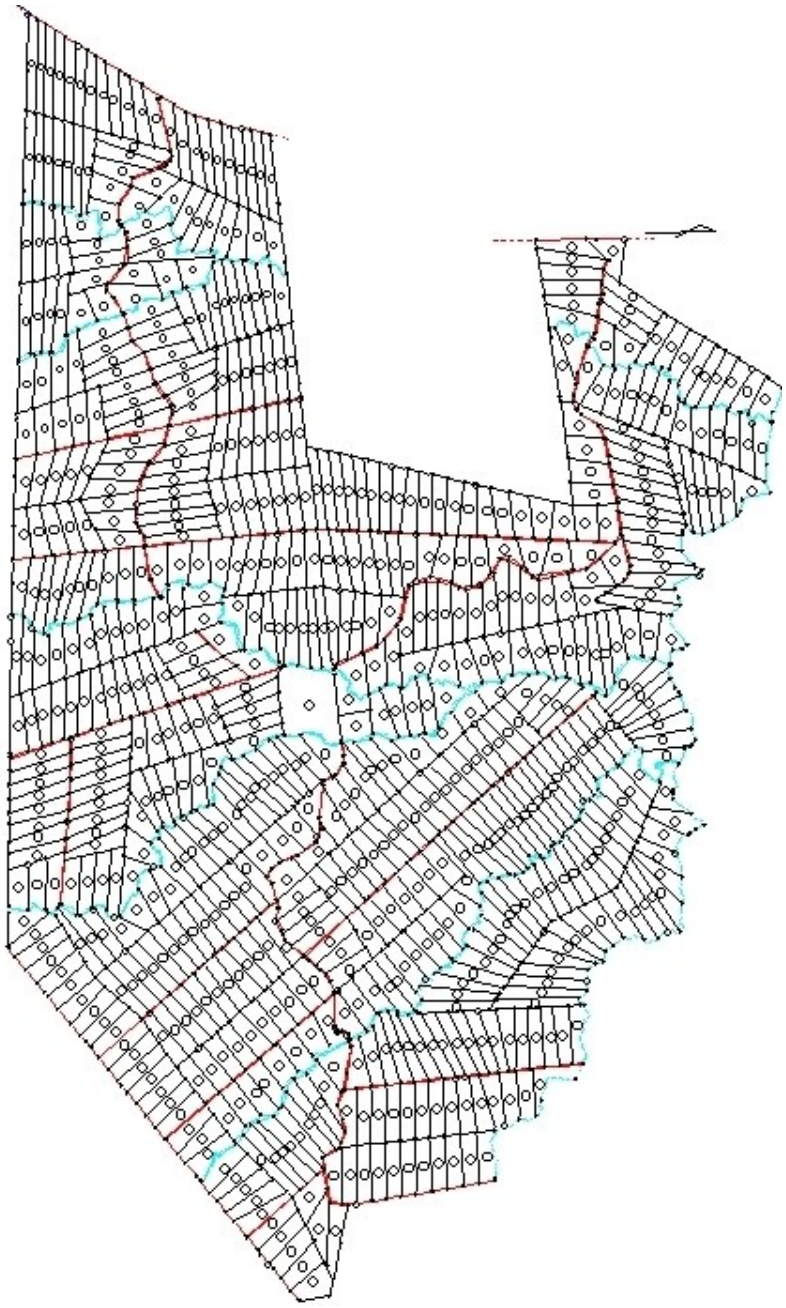


Figure 18. Lot Division at PA 17 de Abril.
Source: INCRA SR 27 (Marabá, personal contact in April 2011).

7.1.5 PA Cabanos and PA Canudos

The PA Cabanos was created in 2003 in an area that was expropriated in 2001. With a total area of almost 3,500 ha, the settlement has the capacity to receive 85 families However, in 2011, only 79 families were recognized as INCRA beneficiaries in that area. After 10 years of creation, PA Cabanos is not officially divided by INCRA. Lots divided by settlers varied from 37 to 50 ha. Despite not having an official division from INCRA, settlers confirmed that they already had access to preliminary credits to be invested in housing and production. The formation of PA Cabanos happened when some squatters were evicted from another invaded area in Curionópolis, 25 km from where they are now.

The PA Canudos was created in 2004 in an area of almost 3,000 ha. That settlement has the capacity to receive 62 families; and according to INCRA (2011), the settlement has the maximum capacity of families. Like PA Canudos, PA Cabanos also is still not divided and mapped by INCRA; however, all settlers are already registered and had access to all credits available during formation of the settlement. At PA Canudos, the main complaint was related to the absence of public transportation. This problem affects the main production activity in the settlement, which is cassava flour. Among all settlements, this is the only one where settlers identified cassava as the main activity if transportation was made available. At PA Canudos, a structure to allocate school and health facilities is still not available. During the camp era, an investment was made by a former mayor in a school built with wood, but because that structure became old, it was destroyed. Lot size at PA Canudos varied from 36 to 50 ha, with the exception of two brothers who divided a lot of 50 ha between them. According to information collected at the INCRA office, lots inside PA's Cabanos and Canudos were not officially divided because government resources were cut and when this happens the oldest PA's are prioritized;

the settlements where this study was conducted are considered relatively new. Both PA Cabanos and PA Canudos were derived from actions led by **MST.**

7.2 Current Phases of Each Settlement

According to INCRA (2011) and referring to phases of settlement creation on Table 8, PAs Alegria, Primeiro de Março, Cabanos, and 17 de Abril are under phase 3, meaning that land where the settlement is installed is under INCRA property and settlers are already registered as land beneficiaries. The PA Canudos, despite being a new settlement and without official land demarcation, is listed at INCRA in phase 4, meaning that a PDA is being developed and settlers are able to access all credits and financial support available through INCRA. The PA Castanhal Araras, the oldest in my sample, is already under phase 6, meaning that investments in basic infrastructure were done and settlers are able to receive a definitive land title. In addition, the settlers at PA Castanhal Araras, if they have paid Pronaf A credits, they are already able to access other types of credits such as Pronaf A/C, B, C, and AF.

7.3 Limitations to Data Collection

No major limitations were experienced during data collection. In the original dissertation proposal, PA Santa Maria do Pontal was inserted in the sample instead of PA 17 de Abril. However, as that settlement was created in an area of conflicts—and it seems they are still experiencing conflicts not related to land but to reconcentration and to external groups—for safety reasons I exchanged and used the facilities provided by the MST to conduct my research in the PA 17 de Abril area. As that settlement was part of the 2006 survey, no changes were made to the research design. In fact, after living in that region and sharing experiences with settlers who live in the PA 17 de Abril, I understand that the effectiveness of data collection was

enriched. As I mentioned previously, the formation of PA 17 de Abril was particularly marked by conflicts and murders, and those events gave organization to all 650 families who were settled after the massacre.

At first glance and without the eyes of a researcher, it is impressive how a little city was created within their village and how they manage to be connected to the larger cities around (Eldorado do Carajás, Parauapebas, and Marabá) to solve their personal demands. Clearly after the formal search was initiated and interviews were conducted, I perceived that PA 17 de Abril has structural problems as well as all the others, and access to land, credit, and habitation was not enough to solve all social and economic problems found at the household level.

Overall, this was my first experience in trying to reconnect to subjects who were interviewed in the past, and an identified problem in the field was to understand that many of those people came from other states and had to hide for general reasons, and because of it, in 2006 they identified themselves with other names making it impossible to match their identification in 2011. In this group, 17% are from the original sample, and after many attempts were made to find those settlers. I decided to work on those who made themselves available again in 2011.

Another limitation experienced in the field was the fact that, despite many efforts from social movements and settlement leaders to reconnect people to the land, many of them decided to leave the settlement even though it was against INCRA rules. According to INCRA, once a person is registered in their list as beneficiaries, workers cannot be reinserted into the list to be settled in another area; and once a settler sells his/her lot, he/she loses the right to accept another piece of land through INCRA settlement projects. Seventeen percent of the 2006 sample was lost because of lot commercialization; and the new owners of those lots, knowing that

commercialization was illegal, did not make themselves available to provide me information about current land use in those areas. Because of the commercialization of the lots, I observed reconcentration of land, with one *settler* buying more than one lot and constituting a medium farm inside a settlement area.

Four of those people who had lots in 2006 and that had sold or lost rights on lots by 2011 were found. Three of them sold their lots, two said that they sold the original lot due to health problems, one said he had access to credit in the past but was not productive and the lack of opportunities to receive new credit caused him to sell his property, and the last one lost her right to be settled because of her history of lot commercialization in the past. From those three who sold lots, one said he was too old, became a widower, and that his retirement salary was enough for him to have a good life—he still lives in the settlement village. The other person sold his lot due to health problems; he said he regretted selling his lot, and now he lives with his entire family in a borrowed room and survives with government benefits provided for his children, which is not enough for all family members. Another former beneficiary still lives in the village where he has a little grocery store to provide basic needs for locals. The person who lost her lot due to past commercialization bought a house in the village and still lives inside the settlement area. She said she works sporadically in Marabá as a housecleaner.

Another reason for not finding people was related to local conflicts. In one case, I was informed that neighbors had problems and, after threats involving firearms, a person who was interviewed in 2006 and during the questionnaire test in 2010, decided to leave behind his house, lot, and animals. Another sample was lost due to the involvement of the settler with the illicit drug trade, which caused other settlers to recommend to me, in 2010 and 2011, to not try to conduct an interview on that lot.

CHAPTER 8. RESULTS AND DISCUSSIONS: CHARACTERIZING HOUSEHOLD PRODUCTION, DECISIONS AND EFFECTS ON WELL-BEING

8.1 General Findings about Household Characteristics

General characteristics such as gender, age, population size, length of land occupation, number of people and families on property, level of education, and general production and consumption of households are cited as drivers of land use change (Walker and Homma, 1996; Perz, 2001; Simmons *et al.,* 2010). In the sample used in this study, 71% of the heads of household were male, and the mean age was 53 years. Usually when a woman has her name as owner of a lot she is either a widow as a result of a land conflict that ensued in the process of an occupation, she joined the settlement without a partner, or her name is used as a cover for the real owner, which happens frequently when her spouse or father is unable to register as an INCRA beneficiary (RB) given past involvement in other settlements or lack of documents requested by INCRA. On average, four people live on each property. The time on property averages 11 years, and property size ranges from 8 to 50 ha with a mean of 33 ha. The head of household had about three years in school, with 23% of those interviewed being illiterate and only one person in the entire sample reaching the maximum level or college degree at 15 years (Table 17).

In terms of lot size, expanding the discussion is important, especially since the sampled population consists of beneficiaries of agrarian reform (or settlers) and therefore have a lot smaller than the limit of a small property classification in Brazil. In fact, classification of lots visited falls within the definition of *Módulo Rural* stipulated in articles 41 and 46 of the Land

Statute (*Estatuto da Terra)*, which indicates rural properties with enough size for family farming, absorbing all available workforce, and assuring subsistence, social, and economic progress to smallholders. In the study area, a *Módulo Rural* has up to 70 ha, and all visited properties are under this size. That said, the size of property limits the feasibility of certain economic activities, and livestock is an extensive production system in the Amazon, requiring large tracts of land to be sustainable.

Table 17. General Characteristics of Households, 2011, *n*=104

Variable	Mean (Std. Dev.)	Min	Max
Age	52.73 (12.18)	19	78
Quantity of People	4.47 (2.57)	0	14
Length on Property (years)	11.71 (4.70)	3	25
Lot Size (ha)	33.68 (10.17)	8	50
Education (years)	3.13 (3.19)	0	15

The primary argument for land distribution and the creation of the PA was to assure conditions for settlers to be self-sufficient in terms of agricultural production, ensuring food security. Nevertheless, across the board those residents interviewed did not recognize this rationale as important. In fact, a review of the data collected on productive activities and income revealed that at the lot level earnings from agricultural production was only the fourth source of income, being surpassed by other sources such as off-farm formal jobs that rank as the most

important source, followed by government benefits in the form of a cash transfer or rural retirement programs, and finally the selling of calves to large ranchers (Table 18). In terms of land-based production, the most import source of earnings comes from commercialization of calves. According to settlers, and statistical analysis presented, availability of credit appears as the main factor driving land use choices. In addition, when settlers are informed that there is not

Table 18. Summary of Annual Income Sources, in Brazilian Reais (BRZ R$), at household level (*n*=104)

Income Source	Mean (Std. Dev.)	Min	Max
Off-farm jobs*	4,004 (7,773)	0	37,200
Governmental Benefits	3,929 (4,837)	0	21,924
Calves	2,377 (3,477)	0	27,000
Agriculture	1,291 (3,279)	0	18,000
Milk	776 (2,544)	0	17,217
Off-farm Labor**	772 (2,112)	0	12,000
Livestock Other animals	514 (1,697)	0	11,800
Cows	453 (1,048)	0	5,000
Pasture Rental	231 (872)	0	6,000
Total Annual Income	14,405 (10,443)	1,200	56,108

* Off-farm jobs refer to formal employment out of the property, meaning that a family member is employed in a formal, continuous job.
**Off-farm labor refers to the amount of days family members sell in other properties.

enough access to credits to be invested in agriculture, they fail for lack of technical support or because of soil and climate conditions.

According to responses collected in the field, most people (68%) receive some support from government as income sources, followed by calves' commercialization (60%) and off-farm jobs (30%). Not surprisingly, in light of nominal earnings from agriculture, on average only 2.8 ha per lot are dedicated to agriculture, while on average 21.6 ha are under pasture. Among the responses about the low quantity of land for crops, the most common reasons cited were the low soil fertility of the land and the greater credits available for investments in cattle pasture improvement, which supports calving operations.

In terms of government support, this includes (1) *bolsa-família*, a governmental support to encourage families to keep children at school instead of using them as agriculture labor; (2) *rural retirement*, a benefit that can be required for all rural workers who can prove he or she had worked and contributed to social security for at least 180 months and is 60 (male) or 55 (female) years old; and (3) *disability retirement* granted to those who prove to have any health issue that makes them unable to work.

Bolsa-família values change according to monthly family income per person, the number of children and adolescents up to 17 years old, and the number of pregnant and lactating women members of the family. The value varies from USD 16 to 151 per month in accordance to the types of benefits: basics, variable, variable linked to teen (BVJ), and extraordinarily variable (BVCE) (see Appendices D and E). Basic benefits are given to families under extreme poverty situations and have a fixed value of USD 35. Variable benefits are given to those families with income up to USD 69 per person, with children ranging in age from 0 to 15 years old and/or with pregnant women or nursing mothers. Per person, in that condition (children, pregnant, or

nursing), the benefit (USD 16) is given monthly; and each family can register up to five people under eligible conditions. The benefit defined as a variable linked to teens (BVJ) is granted to up to two family components with an age of 16 or 17 years old; and per each person, it is given USD 19. The last kind of benefit linked to the *bolsa-família* program is called the variable of special role (BVCE): it is given to families who, during migration from older preliminary benefits, had a financial loss; the value is adjusted to reach the previous benefit values, and this varies from case to case (MDS, 2012). Beneficiaries of *bolsa-família* are also assisted by other programs and social policies of the Federal Government, such as (1) reduced rate of electrical energy (or *social rate*), for those who are part of the *Bolsa-família* program and consume up to 220 kwh, the discount varies from 10% to 65%, depending on consumption range; (2) education classes for adults, to improve education level and reduce the quantity of illiterates in Brazil; (3) vocational training courses, to teach adults about professions that are in demand in the region where they live; (4) shares of employment and income generation that insert beneficiaries after courses to partner with industries; and (5) exemption from federal procurement charges, to promote equality for those who are able to compete for public jobs and access to public colleges (MDS, 2010).

Rural retirement income is always equivalent to one minimum wage, which in Brazil during the time of data collection was USD 270[10]. According to law number 9,876/99, proof of involvement in rural activity is required to grant this benefit, even if it is discontinuous, in the period immediately preceding the application of the benefit for a period equal to the number of months of the matching contribution (Previdência, 2012). Disability retirement is a benefit granted to employees who are incapable of working due to illness or accident, and the disability

[10] Minimum wage in Brazil changes every January 1; in 2011 it was 545 BRZ R$ and in 2012 this value reached 622 BRZ R$.

has to be proved by a medical group who works with the Social Security office. Disability retirement benefits are not permitted for those who joined Social Security after the sickness or injury happened, unless the injury resulted in worsening of the disease (Previdência, 2012)

In contrast to the main motivation of the family farming program and PA creation and despite the many resources provided to settlers to encourage agricultural production for self-consumption (food sovereignty), 88% of the people interviewed buy their primary foods at groceries stores, expending a monthly average of USD 167, or 28% of average income. In fact, one of the settlers said that, currently,

> *It is cheaper to buy vegetables and meat in the grocery stores than produce them* (questionnaire # *89,* PA 17 de Abril*)*.

Because of high values loaned by banks at the moment of settlement creation, payments for credit appears to be the main use of income property level equaling 31%, followed by monthly expenses at the grocery at 27%, and loans to purchase durable goods (such as motorcycles, refrigerators, and TVs) totaling 9%. The increase in loans to purchase durable goods coincides with the arrival of electricity in the settlements as part of the government program *Luz para todos* (Light for all), which started in 2003 as part of a plan to eradicate electricity exclusion in Brazilian rural areas (MME, 2010). Since then, 71% of the sampled population had access to electricity for the first time, with 69% of those accessing electricity only after the first data collection occurred in 2006. In fact, electricity appeared as the fourth highest monthly expense at the property level, showing an average of USD 21, or 3.5% of total income raised yearly. Other expenses, such as medication, water, and rent of houses in the nearest city to send children to school appeared as part of the fixed costs.

8.2 Objective One - Understanding Settlers' Decision to Invest in Cattle as Opposed to Alternative Activities

Despite the original intention of these settlements to promote sustainable development through agricultural diversification, this research reveals that in reality most settlers have invested in cattle as their primary economic activity. This finding shows that settlers are in fact being disconnected from their original objectives and policies, which is to promote diversification through sustainability. The purpose of this research is to understand why.

8.2.1 Panel Data Set Results: Changes in the Local Cattle Economy

A panel data set comparing data collected in 2006 and in 2011 was created using farming systems and general characteristics to evaluate changes at the lot level before and after southeastern Pará was included in the FMD-free status and thus cleared for export beef. Given the predominant literature, Brazilian economic changes and recent research findings show the expansion of the global cattle economy and the participation of southeastern Pará in this process. Added by the involvement of settlers in cattle ranching across the Amazon, the expectation was that the number of respondents identifying livestock as a primary activity would increase; thus, statistical analyses of the panel data would allow a rejection of the null hypotheses (H1) that the number of settlers owning cattle would decrease. Nevertheless, a series of χ^2, paired sample *t*-test, and difference of proportions analyses show some surprising results.

Starting with cattle possession, contrary to my expectation, less people reported owning cattle, meaning that in my sample fewer people had animals on their property in 2011 at 74 (or 71%) than in 2006 with 83 (or 80%). However, considering the limitations to this activity due to lot size and the original objectives for settlements, the finding of 71% of settlers investing in

cattle as their main economic activity still has to be considered substantial and important for future analysis. Comparing both years of the χ^2 results showed that there is a statistically significant relationship between changes in the decision of owning cattle or not in 2006 and in 2011 (χ^2 with one degree of freedom = 6.9103, $p = 0.009$).

Still, comparing changes between T1 and T2, the mean number of animals per property increased from 19 to 21. This finding shows that despite discussions about importance of diversification, settlers who are part of programs of agrarian reform are not different from the colonists described by Walker (2003) when it was found that each colonist in Pará State had an average of 24 animals per property. Cattle quantity variation between T1 and T2 explains changes in the conversion of lots to pasture; and the increase in the mean of hectares devoted to pasture changed almost 19%, increasing from an average of approximately 18 ha to almost 22 ha per property. This finding is connected to unpredicted participation of settlers in the cattle economy as pasture renters. Additionally, some settlers when asked how many animals they had reported a quantity including animals they raise as part of contracts with local large holders. This degree of settlers investing in the cattle economy not only as owners also affected the finding related to quantity of animals per hectare (density). Comparing results, an interesting finding concerns the reduction of animal density, meaning that even with all the discussion to improve productivity and to reduce deforestation and carbon emissions caused by the cattle economy, in five years less animals are distributed by unit of pasture (hectare). Statistically analyzing the results through the paired *t*-test, the change of means of quantity of animals between 2006 and 2011 was not significantly different; however, change of means of area used for pasture and density (animals/hectare) showed a significant difference at 5%.

This unexpected reduction of quantity of people owning cattle and substantial improvement of areas opened for pasture may be connected to the different time of data collection in both years, T1 and T2. While in 2006 data was collected during the Amazonian summer (July), the data collection in 2011 was conducted in the winter (January-April); and distinctions in both times cause the pasture areas to have different values. Summer is not a good season for pasture development; during winter, which is characterized by customary rains, development of pasture is better, animals can be sold easier and faster, and it is also a better season to charge more for pasture rental. Fourteen percent of settlers affirmed that there is a period in the year when more animals are sold, and almost all of them cited that this varies from December to April, when largeholders have more pasture and animals reach weight to be sold faster, confirming that there is a difference in the market between data collection periods.

Lot size presented a small reduction, and several studies (Moran, 1981; Walker and Homma, 1996; Pichón, 1997; Evans *et al.,* 2001; Perz, 2003) analyzing the household life cycles in the Amazon have shown that it is common that, after a period, a family member starts a new family nucleus, and the lot is divided to attend to the demands of this new nucleus. Paired *t*-test, comparing change of mean lot size between T1 and T2, shows that there is a statistically significant difference (at 5%) over time (Table 19). As my expectation was that more people would be investing in cattle, I understand that finding less people owning animals not only brings me to accept the null hypotheses but also to an unexpected finding—even with the affirmation that a well-established cattle chain attracts more settlers to also be part of that activity. However, this does not mean that less people are involved with the cattle economy once an unpredicted situation still connects settlers to a cattle economy: when 9.5% of all settlers are investing in pasture to increase income through pasture rental even if they do not have animals. Another

situation in favor of this finding is timing of data collection, which in 2011 happened during the rainy season, which appears to be a good period to earn income through pasture rental.

Table 19. Comparisons of Changes Between 2006 and 2011

Farm System Characteristics (n=104)	**2006** **mean** (Std. Deviation)	**2011** **mean** (Std. Deviation)	**Diff** (Std. Deviation)
Cattle (heads)	19 (19.47)	21 (27.08)	1.21 (26.75)
Pasture Area (ha)**	18.22 (12.41)	21.66 (11.98)	3.44 (14.24)
Density (animals/ha)**	1.30 (1.15)	0.95 (1.03)	-0.35 (1.39)
Mean Property Size (ha)**	34.66 (11.01)	33.44 (10.11)	-1.22 (4.87)
Education (years)*	2.09 (2.31)	3.15 (3.19)	1.05 (3.67)

*Statistically significant at 1%, ** statistically significant at 5%, *** statistically significant at 10%.

8.2.2 Statistical Analysis: Estimating the Decision of Investing in Cattle and Understanding the Main Driving Factors

8.2.2.1 Results from the Logit Model

The dependent variable, binary 1/0 whether the settler had cattle or not, revealed that 71% did, compared to 29% that did not have cattle. The purpose of this logistic analysis is to

understand which factors are important to their decision to invest in cattle. The dependent variable had the following frequency (Table 20).

Table 20. Frequency of Cattle Ownership Among Visited Settlers, 2011

Do You Own Cattle?	Frequency	Percentage	Cum.
0	30	29	29
1	74	71	100
Total	104	100	

The main results of the logit model are expressed in Table 21. Despite the coefficients shown in the table below, explaining the interpretation of the odds ratio that shows the effect of an independent variable on the dependent variable is important. The odds ratio predicts the effect of an independent variable on the dependent variable, and this value is calculated as the exponential of coefficient value, see Table 22. When ran in Stata 9.2, all outcomes are the same (such as *z* and *P*-values, Log likelihood); the difference is shown in the numbers known as the odds ratio and their confidence intervals and in the absence of odds value for the constant term.

Table 21. Logistic Regression of Data Set Meant to Inform Main Factors Affecting Settlers' Cattle Ownership.

Dependent Variable: Cattle (dummy) n=100			
Independent Variables	**Coefficient**	**Standard Error**	**P> z**
Past_Size	0.0823	0.0306	**0.0070***
Lot_Size	0.0514	0.0309	**0.0960*****
Cred_Cattle	2.6112	0.7076	**0.0000***
Cred_other	-0.6734	0.6172	0.2750
Dep_ratio	-0.5301	0.3688	0.1510
Worksold	-0.0072	0.0071	0.3100
age_hh	0.0136	0.0264	0.6060
green_alt	0.4362	0.6414	0.4960
Eduproxy	0.2506	0.1420	**0.0780*****
time_lot	-0.0558	0.0685	0.4150
Constant	-3.4805	2.0961	**0.0970*****
Prob > chi2 =	0.0001		
Log likelihood =	-40.284158		
Pseudo R2 =	0.3093		

*Statistically significant at 1%; *** statistically significant at 10%.

Table 22. Odds Ratio of Data Set Meant to Inform Main Factors Affecting Settlers' Cattle Ownership

Dependent Variable: Cattle (dummy) n=100			
Independent Variables	**Odds Ratio**	**Standard Error**	P>z
Past_Size	1.0858	0.0332	**0.0070***
Lot_Size	1.0528	0.0325	**0.0960*****
Cred_Cattle	13.6154	9.6349	**0.0000***
Cred_other	0.5100	0.3147	0.2750
Dep_ratio	0.5885	0.2171	0.1510
Worksold	0.9928	0.0070	0.3100
age_hh	1.0137	0.0268	0.6060
green_alt	1.5469	0.9922	0.4960
Eduproxy	1.2848	0.1824	**0.0780*****
time_lot	0.9457	0.0648	0.4150

*Statistically significant at 1%, *** statistically significant at 10%.

Results of logistic regression showed that pasture size, lot size, credit for cattle, credit for other activities, dependency ratio, and combined variable proxy of education presented expected signals in their estimated coefficients. This finding means that pasture size, lot size, credit for cattle, and variable proxy of education have a positive effect on the decision of owning cattle or not, while availability of credit of other activities and dependency ratio have a negative effect on the dependent variable. Credit for cattle and pasture size showed significant results at 1%, while size of lot, variable proxy of education, and constant term were statistically significant at 10%. Credit for other activities and dependency ratio did not show significance, showing that for these two variables results are inconclusive and deserve future research.

Variables with dual expectations, work sold off-farm and age of household, presented negative and positive coefficients, respectively. This result shows that age of household has a positive relationship with the decision of owning cattle or not, while quantity of work sold has a negative relationship. These variables also did not present significance statistically, and again the role of age of household and work sold off farm deserves attention in future research.

Involvement in green alternatives and length on the property presented coefficients different than expected. Involvement in green alternatives showed a positive outcome, while length on the property showed negative. Both variables did not show any significance in the model. This unexpected result when involvement in green alternatives is evaluated deserves attention because it can be the result of years of investment in crops without success or even transfer of income from this activity to cattle. These are only possible reasons, which deserve to be evaluated in future field research. Age of household also deserves attention because in the past it has been said that, as the household ages, he or she does not need to feed children and then production for self-consumption is reduced. However, as this research found that pasture rental

became a good source of income, it can be inferred that older people prefer to rent instead of deal with animals.

Still as in the finding of the logit model, the constant term was negatively statistically significant at 10%. Estimated pseudo R^2 presented a value of 0.31; however, in accordance with Gujarati (2003) and Hosmer and Lemeshow (2000), in models where the dependent variable is dichotomous, the R^2 value is questionable as measures of adjustments for a regression.

Analyzing the coefficients that came out as statistically significant, a 0.8 unit increase is expected in the log odds (or logit) of the probability of having cattle for every one unit increase in pasture size. However, when the odds ratio is taken into consideration, pasture size has no significant effect on the decision of having cattle. Analyzing the odds ratio outcomes for that variable, the interpretation would be that the odds of those who have cattle (1) are 1.08 times more likely than the odds for that group of who do not have cattle (0).

Size of lot showed a lower effect in the decision of having cattle; interpretation of the coefficient results shows that a 0.5 unit of increase in the logit of probability of having cattle happens for every one unit increase in lot size. Again, for the interpretation of odds ratio, no significant effect of lot size was observed on the decision of investing in cattle (1.05).

According to the coefficient value, availability of credit for investments in expansion of cattle activity is shown as the best motivation for settlers to own or not to own cattle. In accordance to the logistic regression, 2.6 units are expected to increase in the log odds of probability of having cattle for every one unit increase in credit availability. The same interpretation is confirmed when the odds ratio is evaluated, showing that the odds of those having cattle are 13.6 times greater than the odds of those who do not have animals on their property when credit for cattle is taken into consideration.

Analyzing years of education of household times access to government benefits, a positive relationship was found with an expectation of a 0.25 increase in the probability of having cattle (log) for every unit of change in the variable proxy of education. However, the effect of this variable on the decision happens to not be significant when the odds ratio is evaluated. This variable only affects those who have cattle 1.28 times when a comparison is made with those who do not have cattle.

The variable related to involvement in agriculture alternatives shows an unexpected coefficient predicting a positive connection between that variable and the probability of having cattle. Results show that the higher the involvement in alternative activities the higher the chance (in log) of settlers investing in cattle. In other words, the expectation is that a 0.44-unit increase in the log odds of having cattle for every one unit of involvement in alternative productions. When the odds ratio is taken into consideration, the effect of this variable is not as successful in affecting the decision of owning cattle. In addition, statistical results showed that the variable is not significant in this model.

The constant term can be interpreted as the probability of settlers owning cattle when all the independent variables are equal to zero. In the general logit model, the constant term showed statistically significant at 10%, and its value can be interpreted as that one-unit increase in the constant that would predict a 3.48-unit decrease in the decision of settlers to own cattle.

The general model showed overall statistical significance; however, the value of log likelihood may reflect the size of sample after drops of missed values. In sum, pasture size and credit for cattle were shown as good factors in the decision of settlers of having cattle, however, due to unexpected outcomes showed in this model, I understand that more research has to be done to understand decision of settlers with more details, meaning that it is important to separate

groups that own cattle and/or rent pasture, and role of seasons in this behavior, to understand better settlers' reasons for being involved in the cattle economy. All analyses for coefficients and the odds ratio consider holding all other variables constant (*caeteris paribus).*

8.3 Objective Two: Impact of Cattle Economy on Improving Well-being

8.3.1 Changes in Wealth

Linked to objective 2, which is to examine how engagement in cattle has impacted the settlers' well-being, a research hypothesis (H3) states that settlers' involvement in the cattle economy (owning animals) would experience positive changes when comparisons are made between data from 2006 and 2011. Given the expansion of cattle and of national and international beef markets, the expectation was that settlers in the region would experience improvements in well-being. To start this analysis, as explained in chapter 6, each household was categorized into a wealth classification for each time evaluated. However, access to durable goods is not the only indication of wealth; and in addition, I describe sources of income and improvements in education in that period to explain changes observed.

At settlement, the period corresponding to arrival appears as the most critical moment for settlers, and most of them reported that they arrived at the lot only with basic needs to start a new life. In fact, poverty is the starting point for organization into groups demanding land and government support at the time of settlement creation. Sixty-five percent of interviewed people were classified in category 1 (or the poorest one) at the moment of arrival, meaning that settlers did not possess any durable goods at that time. In addition to that finding, none of the settlers could be classified in category 4, the wealthiest one. In 2006, the period of the first data collection with the evaluated group, 17% of settlers still remained in category 1; however, 4% were able to be classified under category 4. Improvements in wealth category were confirmed in

the 2011 data collection and showed that only 3% of the settlers were classified in category 1 and 56% (more than half of the settlers) reached category 4 (Table 21). Comparing groups of settlers who own and do not own cattle, it is perceived that no settler is under category 1 if he/she owns cattle while 10% still remained in that category in 2011. Still comparing groups with and without cattle, 67% of those who have cattle reached category 4 in 2011, while only 30% of those who did not have cattle did so (Table 23). Using the *t*-test, all changes were statistically significant at 1%.

Table 23. Changes Related by Settlers Over Time

Period	Total (*n*=104) Category (%)				No Cattle (*n*=30) Category (%)				Yes Cattle (*n*=74) Category (%)			
	1	2	3	4	1	2	3	4	1	2	3	4
Arrival	65	18	17	0	60	30	10	0	67	12	21	0
2006	17	30	49	4	13	43	37	7	19	25	53	3
2011	3	2	39	56	10	0	60	30	0	3	30	67

When asked about changes experienced in their lives before and after arrival in the settlement, 80% of settlers responded that they are experiencing better life conditions now. Among the responses that make settlers consider that they are in better circumstances currently, settlers reported access to land, house ownership, and self-employment conditions as the main reasons. Many respondents said that when they lived in urban areas they did not have access to basic needs and even experienced famine conditions. Among the best responses regarding life quality of the current settlers:

My life improved a lot since I moved here, before the settlement I even did not have a place to live (questionnaire #73, PA 17 de Abril).

In comparison to before, when I did not own anything, it is a lot better; I even finished high school after I moved to the settlement (questionnaire #66, PA Canudos).

Now I have access to electricity, can sell my own production, and access to the city is better (questionnaire #55, PA Alegria).

While I worked in my own land I was able to send 4 children to school and all of them now have a stable and good job, all of them are working for government (questionnaire #20, PA Castanhal Araras).

My children will not need to work for somebody else and all of them are going to school (questionnaire #33, PA Primeiro de Março).

It is better now, because I work for myself and I have my own cattle and furniture (questionnaire #3, PA Cabanos).

Results showed that changes experienced between T0 (time of arrival in the settlement), T1 (2006), and T2 (2011) are statistically significant at 1% for changes in all evaluated periods, meaning that well-being changes over time are important (Table 24). General findings about changes in well-being confirm my expectation and my research hypothesis (H3) is accepted: that smallholders would experience positive changes in terms of well-being.

Table 24. Mean Difference in Changes of Durable Goods Acquisition Over Time

Variable	Diff of Means (Std. Dev.)	P-value	T
T0 to T1	0.864 (1.000)	0.000	-8.76
T1 to T2	1.097 (0.955)	0.000	-11.66
T0 to T2	1.961 (0.907)	0.000	-21.95
***n*=103**			

8.3.2 Assessing Changes in Settlers' Well-being

As stated by the settlement PDA, investment in programs to improve income is part of the action of resource distribution developed by the government. For this study, comparing changes in income since settlement creation was not possible, but understanding sources of income in 2011 was possible. With this, checking how government is reaching its objective of poverty reduction is important and, consequently, how this affects changes in well-being. Data collected in the field in 2011 showed that sources of income are diversified; including government benefits as part of programs of cash transfer, retirement benefits, commercialization of calves, and off-farm jobs. Government benefits appeared as the main source of income and, specifically, cash transfer programs in the form of *bolsa-família* or retirements due to age, death of spouse, or physical disability. These monthly benefits equate to up to USD 151 for *bolsa-família*, and retirement and disability can bring in another USD 270.

A second income source is originated from commercialization of calves at the settlement. Here, a problem exists related to the original objective of the settlements, which is to provide incentives for diversified production; and as cattle demands land, if this activity expands and shows up as a great source of income, less land will be designated to agriculture and more areas will be cleared. This investment in cattle is also a solution for settlers, as they have an established production chain, and there is always somebody at the settlement looking for calves to be commercialized. Regarding this information, a settler reported that

> *"there are more people trying to buy calves than settlers have to offer*" (questionnaire # 100, PA 17 de Abril).

Currently, it seems that calf commercialization is the only activity being well organized in the region. In general, those settlers who have animals and sell to local largeholders, sell from 1 to 36 animals per year, with an average of 7 animals. On average, calves can be sold in the

region per USD 238, depending on size and quality, providing in turn upward of USD 238 to USD 8,554 in income per year, with an average gain of USD 1,666.

A third income source is derived from efforts developed by the government and SMOs to provide stable jobs for settlers. Off-farm jobs are those where the settler or relatives spend most of the day working in activities not related to the property. In the analyzed group, people were hired to teach in the local schools, and truck drivers were hired for local enterprises. Additionally, doormen, cooker, health agent, ambulance driver, and river level reader were found in the sampled group. Wages for those with a formal job varied from a little less than one minimum wage (or USD 270, at the moment of data collection) to almost six minimum wages (USD 1,619) per month.

A fourth source of income is noncattle livestock, although not as regular and well established as the calf chain; but it is an indicator that if policies are made to enhance investment in small animals, the forest will gain when less area is demanded to be opened to pasture, and also the settlers will gain when they have an alternative option of production. Chickens, ducks, and pigs are the small animals most commercialized in the region; and there was an indication in the field that if better efforts were made, fish also could become a great source of income in the region.

Agriculture is only the fifth income source, as cassava flour is the main commercial product cited during data collection. Other products from agriculture were cupuaçu, banana, and açai. All these three crops could be well developed in a system involving both pasture and agriculture. Other sources of income were broken down into (1) cow commercialization, when animals do not produce enough milk or do not reproduce anymore, and it can take up to 16 years; (2) work sold off-farm but still related to agriculture, when settlers and relatives sell their workforce for neighbor properties when their lot is not productive enough or when they do not need a constant

presence of a settler; (3) milk commercialization appeared to be an option mainly at PA 17 de Abril because of the presence of a mini-dairy processer nearby; and (4) pasture rental, which showed as an option for those who do not have resources to invest in production in their properties but still have areas of pasture available.

Looking at all income sources above, at least four of them are from the cattle economy (calves, milk and/or cow commercialization, and pasture rental). This brings again the information that the cattle economy has been expanding in the region because of a well-established chain, and the diversity and duality of that activity make it attractive even for those who do not have a history of participation in the cattle economy. In addition, this information brings the need of future research to understand in which levels settlers are involved in the cattle economy. Comparing annual income of settlers who sell and do not sell calves, it was found that those who sell animals have on average an annual income of USD 7,921 while those who said they do not sell any calves have on average an annual income of USD 5,941.

8.3.3 Assessing Changes in Education

In addition to income improvements, government and SMOs' focus when a settlement is created is to provide access to school for settlers and their children. As part of the settlement creation program, a myriad of efforts were made to expand formal and technical education. Education level of household has been studied as a factor affecting land use dynamics. According to Godoy *et al.* (1998) and Caldas *et al.* (2007), an increase in education is predicted to lead to the pursuit of greater productivity, which translates to more economic investments and probably more income. In addition, this will affect improvements in well-being over time. Examining the years of education of householders in T1 and T2, improvement of 1.05 year is perceived; and according to personal contact with the Landless Workers Movement (MST)

leader in April 2011, this is a result of the partnership with government and SMOs to reduce illiteracy rates in the settlements (see Table 15 in chapter 8). During data collection, I had contact with professors hired to teach adults in those settlements, and many of the survey participants related that in the last five years they learned how to read and write. The difference in means for this variable presented a statistical significance at 5%, meaning that change in means over time was important. Inside settlements, adults go to school at night to learn how to read and write as part of the objective to eradicate illiteracy within rural areas. In fact, not only adults but young people have benefited from this program; and finding settlers whose children are already going to college in the nearby cities was common.

Translated to the cattle economy, this finding infers that more educated settlers become more vulnerable to participate in the activity that is more productive, and, again, the fact that cattle have been the most prominent activity in the region and that credits are available for investments in that activity make those more literate more inclined to be part of that economy.

It is clear that insertion of the landless into the settlements make them experience better life conditions over time. This happens not only in changes of access to durable goods, but as they perceive better life conditions when the time before and after insertion into the settlement is evaluated. Better than access to goods, the source of income was shown as diversified; and some of those sources are results of programs to improve well-being through resource distribution developed by the government. Unfortunately, the expansion of family farming as it was stated by the settlements policy was not perceived as the main source of changes in well-being; but improvements in social factors, such as education level, bring the expectation that if a well-developed project will be started in the future, settlers may be more ready to be part of discussions about sustainable production.

CHAPTER 9. CONTEXTUAL ANALYSES: UNDERSTANDING THE ROLE OF CREDIT POLICY IN THE SETTLEMENTS

As shown in the statistical model in chapter 8, credit for investment in cattle plays an important role in the settler's decision of owning or not owning animals. In addition to that statistical analysis, data collected during this field research found that 76% of settlers had access to credits for investments in cattle, while only 32% received credits for other activities, such as cassava, banana (*Musa* spp.), cupuaçu, and coconut (*Cocos nucifera*) (Table 25). Despite this, that most settlers informed us that they received more credit for cattle than for other activities, there is not a statistical significance when these two responses were analyzed together. When related to crop investments, most of those who received credit for other activities said they do not have it anymore because of the absence of technical support, accidental fire caused by a neighbor, or lack of experience with the proposed crop. According to settlers from questionnaire # 36, PA Primeiro de Março:

> *Crops did not develop due to lack of technical support and evaluation of soils and water in the region. There was not a contract establishing commercialization of banana and I would not know where to sell the production if it worked well.*

Table 25. Availability of Credit by Type, 2011

Did you Receive Credit for Cattle?	Did you Receive Credits for Other Activities? **0**	**1**	**Total**
0	15	10	25
1	56	23	79
Total	71	33	104
	Pearson χ^2 (1) = 1.0389 Pr=0.308		

0=no, 1=yes

In addition to critiques directed to lack of technical support and market evaluation, a common statement was that soils in the region are not suitable to development of any crop if there is no investment in technologies such as soil fertilization, plowing, and gradating with a tractor. Settlers said that those kinds of investments are expensive and that only largeholders have access to them. As result of that, only 9% of those who received credit for other activities remain invested in those (Table 26). However, there is not a statistical significance when responses of those who received credits for other activities and still were analyzed together. Among those who received credit for cattle, 80% of them still have animals on their property (Table 27). Here, responses of those who received credit for cattle and still have animals are statistically significant at 1%.

Table 26. Relationship Between Credit for Other Activities and Production

Did you Receive Credit for Other Activity?	Do you Still Have Alternative Production in Your Lot?		
	0	**1**	**Total**
0	63	8	71
1	30	3	33
Total	93	11	104
	Pearson χ^2 (1) = 0.1129 Pr=0.737		

0=no, 1=yes

Table 27. Relationship Between Credit for Cattle and Cattle Possession

Did you Receive Credit for Cattle?	Do You Have Cattle?		
	0	**1**	**Total**
0	14	11	25
1	16	63	79
Total	30	74	104
	Pearson χ^2 (1) = 11.8229 Pr=0.001		

0=no, 1=yes

Availability of credits for cattle production also appears as the main driver of investments in that economic activity when settlers were asked to cite freely the reasons to invest in cattle. The most recurrent response was related to credit availability for investment in animals, followed by better economic returns and to produce milk for self-consumption and for market. When all reasons were put together (frequency of reasons cited), credit availability remained as the main reason, followed by milk production and cattle culture (neighborhood effects) (Table 28).

Table 28. Responses About Reasons for Investing in Cattle

Reasons Cited	**Ranking**					**Total (frequency)**
	1	2	3	4	5	
Credit available	**23**	6	1			**30**
To produce milk either to sell or to feed family	17	5	**5**	1		**28**
Cattle culture (be a farmer, saw neighbors, status, tradition)	17	5				**22**
It has a better economic return	4	**9**	5			18
Lot is all under pasture	15		1			16
Better productive option in the region (sell calves)	3	8	2	2		15
Soil is not good for anything else	1	5	2			8
It is easy to raise cattle	6	1				7
It works as a savings account	3			2	1	6
Other	1	3				4

Other responses deserve attention because of the possibility of development of public policies to reverse settlers' decision. One of those responses is related to the lot being already all under pasture at the time of arrival. With investments in technology to reverse pasture to crops, it

would be possible to invest in crop production; however, when asked about this possibility, settlers agree that they need not only availability of technology but also permanent technical support. In practice, technical supporters only visit settlements during the period of PDA elaboration, and their contract with the government lasts six months. By the time the settler is starting to receive all credits for production, they do not have support to show them how to conduct and keep better practices to improve and diversify production.

When I visited local agronomists responsible for settlement assistance, I was told that in the past technical support was paid by the Ministry of Agrarian Development (MDA) for up to three years; but currently, this only lasts up to one year (STR, personal contact, March 2011). To justify their decision on encouragement of settlers to invest in cattle, all visited technical supporters said that—despite the region would be a good option for production of cassava flour, banana, pineapple (*Ananas comosus L.*), passion fruit (*Passiflora sp.*), cupuaçu, and açai (*Euterpe oleracea*)—there are problems that have to be solved before the establishment of those crops. First, they cited that a production chain is not well developed for those products and also that roads are in bad conditions during rainy season, making it impossible to bring perishable products to the city on time to have a good return. On the other hand, when settlers perceive that a chain is well organized for calf commercialization, they start to open small plots of pasture without any credit; and they refuse, by the time of PDA development, to switch production to a more diversified plan. Another problem, cited in general by third-party technical supporters, was related to discontinuity of support after the contract with INCRA was completed. In addition to that information, agronomists said that a formal analysis of soils was not performed due to lack of laboratories in the region. One technical supporter told me:

> *I go to the lot, look at what is developing around and I define by* ***looking at*** *which kind soils is and which crop I can recommend to the area* (personal contact on March, 2011)

When it is time to define what to recommend to the region, the logistics have more impact than the physical and chemical soil characteristics. According to the representative of the oldest technical support company in Marabá, *acerola* cherry (*Malpighia glabra*) and açai need to be in the market within 24 hours after harvest, and cupuaçu can wait 4 days before being transported to market. Cattle, on the other hand, move by themselves; and in addition to this, they produce milk for self-consumption. Despite this perspective that cattle are a better alternative, the informant was clear that

> *Family farming is specializing in pecuarização (cattle); however, family farming cannot survive on monoculture—it is necessary to find a balance between food security and commercialization and it is far from happening in this region. The best solution would be the consortium of perennials and cattle; annuals and trees. Until the arrival of cattle in the region, we did not report any problem about lack of water in the lots; however, cattle will keep strong in the region because settlers don't have enough information about unsustainability and damage caused by cattle production.*

9.1 Rationality of the Decision

It is clear that credit is most directed to cattle, and technical support does not encourage diversified production. However, it is not clear if investing in cattle is by far the best option in the region. To assess the **profitability response**, primary data was gathered to allow for understanding of settlers' and social movements' thoughts about profitability of other activities. In addition, secondary data was gathered to verify comparison of profitability based on production costs for crops that are well known in the region to understand how better off a person could be who is involved in production other than cattle. I also conducted informal data collection with a producer who is being connected to markets through diversification.

9.1.1 Settlers' Perception of Profitability

Starting with settlers' perceptual experience about profitability of diversified production, of those who had invested in alternative production, only 27% considered this more profitable than investing in cattle (Table 29). These responses about investment in green alternative and whether it is more profitable than cattle showed statistically significant at 1% when compared.

Table 29. Investments in Green Alternatives and Settlers' Perceptions about its Profitability

Do you Invest in Green Alternative?	Is Alternative Production More Profitable than Cattle?		
	0	**1**	**Total**
0	71	0	71
1	24	9	33
Total	95	9	104
	Pearson χ^2 (1) = 21,1981 Pr= 0.000		

0= no 1= yes

Among those who affirmed that diversified or alternative production was more profitable than cattle, the most recurrent explanation was related to the size of lot and long-term unsustainability of pasture for small farms. One settler said:

> *Agriculture is more profitable than livestock if land is small* (questionnaire #59, PA Canudos)

However, settlers understand that profitability and productivity are related to seasonality of production, investment in technology, and soil quality in the region. In fact, seasonality affects responses in accordance with the period when data is collected. For example, when the questionnaire was tested in July 2010, settlers from PA Castanhal Araras reported that the region was not good for anything and that after 23 years of creation not a profitable plantation existed in the region. However, during the final data collection in January-April 2011, the season for

cupuaçu, it was found that during that time many settlers were part of that fruit production and they reported that it was possible to sell up to 60 kg of pulp per day, up to USD 2.5 per each kg. On the other hand, instability of the price of crops in the region makes the activity less interesting than investing in calves, which have a stable price and demand. However, according to an agronomist in the region (technical support #2), now that electricity reached all rural areas, problems with prices and seasonality can be reverted through frozen pulp production; but because of legal issues in producing it locally, the government had to make strategic investments to create mini-industries around major areas for facilitating fruit processing following health rules. In comparing profitability of cattle and crops, one settler said:

> *It is all the same, because it depends on seasonality of both* (questionnaire #80, PA 17 de Abril).

In reality, in comparing responses about a better period to sell calves, the demand for cattle is more concentrated during the dry season (June to September) and cupuaçu production is concentrated from December to April. However, another difficulty reported in investing in cupuaçu during the wet season was the fact that road conditions are an obstacle to receiving good payments for production. Not only are road conditions a barrier for investments in the commercialization of cupuaçu, a manager of technical support third party also reported that even those settlers who are investing in banana and cassava, and are being productive, have experienced problems due to lack of options for commercialization during the rainy season. As a result of this failure, many settlers in the short term, even those who received credit for agriculture, shift their land use to pasture and start to invest in cattle. This also happens because after failure in crop production settlers believe that cattle are the only well-consolidated chain in the region.

However, even for those who do not expect to return land use to agriculture, all technical supporters understand that *sustainable* ranching could be developed even in small lots without the need to open new areas. To do that, barriers related to investments in technology have to be broken and a system of family farming intercalating fruits and pasture divided in paddocks, to allow rotation of animals, could increase the forage's capacity by 40% without any special tracts in the pasture (Servtec, personal contact, March 2011). Pasture rotation can improve its capacity from 1.5 animal units per hectare to up to 6 animal units per hectare (Servtec, personal contact, March 2011). To make it a reality, more efforts to bring soil analysis labs to the region has to be achieved as well as investments to maintain a technician responsible for each project financed by government to stay in contact with the settlement for continuous or a longer time. Settlers and agronomists also commented that, if keeping a legal reserve as the law establishes (80%) is of interest, the forest has to provide some economic gain.

> *Nobody wants to have a forest only to look at and without fast economic gain*
> (Manager of technical support group #1).

When asked why and how the relationship between settlers and largeholders happened, CPT's lawyer stated that the cattle economy is historically the only option in the region. Despite that the settler arrives in the region with the idea of taking over unproductive land from largeholders to convert to family farming and to promote food sovereignty, *the culture of pasture* is already in the region; and the model reproduced by technical support and credit providers follows the economy established by large holders. Because of this reproduction of a system already developed, settlers became the largest suppliers of calves in the region—and it is difficult to convince settlers to spend time, money, and labor on diversification.

9.1.2 Estimating Production Costs in the Region

Making a comparison using production costs acquired in the region for horticultural products (okra, *Abelmoschus esculentus* L.; gherkin, *Cucumis anguria* L.; lettuce, *Lactuca sativa*), fruits (passion fruit, pineapple, banana, cupuaçu, and açai), corn, cassava, and livestock (aviculture, sheep, swine, fish, goat, and cattle)[11], a project where only cattle activity is recommended basically involves fencing, pasture seeds, purchase of animals, and some labor; while projects for agriculture or small animals involve soil correction through fertilizers, material for a greenhouse (for horticultural products during the rainy season), seeds, tractor hours, production costs and calculations for each crop in the project, and labor.

To determine production costs, assessing all costs originating from the use of material goods (such as raw-materials, workforce, depreciation of machinery, and others) would be necessary. In economics, these total costs (TC) are derived from the sum of fixed costs (FC) and variable costs (VC). Variable costs are those where change happens in accordance to seasonality and level of production in the property, such as fertilizers and fuel. Fixed costs do not vary; those can be defined as fixed taxes, costs with animals' management, and rental expenses. Then,

$$TC = FC + VC$$

Below, I try to show, in a table, estimated production total costs and revenues for several crops and livestock in the region based on data collected in the region (Table 30). However, what I call net revenue does not include transportation costs, which become high during the rainy season and in farther areas, but this price was not made available. This said, there is a lack of information in bringing together all costs involved to result in the total cost (TC).

[11] Data provided by EMATER-PA and BASA on April 2011 (personal contacts).

Table 30. Production Costs for Different Crops and Livestock in Southern Pará

Activity	Area	Estimated Production Costs (USD[1])	Time to Start Production	Estimated Revenues (USD)	Net Revenue (US$)
Livestock					
Aviculture	20 m^2	3,648.51	90 days	5,878.71	2,230.20
Sheep	836 m^2	6,424.75	1 year	7,797.03	1,372.28
Pisciculture	60 m^2	3,951.49	10 months	8,983.66	5,032.17
Goat	836 m^2	5,996.53	1 year	7,797.03	1,800.50
Swine	1,270 m^2	5,122.28	180 days	7,900.99	2,778.71
Cattle	10,000 m^2	7,513.46[b]	1 year[c]	21,386.37[d]	13,872.91
Crops					
Banana	10,000 m^2	3,406.39	1 year	5,940.59	2,534.20
Corn	10,000 m^2	907.43	90 days	1,980.20	1,072.77
Cassava	10,000 m^2	1,211.39	1 year	3,713.11[e]	2,501.72
Cupuaçu	10,000 m^2	2,141.09	4 years	2,376.53[f]	235.44
Açai	10,000 m^2	2,123.76	4 years	2,970.64[g]	846.88
Passion Fruit	10,000 m^2	3,649.78	1 year	7,921.18[h]	4,271.40
Pineapple	10,000 m^2	4,919.56[i]	1 year	9,616.34	4,696.78
Lettuce	10,000 m^2	5,841.58	70 days	14,851.49	9,009.91
Gherkin	10,000 m^2	780.20	60 days	1,485.15	704.95
Okra	10,000 m^2	1,282.18	60 days	3,712.87	2,430.69

[a] 1 USD=2.02 BRZ R$ on July 18, 2012.

[b] Costs estimated based on information about pasture reform, the price of five animals, corrals, and fences.

[c] In the first year, animals start to produce milk.

[d] Each animal, on average in the region, produces 20 liters of milk daily, providing continuous revenue of at least USD 12 per day, considering one liter per USD 0.15. In the second year, calves are sold and each animal costs from USD 148 to 272.

[e] Estimated revenue for cassava flour.

Table 30 (cont'd)

[f] In the fourth year, each plant provides 8 fruits, giving revenue of USD 2,376. From the fifth year, each plant produces up to 12 fruits providing revenue of USD 3,564.
[g] In the fourth year, each plant provides 15 kg of fruit, giving revenue of USD 2,970. From the fifth year, each plant produces up to 40 kg of fruits providing revenue of USD 7,921.
[h] First and second years provide a revenue of USD 7,921. In the third year, revenue of USD 3,960 is expected.
[I] In the first year, an investment of USD 3,633 is expected, and in the second year, it is invested USD 1,257 on harvesting, fertilizers, and herbicides.

The costs above are an estimate considering that climate, roads, soil, and market conditions are constant. It is known that for agriculture, risks are involved; and in southeastern Pará, as the cattle chain is already organized, a phrase is repeated everywhere by settlers: *cattle is better because they move by themselves,* and in addition to that, the possibility of daily milk production makes cattle activity even more attractive. One observation made on the cost tables provided to me is seasonality of crops. In the field, I was told that without investments in a greenhouse, producing horticultural crops during the rainy season is not possible. An average cost of a greenhouse is around USD 891.

9.1.2.1 Estimating Production Costs of Livestock

The area designated for chicken production involves construction of a structure of 20 m^2 to raise 200 chicks. Construction involves an investment of USD 1,139, and investments of more than USD 1,980 in feeding animals for a period of 90 days when they will be ready to be sold in the market. An investment of USD 198 is also added to acquire chicks. A mortality rate of 5% is considered, and each animal can be sold for USD 12.4 by the end of that step. To reach the final revenue, consultants from BASA consider that cycle is being repeated four times in a period of one year. However, estimated costs from BASA do not include costs of vaccines and

supplements, which in accordance with EMATER is about USD 44.6 per animal cycle, meaning that at the end of four cycles estimated costs are USD 178.2. This additional cost has to be accounted for in the total costs (TC) as part of variable costs (VC), reducing the net revenue to USD 2,052. Net revenue does not consider gains with eggs' commercialization, transportation costs, and rates of family consumption. In addition, as a settlement is considered a process of inclusion through family farming, it is not considered external labor hired to this activity. Theoretically, this seems a good alternative as this activity does not demand a large tract of land and employs family members. In practice, chickens are not a profitable activity, as many people reported unexpected problems, such as unknown diseases, robbers, and the need to self-consume due to the lack of other sources of protein in daily meals. In general, aviculture is treated as a proxy of saving, with settlers only selling animals in case an unexpected need happens. Most times, investment in chickens starts to supply self-consumption.

An estimated total cost for investments in sheep production involves construction of a 36-m^2 sheepfold plus 800 m^2 of fences. Twenty-one animals (one male, 20 female) are included in the estimation, with a total cost of USD 2,871. Costs with medications and vaccines are around USD 297. An index of mortality of 0.01% and a reproduction rate of 1.5% are calculated to arrive at the final revenue of USD 7,797. However, because of the high costs for construction of fences and folds, final net revenue (not considering transportation costs) is about USD 1,372 at the end of the first cycle (first year).

Estimated costs for starting fish production includes construction of two tanks at a cost of USD 2,970; investments of USD 15.1 in supplements; investments in pipes, roses, and nets of USD 177; and investments in food of USD 521.3. The first lot of fish costs USD 84.2. In a one-year period, investing in two lots of fish is possible, which at the end of that period will provide

net revenue higher than USD 5,000. During data collection in the region, fish production would be a profitable activity; however, because tanks need to be built, an environmental impact study is necessary, and settlers do not do that because of costs and time involved. Those who tried to build tanks by themselves, without technical support, experienced problems keeping water stored because of the sandy soil in the region.

Costs for investment in goat production involves the acquisition of 20 females and 1 male at a cost of USD 2,475, plus investments in medications and supplements (USD 297), and a goat hold and fence construction (USD 3,224). After calculation of mortality and reproduction is considered, in one year it is possible to build an income of USD 1,800. Despite the estimated costs for this kind of livestock, in the field it was not common to perceive a demand for this activity.

Estimated costs for swine production include the purchase of 5 females and 1 male at a cost of USD 1,114. Construction of swinery, including an area for reproduction and material for fences, costs USD 2,177. To feed two cycles of animals in one year, the cost is USD 1,163; and USD 99 is necessary for costs with vaccines, medication, and food for the animals. By the end of one year of investments in swine activity, revenue is expected of USD 2,779.

Finding settlement people with mixed animals to produce milk and calves is said to be common. To estimate revenue of cattle, milk was not considered self-consumption, which appeared as an important reason for starting the activity. In fact, when BASA provides credits for cattle in settlement areas, the initial project is designated to milk production with the purchase of four cows and one bull. Those animals have an estimated cost of USD 1,832, and in the first year only milk production is expected. According to BASA, an animal is supposed, on average, to produce 20 liters of milk per day, providing annual revenue of USD 13,872. By far, this is (until

now) the highest revenue an activity can provide; however, in the field, cows acquired with the help of technical supporters have a price of animals with good genetics—but in fact they are mixed animals that do not provide more than 5 liters of milk per day. Following that information collected in the field, net revenue on the first year of investments in cattle drops to a negative value of USD 2,167, showing that in fact settlers during the first year of production have a loss. In addition, BASA, EMATER, and CPT have observed that in the second year the quantity of animals expands and that there are always calves to be sold, which provides the settler an idea of continuing revenue that originated from the investments in cattle.

9.1.2.2 Estimating Production Costs of Crops

Estimates of production costs of crops include land preparation costs such as clearing of the area, soil correction through use of fertilizers, use of tools, and labor hired. Usually more labor is needed in the first year to clear the areas. For bananas, for example, in the first year of implementation the costs are expected to be USD 2,540, with the expectation of gains only in the second year. Usually a project for crops is developed for 1 ha (10,000 m^2); and for the quantity of bananas expected to be produced, a project also should include a study of market and commercialization options. At PA Primeiro de Marco, for example, many settlers related that their first credit was designated for bananas, but none of them were successful with the activity because of lack of knowledge of that activity—and most of them ended up being engaged in calf production.

Production costs of corn involve soil preparation (USD 203), seeds (USD 27), application of fertilizers (USD 497), planting (USD 24.8), and harvesting (USD 124). Corn is sensitive to climate changes; and considering the rainy season in the region, corn could be harvested twice a year at most, producing annual net revenue of USD 1,073/ha planted.

Cassava or yucca is a very important crop in the region for cultural reasons. It is present in every main meal of *Paraense* in the form of cassava flour. In fact, at PA Cabanos I was informed that, if road conditions were good all year long, cassava flour would be the best production for investment. Production costs of cassava involve land preparation (USD 396), planting (USD 37), harvest (USD 123.8), seeds (USD 24.8), and processing from root to flour (USD 629.7). One hectare produces enough cassava to generate 3,750 kg of flour, divided into 75 sacks. The revenue on each sack is estimated at USD 49.5; however, by the time of data collection it was being paid at USD 59.4. According to settlers and depending on supply and demand, a sack of flour varies from USD 29.7 to 59.4, making the revenue vary from USD 2,228 to 4,455.

Much like cassava, cupuaçu has an important role in the region. Pulp of that fruit has a particular flavor, and it is used in several recipes of cakes and ice cream. For being a fruit that is endemic from that region, other states in south-central Brazil started to import from Pará. Costs of production are mostly accrued in the first year. During the first year, seeds, land preparation, and soil fertilization are expected to cost USD 937. During the second year, fertilization and pest control are expected to cost USD 2,421. The third year requires investments of USD 564. Other costs (USD 199) involve acquisition of tools to harvest fruit and clean trees. Only in the fourth year do trees start to produce fruit, reaching maximum production capacity in the fifth year (12 fruits/tree/cycle). Once cupuaçu is established, the only costs are related to soil and plant management, and then from the fifth year, cupuaçu revenue reaches USD 3,564.

Açai has the same cost of development as cupuaçu, and only in the fourth year are most of the revenues reached from that fruit. In the fourth year, each plant provides 15 kg of fruit; and from the fifth year, this production reaches 40 kg per plant, improving revenues up to USD 7,921

per cycle. In the first year during the planting of 1 ha, an investment of USD 456 is needed. In the second year, an investment of USD 280 is needed, followed by an investment of USD 198 in the third year. In the fourth year, harvest starts, needing investments of up to USD 436. Other expenses are for tools and fertilizers of around USD 434/year.

Much like other crops, production costs of passion fruit involve land preparation, fertilizers, and tools. The difference for passion fruit is the need for investments in sacks to produce plants separately and for poles to support each plant. Despite high production costs (USD 3,640), returns from the production, if no problems occur, are USD 4,271; and this revenue will repeat in the next year if plants are free of pests. Only in the third year does production start to decline, and then it is time to invest in new plants.

Settlers reported that pineapple would be a good investment in the region because most of the fruit consumed in the region comes from the neighbor state, Maranhão. Production costs are divided in the first and second year, with most of the costs being invested during the first year (USD 3,364). One hectare can produce up to more than 27,000 fruits, and revenue is expected to be USD 4,697 from the first year of investment.

Planting 1 ha of only one temporary crop seems unrealistic; however, all projects I had access to were explicit in this way. Even though lettuce production appears to be the most profitable, the area of evaluation is 10,000 m^2 (1 ha), and this is unrealistic when we think about the small producer who is supposed to diversify production. For vegetables like lettuce, gherkin, okra, cilantro, and parsley to be productive all year long in a region with continuous rain, investments in a greenhouse are necessary and no settler was found with any credit developed including this. To build a greenhouse with 150 m^2, an investment of USD 891 is necessary. Even though how often settlers have to change a structure is not specified and in looking at

revenues for vegetables like lettuce (USD 9,010), Gherkin (USD 705), and okra (USD 2,431), the investment in a better structure to provide continuous production seems to be a good way to start diversifying production in the region.

9.1.2.3 Comparing Production Costs

Comparing revenues of livestock and crops above, it is understood that cattle is the most profitable activity in the region; however, in the first year there is a loss of investments that is not being accounted for when the activity is already started. Factors such as transportation costs, labor, seasonality, and market are still not well evaluated in the final costs; and these factors deserve to be evaluated in future research. Another comparable factor to be observed is the area demanded for each activity. In the project presented from BASA and EMATER, production costs for cattle are created for 1 ha of pasture; however, an initial project is developed for 5 animals, and in the Amazon it is estimated that each hectare of pasture supports up to 1.5 animals, meaning that to support 5 animals it is necessary to have at least 7.5 ha of pasture. Comparing revenues of how the projects were reported to me, it seems cattle is more profitable; but considering an activity more specialized and organized and accounting for the amount of land used, cattle becomes not as profitable as it appears to be when compared with other production net revenues and area demanded.

An implementation of a diversified project, including cattle, could be possible and could extend profitability, also reducing areas cleared in each lot. Crops, such as cupuaçu, for example, can be developed concomitant with pasture, and then extend possibilities of participation in the market solving problems caused by seasonality. However, even examples of diversification found in the field seemed to not follow an organized plan of production, as we can verify below.

9.1.3 Success or Illusion? An Example of Diversification Found in the Region

While I was looking for someone who could be a case study about diversification within those settlements where I was doing my research, I was always referred to a person called Tião do Cupu. Despite Mr. Tião not being settled in those settlements I was visiting—in fact he is settled in the PA Piquiá, south of Marabá—I thought it would be interesting to see and hear from a person who is known for the success on his lot for diversifying production. Unfortunately, Mr. Tião was not at home, but there I met his father, Mr. Felizardo, who works with his two sons and together they hold four properties (would this be a case of land reconcentration?) at PA Piquiá. My curiosity about their production increased because even in the government sectors they were cited as a success case, and many of the SMOs and government representatives seemed frustrated when I said I did not plan to visit that property.

The PA Piquiá was created in Marabá in 2002, and 68 families are settled there. Despite being officially created in 2002, all families already lived in the area since the early 1990s as *posseiros* (squatters); and after many years, government, after the intervention of STR, understood it was time to give those families rights to produce on the land legally. Mr. Felizardo and his family arrived from Maranhão in 1990. At that time, he **bought** a lot with 50 ha from another squatter who had lived in the area previously. Mr. Felizardo and his family started to produce honey, to open pasture, to plant cupuaçu and açai, and to create tanks for fishes. The initial opened pasture failed because of lot size. He affirmed that, because of lot size and lack of access to technology, it is not viable to invest in cattle. However, one of his sons keeps his lot only for producing cattle (**pasture**) and fish, and he (his son) is not an example of diversification.

Currently, Mr. Felizardo says he has four cows for milk production. After the settlement was officially created, he had access to FNO[12] and PRONAF A. With those credits, he and his sons invested initially in cattle, cassava, and rice. With his production, he paid off all credits. He said that agricultural production was and is still good, but it demands hard work and dedication. The only problem he has is a planted area that is now witch's broom (*vassoura de bruxa*) in the cupuaçu, an endemic disease spread through all of South America caused by a fungus (*Crinipellis perniciosa)* that attacks plants and compromises production (Figure 19) (Purdy and Schmidt, 1996). Mr. Felizardo says that in an area with 50 ha, if a settler knows how to work, production is more than enough to make a profit and to feed a family. However, he does not know how to specify the income he is able to earn from his lot, but he understands that now he can live with more comfort and pays for health care for him and his wife (who, at the time of my visit to his property, was in Brasília, the Brazilian capital, almost 1,700 km from Marabá, to have a surgery) and also for education for his sons (one of them is an Agricultural Technician who works at the oldest Technical Support office in Marabá) and daughters who wanted to finish degrees.

According to Mr. Felizardo, initially, cattle are much more profitable than other activities; but when it is time to reform the pasture, keeping profit in a small area is difficult. He understands that cupuaçu in the region is great because consumers are always looking for it, but seasonality is restrictive (December to April). Fish is not the best option because of costs with specific food, but he still has about 6,000 fish in his tanks. The market is good for fish; and according to Mr. Felizardo's information, if he had more fish he would sell them—and consumers even go to his lot to buy those fish.

[12] FNO is *Fundo Constitucional de Financiamento do Norte* (Constitutional Financing Fund of the North), a credit provided from BASA. Mr. Felizardo received that credit to invest in cattle.

When he arrived, all his lot was under forest; he then cleared almost all of his lot. After he started reforestation, he says he now has around 50% forested area. He did not receive any credit for reforestation. Nobody encouraged diversification; he started because of his past experience with agriculture. Technical support was provided, but it was not enough to make production better.

Figure 19. The cupuaçu plant (A), and its pulp without (B) and with (C) incidence of witch's broom. Pictures by the author.

Mr. Felizardo's history corroborates the information that lack of technical support is a problem in the region. Additionally, it was observed that despite the fact that he and his family understand that they are better off with diversification, they do not keep specific notes about profitability of each crop. Mr. Felizardo informed us that he sells what is produced in the region, but he has no idea which production brings to him better profitability.

9.2 Why Cattle?

The logic for a settler who is not familiar with concepts of gains for the long term and of sustainability is to follow the activity that implies less labor and easy credit—this perpetuates cattle in the region. In fact, even technical supporters (who in theory were supposed to explain the gains of diversification) affirm that to make more profit and to have time to work in several settlements recommending investments in cattle is easier than designing a specific project for each settler in accordance to his/her history, as the PDA and policy require.

According to Batista, CPT's lawyer (personal contact, April 2011), smallholders work following the logic of immediate results, and the logistics of bringing products closer to larger cities are still a challenge. According to Mr. Batista, even settlers currently arriving in the lots know that diversification would be a better option; however, pursuing credits only for cattle is easier. In addition, Mr. Batista emphasized that the origin of settlers who worked in farms as *vaqueiros* (cowboys) is an important factor when it is time to decide about investments in the lot.

Aware of the possible economic gain of diversification and the need for reduction of deforestation that arrived in the region (such as the inclusion of Marabá in the Programa Municípios Verdes[13]), agronomists have been looking for ways to include settlers in initiatives to promote less deforestation. However, barriers are already cited in including small lots. The main barrier concerns lot size. A project to raise funds from forest through carbon sequestration, for example, needs an area with at least 1000 ha. The barrier here stands in the need to convince a group to work together, and it also takes several years until the standing forest generates

[13] Marabá was added in the list of priority municipalities in reduction of deforestation and degradation in 2009 through decree 102, from the Environmental Ministry. "MMA DECREE No. 102 OF 24 MARCH 2009 provides for the list of municipalities located in the Amazon Biome priority actions which focus on prevention, monitoring and control illegal deforestation."

income through carbon sequestration. According to key informants in the region, here starts the idea of not having just a piece of land available under forest without any profit.

9.3 Soils as Barriers to Sustainable Development

Not only were road conditions, lot size, and lack of technology cited as barriers to diversifying production, a recurrent complaint was related to the quality of soils. In many cases, settlers reported that they invested in cattle because

...soil is not good for anything else (questionnaire #9 and 15, PA Cabanos).

The response about quality of soil as the main driver for investment in cattle was common in both data collections (2010 and 2011) at the settlement level. To understand this response and the role of soil quality in the current land use, I overlapped layers of soil type and settlement boundaries to go through information about the predominant classes of soils in those areas, which are displayed in Tables 31 and 32. Unfortunately, none of the visited government offices, social movement groups, or technicians had done in fact a soil analysis by the time of the PDA creation. However, soil predominance in each settlement is expected to be covered by soil classification data developed by the Brazilian Institute of Geography and Statistics (IBGE) and by the Brazilian Agricultural Research Corporation (EMBRAPA)

Table 31. Soil Classification Within Settlement Boundaries

Settlement Name	Soil Predominance
Cabanos	Inceptisol (Cambisol) Yellow Red Latosol (Oxisol)
Canudos	Yellow Red Latosol (Oxisol) Red Yellow Podzolic
17 de Abril	Inceptisol (Cambisol) Yellow Red Latosol (Oxisol) Red Yellow Podzolic
Alegria	Red Yellow Podzolic
Primeiro de Março	Inceptisol (Cambisol)
Castanhal Araras	Inceptisol (Cambisol)

Table 32. Soil Fertility Within Settlement Boundaries

Settlement Name	Soil Fertility
Cabanos	Low to medium
Canudos	Low to medium
17 de Abril	Low to medium
Alegria	Low
Primeiro de Março	Low to medium Low
Castanhal Araras	Low to medium Low

In the Amazon, soils with low fertility are predominant, and this is a result of its formation process. However, in general, low fertility in the Amazon can be converted through use of chemical fertilizers (EMBRAPA, 2010). Types of soils predominant in the areas where settlements are formed deserve investments in technologies and better practices to keep production well developed in the long term.

Cambisol is a soil characterized mainly by weak B horizon development (Schaetzl and Anderson, 2007). Cambisols (or Inceptisols) are shallow and are often full of gravel. These soils are *young*, presenting primary minerals and high silt even in the surface horizons (Embrapa, 2010). The high content of silt and shallow depth make these soils have very low permeability, increasing the risk of erosion. Because of this, furrows are easily formed in these soils by runoff, even when they are used for pasture (EMBRAPA, 2010). Inceptisols have strong limitations on use because of the high presence of rocks and/or stones in its composition and its location in hilly areas. A rational cultivation would require sophisticated conservation practices, and better utilization would be addressed in investments for reforestation (UFLA, 2010). In this classification, there are four settlements: Cabanos, 17 de Abril, Primeiro de Março, and Castanhal Araras. The last two settlements were distributed in areas where only this kind of soil is predominant.

Yellow-red Latosols are well-drained and are characterized by the occurrence of a B horizon with color varying from red to red-yellow, with Fe_2O_3 (iron oxide or rust) content of ≤ 11% and usually > 7 % when the texture is clay or heavy clay (EMBRAPA, 2010). These are deep soils, and their physical characteristics are very favorable to agricultural use, reflected in good internal drainage, good aeration, and no physical impediments to mechanization or root penetration. However, chemical characteristics bring limitations for its agricultural use, imposing implementation of practices to correct chemical shortages related to low fertility and high acidity. These soils can be used either for pasture or for crops, but they need to be covered all the time by some type of vegetation to avoid compaction. Its occurrence usually happens in areas not hilly: < 7% slope (EMBRAPA, 2010). Among the soils found in the six evaluated areas, this

seems to be the easier soil to manage under improvements. This soil was found at settlements Cabanos, Canudos, and 17 de Abril, all located in Eldorado do Carajás municipality.

Red-yellow Podzolic soil is found in some areas of southern Pará, in relief with variable topography (IstoeAmazonia, 2012). This soil is characterized by low fertility, sandy texture, high acidity, and low permeability (Driessen and Dudal, 1991). The origin is related to the sandy-clayey sediments of the Tertiary and Quaternary periods. These are mineral soils, not hydromorphic, shallow to deep (50-200 cm), characterized by the presence of a textural B horizon of red-yellow. They typically have an A horizon that is moderate, light-colored, reflecting the loss of clay, and sending materials into the B horizon. Depending on the material of origin, it may have gravel along the profile. Likewise, the natural fertility is highly variable, but always poor in Fe_2O_3. The vast majority of them, however, are dystrophic or alic; and most often have low activity clay. They are primarily used for pastures and annual crops. This soil was found in the settlements of Canudos, 17 de Abril, and Alegria. At PA Alegria, this is the only predominant soil.

To be considered a soil suitable to develop any kind of crop, it must have a deep root zone, varying from 1 m for annual crops to 2 m for perennials and trees (Roy *et al.,* 2006). None of the settlements visited have a soil classified as deep or with fertility superior to medium; and in addition to poor classification, all of them seemed to be formed over stony or densely compacted layers, bringing limitations to investments in perennial crops. Moreover, being situated in a rainfall forest, soils uncovered after deforestation are prone to erosion and fast loss of nutrients.

Not only soil quality has to be understood in settlement areas, householders also have an essential role in land use and the future stock of nutrients. Traditional populations have long been

documented for their accurate knowledge for selecting soils and lands for different uses depending on existing vegetation and other ecological site characteristics (Moran, 1974; Behrens, 1989; Summers *et al*., 2004). While new settlers, as migrants from other areas and many times not as familiar with agriculture as locals, lack the necessary knowledge. In addition, new settlers are linked for fast deforestation and shorter use of areas under agriculture, driving them to migrate to new areas and enhancing soil nutrient loss. Carpentier *et al*. (2000) stated that settlers are likely to be part of deforestation and soil quality decreases because they must produce to eat. To do so, they will continuously bring new land into cultivation to keep the same level of production; and the only way to keep production stable would be through the use of commercial fertilizers, changing the product mix, letting land go fallow, or expanding into new areas (new deforestation). In fact, when characteristics of soils are as presented above, investments in technology are necessary for the success of production; and the Amazon is known for its lack of access to fertilizers because of prices and the absence of policies addressed to soil improvement.

9.4 Realities in the Twenty-first Century

Despite the elaborate policies and procedures providing guidelines and actions for PA creation, many policies do not work in reality. This happens because of the failure of investments in infrastructure, bureaucracy, discontinuity of technical support, and incapability of assuring food security, sovereignty, and sustainability in the PAs. The failures cited above are ignored by government representatives and emphasized by Social Movement Organizations (SMOs) as the cause for no continuous improvements in life quality—even after the decades that settlers started their access to land, which resulted in land turnover.

Investments in infrastructure are cited in the PDA as the main way to establish settlers in the land, preventing them from going to periphery areas around large cities (land turnover). The

main way to establish development and integration between markets and settlements would be investments in roads. However, despite being cited as important in the program of settlement consolidation in the Amazon because of the long rainy season, finding people who are not able to leave their lots during several months of the year is common. Consequently, they are not able to bring their products to the closest markets. Other infrastructures cited in the PDA were related to access to school and health assistance, but schools and medical clinics are secondary when a settlement is established. For example, PA Canudos, one of six evaluated settlements in Pará State, was created in 2004; and no access to schools or a health system was built by the PA. It has been using the association infrastructure as classrooms for children until the fourth grade; after that, if roads are in good condition children can complete high school at PA 17 de Abril or move to the closest city, Eldorado do Carajás. Because of this deficiency, many families with children sometimes move to the city and sell their lot, which is not allowed by INCRA.

Despite the SMOs use of the absence of diversification as an excuse to expropriate land and redistribute it in pieces to families of settled people, no plan is available to supervise production or to provide adequate technical support. During interviews, it seemed that there is no common sense between actions from INCRA, banks, settlers, and technicians. While banks, INCRA, and settlers' association representatives say they would not approve a project only for cattle, for example, in practice, most of the approved projects are for that activity; and the main argument at the field level is that the project is already done, easier, and with no need to specify and evaluate several and different production systems. Another problem cited during informal interviews was that technical support is not continuous.

Association, third-party technical support, and social movements are between settlers and INCRA; and they all have voices and rights to specify projects for settlers. For example, to

establish a project for credit, INCRA has to approve a third-party technical support group; this also has to be approved by the association, then the process of analysis and PDA creation start as soon as the project for credit is done. INCRA needs to study the settler's situation and name him/her as a beneficiary (RB) of agrarian reform at the bank. Now the settler can go to the bank to sign the loan documents, but many times the money comes through the association; it is rare that a settler says he or she had direct access to the money. I have been told many times that leaders of the settlements' association are responsible for access to credits, but they do not distribute those credits evenly to settlement participants or there are agreements between a third party and farms who provide animals for the project. These animals are sold to settlers whose animals do not have good milk production, and settlers are then obligated to commercialize calves for lack of milk production (personal contact, January 2011).

In addition to the local bureaucracy, national problems also generate discontinuity in technical support. Finding a settler who never received any technical support beyond the first visitation at the time of settlement creation is common. The main cause, I have been told, for discontinuity in technical support is the lack of investments by the Brazilian government for the long term. The INCRA is responsible for paying third-party technical support; however, all technicians that I visited said that economic support only arrives for a determined time and, after that, settlers have no access to them. As a result of this situation, many people who received individual and collective credits said that they could not be successful in the production. Now, they do not have a plantation and cannot pay the bank off; and they are still in a poverty situation owing the bank and without any production.

According to a representative of INCRA, Marabá–SR27 (personal contact, February 2011), when a need to curb expenses exists in the government, the first source of investments

that is taken from is Agrarian Reform. The area covered by INCRA–SR27 did not have any investments in technical support since mid-2010, and there was no prospect as to when it would restart (this information was acquired in March 2011). In addition, investments in lot demarcation and mapping were cut, and settlements created since 2004 were not yet divided into lots designated to each family. In addition to the problems cited above, structural problems in the Amazon were observed, such as access to a laboratory to analyze soil classification, making it impossible to recommend production in accordance to the soils' ability.

Another common problem found in the field was the absence of market demand studies. During data collection, technicians, settlers, and government representatives reported that fish, fruits, and herbs are imported from Maranhão State because of the incapability of local production to supply local demand. The last, but not least, problem observed was the change of credit use after a project was approved. For example, because of the discontinuity of technical support, it is common to find settlers who applied for credit to start planting bananas (for example), but instead used credit to buy cows or other products.

The problems cited above lead to barriers to diversified production and improvement of the investment in cattle. This happens because the cattle chain is well organized, has a good market, and has a constant and high demand, which makes it hard to convince settlers that diversified agriculture can be as or more productive than cattle ranching. Those barriers are enhanced by weak road conditions, which make the distribution of agricultural products to markets unstable and dangerous when compared to investment in animals. Lack of good access between settlement and market also drives settlers to not be interested in planting trees just for fruit production and reforestation purposes. Investment in tree plantations to recover forested areas claimed by Brazilian laws would lead settlers to produce fruits and to sell wood for several

mining companies, which are established around Marabá and demand wood to keep production constant (Emater, personal contact, March 2011). When questioned for the viability of profitability from wood production, INCRA, settlers, and technicians had a common response in affirming the feasibility of this economy. However, when reforestation is practiced, most of the time the plantation most used is focused on mining activity, such as eucalyptus, a nonnative tree, which is not part of the local biodiversity and its effect on the local environment is being questioned.

CHAPTER 10. STRUGGLING FOR LAND: FROM FORMATION OF SETTLEMENTS TO THE NEW RELATIONSHIP BETWEEN SETTLERS AND LARGEHOLDERS

Context analysis in this study used qualitative data to entail a variety of information designed to provide the appropriate understanding essential to assess a comparison of changes in local land conflict dynamics, as part of the third objective of this dissertation. With these analyses, I focused on information and an investigation to follow objective 3 and on efforts to address reasons for the failure of the current policy.

In objective 3, I proposed to identify how the insertion of settlers into the global cattle economy has impacted the contentious relationship between settlers and largeholders in the region and whether this has mitigated violent land conflict. I anticipate that the relationship in the present seems to be filled with interaction from both parts. However, the topic of conflicts seems to be *sensitive* and, even with the history of land contentiousness during formation of the visited settlements, no one agreed to compare changes between past and present. Most of the analyses related to this objective are derived from observation and comments during application of the formal survey, from interviews with SMO representatives, and from newspapers available at Casa da Cultura museum in Marabá.

The process of settlement formation involves struggles between landless and largeholders; and this derived conflicts, threats, and massacres where the landless usually experienced losses. However, it seems that after a settlement is formed, the relationship between settlers and largeholders takes another direction, and both groups start to act together to supply the market. In the study area, the market demands cattle; and among those settlers who have

cattle, 93% reported that they sell animals for largeholders in the region and sometimes they establish a partnership with the largeholder providing animals to be raised by settlers, to return part of those animals at the end of a period. Below I describe changes in the types of conflicts in the region, and how changes happen from the point a settlement is legally created.

According to CPT (personal contact, April 2011), conflicts in the region are defined in accordance with different levels: (1) for access to land between settlers and largeholders, (2) conflict between settlers, (3) conflict caused by ideologies of largeholders, (4) conflict among locals (*ribeirinhos, quilombolas*), and (5) those conflicts that are caused by the absence of government. The CPT's representative also stated that after a settlement is formed it is more common to have conflicts between settlers (2) than conflicts between settlers and largeholders (1), who during the camp process were in charge of most conflicts (personal contact with CPT's lawyer in Marabá on April 2011).

10.1 A Massacre and its Effects on Agrarian Reform Policies

In some settlements, because of their history of land conflicts during the period of camp, asking about conflicts is sensitive. The dilemma at PA 17 de Abril in 1996 appeared to be the largest, where a massacre happened and police killed 19 people connected to MST and injured many more while they marched on highway PA-150 (now known as BR-155) to bring attention to the land struggle in the region and to require the creation of a PA in a 40,000-ha farm that was all in pasture and recognized as unproductive by MST—that farm was called *Fazenda Macaxeira*. Despite the many people who survived the massacre and are now living in PA 17 de Abril. there is no consensus about the level of conflict in the present. Even after reports of people having mental problems because of the massacre, which is known as *Massacre da Curva do S*,

there is an understanding that now they are better off and that the massacre was the starting point to advances being done in the agrarian reform policy.

According to Wright and Wolford (2003), the outcome of the massacre on April 1996 is both a sad failure and a semi-victory to the landless movement nationwide because public opinion was formed in favor of the movement from that episode and also because it forced a number of expropriations in favor of the landless movement to increase. As a result of the massacre, the number of expropriations increased along with more demand for credits and actions to bring settlers to market. In Marabá, for example, INCRA established its first decentralized regional office in 1997, which is currently responsible for around 500 settlements distributed in 39 municipalities in the south and southeast of Pará State (Edson Bonetti, INCRA SR–27 superintendent, at Correio do Tocantins, 2011b). However, despite all gains post-massacre (according to Mazzini, 2007), during implementation of new PAs land is being distributed to families of the landless—but the conditions of development do not follow policies and exclusive production for market is valued while family farming is not.

10.2 Understanding the Local to Global Connection

Implementation of rural settlements directed toward the consolidation of a farmer-integrated market exclusively may work for those who are already familiar with the economic market, but not for the majority. This drives out the idea of agrarian reform settlements from principles such as cooperation, food security, and subsistence agriculture in favor of the idea of agriculture only for profit, not for subsistence. In Pará State, the role of settler is known as the main provider of calves to largeholders, but no study is available or policy to understand what affects this interaction. The area where this dissertation research was developed is also the main

producer of beef in the state, and most of the production goes to other Brazilian states or even overseas.

The connection between local agents, or settlers, and the global market is not yet well identified and studied. However, at the field level, the relationship between settlers and largeholders is well perceived. This said, I will try to explain this relationship chain through the settlers' surveys, slaughterhouse information, and the viewpoint of the largeholder. During data collection, when asked if settlers sold calves, 93% of those who owned animals were connected to market through a promissory and well-developed chain of calf production. When asked about customers' profiles, the answer always pointed to the participation of the middleman and local largeholders as part of the interaction. The middleman, however, has a group of largeholders to whom he sells animals, while largeholders have a group of settlers that they keep in the long-term. On the other hand, farmers buy animals from the middleman and keep the animals until fattening and sell to slaughterhouses installed in the region (Figure 20).

Usually large slaughterhouses, connected to national and international markets, only buy animals in certain quantities, never less than 18 per time, which makes it difficult for settlers to participate in the complete chain from raising to fattening[14]. At a local slaughterhouse, I was informed that there is not a system to track calf production, they only request from the farmer who is providing animals to slaughter for their personal information and FMD vaccine proof for the animals. What happens to animals before they arrive at the farm that will provide fattened animals to slaughterhouse becomes, then, a missed action. This involves participation of settlers in deforestation to open new areas of pasture to raise calves. At that same slaughterhouse, I was

[14] It is understood that lot size is a limiting factor to increasing herd size as well.

informed that all beef produced there goes to southeastern Brazil; and small parts (such as tripe, tongue, kidney, and aortic) are all exported to China (Figure 20).

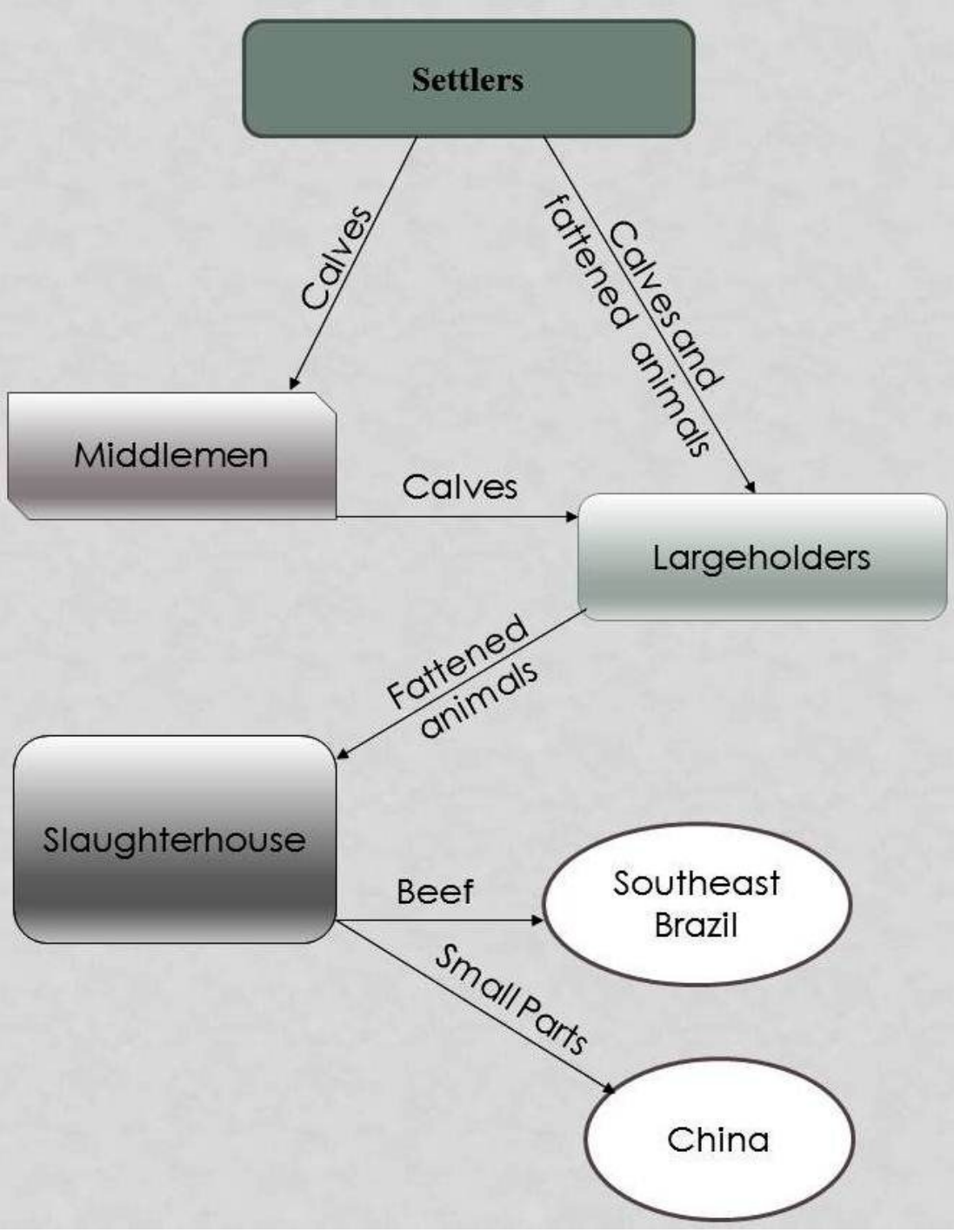


Figure 20. Observed Cattle Chain in Southeastern Pará: From Settlers to the Market.

The relationship between settlers and largeholders can be reported as having positive or negative impacts. The negative aspect is concerned with the kind of contracts that are developed between actors. Largeholders are always in gain, while settlers (despite celebrating land ownership) are still developing a relationship of power where the wealthier makes more money either buying calves cheaper than in other areas of Brazil or by having the most profit when animals are ready to be slaughtered. In fact, according to Fernandes (2012, personal contact through e-mail), after the official establishment of settlements, conflicts are likely to decrease and settlers begin to produce for the market—however, they are always *exploited* because of the historic relationship of subordination. At this point, it is important to observe that even with gains due to access to land and government support there is no change in relationships between settlers and largeholders. This is observed also in Velho's (1981) explanation about *aviamento* and contracts where the poor are always in debt with the rich due to exchange of favors. This shows that the current social chain is not eliminating the exploration already observed in the past. The positive aspect seems to be the continuous demand for cattle, making the settler better off when their durable goods acquirements were measured. Either, calves or pasture, is seen as saving proxy, and it seems that anytime there is a need for income the easier the liquidity of the product makes the activity more attractive.

10.3 Globalization of Cattle and Implications for Land Conflicts

According to Girardi (2008), land conflicts could be solved with market integration. Therefore, if we take into consideration that the Pará State (and particularly in the southern part of the state where this study was conducted) responses for more than 30% of all land conflicts are land related in Brazil, it is expected that a relationship between settlers and largeholders to

improve calf commercialization would, in fact, present a positive outcome when reduction of land conflicts is speculated.

However, Luxemburgo (1985) stated that, at the same time, markets re-create and destroy settlers' organization. This happens because of the control exerted by those who own power through capital. A good example of this power performed by those who have capital was found mostly in the three settlements located in Eldorado do Carajás County. Even when exploitation is not perceived in the relationship with largeholders, settlers reported that it is common to raise cows for largeholders in exchange for half of the calves reproduced while settlers have the cows on their property. However, because of the need to buy vaccines and material for fences and to keep the pasture in a condition to receive animals, settlers start a debt with largeholders and, by the time animals have to be returned to the largeholders, settlers already own those animals that were supposed to remain on their property as part of their payment.

> *Almost all settlers here have shared cattle (gado de meia) with the same largeholder in this region, he (the largeholder) gives us heifers, and then we have to return those animals to the largeholder at the end of the contract, plus half of the calves they reproduced while in the settlement. Pasture and vaccines are costs covered by the settler* (questionnaire #64, PA Canudos).

During data collection, *partnerships* where settlers are always in debt with largeholders because of current forms of contracts established with largeholders were found; however, it was not possible to quantify how many of them were under this condition. This relationship of exploitation happens because a settler donates his/her labor and land to invest in calf production in exchange for some of the animals. However, it is not perceived (nor paid for by largeholders) that the settler's labor and pasture rental are factors to be included in the exchange. Many times, by the time the settler is supposed to return animals to ranchers, he/she already owns the cattle acquired during the exchange contract.

> *At the end of the contract, I ended up owing 22 animals to a large farmer because I needed to rebuild the fence and paddocks and borrowed money from the farmer to invest in that. In addition to those animals I owed to him; I had to sell my own animals to a largeholder for USD 99 each, instead of USD 247. When we return cows and calves to the largeholder, it is almost ready to go to slaughter; and sometimes I have to sell my calves to feed mine and his animals. I am on this system for 4 years now* (questionnaire #3, PA Cabanos).

Analyzing this relationship closely, many researchers (including political ecologists who analyze types of conflicts) would define this behavior as conflict. However, at the settlement level when asked if there are conflicts in the region, 100% of interviewees reported that, currently, there is no conflict with largeholders or neighbors. However, the quotes above remind us about the semi-slavery system still found on some large farms in Brazil, when after a month of work the employee does not have a salary because he or she already owes all of his salary to the farmer as part of the payment for groceries acquired on the property (Velho, 1981). Meantime, when asked about their views concerning this relationship, settlers reported that they do not feel this current relationship as harmful for their production. Settlers understand this relationship as necessary to make them part of local economy, and without largeholders, this participation would not be possible. It seems conflicts are hard to measure at the settlement level because after this is created all struggles are directed in getting support from the government. When a settlement is created, it is time to ensure that all credits are directed to the newly formed area (settlement) and that the main actions now are designated to bring the attention of INCRA to assure credits for housing and production. This said, I understand that I do not have enough information to measure how the relationship between settlers and largeholders mitigates conflicts; however, it is recognized that this relationship should be better understood if research is to be done in a case study since formation of camps to settlement creation was done—all of my sampled settlements were already created and part of economy when I started to study them.

Despite settlers reporting a relationship where they are using labor and land to raise largeholders' animals, they do not perceive that an exploitation system is a term to be used in this relationship. Settlers understand that once they are on their own land, times of conflicts ended—this now is only a part of thousands of camps still being created in the demand for land.

CHAPTER 11. CONCLUSIONS

The Brazilian Amazon is a complex environment with particularities that have to be understood separately—this means that public policies that have been developed for settlements at a national level should be regionalized to respect differences inside Brazil. For example, when I analyzed types of credits given to settlers, I found that all settlers in the country have the same access to initial credits. This initial observation may be the starting point for complexities found in the field and should start a discussion about availability of credits in accordance to each region's production capacity and market. Despite all facilities to improve family farming and diversification of production, it seems that the well-developed cattle chain and increasing participation of Pará State in the national and international beef production market is bringing settlers in to be part of this economy. This is problematic not only because of the social and environmental aspects but because this activity results in settlers not following activities suggested in the PDA. As a result, diversification is not a priority in those settlement areas, and settlers replicate the problem of deforestation due to pastureland expansion. It is clear at this point that there is a disconnect between discussion and practice when globalization of beef markets created chains with a variety of social and environmental impacts at the local scale. Those social and environmental impacts are related to the nonparticipation of settlers in a diversified production system exposing them to problems related to market crashes and bringing them to become active participants in the deforestation process that organizations such as REDD+ are trying to reverse.

The finding of the disconnect between policy and practice deserves future research to understand the role of credits in different environments, and how changes could be effective in

improving settlers' participation in their local production. With this dissertation, I do not want to state that all systems of settlement created in Brazil by now are wrong. I believe changes and alternatives need to be followed, but I also believe that understanding errors is a bridge to pursue success. Each settler has a different origin, and this has to be understood and evaluated in accordance with the settler's expectation and also with land capacity. This dissertation addresses changes occurring in production decisions and household characteristics as well as the reasons and effects of settlers' choices.

The main goal of this study was to identify the factors that encourage settlers to invest in cattle as opposed to other alternative productions. To achieve this goal, I returned to settlements visited in 2006 and identified settlers interviewed at that time. Three hypotheses were identified in this dissertation, and data collected in the field was the support to develop those hypotheses. The first two hypotheses were related to measurement of engagement of settlers in the cattle economy and with the reasons for that arrangement. The third hypothesis was related to the impact of the cattle economy in settlers' well-being. Specifically, my first research hypothesis stated that the quantity of people engaged in cattle production would increase when comparisons were made with data from 2006 and 2011. The second hypothesis stated that settlers are motivated by several factors, such as availability of credit, to acquire animals. The third research hypothesis stated that cattle ownership would affect well-being positively.

Despite the complexity of settlement formation and the study area, I was able to reach 105 settlers in six settlements in southern Pará; and to achieve my goals I applied a 10-page survey instrument that was focused on economic production, land use, and household characteristics. In addition, during and after data collection at the settlement level, I conducted key informant informal interviews to better understand the collected data and to collect

secondary data, such as guidelines of a PDA and production costs, with Social Movement Organizations' leaders, government officials, faculties, and settlement associations' representatives.

The first hypothesis of this dissertation, which aimed to measure changes of quantity of settlers who own cattle, was evaluated through statistical analysis developed through an elaboration of a panel data set with data collected in 2006 and in 2011. To develop the panel, a set of questions were repeated to the same settlers in the second visit. Contrary to my expectation that more people would have cattle because of Brazilian expansion in the beef markets, the results of the panel data set showed less people owned cattle. This unexpected finding can be addressed to the different periods of data collection; in 2006, it was done during the summer, while in 2011 data collection happened during the winter. This difference in seasons seemed to affect pasture formation and demand for calves, since during the wet season pastures are well developed and prices for renting are favorable. During data collection in 2011, I found that even those who are not commercializing calves are participating in that activity by renting pasture in exchange for income or benefits to the lot, such as fences or pasture reform and, thus, participating indirectly in the cattle economy. The use of pasture as a rentable good was confirmed by the greater amount of property opened and by information collected in the field. In addition, I found that those settlers who still have animals are investing more, resulting in a higher quantity of animals per property. Statistically, changes in pasture area, quantity of animals per hectare (density), property size, and years of education of household showed a significant difference when data from 2006 and 2011 were compared.

From previous analysis that still confirmed a high percentage of settlers investing in cattle as their primary activity, I developed a logistic model to find the main reasons for that

engagement. This was part of my second hypothesis that stated that settlers are motivated by a set of factors identified in the conceptual model, such as age of household, dependency ratio, availability of credit, and education level. Those factors resulted from current economic interactions and have been well discussed in studies such as Walker and Homma (1996), Pichón (1997), Walker *et al.* (2002), Vanwey *et al.* (2007), Caldas *et al.* (2007), and others. In a logit model, availability of credit appeared as a strong reason for acquiring cattle; however, variables such as pasture size, lot size, and education also was significant in the final model. Access to other types of credits to be invested in crops and other animals were found; however, due to lack of technical support and knowledge about that complex environment, most of those who received those credits ended up owing banks and without production. Taking a close look at the role of credit availability in settlers' decisions, public policies are being misused and promoting concentration of production in one commodity only. In fact, public policies seem to affect the direction of production, occupation, and land use since the early programs were developed to attract people, investment, and better infrastructure to the region. In the logistic model, availability of credit for other activities, dependency ratio, work sold off farm, age of household, involvement in green alternatives, and length on the property were not statistically significant; and the role of these variables deserve to be understood in future research.

The third hypothesis enquired about effects of involvement of settlers in their well-being. Improvements were expected due to expansion of the cattle economy in the region; however, how this activity can be sustainable in the long term in rainforest areas, small lots, and with small or no investment in technologies is questionable. Not surprisingly, after a settlement is formed and access to several types of credits and benefits is granted, settlers experience better and significant life conditions reflected in the quantity of durable goods acquired, improvements in

level of education, and access to several sources of income on-lot and off-lot. Among those who have cattle, better improvements in well-being were observed. Currently, improvements were detected, but I am still curious to find out about this in the future if the same settlers were found.

In fact, land turnover was already detected in 2011 when 17% of the original sample was lost due to settlement abandonment, meaning that several factors had driven settlers to act against settlement rules and sold their lots. This happened most after production did not work and the settler did not have funds to pay off banks or because they did not have access to schools, which is part of the PDA, or had health problems. Those problems are the most cited by those who sold their lots and moved to poor areas in the nearest city. I was able to find three settlers who were interviewed in 2006, and in 2011 they did not have a lot because there was a need to sell lots due to health problem (1 person); health, age, and access to retirement (1 person); or was unable to keep production up to pay credits off (1 person).

Still related to well-being, a diversified source of production was found; however, the main sources of income are not derived from family farming, which is the main objective of settlement formation. Again, government has a strong role in this finding because the main source of income is related to benefits from government, such as retirement, cash transfer programs, and credits for cattle. A positive finding related to well-being was the verification that more people are investing in education and a perceptible change was found when data from 2006 and 2011 were compared. A summary of main results can be found in Table 33.

Table 33. Main Findings Derived from this Dissertation

Hypothesis	Main Findings
(H1) Smallholders' involvement in the cattle economy will increase when data from 2006 and 2011 are compared.	71% percent of interviewed settlers are involved in the cattle economy; however, there was not an increase in quantity of people owning cattle as I expected. More area is being used for pasture, and settlers found pasture rental and shared production as an interesting activity as well.
(H2) Settlers are motivated to invest in cattle by factors such as availability of credit, lot size, and household economic and social characteristics.	Availability of credit for cattle appeared as a strong factor in both analyses: quantitative and qualitative. Additionally, pasture size, lot size, and education level were significant variables in the logistic model used.
(H3) Involvement in the cattle economy will affect settlers' well-being when data from 2006 and 2011 are compared.	Settlers are experiencing better and significant life conditions that are translated into the quantity of durable goods acquired, improvements in education level, and diverse income sources.

Last but not least, I aimed to understand land contentions in the region caused by the relationship between settlers and large holders to complete the cattle chain. This derives from the history of land conflicts in the region, and the attempts of many largeholders to avoid expansion of land occupation in their areas. Unfortunately, during formal survey data collection, settlers did not collaborate in linking past conflicts with current largeholders who are interacting in the cattle

chain. However, informal data has shown that despite the perception of life condition improvements, settlers do not understand that a new relationship started between settlers and largeholders to fill cattle production—where largeholders are still the most benefited. This is said because in several cases (mainly in settlements located in Eldorado do Carajás where a historic massacre of landless occurred in 1996), settlers provide calves to largeholders; but because of a previous contract to raise cows, build fences, and reform pasture, by the end of the contract settlers already own all the animals that should remain on their property as part of the payment for raising the largeholders' animals.

Without decent technical assistance and with most credits designated for cattle activity, settlers will not know about the rationality of their decisions and will continue economic decisions based on what they sense, how better their neighbors are, or how often somebody is looking to raise calves on their property. Barriers are historically tied to poor public policies, which in the past brought people to a land without infrastructure and in the present distribute credits in favor of cattle acquisition. These incentives (credits) encourage the participation of settlers in deforestation rates. In theory, credits are for perennial and annual crops, but a not well-established chain brings former landless people to replicate the problems they fought against to receive their land. Those problems are related to misuse of land in a harmful production, such as cattle, far from the family farming production that they aimed to develop. According to Ludewigs *et al.* (2009), settlement success can be measured if its creation provides consolidation of family farming and if it is created on productive land. Those measurements of success are not being replicated in those evaluated areas. In addition to failures in the main goals, the result of settlement creation within the Amazon territory is also linked to deforestation. As I said before,

pasture is the main use of deforested areas; and if settlers are part of that productive chain, they are also part of the deforestation rates.

In summary, settlement creation reduces the number of landless but replicates all the mistakes from the past when government efforts were being used to feed current demands and did not create green alternatives. If new policies are not established, those settlers who are better off will buy areas from those who are not doing well in the activity; and the cyclic turnover will remain in the region. Additionally, if few years from now, other researchers decide to re-find those settlers who were interviewed in 2006 and in 2011, many of them will be part of the crescent slum areas in the largest nearby city. It seems the problem of poverty in the Amazon is far to be solved and public policies are being done to repair current problems of landlessness without giving satisfactory solution in the long-term.

APPENDICES

APPENDICES

APPENDIX A. SETTLEMENT NAME, YEAR OF CREATION, AND QUANTITY OF FAMILIES

Table A. 1. Settlement Name, Year of Creation, and Quantity of Families Settled

Settlement name	Location	Year creation	Quantity of Families
1 de Março	São João do Araguaia	1998	349
Alegria	Marabá	1999	95
Castanhal Araras	São João do Araguaia	1987	83
Canudos	Eldorado dos Carajás	2004	56
Cabanos	Eldorado dos Carajás	2003	81
17 de Abril	Eldorado dos Carajás	1996	688

APPENDIX B. BASIC GUIDELINES FOR THE DEVELOPMENT PLAN OF THE SETTLEMENT – PDA

1. Introduction

Describes actions of technical support (ATES) and reunites essential elements of a PDA. In the introduction, the diversity of each case and the several biomes involved in the region are observed, with highlights of the physiographic, social, environmental, and cultural aspects. The presentation of a PDA has to be objective, showing actions planned to be executed by ATES. It has to be presented in one page.

2. Methods

2.1. PDA Elaboration

This section describes briefly, clearly, and objectively methods and techniques applied during elaboration of the PDA. This has to be focused on the pedagogical methods developed by technicians responsible for studies about availability of natural resources. This document has to be written in a way to make it accessible by settlers. Here it has to be clear that settlers are the main focus and that their participation is essential for elaboration of this document.

2.2. Technical, Social. and Environmental Monitoring of the Implementation of the Plan

This section describes methods and techniques applied by ATES. This has to be focused on the composition of the team, teaching methods, and techniques used to bring settlers together with public authorities and local institutions.

3. Settlement Characterization

3.1. General

In this section the name of the property before settlement was created is listed; the name of the settlement; the date of expropriation decree; the date of emission of lots; and the date and number of settlement creation.

3.2. Specific

Distance of main closest city(ies); total value of investments in improvements and credits needed, after date of emission of lots; total area defined including (1) required in the law as legal reserve; (2) effective area of legal reserve; (3) area required by law for Permanent Preservation; and (4) effective permanent preserved area, capacity of quantity of families to be settled, average area of the lots (if already divided), quantity of families settled and current capacity of settlement, and the name of association that represents settlers and its registration number.

4. Diagnosis on the Area of Influence of Settlement

4.1. Location and Access

Describe location, using maps or sketches, showing settlement distances from the closest city and state capital. Describe routes of access to the core of the closest city and to the state capital.

4.2. Socioeconomic and Environmental Context of the Settlement Project's Area of Influence

Perform identification and cartographic representation of the basin or sub-basin in which the settlement was created. Describe if important for settlement (1) weather conditions prevailing and its seasonality; (2) soils, vegetation, water resources, topography, and land use characteristics; (3) conditions of conservation and/ or environmental degradation of settlement areas, indicating if there is any negative impacts for the settlement; (4) general situation in the region concerned with social, demographic, and land distribution characteristics: (5) regional and local urban and rural population, population density, migration rates, land ownership, land

conflicts, location and quantity of rural workers and farmers, education rates and average income of the population; (6) main economic activities developed in the region; and (7) in case the region already has economic or economic–ecological zoning developed, to identify characteristics of the area where the settlement project was created.

Note:

When dealing with expropriated land, consider the documents already produced by INCRA, such as the Regional Diagnosis of Agronomic Monitoring Report, which should be enriched and updated.

5. Diagnostics of Settlement Project (PA)

5.1. Physical, Soils and Climate Conditions of Settlement (PA)

5.1.1. Topography

Define topography based on available information contained in the report of the survey or other sources and, where necessary (for example), as a condition to subsidize project division and an environmental license, conduct field survey, and mapping on a scale compatible with the project. Topography of the area should be set based on estimated percentages by type according to the table below:

Table B. 1. Topographic Classification and Slope Existing in the Property

Topographic classification	**Classes of slope**		
Description	Percentage	Inclination (in degrees)	**Percentage of property**
Plan	0 – 3	0 – 1,7	
smooth wavy	3 – 8	1,7 – 4,6	
Wavy	8 – 20	4,6 – 11,3	
strong wavy	20 – 45	11,3 – 24,2	
mountainous	45 – 75	24,2 – 36,9	
Steep	> 75	> 36,9	

5.1.2. Soils

Define the types of soil based on the available information contained in the report of the survey and other sources and, where necessary (for example), as a condition to subsidize project division and an environmental license, perform soil surveys in scale compatible with the project area identifying and mapping major soil units existing in accordance with the classification adopted by the Brazilian Society of Soil Science, conservation status, and main problems of degradation with its causes limiting the disturbed area. Also use as reference the classification RADAMBRASIL, CODEVASF, CETEC, SUDENE, etc., according to the region to be imaged.

Note:

The responsibility to perform or hire the services relating to the project installment is directed to INCRA, while the soils and climate surveys of the settlement area team is directed to the ATES team, which is responsible for developing the PDA

5.1.3. Water Resources

Identify and map the availability of surface and groundwater; current use and potential for human consumption and exploitation of productive activities; conservation status and main problems related to this resource, in terms of degradation and its causes; the existence of concessions; and potential impacts and conflicts generated by the settlement project related to the basin and subbasins.

5.1.4. Vegetation

List and map the predominant species, conservation status, and main degradation problems and their causes to underscore the endemic species protected by law (quote scientific and common names).

5.1.5. Wildlife

List and map the predominant species, the main problems of survival of wildlife and their causes, establishing linkages with the diagnosis of vegetation and existing species identified previously. Identify the endemic and endangered (quote scientific and common names).

5.1.6. Land Use and Land Cover

Display table and distribution map of use and occupation of land, with analytical description, including the current status of the vegetation (native and artificial). The statement shall specify the areas used in the property (with pasture, agriculture, improvements, etc.) and vegetation cover (stratified by type and state of vegetation succession).

5.1.7. Area of Legal Reserve and Permanent Preservation

Present a map with the reality of legal reserves (if any) and preserved areas, confronting them with the requirements of environmental legislation. List the problems of degradation of areas of permanent preservation and legal reserve and point out their causes.

(1) In some cases, a reallocation of Legal Reserve area may be required, which will be proposed in the action plan in the program of territorial organization.

5.1.8. Environmental Stratification of Agro-ecosystems

Identify, in accordance with the above items, the agro-environment (or landscape units) in order to summarize the soil / topography / water / vegetation that characterize them, relating them to their potential and limiting production, in accordance with settlers' expectation. Produce a cartographic representation of these units. Identify the environmental units in sketches, built along with the settlers.

5.1.9. Land Use Capability

Considering the analysis of soil quality, topographic conditions, current usage, and climatic conditions of the region and environmental stratification developed in conjunction with the settlers, state it in a map and in a table with quantitative classes of soils, according to the classification adopted by the Brazilian Society of Soil Science.

5.1.10. Brief Analysis of the Potential and Limitations of Natural Resources and the Environmental Situation in/of the Settlement

Considering the previous items and, in particular, the synthesis effect in the last two, make a brief analysis of the potential and limitations of natural resources and the state of conservation / environmental degradation highlighting the main problems and their causes.

5.2. Current Spatial Organization

Display the delimitation or demarcation of boundaries and splitting (if any), the distribution of families in the area and existing infrastructure (roads, water supply, rural electrification, paddocks, churches, schools, warehouses, etc.), and systematizing such information is mandatory on a map.

5.3. Socioeconomic and Cultural Status

5.3.1. History of Settlement Project

Describe the history of the conquest of the area by settlers, the origin of the settlers and their socio-economic statuses.

5.3.2. Population and Social Organization

Characterize and analyze the total population by age, gender, and education level; identify possible causes of the exodus of the young or abandonment of plots; as well as relating the main productive activities developed (agricultural and nonagricultural). Display the percentage of households with access to benefits, savings, and retirement pensions, disability and / or dependence. Identify the various forms of organization of the existing population as well as the degree of effectiveness of its operation, the main purposes where organizations engage effectively, and the level of participation of women and youth. Identify and list the forms and also the level of articulation of settlers' organization with other governmental and nongovernmental organizations.

5.4. Physical, Social, and Economic Infrastructure

Identify the equipment and facilities that may be used, as a group or community (such as schools), buildings that can serve for the installation of community centers, nurseries, playrooms,

collective dining rooms, and laundries, stables, pastures, watering places, and other structures of collective interest.

5.5. Productive Systems

Identify products generated in the settlement; production systems and technological models adopted; responsible for production, marketing channels, problems related to these systems; income earned by households, considering the participation of men, women, and youth; their forms of organization, management, and trade in agricultural and nonagricultural activities; forms of production (individual, group, or associative); and the problems related to their socio-economic conditions.

5.5.1. Brief Analysis of Productive Systems

Based on the information gathered above, analyze the positive and negative aspects of the productive systems, correlating them with the infrastructure (roads, transport, electricity, etc.) with the availability of technical assistance, with the form of organization of production, and with the regional economy.

5.6. Production Support Services

5.6.1. Technical Support and Research

Identify activities of technical assistance (social and environmental), agricultural extension, and research available in the city.

5.6.2. Credit

Identify the existing credit facilities extended to the settlers, as well as their respective sources (public and private) and other related credit arrangements for the settlers.

5.6.3. Professional Training

Describe the services of professional training available to the settlers and the structure of existing professional training in the city.

5.7. Social Basic Services

5.7.1. Education

Identify existing education policy in the city for the countryside, conditions and care needs of the PA, the main problems (location, distance, transportation, meals, adequate to the reality of teaching, teacher qualifications, student achievement, degree of avoidance, etc.), and alternative routing.

Display number of people settled according to their education, by age group, as shown below:

Table B.2. Quantity of People Settled and Their Education Level

Age	**Education level**					**Total**
	Illiterate	Children education	Elementary education	High school	College	
< 6						
7 to 10						
11 to 14						
15 to 17						
18 to 24						
25 to 40						
>40						
Total						

Note: When possible, specify education level and gender.

5.7.2. Health and Sanitation

Identify the policy of health and sanitation in the municipality, to the rural environment, conditions and care needs of the PA, the main problems, and alternative routing.

Identify the disposal of garbage, waste, and sewage with the origin and quality of drinking water as well as the number of families who use it. Accordingly, in consideration of the items of the WHO (World Health Organization) on primary health care. Identify topics considered taboo, such as alcoholism, drugs, and other elements that cause addiction and organic disorders compromising human health.

5.7.3. Leisure

Identify the main manifestations of leisure practices for adults, youth, children, women, and elderly, as well as existing structures (in the city and settlement) that may be potentiated(used?).

5.7.4. Culture

Identify relevant cultural traits that are endowed with different social groups to exchange experiences and to develop fully integrated and harmonized members of the settled community.

5.7.5. Housing

Identify the existence of housing or building materials that can be used for building houses, as well as the presence of professionals among the settlers (mason, carpenter, firefighters, electricians), quantifying them for specifics.

Identifying number, functionality and quality of housing, as shown below:

Table B. 3. Housing Quality at Settlements

Quantity	House type	Roof		Floor			Toilet			Hydraulic installation		Electricity	
		Tile	Leaves	Soil	Brick	Tile	Without	Toilet	Other	Without	With	Without	With
	Brick												
	Clay/ mud												
	Wood												
	Plastic												

Notes: The ATES should seek alternatives to the rational application of credit designated for housing mode acquisition of building materials (for building / repairing housing), valuing the knowledge of the community, and the materials available. The diagnosis should be considered under housing cultural aspects, health, and quality of life, enhancing local skills and technologies, whether for construction or for the improvement of existing housing units.

Check also other government programs and nongovernmental organizations, statewide, municipal, and federal actions for the settlement or what may be allocated to it. Register even the existence of municipal councils (CMDRS, CODEMAS, etc.) and the resources inherent in their programs and actions that can be made available to settlers. For making the diagnosis, data should be sought from the Information System of Settlement Projects (SIPRA), and other available sources.

5.8. Analysis of Potentials and Constraints

To analyze the diagnosis, characterize the environmental, institutional, economic, and social dimensions of a settlement under a comprehensive overview, outlining the major limitations and potential constraints that may affect sustainable development.

6. Plan of Action for the Sustainable Development of the Settlement

6.1. Introduction

The plan will unfold in the form of thematic programs, subprograms that will materialize into projects, and actions to be formulated with the participation of the community in close harmony with the situation diagnosed for the area in order to make it affordable and feasible in their understanding in operational terms, thus facilitating the negotiations in terms of meeting the requirements of environmental licensing and funding sources. It should be noted that one of the purposes of the PDA is to support the development of technical and specific projects.

6.2. Objectives and General Guidelines

The objectives and guidelines to be defined by households with the technical assistance activities of ATES, INCRA, and other partners must be adjusted to the elements of the diagnosis made and directed to the development of the settlement, in its many dimensions (economic, social, cultural, and environmental) and considering the territorial organization, the production system, the infrastructure and basic social services, environment and other material resources, and human and financial resources available for such purposes to implement the actions to be defined for the plan.

6.2.1. Spatial Organization

The plan shall allow or permit settlement capacity and forms of land use, access roads / displacement, water access, preservation / conservation, implementation of physical infrastructure, social and productive local housing, and social life, identifying the demands and interests of women in the architectural construction of residences.

6.2.2. Services and Basic Social Rights

The plan must provide for the security and enforcement of fundamental human rights provided for in the constitution, as well as the infrastructure and basic social services for the various areas of community interest, such as health (hygiene and sanitation), education (environmental among other modalities), alternative work (craft, tourism, agribusiness and home gardens, leisure and a food program for obtaining civil documents, and labor).

6.2.3. Productive Systems

The plan should address the organization and articulation of production lines, technologies, and models proposed by the settlers, who are better adjusted to the ecosystem, taking into account the evidence for an agro-ecological transition.

6.2.4. Environment

Define along with the settlers the adoption of techniques and management practices that contribute to the rational use of natural resources with a goal of preservation, restoration, and conservation.

6.2.5. Organizational Development

Define along with the settlers, taking into account preexisting organizational forms, organizational alternatives, and sociability that best meet the aspirations and needs of the settled

community in general. Explain the debate on ways to participate in management to implement the plan.

6.2.6. The Technical, Social, and Environmental Monitoring of the Implementation of the PDA

Coordinate, support, and provide technical information to assist the settled families in formulating and implementing programs under the plan and in strict observance of the situations identified during the diagnosis concerning matters contained in the previous topics. Also at this stage, define the composition of partnerships in the formulation and implementation of programs as well as their respective contributions of funds, funding sources, etc., advise on the development of projects, and search for training, among others. Contribute to the establishment of public policies; evaluation of results of applications for credit and other resources for men, women, and youth; the forms of involvement of these actors in the process of training and education; as well as the availability of infrastructure.

6.3. Programs

Describe the specific objectives of each program, its constitution in terms of actions to be operationalized, time horizon, and responsibilities of different actors involved. Sort programs according to priority of families in order to guide the partners to better direct their demands in terms of feasibility, given the available resources.

6.3.1. Spatial Organization Program

For this topic, collectively define the assumptions, goals, actions, and timelines for implementing the spatial organization of the settlement, as well as the responsibilities of different actors involved in the construction of this process. Plan actions to be performed, based on an

established diagnosis, as well as the needs raised by families settled *a priori*, without conditioning on budget availability.

6.3.2. Productive Program

Collectively define the assumptions, goals, actions, and implementation schedules for the production of the PA program and the responsibilities of various actors in the formulation and implementation, including the participation of women and youth in its various phases and productive projects. This construction should include production activities, products, the technological base, the necessary infrastructure, the needs and organizing strategies, the timing of activity (with the goals' productive horizon), the market possibilities of transformation, generation of nonagricultural incomes, and the needs of professional and technical assistance.

6.3.3. Warranties Social Rights Program

For this topic, collectively define the assumptions, goals, actions, and timelines for implementing the program guarantees of social rights for settlers, as well as the responsibilities of different actors involved in the construction of this process. The program and subprograms aimed at ensuring social rights should be widely discussed by settlers with the various related government agencies, like the municipal authorities, given the fact that they are expanding their activities in the areas of education, health, housing, etc. Women's access to care services and reproductive health should be a subprogram to be discussed with other agencies. Anthropological and sociological analysis should also be developed considering the relationship between culture, livelihood, and the experiences of families in the projects.

6.3.4. Assurance of Environmental Rights Program

For this topic, collectively define the assumptions, goals, actions, and timelines for implementation of actions in relation to guaranteed environmental rights in the PA as well as the responsibilities of different actors involved in the construction of this process. This program should be identified with the potential impact activities (such as the removal of native vegetation, use and granting of water for irrigation, soil movement, etc.) as well as the formulation and implementation of mitigation or elimination of such impacts (such as environmental education projects), with an emphasis on sustainable technologies (such as the agro-ecology, solid waste processing, and packaging of pesticides), sewage disposal, among other problems diagnosed with environmental impacts caused by the projects to be undertaken in the area.

6.3.5. Organizational Development and Management Plan Program

Collectively define the assumptions, goals, actions, and timelines for implementing the program of organizational development and management plan, as well as the responsibilities of different actors involved in its formulation and implementation. This program seeks to define a simplified model of management actions to be developed in the settlement in accordance with the plan, taking into account the experiences of the settlers and management structures of preexisting, like group working committees (commercialization of products, health, education, infrastructure, training etc..), formal or informal, to be instituted. This part shall, in addition to establishing appropriate management structures and aligning to the reality of the settlement, provide a table with all the resource requirements, specified by year, to carry out the activities and investments under the plan, plus the breakdown of their funding sources and resource providers, public or private.

6.3.6. Technical, Social, and Environmental Support – ATES

Collectively define the assumptions, goals, actions, and timelines for implementation on the program of technical, social, and environmental support – ATES, the settlement, as well as the responsibilities of different actors involved in its formulation and implementation. This is one of the major programs to support development of the settlement on a sustainable basis. The activities must be structured based on the PDA, considering its constituent programs, as well as the need for articulation with the application of different types of credit. In addition, a function of ATES is to identify and promote cooperation with different public and private organizations that are developing other investments of interest to the PA in their areas of influence. This program should plan how the methodology of the core ATES should systematize information in order to assist in the management of the PA, its implementation, evaluation, and redesign.

6.4. Indicators of Sustainability

Address broadly based programs in structuring the plan, the main signs of viability of settlement—taking into account their social, economic, and environmental dimensions—which advocates a process of inclusion and the promotion of citizenship contingent of rural workers who are devoid of any means of production, except for its workforce. Ratifying the project / program / subprogram is designed according to the principle of rationality that guides the actions planned, taking into account primarily the real cultural and material conditions of settled families, which adds to the reality diagnosed in the area to be worked and requiring continued investment.

6.5. General Provisions

Actions of the PDA should be directed to the effective inclusion of settled women in the economic activities and to generate income by meeting their demands for the economy of the settlement and their participation in local discussions. This can be accomplished through methodologies that enhance their political participation and economics and that questions the division of labor based on gender, as well as through specific educational activities for women to develop projects for financing of production to ensure the generation of cash income of their own, encouraging the formation of collective organizations of women for the production.

7. Detailed Maps / Sketches to be Presented

A1 – Map of the basin or sub-basin location of settlement

This map has to provide an overview of the environmental context in which the area is part of the settlement project, especially in the case of information being available, land use, vegetation cover, and the presence of degradation.

A2 – Map of current land use and vegetation cover

This map contains detailed information about the current use of the property, indicating crops, pastures, location of production systems detected, the remaining areas, the legal reserve, permanent preservation areas, and improvements.

A3 – Sketch of environmental stratification of agro-ecosystems

Representing spatial distribution of agro-environmental area.

A4 – Map of current territorial organization

This map has to show location of productive areas, reserves for protection of fauna and flora, rural villages, other infrastructure.

B1 – Map of the draft installment areas including legal reserve and permanent preservation and infrastructure, existing and projected

This map includes the design of the division of lots (if already divided), common areas, the legal reserve, permanent preservation areas, infrastructure (roads, water supply, rural electrification, etc.).

B2 – Maps / sketches of the plots

This map has to include the design of the plots with the new proposed land use (areas of agricultural use, planted pasture and natural extraction, home, garden, forest reserve, etc.).

APPENDIX C. 2011 SURVEY INSTRUMENT

001. Number _____ 002. Date __ / __ / ____

003. Interviewer _____ 004. Reviewer _____

PERSONAL INFORMATION (USED ONLY FOR CODIFYING DATA, AND THEN OMITTED IN GENERAL ANALYSIS)

005. Settlement name _____

006. Location (municipality)

_____

007. Lot # _____

008. Village name_____

009. Distance from city _____

010. Name of the Interviewee _____

010a. Same person was interviewed in 2006? Y ___ N___

010b. Same family? Y___ N___

011. Interviewee condition

1 ___ Owner

2 ___ Spouse

3 ___ Son/Daughter

4 ___ Other. Explain _____

012. Name of the lot owner (in case not the interviewee) _____

General Data

013. Where does the owner live?

013. 1 ___ In the lot (settlement)

013. 2 ___ In the city. City name _____ State ___

Distance from lot _____ km

013. 3 ___ In another rural lot. City_____ State ___

Distance from lot _____km

014. How many lots does the owner have? _____

15.1. City name? _____15.1.1 State _____ 15.1.2 Size_____

15.2. City name? _____ 15.2.1 State _____ 15.2.2 Size_____

15.3. City name? _____ 15.3.1 State _____ 15.3.2 Size_____

15.4. City name? _____ 15.3.1 State _____ 15.3.2 Size_____

015. Do you have any document (title) of this lot? ____ yes ___no

015.1 **If yes,** which kind? _____

Table C.1 History of Durable Goods Possession

	When arrived		**Now**	
16.1 House built with bricks	___ yes	___ no	___ yes	___ no
16.2 Other kind of construction (wood, palm leaves, etc.) (_____)	___ yes	___ no	___ yes	___ no
16.3 Electricity (year_____)	___ yes	___ no	___ yes	___ no
16.4 Sawchain	___ yes	___ no	___ yes	___ no
16.5 Electricity generator	___ yes	___ no	___ yes	___ no
16.6 Tractor	___ yes	___ no	___ yes	___ no
16.7 Truck	___ yes	___ no	___ yes	___ no
16.8 Motorclicle	___ yes	___ no	___ yes	___ no
16.9 Bicicle	___ yes	___ no	___ yes	___ no
16.10 Car	___ yes	___ no	___ yes	___ no
16.11 Stove	___ yes	___ no	___ yes	___ no
16.12 Sewing machine	___ yes	___ no	___ yes	___ no
16.13 Refrigerator	___ yes	___ no	___ yes	___ no
16.14 TV	___ yes	___ no	___ yes	___ no
16.15 DVD reader	___ yes	___ no	___ yes	___ no
16.16 Cable antenna	___ yes	___ no	___ yes	___ no
16.17 Radio	___ yes	___ no	___ yes	___ no
16.18 House in the city	___ yes	___ no	___ yes	___ no
16.19 House in the PA village	___ yes	___ no	___ yes	___ no
16.20 Others (_____)	___ yes	___ no	___ yes	___ no
16.21 Others (_____)	___ yes	___ no	___ yes	___ no

Table C. 2.Average Monthly Expenses

What	R$/month	What	R$/Month
G1. Electricity		G7. Others (_____)	
G2. Water		G8. Others (_____)	
G3. House renting		G9. Others (_____)	
G4. Groceries		G10. Others (_____)	
G5. Bank financing		G11. Others (_____)	
G6. Association fee		G12. Others (_____)	

Social and Economic History

S01. How many people live in your property? _____

S02. Starting by the household, please inform age, genre, and relationship degree of each resident

Table C.3. Age and Genre of PA Residents per Property Visited in 2011

	S1.1 Age	**S1.2 Genre**	**S1.3 Relationship**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			

S03. How many years did you go to school? _____

If you are not the property owner:

S03.1 How many years did the property owner go to school? _____

S04. Where was the property owner born? State_____

S04.1. Where were your parents born? State _____

S04.2. Where were your grandparents born? State _____

S04. 3. Who was the first person in your family to migrate to Pará? _____

S04.3a. When? _____

S04.3a. Why (mining, new roads, explain reasons for migration)? (If they migrate because of the Brazil Nut economy, please cite the "*castanhal*" name)

_____

_____

S05. When did you receive this lot? Year_____

S06. Do you sell work to other properties? ___ yes ___no

S06.**1 If yes,** how many days did you sell last year (2010)? _____

S6.2 In this region, how much costs a day of work? R$ _____

S06.3 Do other residents of this lot sell work to other properties? ___ yes ___no

S06.4 **If yes,** how many days did each person sell in 2010? Specify per person below

Table C.4. Employment Off-Farm

S06.4a Person name/relationship	**S06.4b Quantity of days**	**S06.4c R$/day**

S07. Did you receive any government benefit? (social programs, rural retirement, others)

___ yes ___no, **If yes,** please specify in the table below:

Table C.5. List of Government benefits Available per Visited family

	1.1 kind	1.2 year it started	1.3 value (R$)
S7. 1	Basic food needs		
S7. 2	Bolsa- familia(government cash transfer program)		
S7. 3	Rural retirement (by age)		
S7. 4	Retirement for disability		
S7. 5	Other(_____)		
S7. 6	Other(_____)		
S7. 7	Other(_____)		

Social Capital

C1. Which social movement organized this settlement?

___ STR (Rural workers syndicate)

___ MST (Landless movement)

___ CPT (Pastoral Land Commission)

___ Other (_____)

C2. For how long did you camp before settlement creation? _____ (years/months)

C3. Did you participate since the camp process? ___yes ____no

C3a. Other people from your family participate? ___yes ____no

C3b**. If yes**, how many relatives? ____ (relationship_____)

C3c. Why did you choose this lot? _____

_____

Agricultural Experience

A1. Did your parents work in the agricultural sector? ___ yes ___ no

A2. How old were you when you started to work in agriculture? _____

A2.1. **If NOT the lot owner:** How old was the owner when he (she) started to work in agriculture? _____

A3. Did you receive any training in agriculture? ___yes ____no

Table C.6. Types of Training in Agriculture Received by Settler

A3.1 Explain	A3.2 For how long?	A3.3 Who provided?

A5. How many hectares of your lot is being used for agriculture? _____

A5.1 What do you plant in your lot?

Table C.7. Land Use for Agriculture

A5.1a Crop name	A5.1b Planted area (ha)	A5.1c How much did you harvest in 2010? (kgs)	A5.1d How much did you sell in 2010? (kgs)	A5. 1e Do you use fertilizers, pesticides, others? Which?	A5.1e1 Which?	A5.1f. Do you use any agro-ecological method	A5.1f1 Which?
A5. 1a1.				___yes ____no		___yes ____no	
A5. 1a2.				___yes ____no		___yes ____no	
A5. 1a3.				___yes ____no		___yes ____no	
A5. 1a4.				___yes ____no		___yes ____no	
A5. 1a5.				___yes ____no		___yes ____no	
A5. 1a6.				___yes ____no		___yes ____no	

A6. How much per month or year do you spend with fertilizers and pesticides? _____

A7. How much per month or year do you spend with seeds? _____

A8. How much did you earn selling agricultural products in 2010? _____

Cattle Investment

I1. Do you own cattle? Yes ____ No ____ (**if yes, answer questions below**)

I1.1. How many animals do you have? _____

I1.1a. How many animals did you have in 2006? _____

I1.1b. Did quantity of animals increase or decrease? Why? _____

_____

1.2 Are they for milk or beef? _____ Specify quantity for each

_____

I1.2. How many hectares of your lot is being used for pasture? _____ ha

I1.3. Calves and cows use the same pasture area? yes ____ no ____

I1.3b Is your pasture divided in paddocks? yes ____ no ____ In how many pieces? _____

Table C.8. Specification of Paddocks Division at Lots Visited

Paddocks specification	Size	Age	Notes
P1			
P2			
P3			
P4			
P5			

I1.4. When did you start to raise cattle? _____Year

I1.5. Did you receive any specific credit for cattle? yes ____ no ____ (**if yes, mark options below)**

I1.4.1 ___Pronaf _____ Year

I1.4.2 ___Procera _____ Year

I1.4.3 ___FNO _____ Year

I1.4.4 ___Other (_____) Year _____

I1.5.Did you receive credit for other activities? yes ____ no ____ (**if yes, mark options below**)

For what?

( ) Agriculture. which crop? _____

( ) Extractivism. Explain _____

( ) Livestock (pigs, chickens, goats). Explain _____

( ) Others. Explain _____

From where?	When?	How much?
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

I1. 5. Why did you start to raise cattle? (Please rank the reasons for starting with the most important)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

I1. 6. Do you use vaccine, medication? ___yes ____no

I1.6.1. **If you used vaccine,** specify in the table below:

Table C.9. Vaccines used in the Cattle

I1.6.1a. For what?	I1.6.1b Who applies?	I1.6.1c. Is it obligatory?
		___yes ____no
		___yes ____no
		___yes ____no
		___yes ____no
		___yes ____no

I1.7. Since you started to invest in cattle, how many hectares of pasture were formed? _____ha

I1.7.1 Were those new pasture areas opened from forest? ___yes ____no

I1.7.2 Were those new pasture areas opened from secondary forest growth? ___yes ____no

If possible, specify the age of secondary growth _____

I1.7.3 Were those new pasture areas opened in areas used for agriculture? ___yes ____no

I1.7.3a On average, after how many years using the area for agriculture do you change for pasture? _____years

I1.7. Are you thinking of increasing your pasture area? ___yes ____no

I1.7.1Why?_____

_____

I1.8. Are you thinking in increasing your cattle herd? ___yes ____no

I1.8.1.Why?_____

I1.8.2. Do you believe you will be able to get more credit for cattle? yes___ no___

I1.8.3. Do you plan to invest your own money to improve your cattle herd? yes___ no___

Cattle Market

M01. Do you sell calves to the large farms in the region? ___yes ____no

(**if yes,** ask past and present relationship between them, and **if possible name of the farmer**)

_____

_____

M01.a. **If yes,** who transports the animals?

___smallholder __ farmer __others (_____)

M01.b **If the smallholder transports animals,** how much does it cost? _____ R$/animal/km

M01.c When did you start to sell calves? _____ Year

M02. Have you always sold animals to the large farmers in the region? ___yes ____no

M03. For whom did you sell your animals before? _____

M04. Is there a time in the year when you sell more animals? yes ____ no ____.

If yes, when/why? _____

M05. For whom do you sell cows and animals ready to be slaughtered? _____

_____

M06. Do you sell animals to the slaughterhouse? ___yes ____no

M07. How many animals do you sell per year? _____Calves _____Cows/bulls

M08. How much do they cost _____ calves (R$/kg or animal)

_____ cows/bulls (R$/kg or animal)

M09. How much do they weigh _____ calves (kg or @)

_____ cows/bulls (kg or @)

M10 How old are animals when you sell them? _____Calves

_____ cows

_____bulls

M11. What is the distance between your lot and the slaughterhouse? _____ km

M12. Since the slaughterhouse started in this region, did you invest more in cattle than before?

___yes ____no

M13. Since the slaughterhouse started in this region, did the price of calves change?

___yes ___no

M13.1 **If yes**, Explain if the price increased or decreased and how much.

_____

_____

M09. Since you started to invest in cattle, did you reduce your dedication to agriculture?

___yes ____no

How? _____

Economic Alternatives and Reforestation

Ear1. Which other alternatives of production have you tried? _____

_____

Ear2. Do you still produce this? ___yes ___no

Ear2.1. Explain why or why not you continued this production. _____

_____

Ear2.2. Who gave you the incentive to start this production? _____

_____

Ear2.3. Do you think this is more productive than cattle? ___yes ___no

Explain _____

_____

Ear.2.4 Why did you start this production? _____

_____

Ear.2.5 Has this activity changed due to soil quality? ___yes ___no

Ear.2.5a. How has this change been perceived? _____

_____

Ear3. Do you have other animals? (chicken, pigs, goats) ___yes ___no

If no, Why not? _____

If yes, do you sell them? Is it better than cattle? Why? _____

_____

Ear4. Have you heard about agro-ecology? From where? What do you know about it? _____

_____

_____

Which kind of procedures have you heard about and use?

Table C.10. Alternative practices for Agricultural Production

Native trees and crops consortium		**Direct planting**	
Terracing		Other_____	
Natural fertilization		Other _____	

Ear5. Have you received credit to invest in reforestation? ___yes ___no

Ear6. Are efforts to reforest your lot being made? ____yes ____no

Ear6.1 **If yes,** which kind of trees are you planting? _____

Ear6.2 Why? _____

Ear6.3 When did you start to reforest? _____

Ear6.4 Did you have an idea about what to plant before? _____

Property Management

P01. Do you use fire to open new areas? ___ yes ___no

P01.**1 If yes**, how many times per year? _____

P01.2 When (month)? _____

P01. 3 **If not**, what do you do to the area after crop production? _____

_____

P02. Do you leave areas to fallow? ___ yes ___no

P02.1 For how long? _____

P02.2 Why do you do it? _____

P03. Do you have problems with soil fertility? ___ yes ___no

P03.1 **If yes,** is it a barrier to invest in cattle? ___ yes ___no

P03.2 Did the soil quality decrease since you started to invest in cattle? ___ yes ___no

P03.2a. Explain the problems (erosion, fertility, weed) _____

_____

Historic Forest Opening in the Property

H1. When you arrived, how many hectares of this lot was opened already? _____ha

H2. Who opened that area previously? _____

H3. How many hectares do you have opened now? _____ha

H4. How many hectares of forest do you have now? _____ ha

H5. Since you started in this lot, did you open new areas? ___yes ___no, **if yes** complete the table below.

Table C.11. Areas Opened After Settlement Creation

	H5.1 Year	H5.2 Quantity of hectares	H5.3 Who opened?	H5.4 Did you hire off-farm labor to do it?
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

History of Conflicts

H3d. Were there land conflicts during this settlement formation? ___yes ____no

H3d. 1. **If yes,** with who? _____

H3d. 2. Why? _____

H3d.3. Was somebody in your family murdered due to this conflict? yes__ no__

H3d.4. Who? _____

H3e. Currently, is there any land conflict related to this settlement? ___yes ____no

H3e. 1**. If yes,** with who? _____

H3e. 2. Why? _____

C6. Did you know somebody who was murdered due to land conflicts? ___ yes __no

If yes, take notes about year, name, relationship with the interviewee, causes and possible murderers.

Table C.12. Conflicts Related to Visisted Settlement

Year	Name	Relationship	Causes	Murderers

APPENDIX D. VALUES DISTRIBUTED FOR FAMILIES WITH MONTHLY INCOME UP TO USD 35 PER PERSON/MONTH

Table D.1. Values Distributed for Families with Monthly Income up to USD 35 Per person/ Month

Number of pregnant women, nursing mothers, children and adolescents up to 15 years	Number of young people aged 16 to 17 years	Type of benefit	Value of benefit (USD)
0	0	Basics	35
1	0	Basics + 1 variable	51
2	0	Basics + 2 variables	66
3	0	Basics + 3 variables	82
4	0	Basics + 4 variables	98
5	0	Basics + 5 variables	114
0	1	Basics + 1 BVJ	53
1	1	Basics + 1 variable + 1 BVJ	69
2	1	Basics + 2 variables + 1 BVJ	85
3	1	Basics + 3 variables + 1 BVJ	101
4	1	Basics + 4 variables + 1 BVJ	117
5	1	Basics + 5 variables + 1 BVJ	133
0	2	Basics + 2 BVJ	72
1	2	Basics + 1 variable + 2 BVJ	88
2	2	Basics + 2 variables + 2 BVJ	104
G	2	Basics + 3 variables + 2 BVJ	120
4	2	Basics + 4 variables + 2 BVJ	136
5	2	Basics + 5 variables + 2 BVJ	151

[1] Types of benefits: basics, variable, variable linked to teen (BVJ), and extraordinarily variable (BVCE).
Source: Ministry of Social Development (2012)

APPENDIX E. VALUES DISTRIBUTED FOR FAMILIES WITH MONTHLY INCOME OF USD 35 TO 69 PER PERSON

Table E.1. Values Distributed for Families with Monthly Income of USD 35 to 69 per Person

Number of pregnant women, nursing mothers, children and adolescents up to 15 years	Number of young people aged 16 to 17 years	Type of benefit	Value of benefit (USD)
0	0	Do not receive any benefit	-
1	0	1 variable	16
2	0	2 variables	32
3	0	3 variables	48
4	0	4 variables	63
5	0	5 variables	79
0	1	1 BVJ	19
1	1	1 variable + 1 BVJ	35
2	1	2 variables + 1 BVJ	51
3	1	3 variables + 1 BVJ	66
4	1	4 variables + 1 BVJ	82
5	1	5 variables + 1 BVJ	98
0	2	2 BVJ	38
1	2	1 variable + 2 BVJ	53
2	2	2 variables + 2 BVJ	69
3	2	3 variables + 2 BVJ	85
4	2	4 variables + 2 BVJ	101
5	2	5 variables + 2 BVJ	117

[1] Types of benefits: basics, variable, variable linked to teen (BVJ), and extraordinarily variable (BVCE).
Source: Ministry of Social Development (2012)

APPENDIX F. BRAZILIAN DIVISION UNDER TREATY OF TORDESILLAS

Figure F.1. Brazilian Division Under Treaty of Tordesillas

BIBLIOGRAPHY

BIBLIOGRAPHY

ABrasil (2001). *Relatório Anual de Atividades*. Retrieved on 11 May 2012 from http://www.abrasil.gov.br/index.htm

ABrasil (2002). *Programa Novo Mundo Rural: Consolidacao dos Assentamentos*. Retrieved on 2 January 2012 from http://www.abrasil.gov.br/nivel3/index.asp?id=82&cod=BUSCA

Aldrich, S. (2009). *Largeholder deforestation and land conflict in the eastern Brazilian Amazon* (Doctoral dissertation). Michigan State University, East Lansing, MI, 305 pp.

Aldrich, S., Walker, R., Arima, E., Caldas, M., Browder, J. O., & Perz, S. (2006). Land-cover and land-use change in the Brazilian Amazon: Smallholders, ranchers, and frontier stratification. *Economic Geography*, *82*, 265–288.

Aldrich, S., Walker, R., Simmons, C., Caldas, M. & Perz, S. (2012) Contentious Land Change in the Amazon's Arc of Deforestation. *Annals of Association of American Geographers*, 102 (1), 103-128.

Alencar, A., Nepstad, N., Mcgrath, D., Moutinho, P., Pacheco, P., Diaz, M. D. C. V., & Soares-Filho, B. (2004). *Desmatamento na Amazônia: Indo Além da Emergência Crônica*. Manaus: Instituto de Pesquisa Ambiental da Amazônia (Ipam), 89 pp.

Almeida, A. L. O. de (1992). *The colonization of the Amazon*. Austin: University of Texas Press.

Almeida, A. L. O. de & Campari, J. S. (1995). *Sustainable settlement in the Brazilian Amazon*. Oxford, UK: Oxford University Press.

Almeida, M. A. F. de (1982). *A ocupação recente da Amazônia através das grandes empresas pecuárias* (thesis). Belém: NAEA, 182 pp.

Almeida, R. (2009). Araguaia-Tocantins: Fragmentos de 20 anos de Luta pela Terra. *Democracia Viva, 41*, 34–39.

Altieri, M. A. (2010). Agroecologia, agricultura camponesa e soberania alimentar (agroecology, peasant agriculture and food sovereignty). *NERA*. São Paulo. v.13. n. 16. P.22-32. January-June-2010.

Andersen, L. E. (1997). *A cost-benefit analysis of deforestation in the Brazilian Amazon*. Discussion paper 455. Rio de Janeiro: IPEA.

Andersen, L. E., Granger, C. W. J., Reis, E. J., Weinhold, D., & Wunder, S. (2002). *The dynamics of deforestation and economic growth in the Brazilian Amazon*. Cambridge, UK: Cambridge University Press.

Angelken, A. (2012). Pará pode ser área livre de aftosa ainda este ano. Agencia para de Noticias. Secretaria de Comunicacao. Retrieved on 11 February 2012 from http://www.agenciapara.com.br/noticia.asp?id_ver=93418#

Anualpec (2006). *Anuario da Pecuaria Brasileira*. Sao Paulo: AgraFNP, Instituto FNP, 369 pp.

Anualpec (2011). *Anuario da Pecuaria Brasileira*. Sao Paulo: Informa Economics-FNP, 378 pp.

Arima, E., Barreto, P., & Brito, M. (2005). *Pecurária na Amazônia: tendências e implicações para a conservação*. Imazon: Belém.

Arima, E. & Uhl, C. (1996). *Pecuária na Amazônia Oriental: Desempenho Atual e perspectivas Futuras*. Imazon: Belém,

Arima, E. & Uhl, C. (1997). Ranching in the Brazilian Amazon in a national context: Economics, policy, and practice. *Society and Natural Resources*, *10* (5), 433–451.

Arima, E. & Veríssimo, A. (2004). *Brasil em Ação: ameaças e oportunidades econômicas na fronteira amazônica*. Imazon: Belém, 24 pp. Downloaded from: http://www.imazon.org.br. , in 03/25/2007

Assis, W. S. (2007). *Construção da Representação dos Trabalhadores Rurais no Sudeste Paraense* (Doctoral dissertation). Rio de Janeiro: Universidade Federal Rural do Rio de Janeiro (UFRRJ), 242 pp.

Banco Central do Brasil (2010). *FAQ - Programa Nacional de Fortalecimento da Agricultura Familiar – Pronaf*. Retrieved on 4 January 2012 from http://www.bcb.gov.br/?PRONAFFAQ

Barbanti, O., Jr. (1998). *Urban dimensions in rural livelihoods: Implications for grassroots development and sustainability in Brazilian Amazon* (Doctoral dissertation). London: London School of Economics and Political Science.

Barbieri, A. F. & Bilsborrow, R. E. (2009). Dinâmica Populacional, Uso da Terra e Geração de renda: Uma Análise Longitudinal para Domicilios Rurais na Amazônia Equatoriana. *Nova Economia,* 19 (1), 67–94. Belo Horizonte.

Barbosa, L. C. (2000). *The Brazilian Amazon rainforest: Global ecopolitics, development and democracy*. Lanham, MD: University Press of America, 196 pp.

Barnum, H. N. & Squire, L. (1979). *A model of an agricultural household: Theory and evidence*. Paper number 27. Washington, DC: World Bank.

Barreto, P. & Silva, D. (2009). *Os desafios para uma pecuária mais sustentável na Amazônia*. O estado da Amazonia 14. Imazon: Belem, 6 pp.

Barreto, P., Souza, C., Jr., Noguerón, R., Salomão, R., & Wiles, J. (2006). *Human pressure on the Brazilian Amazon forests*. Belém: Imazon/WRI.

Barros, G. S. C., De Zen, S., Bacchi, M. R. P., Ichihara, S. M., Osaki, M. E., & Ponchio, L. A. (2002). *Economia da pecuária de corte na região norte do Brasil*. Piracicaba: CEPEA/Esalq/USP.

Becker, B. (1990). *Amazonia*. São Paulo: Ática.

Becker, B. K., Miranda, M. H. P., & Machado, L. O. (1990). *Fronteira Amazônica : Questões sobre a Gestão do Território*. Brasilia: UNB/UFRJ.

Behrens, C., 1989. The scientific basis for shipibo soil classification and land use. *Am. Anthropol*., *91*, 10–83.

Blaikie, P. (1985). *The political economy of soil erosion in developing countries*. New York: John Wiley.

Blaikie, P. & Brookfield, H. (1987). *Land degradation and society*. London: Methuen, 296 pp.

Bobrow-Strain, A. (2001). Between a ranch and a hard place: Violence, scarcity, and meaning in Chiapas, Mexico. In: N. L. Peluso & M. Watts (Eds.), *Violent environments*. Ithaca, NY: Cornell University Press, pp. 155–188.

Branco, H. C. (1964). *Estatuto da Terra, Lei # 4504, Presidência da República Casa Civil, Subchefia para Assuntos Jurídicos*. Rio de Janeiro: República do Brasil.

Brandao, A., Jr. & Souza, C., Jr. (2006). Deforestation in land reform settlements in the Amazon. *O Estado da Amazônia*, *7*, 1–4.

Brasil (1970). *Presidência da República. Metas e bases para a ação de governo*. Brasília.

Brasil (2003). *Programa Avança Brasil*. Retrieved on 11 February 2012 from www.abrasil.gov.br

Brasil (2012). *Programa de Aceleração do Crescimento*. Retrieved from http://www.brasil.gov.br/pac

Brasil/SPVEA (1958). *SPVEA. Rodovia da Unidade Nacional*. Superintendência do Plano de Valorização Econômica da Amazônia: Belém.

Brasilia Ministerio do Desenvolvimento Social e Combate a Fome (MDS) (2012). *Bolsa Familia: Valores dos Benefícios*. Ministerio do Desenvolvimento Social e Combate a Fome. Retrieved on 12 March 2012 from http://www.mds.gov.br/bolsafamilia/valores-dos-beneficios

Browder, J. O. (1988). Public policy and deforestation in the Brazilian Amazon. In M. Gillis & R. Repetto (Eds.), *Public policies and the misuse of forest resources*. Cambridge, UK: Cambridge University Press.

Browder, J. O. & Godfrey, B. J. (1997). *Rainforest cities: Urbanization, development, and globalization of the Brazilian Amazon*. New York: Columbia University Press, 429 pp.

Browder, J. O., Pedlowski, M. A., Walker, R.,Wynne, R. H., Summers, P. M., Abad, A., Becerra-Cordoba, N., & Mil-Homens, J. (2008). Patterns of development and land cover change in the Brazilian Amazon: A farm-level analysis of Rondonia's settlement frontier, 1992-2002. *World Development, 36* (8), 1469–1492.

Brown, J. C. & Purcell, M. (2005). There's nothing inherent about scale: Political ecology, the local trap, and the politics of development in the Brazilian Amazon. *Geoforum, 36*, 607–624.

Bruner, A., Gullison, R., Rice, R., & Fonseca, G. (2001). Effectiveness of parks in protecting tropical biodiversity. *Science, 291* (5501), 125–128.

Bryant, R. L. (1992). Political ecology: An emerging research agenda in third world studies. *Political Geography, 11* (1), 12–36.

Caldas, M. M. (2008). *Settlement formation and land cover and land use change: A case study in the Brazilian Amazon* (Doctoral dissertation). Michigan State University, East Lansing, MI.

Caldas, M., Walker, R., Perz, S., Arima, E., Aldrich, S., & Simmons, C. (2007). Theorizing land cover and land use change: The peasant economy of colonization in the Amazon basin. *Annals of the Association of American Geographer, 97* (1), 86–110.

Campos, A. S. (2002). *O Confronto em Eldorado do Carajas*. Promev: Belem.

Cardoso, F. H. (1997). *Reforma Agrária: Compromisso de Todos. Brasilia: Presidência Da República.* Retrieved on 5 December 2011 from http://www.planalto.gov.br/publi_04/COLECAO/REFAGR.HTM

Cardoso, F. H. (1998). *Decreto Executivo # 2829, de 29 de outubro de 1998*. Retrieved on 11 May 2012 from http://www.planejamento.gov.br/secretarias/upload/Legislacao/Decretos/981029_dec_2829.pdf

Carpentier, C. L., Vosti, S. A., & Witcover, J. (2000). Intensified production systems on western Brazilian Amazon settlement farms: Could they save the forest? *Agriculture, Ecosystems and Environment*, *82*, 73–88.

Casa Civil (2004). *Plano de Ação Para Prevenção e Controle do Desmatamento Ilegal na Amazonia Legal*. Grupo Permanente de Trabalho Interministerial Para redução dos Indices de Desmatamento da Amazonia Legal. Decreto de 3 de julho de 2003. Brasilia, DF, Marco.

Castro, E. R., Monteiro, E., & Castro, C. P. (2004). Dinâmica de Atores, uso da Terra e Desmatamento da Rodovia Cuiabá-Santarém. Belém: *NAEA*.

Cavalcanti, M. De B. (1967). *Da SPVEA a SUDAM*. Belém: Universidade Federal do Pará.

Celentano, D., & Verissimo, A. (2007a). *O estado da Amazônia: indicadores. A Amazônia e os objetivos do milênio*. Imazon, 50 pp. Retrieved 21 March 2008 from http://www.imazon.org.br

Celentano, D., & Veríssimo, A. (2007b). *O Avanço da Fronteira na Amazônia: do boom ao colapso*. O Estado da Amazônia - Indicadores, 48. Belém: Imazon.

Chayanov, A. V. (1925). Peasant farm organization. In D. Thorner, B. Kerblay, & R.E.F. Smith (Eds.), *A.V. Chayanov on the theory of the peasant economy*. Homewood, IL: Richard D. Irwin, Inc.

Chomitz, K. & Thomas, T.S. (2000). *Geographic patterns of land use and land intensity*. World Bank, Development Research Group, Draft Paper, Washington, D.C.

Ciccantell, P. S. (1999). It's all about power: the political economy and ecology of redefining the Brazilian Amazon. *The Sociological Quarterly, 40*, (02), 293–315. Retrieved on 28 February 2008 from http://links.jstor.org/journals/mss.html

Collier, P. (2000). *Economic causes of civil conflict and their implications for policy*. Washington, DC: World Bank.

Collins, J. L. (1986). Smallholder settlement of tropical South America: The social cases of ecological destruction. *Human Organization,* 45 (1), 1–10.

Correio do Tocantins (2011a). *Massacre da Curva do S completa 15 anos*. Caderno 4, Marabá, Pará, 16 a 18 de abril de 2011.*(Newspaper)*

Correio do Tocantins (2011b). *Após Abril de 1996 Reforma Agrária Teve Grande Avanço*. Caderno 4, Marabá, Pará, 16 a 18 de abril de 2011. *(Newspaper)*

Costa, F. A. (2000). Formação agropecuária da Amazônia: os desafios do Desenvolvimento Sustentável. Belém: UFPA/NAEA

CPT (Comissão Pastoral da Terra) (2003). *Conflitos no Campo 2002*. Belém, Brazil: CPT

CPT (Comissão Pastoral da Terra) (2010). *Conflitos no Campo 2009*. Belém, Brazil: CPT

Driessen, P.M. & Dudal, R. (1991). *The major soils of the world*. Wageningen, The Netherlands: Agricultural University.

Ellinger, P. & Barreto, P. (2011). Código Florestal: Como Sair do Impasse? Imazon: Belem, 13 pp. Retrieved on 10 March 2012 from http://www.imazon.org.br/publicacoes/outros/codigo-florestal-como-sair-do-impasse

Ellis, F. (1993). *Peasant economics: farm household and agrarian development*. New York: Cambridge University Press.

Embrapa (2010). *O estado do Mato Grosso, Embrapa Monitoramento por Satélite*. Retrieved on 18 December 2011 from http://www.qmdmt.cnpm.embrapa.br/715.htm

Evans, T. P., Manire, A., Castro, F., Brondizio, E., & McCracken, S. (2001). A dynamic model of household decision-making and parcel level land cover change in the eastern Amazon. *Ecological Modelling, 143,* 95–113.

Faminow, M. (1997). Spatial economics of local demand for cattle products in Amazon development. *Agriculture, Ecosystems and Environment*, *62*, 1–11.

Fearnside, P. M. (1984). Brazil's Amazon settlement schemes: Conflicting objectives and human carrying capacity. *Habitat International*, *08* (01), 45–61.

Fearnside, P. M. (2003). *A floresta Amazônia nas mudanças globais*. Manaus: Instituto Nacional de Pesquisas da Amazônia (Inpa), 134 pp.

Feijó, R. L. C., 2001. The impact of a family farming credit program on the rural economy of Brazil. In Anais da ANPEC, XXIX Congresso de Economia, Salvador- Bahia, 11–14 de dezembro de 2001.

Fernandes, M. (1999). *Donos de Terras: trajetória da União Democrática Ruralista*. Belém: NAEA/UFPA.

Furtado, C. (1984). *Formação Econômica do Brasil*. São Paulo: Companhia das letras.

Girardi, E. P. (2008). *Proposição teórico-metodológica de uma cartografia geográfica crítica e sua aplicação no desenvolvimento do atlas da questão agrária brasileira* (Doctoral dissertation) (Doutorado em Geografia). Programa de Pós – Graduação em Geografia, Faculdade de Ciências e Tecnologia, Universidade Estadual Paulista, campus de Presidente Prudente.

Godoy, R., Groff, S., & O'Neill, K. (1998). The role of education in neotropical deforestation: Household evidence from Amerindians in Honduras. *Human Ecology, 26* (4), 649–675.

Gonçalves, E. C. & Fernandes, B. M. (n.d.). *Análise e mapeamento dos tipos de assentamentos de reforma agraria e reforma agraria de mercado no Brasil: contribuição para compreensão da diversidade e a atualidade da reforma agrarian brasileira*. FCT/Unesp: Presidente Prudente. Retrieved on 14 December 2009 from http://egal2009.easyplanners.info/area06/6305_Goncalves_Elienai.pdf

Greenpeace (2009). *Amazon cattle footprint, Mato Grosso: State of destruction*. Retrieved on 15 May 2009 from http://www.greenpeace.org/international/press/reports/amazon-cattle-footprint-mato#

Guanziroli, C. E. (2007). PRONAF dez anos depois: resultados e perspectivas para o desenvolvimento rural. *Revista de Economia Rural, 45 (*2), 301–328.

Guedes, G., Antigo, M., Machado, A. F., Brondizio, E., & VanWey, L. (2010). *Poverty dynamics, ecological endowments and land use among smallholders in the Brazilian Amazon*. Texto para discussao n 415. Belo Horizonte: UFMG/Cedeplar, 26 pp.

Guerra, G. A. D. (2001). *O Posseiro da Fronteira: Campesinato e Sindicalismo no Sudeste do Pará*. Belém: UFPA/NAEA, 170 pp.

Gujarati, D. N. (2003). *Basic econometrics* (4th ed.). New York: McGraw-Hill, 1002 pp.

Gurr, T. (1971). *Why men rebel*. Princeton, NJ: Princeton University Press.

Hagemann, H. (1994). *Not out of the woods yet: the scope of the G7 initiative for a pilot program for the conservation of the Brazilian rainforests*. Sabrücken: Verlag für Entwicklungspolitik Breitenback.

Hall, A. (1987). Agrarian crisis in Brazilian Amazonia: The Grande Carajas programme. *The Journal of Development Studies, 23* (4), 522–552.

Hall, A. (1989). *Developing Amazonia: Deforestation and social conflict in Brazil's Carajas programme*. Manchester, UK: Manchester University Press.

Hall, A. (1991a). O programa Grande Carajás: gênese e evolução. *In*: HÈBETTE, J. (Org.) O cerco está se fechando. Petrópolis: Ed. Vozes: FASE: NEA/UFPA, 1991. Pp-38-45

Hall, A. (1991b). *Developing Amazônia: Deforestation and social conflict in Brazil's Carajás Programme*. Manchester, UK: Manchester University Press.

Hall, A. (2011). Getting REDD-y: Conservation and climate change in Latin America. *Latin American Research Review,* Special Issue, *46*, 184–210.

Hébette, J. O. (1997). *O sindicalismo dos trabalhadores rurais na micro-região de Marabá*. Marabá, Brazil: UFPA.

Hecht, S. B. (1982). *Cattle ranching development in the eastern Amazon: Evaluation of a development policy* (Doctoral dissertation). Los Angeles, CA, USA: Univ. of California,, 454 pp.

Hecht, S. B. (1985). Environment, development and politics: Capital accumulation and the livestock sector in eastern Amazon. *World Development, 13* (6), 663–684.

Hecht, S. B. (1993). The logic of livestock and deforestation in Amazonia. *BioScience, 43* (10), 687–695.

Hecht, S. B. & Cockburn, A. (1989). *The fate of the forest*. London: Verso.

Helfand, S. M. (2001). The distribution of subsidized agricultural credit in Brazil: Do interest groups matter? *Development and Change*, *32* (3), 465–490.

Heredia, B., Medeiros, L., Palmeira, M., Leite, S., & Cintrão, R. (Eds.) (2001). *Os Impactos Regionais da Reforma Agrária : Um Estudo Sobre Áreas Selecionadas, Rio de Janeiro*. Rio de Janeiro: CPDA – UFRRJ/Nuap – PPGAS – UFRJ, 479 pp.

Homer-Dixon, T. F. (1999). *Environment, scarcity, and violence*. Princeton, NJ: Princeton University Press.

Homma, A. (1976). *Programacao das atividades agropecuarias, sob condicoes de risco, nos lotes do nucleo de colonizacao de Altamira* (Master's Thesis). Minas Gerais, Brazil: Universidade Federal de Vicosa.

Hosmer, D. W. & Lemeshow, S. (2000). *Applied logistic regression* (2nd ed.). New York: Wiley.

Huntington, S. (1971). *Political order in changing societies*. New Haven, CT: Yale University Press.

Ianni, O. (1978). *A Luta pela terra*. Rio de Janeiro: Vozes.

Ianni, O. (1979). *Colonização e Contra-Reforma Agrária na Amazônia*. Petropolis, RJ: Vozes.

IBAMA (2011). *História*. Retrieved on 5 December 2011 from http://www.ibama.gov.br/am/institucional/historia.htm

IBGE (2002). *Censo Demográfico*. Available at www.sidra.ibge.gov.br

IBGE (2008). *Censo Demográfico*. Available at www.sidra.ibge.gov.br

IBGE. (2009). Censo Agropecuário 2006 Brasil, Grandes Regiões e Unidades da Federação. Brasilia: IBGE. 67p.

IBGE (2010). *Censo Demográfico*. Available at www.sidra.ibge.gov.br

IBGE (2011). *Censo Demográfico*. Available at www.sidra.ibge.gov.br

IBGE (2012). *Pesquisa Pecuária Municipal*. Available at www.sidra.ibge.gov.br

IDESP (Instituto de DesenvolvimentoEconômico-Social do Pará) (1996). *Pará Desenvolvimento: Informação a Base do Planejamento*. Belém: IDESP.

INCRA (2009). *Crédito instalação*. Retrieved 14 December 2009 from http://www.incra.gov.br

INCRA (2011a). *Histórico da Questão Agrária*. Retrieved on 5 December 2011 from http://www.incra.gov.br

INCRA (2011b). *Programas e Projetos. Crédito Instalação*. Retrieved on 15 June 2010 from http:// www.incra.gov.br

INPE (2011). *Estimativas Anuais desde 1988 até 2010 Taxa de desmatamento anual (km^2/ano)* . Retrieved on 4 October 2011 from http://www.obt.inpe.br/prodes/prodes_1988_2008.htm

IPEA (2002). Desenvolviment Rural. *Politicas Sociais: Acompanhamento e Analise.* Retrieved on 4 January 2012 from http://www.ipea.gov.br/sites/000/2/publicacoes/bpsociais/bps_05/desenv.pdf

Ipeadata (2011). *PIB estadual a preços constantes*. Retrieved on 8 December 2011 from http://www.ipeadata.gov.br

IPEAN (1974). *Os Solos da Rodovia Transamazonica: Trecho Itaituba- Rio Branco*. Belem: Instituto de Pesquisas Agropecuaria do Norte.

IstoeAmazonia (2012). *Pará, o estado: Relevo, Solos e Subsolos*. Retrieved on 9 March 2012 from http://www.istoeamazonia.com.br/

Junming, Z. (1997). *Multilevel analysis of rural outmigration in Guandong, China*. Working Paper Series no. 97.03, Harvard Center for Population and Development Studies, Harvard University, Cambridge, MA.

Kleinpenning, J. M. G. (1975). *The integration and colonization of the Brazilian portion of the Amazon basin*. Nijmegen, Netherlands: Institute of Geography Planning.

Kleinpenning, J. M. G. (1977). An evaluation of the Brazilian policy for the integration of the Amazon region (1964-1974). *Tidjschrift voor Econ. En Soc. Geografie, 68* (15), 297-311.

Kleinpenning, J. M. G. (1979). *An evolution of the Brazilian policy for the integration of the Amazon basin (1964-1975)*. Nijmegen, Netherlands: Institute of Geography Planning.

Kohlhepp, G. (2002). Conflitos de Interesse no Ordenamento Territorial da Amazônia Brasileira. *Estudos Avançados,16* (45), 37– 61.

Kotscho, R. (1981). *O Massacre dos Posseiros: Conflito de Terras no Araguaia-Tocantins*. Sao Paulo: Brasiliense.

LASAT (1998). *Desmatamento e Agricultura na regiao de Marabá*. Marabá: UFPA.

Láu, H. D. (2006). *Pecuária no Estado do Pará: Īndices, Limitações e Potencialidades*. Documentos 269. Belém: EMBRAPA Amazônia Oriental, 36 pp.

Laurance, W. F., Cochrane, M. A., Bergen, S., Fearnside, P. M., Delamônica, P., Barber, C., D'angelo, S. E., & Fernandes, T. (2001). The future of the Brazilian Amazon. *Science*, *291*, 438–439.

Laurance, W. L., Albernaz. A. K. M., Fearnside, P. M., Vasconcelos, H., & Ferreira, L. V. (2004). Deforestation in Amazonia. *Science*, *304*, 1109–1111.

Le Billion, P. (2001). The political ecology of war: Natural resources and armed conflicts. *Political Geography, 29*, 561–584.

Le Tourneau, F. & Bursztyn, M. (2010). Assentamentos Rurais na Amazonia: Contradicoes entre Politica Agraria e a Politica Ambiental. *Ambiente e Sociedade, XIII* (1), 111–130.

Lentini, M., Pereira, D., Celentano, D., & Pereira, R. (2005). *Fatos Florestais da Amazônia 2005*. Imazon: Belém, 141 pp. Retrieved on 2 October from http://www.imazon.org.br

Lima, M. (2010). *As nossas propostas para o campo brasileiro*. Jornal Sem terra. n. 306. Retrieved on 2 December 2010 from http://www.mst.org.br/jornal/306/entrevista

Ludewigs, T., Oliveira D'antona, A., Brondízio, E., & Hetrick, S. (2009). Agrarian structure and land-cover change along the lifespan of three colonization areas in the Brazilian Amazon. *World Development*, *37* (8), 1348–1359.

Luxemburgo, R. (1985). *A Acumulação do Capital*. São Paulo: Nova Cultural, 320 pp.

MAB (2008). *Informes Movimento dos Atingidos por Barragens*. Retrieved on 15 February 2008 from http://www.amazonia.org.br

Machado, E. (2011). *INCRA fixa regras de crédito instalação para beneficiários da reforma agrária*. Agência Brasil; Empresa Brasil de Comunicação.

Machugata, M. & Brown, K. (2002). Cows, colonists and trees: Rethinking cattle and environmental degradation in Brazilian Amazon. *Agricultural Systems*, *76*, 797–816.

Mahar, D. J. (1979). Frontier development policy in Brazil: A study of Amazonia. New York: Praeger Publishers.

Mahar, D. (1989). *Government policies and deforestation in Brazil's Amazon region*. Washington, DC: The World Bank.

MAPA (2012). *Sanidade Animal*. Retrieved on 11 February 2012 from http://www.agricultura.gov.br

Margulis, S. (2004). *Causes of deforestation of the Brazilian Amazon*. World Bank Working Papers, Washington, DC, USA.

Mattei, L. (2005). *Impactos do PRONAF: Análise de Indicadores*. Brasilia: Ministério do Desenvolvimento Agrário (MDA) / Núcleo de Estudos Agráriose Desenvolvimento Rural (NEAD), 136 pp.

May, P.H., Millikan, B., & Gebara, M.F. (2011). *The context of REDD+ in Brazil: Drivers, agents and institutions*. Occasional paper 55 (2nd ed.). Bogor, Indonesia: CIFOR.

Mazzini, E. J. T. (2007). *Assentamentos Rurais no Pontal do Paranapanema - SP: Uma Política de Desenvolvimento Regional ou de Compensação Social?* (Master Thesis). Presidente Prudente, Brazil: UNESP.

McCracken, S. D., Brondizio, D. E., Nelson, E. F., Moran, A., Siqueira, A. D, & Rodriguez-Pedraza, C. (1999). Remote sensing and GIS at farm property level: Demography and deforestation in the Brazilian Amazon. *Photogrammetric Engineering & Remote Sensing, 65* (11), 1311–1320.

MDA/INCRA (Ministério de Desenvolvimento Agrário). (2005). Norma De Execução Nº 45, De 25 De Agosto De 2005. DOU 166, de 29/8/2005, seção 1, p. 122 – B.S. 35, de 29/8/2005

MDIC (Ministério de Desenvolvimento da Indústria e Comércio). (2005). *Sistema Aliceweb*. Retrieved on 11January 2011 from http://aliceweb.desenvolvimento.gov.br/.

MDIC (2011). *Secretaria de comércio exterior. Sistema Aliceweb*. Retrieved on 2 October 2011 from http://aliceweb.desenvolvimento.gov.br/

MDS (Ministry of Social Development) (2010). *Programa Bolsa Família: Agenda da Familia*. Brasilia: MDS, 42 pp.

MDS (Ministry of Social Development) (2012). *Bolsa Familia: Valor dos Beneficios*. Brasilia: Ministerio do Desenvenvolvimento Social e Combate a Fome.

Mendras, H. (1978). *Sociedades Camponesas*. Rio de Janeiro: ZAHAR Editores.

Mertens, B., Poccard-Chapuis, R., Piketty, M. G., Lacques, A. E., & Venturieri, A. (2002). Crossing spatial analyses and livestock economics to understand deforestation processes in the Brazilian Amazon: The case of São Félix do Xingu in South Pará. *Agricultural Economics, 27*, 269–294.

Millikan, B. H. (1992). Tropical deforestation, and society: Lessons from Rondônia, Brazil. *Latin American Perspectives. The Ecological Crisis of Latin America*, 11 (1), 45–77. Retrieved on 10 February 2008 from http://www.jstor.org

Mindlin, B. O. (1991). Programa POLONOROESTE. In J. Hébette (Ed.), *O cerco está se fechando* (pp. 258–277). Rio de Janeiro: Vozes.

Ministry of Mines and Energy (MME) (2010). *Light for all: A historic landmark, 10 million Brazilians out of the darkness*. Brasilia: Governo do Brasil, 140 pp. Retrieved on 11 February 2012 from http://luzparatodos.mme.gov.br/luzparatodos/Asp/o_programa.asp

Ministry of the Environment / World Bank (2000). *Pilot program annual report 1999-2000*. Brasilia: MMA/SCA.

Miranda, S. H. G. De (2001). *Quantificacao dos Efeitos das Barreiras Nao-tarifarias Sobre as exportacoes Brasileiras de Carne Bovina* (Doctoral dissertation). USP/Esalq, Piracicaba, Brasil, 254 pp.

Moran, E. F. (1974). The adaptive system of the Amazonian caboclo. In C. Wagle (Ed.), *Man in the Amazon* (pp. 136–159). Gainesville, FL: University of Florida Press.

Moran, E. F. (1976). *Agricultural development along the Transamazon Highway*. Center for Latin American Studies Monograph Series. Bloomington, IN: Indiana University.

Moran, E.F. (1981). *Developing the Amazon*. Bloomington, IN: Indiana University Press.

Moran, E. F. (1983). Government-directed settlement in the 1970s: An assessment of Transamazon Highway colonization. In: E. F. Moran (Ed.), *The dilemma of Amazonian development*. Boulder, CO: Westview Press.

Moran, E. F. (1984). Colonization in the Transamazon and Rondônia. In: Schimink, M. and Wood, C. (Eds.), *Frontier expansion in Amazonia* (2nd printing, 1991). Gainesville, FL: University of Florida Press.

Moran, E. F. (1990). Private and public colonisation schemes in Amazonia. In: D. Goodman & A. Hall (Eds.), *The future of Amazonia: Destruction or sustainable development?* New York: St. Martin's Press.

Morris, S. S., Carlleto, C., & Hoddinott, L. J. M. (2000). Validity of rapid estimates of household wealth and income for health surveys in rural Africa. *Journal of Epidemiology and Community Health*, 54, 381–387.

MPF (2012). *Carne legal*. Available at http://www.carnelegal.mpf.gov.br/carne/origem-da-carne

Nepstad, D., Capobianco, J. P., Barros, A. C., Carvalho, G., Moutinho, P., Lopes, U., Lefebvre, P. (2000). *Avança Brasil: Os Custos Ambientais para a Amazônia*. Belém: Gráfica e Editora Alves.

Nepstad, D., Stickler, C., & Almeida, O. (2005). Globalization of the Amazon soy and beef industries: Opportunities for conservation. *Conservation Biology*, 20 (6), 1595-1603.

Neumann, R. P. (2001). Disciplining peasants in Tanzania: From state violence to self-surveillance in wildlife conservation. In: N. L. Peluso & M. Watts (Eds.), *Violent environments* (pp. 305–327). Ithaca, NY: Cornell University Press.

Neumann, R. P. (2005). *Making political ecology*. New York: Oxford University Press, 213 pp.

Ney, M. G. & Hoffman, R. (2009). *A distribuição da posse da terra e a recente queda da desigualdade de renda no Brasil*. Presented at forty-seventh SOBER annual meeting, Porto Alegre, Brazil.

O'Brien, R. M. 2007. A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Quality and Quantity,* 41(5), 673 – 690.

Oliveira, A. U. (1988). *Integrar Para Nao Entregar: Politicas Publicas e Amazônia*. Campinas, SP – Papirus.

Paiva, A. (2007). *Rights in the forest: Environmental justice in the Amazon campaign*. Rio de Janeiro: PAD, 36 pp.

Peet, R. & Watts, M. J. (Eds.) (2004). *Liberation ecologies: environment, development, social movements*. London: Routledge.

Peluso, N. L. & Watts, M.(Eds.) (2001). *Violent environments*. Ithaca, NY: Cornell University Press.

Pereira, R. & Barreto, P. (2008). A pecuária na Amazônia legal: Expansão da produção e mercados. In: N. Bensunsan & G. Armstrong (Organizers), *O manejo da paisagem e a paisagem do manejo*. Brasilia: Instituto Internacional de Educação do Brasil.

Perz, S. G. (2001). Household demographic factors as life cycle determinants of land use in the Amazon. *Population Research and Policy Review*, *20*, 159–186.

Perz, S. G. (2003). Social determinants and land use correlates of agricultural technology adoption in a forest frontier: A case study in the Brazilian Amazon. *Human Ecology, 31* (01), 133–165.

Perz, S. G. & Walker, R. (2002). Household life cycles and secondary forest cover among small farm colonists in the Amazon. *World Development, 30* (6), 1009–1027.

Pichón, F. J. (1997). Colonist land allocation decisions, land uses and deforestation in the Ecuadorian Amazon frontier. *Economic Development Cultural and Change, 35* (3), 707–744.

Plano Brasil (2011). *Plano Brasil de Todos*. Participacao e Inclusao 2004-2007. Available at http://www.planobrasil.gov.br

Plano de Desenvolvimento do Assentamento (PDA) Canudos (2004). *Projeto de Assentamento Canudos*. Marabá: COOMARSP, 67 pp.

PNEFA (2008). *Relatório Anual: Ano Base 2007*. Brasilia: Departamento de saude Animal, 38 pp.

Poccard-Chapuis, R., Tourrand, J.F., Piketty, M.G., & da Veiga, J. (2001). *Cadeia produtiva de gado de corte e pecuarização da agricultura familiar na Transamazônica*. Belm: EMBRAPA.

Poloni, G. (2010). Vale prepara maior expansão da história em Carajás. *Caderno Economia*. Retrieved on 11 June 2012 from http://economia.ig.com.br/empresas/industria/vale+prepara+maior+expansao+da+historia+em+carajas/n1237726862142.html.

Previdência (2012). *Aposentadoria por Idade*. Retrieved on 12 March 2012 from http://www.previdencia.gov.br

Prioste, F. G. V., Avanci, J., Pacher, L., & Vieira, J. (2009). *Mudanças na legislação ambiental e os reflexos na agricultura familiarcamponesa e povos e comunidades tradicionais:subsídios técnicos e políticos para o debate*. Curitiba: Terra de Direitos, 24 pp.

Purdy, L. H., Schmidt, R.A. (1996). Status of cacao witches´ broom: biology, epidemiology and management. *Annual Review Phytopathology, 34*, 573–594.

Rabello, A. C., Ferreira, L. F. (n.d.). *(Re) Colonizando o Sudoeste da Amazônia - Corumbiara/Ro (1975-2005)*. Rondonia, Brazil: UNIR.

Reforma Agrária (1997). *Compromisso de Todos*. Brasília: Presidencia da república, Governo Fernando Henrique Cardoso.

Richards, P. (2001). Are "forest" wars in Africa resource conflicts? The case of Sierra Leone. In N. L. Peluso & M. Watts (Eds.), *Violent environments* (pp. 65–82). Ithaca, NY: Cornell University Press.

Robbins, P. (2004). *Political ecology: A critical introduction*. City, ST: Blackwell Publishing.

Roy, R. N., Finck, A., Blair, G. J. & Tandom, H. L. S. (2006). *Plant nutrition for food security: A guide for integrated nutrient management*. Fertilizer and Plant Bulletin No. 16. Rome: FAO, 366 pp.

Salisbury, D. & Schmink, M. (2007). Cows versus rubber: Changing livelihoods among Amazonian extractivists. *Geoforum*, *38*, 1233–1249.

Santana, A. C., Dávila, J. L., Alencar, M. I. R., Mattar, P. N., Souza, R. F., & Costa, R. M. Q. (1997). *Reestruturacao Produtiva e Desenvolvimento da Amazonia: Condicionantes e Perspectivas*. Belém: BASA.

Santos, M. A. S., Cunha, S. J. T., & Santos, J. S. B. (2007). *Mercado e Dinâmica Local da Cadeia Produtiva da Pecuária de Corte na Região Norte*. Estudos Setoriais 1. Belém: Banco da Amazônia, 48 pp.

Santos, R. A . de O. (1980). História econômica da Amazônia (1800 –1920). São Paulo: T. A. Queiroz, 358 pp.

Schaetzl, R. & Anderson, S. (2007). *Soils: Genesis and geomorphology*. New York: Cambridge University Press, 817 pp.

Schmink, M. & Wood, C. H. (1992). *Contested frontiers in Amazonia*. New York: Columbia University Press.

Serra, M. A. & Fernadez, R. G. (2004). Perspectivas de Desenvolvimento da Amazônia: motivos para o otimismo e para o pessimismo. In: *Economia e Sociedade*. Campinas-SP. V.13. n. 2 (23), p. 107-131. Jul. - Dec. Retrieved on 15 April 2008 from http://www.eco.unicamp.br/ publicacoes/economia_sociedade/download/revista_23/Serra_Fernandez.pdf.

Serrão, E. A. S. (1986). Pastagem em área de floresta no trópico úmido brasileiro: conhecimentos atuais. In: *Simpósio de trópico úmido* (Vol. 5, pp. 47-174). Belém: EMBRAPA.

Silva, T. G. R. D., Miranda, S. H. G. D. (2006). *A febre aftosa e os impactos no setor de carnes*. São Paulo, Brazil: Centro de Estudos Avançados em Economia Aplicada (CEPEA), 15 pp.

Simmons, C. S. (2002). The local articulation of policy conflict: Land use, environment and Amerindian rights in eastern Amazonia. *The Professional Geographer*, *54* (2), 241–258.

Simmons, C. S. (2004). The political economy of land conflict in the eastern Brazilian Amazon. *Annals of the Association of American Geographers, 94* (1), 183–206.

Simmons, C. S. (2005). Territorializing land conflict: Space, place, and contentious politics in the Brazilian Amazon. *GeoJournal*, *64,* 307–317.

Simmons, C., Walker, A. E., Aldrich, S., & Caldas, M. (2007). The Amazon land war in the south of Pará. *Annals of American Geographers, 97* (3), 567–592.

Simmons, C., Walker, R., Perz, S., Aldrich, S., Caldas, M., Pereira, R., Leite, F., Fernandes, L. C., & Arima, E. (2010). Doing it for themselves: Direct Action Land Reform in the Brazilian Amazon. *World Development*, 38 (3): 429–44.

Simon, M. F. & Garagorry, F. L., (2005). The expansion of agriculture in the Brazilian Amazon. *Environmental Conservation, 32* (3), 203–212.

SNUC (2000). *Sistema Nacional de Unidades de Conservação*, Law # 9.985, of July 18th, 2000. Retrieved on 11 May 2012 from http://sosfauna.org/pdfs/SNUC.pdf

SUDAM (1976). *II Plano Nacional de Desenvolvimento da Amazônia: detalhamento do II plano Nacional de desenvolvimento (1975-1979)*. Belém: SUDAM.

Summers, P. M., Browder, J. O., Pedlowski, M. A. (2004). Tropical forest management and silvicultural practices by small farmers in the Brazilian Amazon: recent farm-level evidence from Rondonia. *Forest Ecology and Management*, *192*, 161–177.

Taylor, D. E. (2000). The rise of the environmental justice paradigm: Injustice framing and the social construction of environmental discourses. *American Behavioral Scientist*, *43* (4), 508–580

Teixeira, J. F. (1953). O arquipélago do Marajó. *10th Congresso Brasileiro de Geografia*. Rio de Janeiro: Conselho Nacional de Geografia.

Théry, H. (2005). Situações da Amazônia no Brasil e no Continente. *Estudos Avançados*, *19* (53), 37–49.

Trecanni, G. D. (2001). *Violência e Grilagem: Instrumentos de Aquisição da Propriedade da Terra no Pará.* Belém: UFPA/ ITERPA.

UFLA (2010). *Solos do Cerrado*. Retrieved 29 February 2012 from http://www.dcs.ufla.br/Cerrados/Portugues/CCambissolo.htm

UN-REDD (2011). Retrieved on 18 August 2011 from http://www.un-redd.org/AboutUNREDDProgramme/tabid/583/language/en-US/Default.aspx.

UN-REDD (2011). *The UN-REDD Programme Strategy: 2011-2015*. Retrieved on 11 January 2012 from http://www.un-redd.org/AboutUNREDDProgramme/tabid/583/Default.aspx

UNFCCC (2008). *National Greenhouse Gas Inventory Data for the Period 1990–2006*. New York: UN Framework Convention on Climate Change.

VanWey, L. K., D'Antona, A. O. Brondízio, E. S. (2007). Household demographic change and land use/land cover in the Brazilian Amazon. *Population and Environment*, *28* (3), 163–185.

Vasconcelos, M. N. L., Silva, M. L. da, Maia, J. G. S., & Gottlieb, O. R. (1975). Estudo quimico de sementes de cupuacu. *Acta Amazônica, 5*, 293–295. Retrieved on 9 March 2012 from http://acta.inpa.gov.br/fasciculos/5-3/PDF/v5n3a12.pdf

Vayda, A. P. & Walters, B. B. (1999). Against political ecology. *Human Ecology*, *27* (1), 167-179.

Veiga, J. B. da, Tourrand, J. F., Piketty, M. G., Poccard-Chapuis, R., Alves, A. M., & Thales, M. C., 2004. *Expansão e trajetórias da pecuária na Amazônia*. Brasília: UnB.

Velho, O. G. (1981). *Frente de Expansão e Estrutura Agrária: estudo do processo de penetração numa área da Transamazônica*. Rio de Janeiro: Zahar.

Veríssimo, A., Barreto, P., Tarifa, R., & Uhl, C. (1995). Extraction of a high-value natural resource in Amazonia: the case of Mahogany. *Forest Ecology and Management, 72*, 39–60.

Veríssimo, A., Rolla A., Vedoveto M., & Futada, S. de M. (2011). *Áreas protegidas na Amazonia brasileira: Avanços e desafios*. São Paulo: Instituto de Pesquisa Ambiental da Amazônia and Instituto Socioambiental.

Viana, V. M., Ribenboim, G., Megid, T. & Salviati, V. (2010). *REDD Working Papers: REDD and sustainable development – perspective from Brazil.* IIED, London.

Vosti, S. A., Braz, E. M., Carpentier, C. L., D'Oliveira, M. V. N., & Witcover, J. (2003). Small-scale managed forestry at the Brazilian agricultural frontier: Adoption, effects and policy issues. *International Conference on Rural Livelihoods, Forests and Biodiversity,* 19-23 May 19-23, 2003. Bonn: Germany.

Walker, G. (2009). Contextualization and evolution globalizing environmental justice: The geography and politics of frame. *Global Social Policy, 9*, 355–374.

Walker, P. A. (2003). Reconsidering 'regional' political ecologies: toward a political ecology of the rural American West. *Progress in Human Geography, 27* (1), 7–24.

Walker, R. (2003). Mapping process to pattern in the landscape change of the Amazonian frontier. *Annals of the Association of American Geographers, 93* (2), 376–398.

Walker, R., Browder, J., Arima, E., Simmons, C., Pereira, R., Caldas, M., Shirota, R., & De Zen, S. (2009). Ranching and the new global range: Amazônia in the 21st century. *Geoforum*, *40* (5), 732–745.

Walker, R. T. & Homma, A. K. O. (1996). Land uses and land cover dynamics in the Brazilian Amazon: An overview. *Ecological Economics*, *18* (1), 67–80.

Walker, R., Homma, A., Scatena, F., Conto, A., Rodriquez, C., Ferreira, C., Mourão, P., & Carvalho, R. (1998). *Amazonia: The environment and agricultural development*. A. Homma (Ed.). Brasilia: EMBRAPA.

Walker, R., Moran, E., & Anselin, L. (2000). Deforestation and cattle ranching in the Brazilian Amazon: External capital and household processes. *World Development, 28* (4), 683–699.

Walker, R. T., Perz, S., Caldas, M. M., & Teixeira da Silva, L. G. (2002). Land uses and land cover change in forest frontier: The rolls of household life cycle. *International Journal Regional of Science, 25* (2), 169–199.

Watts, M. (1987). Drought, environment and food security: Some reflections on peasants, pastoralists and commoditization in dryland West Africa. In M. Glantz (Ed.), *Drought and hunger in Africa* (pp. 171–211). Cambridge, UK: Cambridge University Press.

Wolford, W. (2008). Environmental Justice and agricultural development in the Brazilian cerrado. In: Carruthers, D. V. (Ed). *Environmental Justice in Latin America.* Massachusetts, USA/ London, England: The MIT Press.

Wood, C., Walker, R., & Toni, F. (2003). Os efeitos da posse da terra sobre o uso do solo e investimentos entre pequenos agricultoresna Amazônia Brasileira. In: J.F. Tourrand & J. B. Veiga (Eds.), *Viabilidade de sistemas agropecuários na agricultura familiar* (pp. 427-436). Belém: EMBRAPA-Amazonia Oriental,

Wood, C. H. & Wilson, J. (1994). The magnitude of migration to the Amazon Frontier. In: Schimink, M. & Wood, C. (Eds), *Frontier expansion in Amazonia* (2nd printing, 1991). Gainesville, FL: University of Florida Press.

World Bank (2009). *Pilot program to conserve the Brazilian rain forest (PPG7).* Retrieved on 5 December 2011 from http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/LACEXT/BRAZILEXTN/0,,contentMDK:20757004~pagePK:141137~piPK:141127~theSitePK:322341,00.html..

Wright, A. & Wolford, W. (2003). *To inherit the earth: The landless movement and the struggle for a new Brazil*. Oakland, CA: Food First Books.

WWF (World Wildlife Fund) (2008). *Brazilian Amazon protected areas could cut 1.1 billion tons of carbon emissions*. May 29 (accessed March 13, 2009, Retrieved on December 5, 2011 from http://www.wwf.org.uk

Zimmerer, K. & Bassett, T. (Eds.), (2003). Political ecology: An integrative approach to geography development studies. New York: Guilford Press.

Zimmerer, K. S. 2010. Retrospective on Nature-Society Geography: tracing Trajectories (1911-2010) and reflecting on translations. *Annals of the Association of American Geographers.* v.100, n.5, December 2010.