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THE NEGOTIATION BETWEEN CONSERVATION AND DEVELOPMENT OBJECTIVES IN AGRARIAN REFORM SETTLEMENTS IN THE SOUTH OF PARÁ, BRAZIL

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THE NEGOTIATION BETWEEN CONSERVATION AND DEVELOPMENT OBJECTIVES IN AGRARIAN REFORM SETTLEMENTS IN THE SOUTH OF PARÁ, BRAZIL

By

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ABSTRACT

THE NEGOTIATION BETWEEN CONSERVATION AND DEVELOPMENT OBJECTIVES IN AGRARIAN REFORM SETTLEMENTS IN THE SOUTH OF PARÁ, BRAZIL

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Agrarian reform settlements have been declared a top contributor to deforestation in the Brazilian Amazon by the government, despite the incorporation of environmental goals into the development objectives of agencies and organizations instrumental in establishing them. As local level actors are often viewed as the primary agents of land cover change, this thesis addresses how settlers in rural agrarian reform settlements in the Brazilian Amazon negotiated between conservation and development objectives. I investigate this using political ecology framework, examining influential connections to determine how development and conservation objectives have been defined across scales and then carried out in a case study of one agrarian reform settlement located in the Brazilian Amazon.

To accomplish this, I employed a fusionist methodology utilizing and linking both qualitative and quantitative methods. For my qualitative analyses, I utilized key informant interviews and representative documents to derive definitions of conservation and development at national, regional, and local scales. From insights provided by the key informants, I then defined an empirical model examining factors contributing to development success. Finally, I used remotely sensed imagery for a land cover change analysis to quantitatively gauge success of conservation at the local scale.

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APROCTRAM

- *Associação de Produção e Comercialização dos Trabalhadores Rurais do Assentamento Primeiro de Março*
  (Production and Commercialization Association of Primeiro de Março's Rural Workers)

APROVIR

- *Associação dos Produtores Rurais do Grupo Virgulino*
  (Association of the Rural Producers of the Virgulino Group)

ASPRAM

- *Associação dos Produtores Rurais do Assentamento Primeiro de Março*
  (Rural Producers Association of Primeiro de Março)

CPT

- *Commissão Pastoral da Terra*
  (Pastoral Land Commission)

COOPERPRAM

- Cooperativa de Produtores Rurais do Assentamento Primeiro de Março
  (Rural Producers Cooperative of the Settlement Primeiro de Março)

COOMARSP

- Cooperativa Mista dos Assentamentos de Reforma Agrária do Sul e Sudeste do Pará
  (Mixed Cooperative of the Agrarian Reform Settlements in the South and Southeast of Para)

DALR

- Direct Action Land Reform

IBAMA

- *Instituto Brasileiro do Meio Ambiente e Recursos Naturais e Renóvais*
  (Brazilian Institute for the Environment and Natural and Renewable Resources)

INCRA

- Instituto Nacional de Colonização e Reforma Agraria
  (National Institute for Colonization and Agrarian Reform)

MST

- *Movimento dos Trabalhadores Rurais Sem Terra*
  (Landless Worker's Movement)

PDA

- *Plano de Desenvolvimento do Assentamento*
  (Settlement Development Plan)

PDM

- *Primeiro de Março*

PDN

- Programa de Desenvolvimento Nacional
  (National Development Program)

PGC

- *Programa Grande Carajás*
  (Grand Carajás Program)

PIN

- *Programa de Integração Nacional*
  (National Integration Program)

POLOAMAZONIA

- *Programa de polos agropecuarios e agrominerais da Amazonia*
  (Program of Amazonian Agriculture and Mining Poles)

SPVEA

- *Superintendência da Valorização Economica da Amazônia*
  (Superintendency for the Economic Valorization of the Amazon)

SUDAM

- *Superintendência de Desenvolvimento da Amazônia*
  (Superintendency for Amazonian Development)

CHAPTER I

INTRODUCTION

1.1 Problem Statement

Early ideas of conservation and development have frequently depicted them as inherently incompatible, with the encouragement of one causing the other to suffer. Arguably, this conception has led to the creation of many areas cordoned off for environmental protection throughout the world. In the past few decades, however, ideas about balancing development and conservation objectives together in sustainable development programs have also emerged alongside the older ideas of conservation, particularly in developing countries pursuing rapid industrialization. Yet, sustainable development in itself is a controversial topic, criticized for being ambiguously defined and inadequately addressing the causes of environmental degradation and poverty (Lele 1991; Simon 1989; Mebratu 1998). Many of the attempts to enact sustainable development have resulted in failure to meet either development or conservation goals, reinforcing the notion of incompatibility between them.

As the country with the largest area of tropical rainforest on earth, Brazil has been a frequent participant in this debate, particularly recognized for having hosted the influential 1992 UN conference on environment and development in Rio de Janeiro (Bryant 1998). Since the middle of the 20th century, the national goals for Amazonian development have involved geopolitical, economic and social motivations. These included securing national borders, extending national economic growth through exploitation of resource wealth, and appeasing the growing unrest of impoverished and

landless populations (Schmink and Wood 1992; Moran 1989; Mahar 1979; Ianni 1979; Hecht 1982; Browder 1988).

Government colonization programs that grew out of the concern for landlessness are of particular interest to this thesis. Although agrarian reform laws were in place to expropriate and redistribute unproductive agricultural lands throughout Brazil, colonization programs in Amazonia were pursued mostly through State Led Agrarian Reform (SLAR), to distribute public lands, similar to most nations in Latin America. Brazil provided "land without men for men without land," a famous quote by then-president Emilio Medici.

In the midst of the development era, emerging ideas from international politics propagated by the United Nations and other entities about environmental values and resource conservation began to influence the national development agenda for the Amazon region (see discussion in Simmons 2002). International concern about biodiversity and climate change caused by deforestation in the Amazon rainforest prompted an emphasis in Brazilian conservation policy on protecting and preserving forests. Thus far, about 1,896,628 km^2 of land had been set aside by Brazil in conservation areas by 2006, or roughly 37% of the total area of the Brazilian Amazon (Azevedo-Ramos et al. 2006). With the full implementation of Amazon Region Protected Areas Project (ARPA), the same study asserts that this proportion will increase to about 46%.

As large tracts of land were provisioned for agro-industrial adventures designed to increase economic growth, massive road building projects also opened the region that triggered waves of in-migration. In fact, population grew from about 7.5 million people

in 1970 to over 20 million by 2000 (Laurance, Albernaz, and Costa 2002). Additionally, Brazil can tout the success of development objectives to expand agro-industrial development into Amazonia, particularly with cattle ranching, which has been shown to be economically profitable in the Amazon (Walker et al. 2009). Yet, many have suggested that these national development and conservation objectives in the Amazon were contradictory and in fact led to land scarcity and resource conflict.

SLAR has been slow at addressing landlessness, which is believed to include at approximately 4.8 million families (Langevin and Rosset 2000). Given the slow pace of SLAR, many have taken agrarian reform into their own hands, which has been described by Simmons et. al (2005, 2007). Despite forest conservation goals articulated by both government agencies as well as the social movement organizations active in the formation of the settlements, deforestation persists in the settlements (Arruda 2007). One study estimates that agrarian reform settlements are responsible for roughly 15% of the total deforestation in the Brazilian Amazon, asserting that deforestation rate in the settlements is 1.8% per year, roughly four times the average rate of deforestation in the region (Brandão and Souza 2006). Furthermore, a list released in 2008 by Carlos Minc, Brazil's Minister of the Environment, cited agrarian reform settlements as a top contributor to Amazonian deforestation (DPA 2008).

The widespread shortcomings of forest conservation in agrarian reform settlements support beliefs that conservation and development objectives are inherently contradictory. However, there is little research examining internal factors influencing the perception and pursuit of conservation and development objectives by setters in agrarian reform settlements. Therefore, the purpose of this research is to uncover the dimensions

of development and conservation in an agrarian reform community related to environmental change. Given the new focus of agrarian reform settlements as drivers of deforestation, policy changes are likely to follow, making research investigating the dynamics of conservation and development in those sites especially important.

1.2 Research Question(s)

The primary question that this thesis seeks to answer is: how have settlers in rural agrarian reform settlements in the eastern Brazilian Amazon negotiated between conservation and development objectives? Because this is not a 'yes' or 'no' type of question to be answered, a case study was the most suitable approach to focus the investigation (Yin 1998). The case study takes place in the agrarian reform settlement called Primeiro de Março (PDM), located in the southeast portion of the state of Pará, a region referred frequently as the 'South of Para.' Through the case study, I am able to address my primary question by dividing it into a set of secondary research questions including: (1) How do various influences of actors at multiple scales impact policy in PDM in terms of how conservation and development objectives are defined? (2) What do settlers in PDM consider as their conservation and development objectives? (3) What have been the outcomes of the approaches taken to meeting conservation and development objectives in the settlement? and (4) what have been the primary factors that have contributed to these outcomes?

1.3 Conceptual Approach

I employ a political ecology framework to examine the negotiation between conservation and development in agrarian reform settlements in the south of Pará. Political ecology is a contentious and anamorphous concept, and as such numerous definitions and methodologies have been advanced (Simmons et al. 2007). It has been described by numerous authors, including Blaikie and Brookfield (1987), Bryant (1992, 1998), Peet and Watts (1996, 2004), Robbins (2004) and Zimmerer and Basset (2003), among others. At its core, political ecology illuminates connections present in the human-environment relationship, challenging assumptions about environmental issues and environmental change through consideration of political, economic and social aspects (Robbins 2004). Although most works of political ecology have been applied to Third World situations (Bryant 1992), it has been flexibly adapted to explore numerous themes and is in a constant state of both critique and change (see discussion in Walker 2005).

Despite this flexibility on themes and focus, there are elements frequently present within political ecology studies that I incorporate in my thesis, specifically a focus on spatial and temporal interactions to examine conservation and development objectives at the local scale. Because environmental issues exist within space and time, political ecology research is often placed in context of local histories and specific ecologies. Local interactions of resource users are of particular interest because they are most often cited as the agents of environmental change.

Nevertheless, political ecology explicitly takes into account larger, "non-place-based political and ideational forces" that influence local land use decisions (Blaikie 1994:7). As such, political ecology also incorporates multiple scales of analysis. In these

scalar analyses, discourses about the environment are often a point of interest because they are powerful in informing human perceptions, interpretations, and interactions with the environment (Peet and Watts 1996). The interpretation of the environment, environmental issues and appropriate responses are a social process, of which language is an essential part.

Many environmental discourses are formed on a global scale. These discourses in turn influence national policy, placing conditions on economic lending, as we have explicitly seen in the G7 Pilot Program to Conserve the Brazilian Rainforest which explicitly links development aid to conservation of the natural environment and indigenous lands (Simmons 2002). In addition, this discourse forms dominant claims to expertise and knowledge, influencing international environmental NGOs like Woods Hole, Conservation International, and Green Peace, which often have direct links to regional NGOs such as ISA, IPAM, and Imazon. This expert knowledge directly informs national and regional environmental policy, and even local residents come to understand the link between conservation and development via such experts.

Although this thesis is concerned with the broader realm of environmental change in the Amazon, it focuses on the negotiation between conservation and development objectives in agrarian reform settlements initiated by landless social movement organizations in the south of Pará. Several of which include a very specific environmental discourse in their objectives for development. I utilize the case study of PDM as a local example to examine how global, national, regional perceptions and actions influence the settlers' understandings of conservation and development.

1.4 Outline of the Thesis

The remaining chapters of this thesis are organized as follows: Chapter II includes a review of the literature investigating the environment in the context of economic development. Taking a social constructionist approach, it examines first world constructions of the development and conservation that have been exported to the third world. Consequently, these constructions have elicited counter narratives, spurring the formation of new approaches to conservation from alternative constructions the human-environment relationship.

Chapter III contextualizes the case study site through a history of Brazilian development, particularly focusing on efforts and outcomes in the Brazilian Amazon, starting in the 1950s and working towards the present. Social consequences discussed include land conflict and the formation of agrarian reform organizations in response to it, and environmental consequences include large-scale deforestation and the implementation of conservation laws and the inclusion of environmental discourse into traditionally social justice oriented groups like the MST, an organization critical in forming the case study settlement. The specific case study of PDM is further contextualized in Chapter V with an overview of the site. This chapter includes spatial, demographic, environmental, and historical information about the site.

Chapter IV introduces the methods and data. Here I employ qualitative methods utilizing key informant interviews at national, regional, and local scales to derive definitions of conservation and development. Using insight from the key informants, I define an empirical model examining factors contributing to development success. Finally, I use remotely sensed imagery for a land cover change analysis to quantitatively

gauge success of conservation at the local scale. The results and discussion of these analyses are split into two chapters, with Chapter VI presenting the results and discussion of the qualitative analysis and Chapter VII presenting those of the quantitative analyses.

Finally, Chapter VIII ties together various elements from the previous chapters in a discussion of the intersections of conservation and development in PDM, followed by a discussion of key elements that influence the way settlers choose to negotiate between conservation and development and the conclusions to this work.

Chapter II

A Literature Review: The Environment in the Context of Economic Development

2.1 Introduction

In the First World, ideas about the environment have evolved alongside economic development, which relies on the exploitation and consumption of natural resources. Conflicts over the environment and resources have resulted over these demands, subsequently giving impetus for the formation of various environmental movements. As ideas about economic development from the First World have been exported to the Third World, so have ideas about conservation and environmentalism. Yet, the standard approaches to First World environmentalism in the Third World are wrought with colonialist overtones, making them poorly accepted by local communities (Peluso 1993). Unless paired with the goals of a local movement for environmental justice, First World environmental goals may maintain its coercive aspects (Martinez-Alier 2002).

In this chapter, I review literature addressing the emergence and impact of First World economic development and environmentalism in the Third World. I first discuss the concept of the environment as a social construction to lay the foundation for understanding plural perceptions of the environment and approaches to conservation. Next, I present dominating conceptions of the environment that arose in the First World in the context of capitalism and economic growth, and the emergence of environmentalism as a response to those conceptions. Within the context of development, I then discuss how First World conceptions of the environment and

approaches to environmentalism have been transferred to the Third World. After a discussion of some of the conflicts of First World economic development and environmentalism in the Third World, I introduce responses to those conflicts, including a top-down approach to include social interests in conservation initiatives, and the bottom-up emergence of the environmental justice movements that link the protection of livelihoods to protection of environment. Ultimately, the ideas discussed in this chapter of my study help clarify the origins of and challenges to conservation approaches in the context of development in the Brazilian Amazon.

2.2 The 'Environment' as a Social Construction

Studies in political ecology have largely taken a social constructionist perspective of the environment, in which nature is understood to be just as much a social phenomenon as a physical one (see discussion in Robbins 2004; Bryant 1998). While people can physically experience the environment with their senses, the ideas and meanings about those experiences are enhanced through social exchanges and processes. According to the social constructionist perspective of nature offered by Castree (2001: 17), "there is never any way to access, evaluate and affect nature that does not involve socially specific knowledges and practices." This means that nature is "defined, delimited and even physically reconstituted by different societies, often in order to serve specific, and usually dominant, social interests" (2001: 3). In other words, definitions about the environment should not be taken for granted, because they change with shifts in society. This approach therefore affords a critical vantage point from which to gain understanding

about environmental decisions, and more specifically, about the environment in the context of development.

According to Taylor (2000), different groups of people, usually occupying the same social location linked by commonalities such as race, gender, and class, may adopt their own meanings and construct the environment and environmental issues in specific ways. This results in trends of understanding and collective knowledge about nature known as environmental paradigms (Taylor 2000). Furthering this idea, Cronon (1995) asserts that various constructions of nature are specific to context; they have both temporal and cultural components to them. Meanings can therefore shift through time and differ between social groups. As an example, Cronon (1995) points out the shifting ideas of wilderness and nature from something to be feared in earlier western society to something to be protected. He further asserts that the values embodied in nature are a reflection of society itself as it changes.

Shared meanings in society develop through communication. Therefore, an important part of social construction is discourse, which Escobar (1996: 46) defines as "the articulation of knowledge and power, of statements and visibilities, of the visible and expressible. Discourse is the process through which social reality inevitably comes into being." Similarly, Peet and Watts (1996: 14) use the term to refer to an "area of language expressing a particular standpoint and related to a certain set of institutions." Both the definitions of discourse offered by Escobar (1996) and Peet and Watts (1996) point out that discourse is the articulation of understandings that are formed through social interactions. Because social interactions and the use of language are shaped by dominant power structures, discourse itself is often examined in order to understand the values,

perceptions and power relations that may ultimately direct action. Therefore, discourse can be a useful tool to gain understanding of environmental values and resource use.

Within geography and other social sciences, various authors have brought attention to discourse and the social construction of nature to further understand issues that surround environmental conflict and proposed solutions. For example, Neumann (1997) examines discourse to understand conservation efforts put forth by international non-governmental organizations (NGOs) into rural land use practices in communities bordering protected areas in eastern Africa. The international NGOs created a discourse that designated land use practices in a conservation area as 'good,' generally described as 'traditional,' or as 'bad,' which was described as 'modernized.' Resource-use activities were therefore limited to 'good' or often 'traditional' practices regardless of the actual environmental consequences or the imposition on the communities (Neumann 1997). Sundberg (2003) also examines the discourse of international conservation NGOs on acceptable resource use practices, but additionally examined how communities conformed to that more powerful discourse and reshaped their own discourse on their identities and their communities to benefit from resources provided by the NGOs. Both of these case studies show how discourse is a powerful component in shaping human relationships with the environment.

Despite the benefits of using the social constructionist approach to understanding human relationships with the environment, there are also arguments against using it. Relativism, for example, is a concern discussed by Demeritt (2001) and Castree (2001). With relativism, the physical component of the environment is largely overlooked and its values are simply a judgment of the observer. No individual understanding of the

environment is any truer than another, making it difficult to assign any universal values to the environment at all. Ultimately, the basis for judgment against dominant power structures is removed. Demeritt (2001) argues that these concerns about relativism are generally a misunderstanding of social construction and can be reduced with careful explanation of ideas and intentions. Castree (2001) similarly dismisses the claims, saying that both the social component and the physical component of nature exist. To ignore the physical component of the environment would be to commit a similar error of ignoring the social component.

After reviewing the social constructionist perspective, I believe it retains merit as a useful tool for investigation that is beneficial for examining different viewpoints of the environment that contribute to varying ideas of conservation and resource management. Through the social constructionist lens, I will proceed in my thesis to examine the formation of several powerful ideas about the environment and environmental management, each of which is reflective in the various scales influencing the case study.

2.3 Environmentalism Constructed in the First World

Several authors have argued that the emergence of environmentalism in the First World was a response to the rise of a capitalist paradigm of high consumptive demands driven by economic growth associated with economic development (Harvey 1996; Martinez-Alier 2002; Taylor 2000). Because material resources are constantly required to meet the consumptive demands of economic growth, the environment becomes primarily constructed as an external object that functions as a producer of commodities.

With this construction, it is then possible to divide ecosystems to create claims on the various resources which are necessary to fuel economic expansion. However, conflict frequently emerges between various interests over competing claims to resources or consequent degradation of ecosystem services. As a response to the capitalist paradigm and the conflicts generated by this construction of the environment, several environmental movements have subsequently formed, including the two most powerful in the First World: wilderness preservation and resource conservation.

Deluca (2007) considers 'wilderness preservation' as the "core of the environmental movement," identifying it as one dominant type of response to the capitalist paradigm. According to Deluca (2007), this understanding of nature depicts people as being separate and fundamentally antagonistic to the natural world. Nature itself is seen as fragile, pure, and untarnished by the human hand. It has value in both an aesthetic as well as an inherently moral sense, sometimes also portrayed as having sacred characteristics. Therefore, nature needs to be protected and preserved from the destructiveness of people.

In writing an environmental history of the US, Steinberg (2002) presents the wilderness preservationist movement as evolving about the same time as the resource conservationist movement. He describes the resource conservationist movement as another reaction to capitalist resource exploitation, where natural resources were appropriated by the government to ensure that they were used in the best, most efficient ways possible (Steinberg 2002). Although these two movements can sometimes be considered antagonistic to each other in that the resource conservationist movement may concede land or resources for economic gains that the wilderness preservationist

movement would not, Brulle (1996) asserts that the ideologies of the movements overlap in many ways and frequently collaborate in terms of action. Both of these viewpoints tend to favor the protection of 'untouched' nature, usually resulting in the creation of protected areas, or limited-use conservation areas.

Because of their similarities, Martinez-Alier (2002) includes the preservationist and conservationist movements into one paradigm that she calls the 'cult of wilderness.' This paradigm is not against economic growth, but instead accommodates it. The 'cult of wilderness' conceptualizes environmental destruction as necessary for the advancement of industry and society. Therefore, it focuses its efforts to selectively preserve remaining wild natural areas that are minimally influenced by people. Martinez-Alier (2002: 4) further describes this perspective as seeing the environment as a "Sunday luxury and not an everyday necessity." Taylor (2000) also includes the two movements into one paradigm, which she calls the 'romantic environmental paradigm' and characterizes it by efforts to preserve and protect large tracts of land. However, unlike Martinez-Alier, Taylor suggests that this paradigm was the result of efforts to create an alternative to, rather than accommodate, the 'Exploitive Capitalist Paradigm' of rapid consumption and industrial expansion.

As pushes for economic development have spread throughout the world, the capitalist construction of nature and its conflicts have followed. As a result, many developing countries of the Third World have looked towards First World environmentalism for guidance and have followed trends seeking the creation of protected areas.

2.3.1 First World Environmental Constructions in the Third World

In the Third World, the capitalist paradigm of economic development that prompted the social construction of the environment as resources has led to a global process of what has been called 'environmental colonialism.' Colonization can be considered as the "appropriation of a people, nation, or region by another for the purposes of economic exploitation. It imposes an external culture, social structure, laws and institutions, technology, systems of production and even social relations on the colonized society" (Byrne, Glover, and Martinez 2002: 11). Agrawal (1991) and Narain (1996), among others, have argued that patterns of industrialization and consumption of material resources have extended from the First World to the Third World in a way that reflects power structures similar to colonial institutions. However, global economic development targets cultures and livelihoods through an appropriation of the environmental conditions upon which communities depend in addition to labor and resources for colonization.

Bryne, Glover and Martinez (2002) have asserted that the process of colonization brought new species, land uses and land management. Deliberate changes in the ecology included cutting forests to create pastures and plantations, constructing dams and planting new crops in accordance to the colonizer's preferences. Development activities in Third World nations often focus on changing local livelihood ecologies to more extractive activities and may also push towards property systems that privatize water, land and other resources. As a result, commons areas have been greatly reduced, and in some cases, have greatly compromised the capacities of self-determination and independence of indigenous peoples. In this regard, society and ecology have been and continue to be

fundamentally altered in the drive to industrialize social relations (Byrne, Glover, and Martinez 2002: 12).

First World patterns of environmental protection have accompanied the patterns of consumption and industrialization into the Third World. The establishment of protected areas particularly resembles the appropriation and exploitation of local peoples that accompanied colonialism. These patterns can be seen within the US itself, as one of its first efforts for environmental protection resulted in the creation of Yellowstone National Park. The result of the delineation and appropriation of the land resulted in the forced expulsion of the Miwok Indians from the park (Hecht and Cockburn 1989). Often looked upon as a model for parks around the world, many other countries have followed suit in excluding local people.

Another example, written by Nancy Peluso (1993), calls attention to the similarities and links between conservation efforts and colonialist objectives. Using the case studies of Kenya and its wildlife conservation areas and Indonesia with forest management, she highlights the potential use of coercive measures, including violence, to enforce conservation regulations. Although the measures may be promoted as conservation, Peluso asserts that they are simply an excuse for nation-states to control natural resources. Ultimately, it appears that financial incentives are the driving force behind such policies, as state governments often stand to generate income from conservation or extractive reserves (Peluso 1993).

In addition to the issues that surround conservation and resource access, there are other ways in which a First World environmental ethic may promote discrimination and injustice against already marginalized people. Peter Wenz (2007), for instance, discusses

several different examples in which environmentalist efforts have a much larger cost to poor people than they do to the more affluent. In the case of Global Warming, it has been suggested that gasoline taxes should be raised. However, without an efficient public transportation infrastructure, the higher burden would be placed upon the poor who have no other choice but to rely on motor vehicles for transportation. On a global scale, there have also been suggestions that developing countries be limited to burning of fossil fuels. However, that would also have repercussions against the poorest countries of the world which would be denied the same means of development that the richer countries successfully employed for economic development.

Additionally, there have been other environmentalist suggestions that could be interpreted to harm the poor. Wenz (2007) goes on to discuss a proposition that poorer countries with growing populations be denied food aid to control overpopulation. Also, he discusses the environmentalist opposition to agribusiness, which some claim may keep food prices higher and limit the access of poorer people to a nutritious and affordable diet (Wenz 2007). In further discussion, Wenz examines those issues in greater detail and makes the argument that environmental goals are not necessarily 'bad' for the poor, but that simply the wrong approaches to environmental problems have been used.

2.4 New Approaches to Environmentalism in the Third World

In recognition of the potential of conservation projects to further marginalize already burdened people, and as a response to the accusations of environmental colonialism in the Third World, proponents of First World environmentalism have made an effort to incorporate local people into conservation and environmental management

goals. In *Green Development,* Adams (2001) writes about systems of community run conservation where local people are involved in the management of protective reserves. Furthermore, Adams' chapter also discusses the importance in combining conservation with development into Integrated Conservation and Development Projects (ICDPs) (Adams 2001).

This approach to the environment has been called 'new conservation.' Brown describes it as "a shift away from a state-centric to a community level focus; a reconceptualization of conservation based on ideas of sustainable development, utilization and ecological dynamics, and incorporation of neo-liberalism ideas and market forces to 'make conservation pay'" (Brown 2002: 89). In other words, community interests must be taken into account within conservation programs, and financial incentives for environmental protections must be incorporated into projects.

Despite some attempts to be community friendly, many efforts to include local people in conservation projects have perpetuated coercive elements. Projects such as these are still largely top-down and have been accused of just creating the façade of community management but in reality perpetuating systems of ecological colonialism. Conservation efforts still impose a particular set beliefs regarding the environment and resource use, largely ignoring local conceptions of the environment (Neumann 1997). ICDPs have received additional criticism in that successful projects have a danger of creating a 'development pole' that draws people into the community and eventually creates a greater demand on local resources than there was before the project (Brechin 2003).

However, ideas of conservation have also been generated and used as a tool of power by traditionally marginalized people in environmental justice movements, also called 'environmentalism of the poor' by Martinez-Alier (2002). In the Third World, this is frequently manifested by the appropriation of ideas of conservation into social justice agendas. Generally, ideas about conservation are linked to the protection of traditional livelihoods and resistance to other resource domination, such as competing ideas about development (Harvey 1996; Martinez-Alier 2002; Taylor 2000) .

Edwards (1995), and Harvey (1996) differentiate environmental justice from other environmental approaches in that it puts questions of ecological distribution conflicts at the forefront of its ideology. Particularly in the Third World, environmental justice may focus on the protection of the quality and access to resources to ensure livelihood security. Consumption of natural resources continuously drives industry into new frontiers for materials, which may create competition and conflict over rights to the resources (Martinez-Alier 2002). Because resources are generally extracted, processed and consumed in different locations, a "geographical displacement of sources and sinks" ultimately develops wherein the local people generally absorb the environmental repercussions while the benefits are exported elsewhere (Martinez-Alier 2004: 10). This may illicit a community response for environmental and resource protection to maintain their health or livelihoods.

While motives for social justice are at the heart of environmental justice movements, the inclusion of conservation objectives sometimes meshes with the goals of First World environmentalism, whose main concern is protecting nature. As environmental justice is also a response to conflicts that can arise over the appropriation

and overconsumption of resources for economic development, environmental justice groups may be able to collaborate with environmental organizations to meet overlapping goals. Both indigenous groups as well as rubber tapper groups in Brazil, for example, have appealed to and been supported by international conservation organizations on claims that these groups protect the forest from other interests (Redford and Stearman 1993). Additionally, Redford and Stearman (1993) point out that international environmental organizations benefit from local collaborations because they can be used to refute claims of environmental colonialism.

2.5 Chapter Summary

This chapter examined the environment as a social construction, which can also be used as a tool of power. Particularly, I discussed First World constructions of the environment in the context of economic development, and how the exportation of those constructions has led to conflict to the Third World. Consequently, alternative constructions of the environment and development have arisen from the Third World. This has resulted in different approaches to conservation particularly involving the concepts of social justice.

As government efforts have in the Brazilian Amazon have focused on economic development for the past 60 years, dominant notions of environmentalism have also accompanied it and have influenced action of various scales. International concern over the quickly disappearing rainforest has been instrumental in persuading the national government to create protected areas and enact laws also calling for protection of forest cover. The government policy is then imbued on the local level, where communities

required adhere to it, thus shaping local conceptions of the environment and directing beliefs of appropriate resource use. In the next chapter, the history of development and conservation in the Brazilian Amazon will be examined in detail, giving further insight into the dynamics of conservation and development in the region.

Chapter III

Amazonian Development: History and Outcomes

3.1 Introduction: Perspectives of Amazonian Development

Covering an area of approximately six million square kilometers, the Amazon rainforest extends over nine South American countries and totals roughly half of the earth's remaining rainforest cover. About two-thirds of this area is found in Brazil, amounting to roughly 40% of the country's territory. Although frequently depicted as a vast and empty wilderness, in the last half-century the region has also been a symbol of economic and social hope, sparking a series of ambitious development efforts that have resulted in dramatic change in a relatively short period of time. These development plans have given rise to serious controversies that are frequently manifested in violent conflict and land degradation.

Although arguably remote, the region does not exist in isolation, but rather is influenced by national, regional, and global connections. Additionally, the processes and consequences of land-use change presently occurring in the Brazilian Amazon can be understood as a product of its historical context. This history includes uneasy shifts between colonial, military, and democratic governments that each pursued goals influenced by national and international relationships. This chapter is broken into three main sections discussing 1) the early years of colonialism that established patterns of labor abuse and land inequality that persist throughout Brazil and its Amazon region, 2) the government efforts to develop the Amazon region beginning in the 1950s and the

string of development projects that followed, and 3) the negative consequences of the development initiatives and responses by both the government and the populous. Together, these sections outline the history of development of Brazil's Amazon region and how the past trajectory of development has influenced its present conditions, particularly in the South of Pará, where the settlement case study is located.

3.2 A Colonial Legacy

European colonists first arrived on the shores of Brazil's Northeast coast in the early 16th century, initiating an era of colonial rule that would remain reflective in governing institutions long after ties to the colonial motherland had been broken. During the early years, thousands of indigenous groups populated Brazil, and for the first couple of decades the relationships between colonists and indigenous communities remained fairly stable, despite waves of illness suffered by the indigenous peoples as they were exposed to diseases carried by the colonists (Hecht and Cockburn 1989; Anon. 2008a). European settlement was mostly limited to the coast where interactions focused upon trade, particularly of Brazilwood (*Caesalpinia echinata)*, which produced a red dye highly valued in the European textile industry. These settlers lived either among the coastal indigenous villages or at the trading posts that were set up nearby (Anon. 2008a).

From the onset of the European arrival, this area was exploited for the benefit of the distant ruling countries. The 1494 Treaty of Tordesillas solidified this perspective by dividing South America between Spain and Portugal. By the mid-16th century, the Portuguese had effectively established themselves as the colonizers of Brazil, although they still occasionally were challenged and forced to defend the territory from competing

colonial powers. The colony was originally divided into hereditary captaincies that were given to favored persons that each extended about 160 miles along the coast and an indefinite distance inland (Alston, Libecap, and Mueller 1999). While these divisions of land were eventually dissolved after a couple of decades and then divided in other ways, a trend had been started that maintained property in the hands of a few elite. Soon, large sugarcane plantations were established to feed European demands. This new economy initiated the trends of large-scale inequality and labor abuse that would characterize and persist in Brazil through the present. It spread to the South and Southeast where members of the elite would control vast coffee plantations and cattle ranches, and into the Amazon region with the establishment of the rubber industry and Brazil nut (*Bertholletia excelsa*) operations that would much later give way to large ranches.

3.2.1 Early Exploitation in the Amazon

Because the cultivation of sugarcane required large amounts of labor, many indigenous people were enslaved during the early colonial period (Schmink and Wood 1992). However, disease and terrible work conditions decimated the coastal indigenous populations, causing slave traders to turn to the interior in search of more labor. The Amazon River offered an attractive entrance inland for slaving expeditions in search of unexploited indigenous populations. These populations, and the access offered by the river, also attracted Jesuit missionaries looking for converts. The missionaries established religious settlements in the region called *aldeias,* where indigenous people were spared from slavery, but lived in miserable and unsanitary conditions (Hecht and Cockburn 1989; Schmink and Wood 1992). Whether converted in missions or captured

into slavery, indigenous people suffered high rates of mortality. As populations dwindled, the use of native labor in greater Brazil gave way to the importation of slaves captured in West Africa until slavery was officially abolished in Brazil in 1888. However, slaves were not commonly brought to the Amazon and accounts of indigenous peoples captured and forced into slavery persisted through the early 20th century with reports of indigenous peoples being enslaved to collect rubber (Weinstein 1983).

Beginning in the late 19th century, the Amazon region was impacted by a myriad of economic boom and bust cycles based on resource extraction. Of particular importance was the rubber boom that began in 1879 and lasted until roughly 1910. With the invention of the vulcanization process, rubber became a valuable commodity demanded throughout the world (Schmink and Wood 1992). During this same time, Brazil's northeastern population suffered from drought, high rates of unemployment, and concentrated land ownership that resulted in a large landless population. Drawn in by the prospect of tapping rubber, massive numbers of people migrated from the Northeast into the Amazon region. As a result, the population of the Amazon region after World War I was twenty-five times what it had been in 1850, and many new towns were established (Anon. 2008a). The rubber tapping industry was characterized by a scheme of debt-peonage known as the *aviamento* system of labor. Rubber tappers collected rubber in remote locations to eventually exchange it at the trading posts, generally for supplies at inflated prices. Eventually, they entered into a cycle of debt that obligated them to keep working (Schmink and Wood 1992).

Around 1910, the market was flooded by low-cost rubber cultivated from British plantations in Asia, causing the Amazonian rubber industry to crash (Barham and

Coomes 1994). Not all parts of the Amazon region were affected equally. In some areas, a severe economic downturn took hold that resulted in an out-migration of people back to the Northeast. However, in the South of Pará different industries began to emerge. In the specific location of the case study site near the city of Marabá, the collection and exportation of Brazil nuts rose as the next dominant industry. Known particularly as the Brazil nut polygon, the area was renowned for its rich concentration of Brazil nut trees. By 1920, Brazil nuts had become Pará's primary export commodity (Schmink and Wood 1992; Foweraker 1981). Yet, economic success was achieved at a high human cost. Labor was generally treated terribly, and workers who demanded better conditions were beaten and sometimes killed. Because of the remoteness and inaccessibility of the area, few reports of labor abuse spread outside the region (Branford and Rocha 2002).

The system for the marketing and exportation of Brazil nuts shared some strong commonalities with that of the rubber industry. Similar to the system of the rubber traders, only a few families were in control of purchasing and transporting of Brazil nuts, and these families also monopolized the credit extended to the nut collectors. Despite this similarity, a major difference also existed between the powerful families of the Brazil nut industry and the rubber industry. Those who controlled the Brazil nut industry also sought out legal rights to the vast groves of Brazil nut trees through a long-term lease known as *aforamento perpétuo,* which would continue to extend political power to the controlling families after the Brazil nut industry declined and major changes were brought to the area through new government development plans (Emmi 1999).

3.3 A Push for Development and Integration: the 1950s and Onward

Beginning in the 1950's, the Brazilian push to develop the Amazon led to a drastic transformation of the region, especially in the South of Pará. The impetus for national policy change can be considered in terms of geopolitical, economic and social reasoning, which included motivations to secure national borders, to extend national economic growth through exploitation of resource wealth, and to appease the growing unrest of impoverished and landless populations. Concepts of regional development were shaped to meet these demands, and have influenced a long series of development programs aimed at the Amazon through to the present, including Operation Amazonia, the National Integration Program (PIN), POLOAMAZONIA, the Calha Norte Project, Grand Carajás Program (GCP), and the more recent string of programs that have involved mega projects.

Throughout the early twentieth century, Brazil's boundaries went through a series of contestations and shifts, including border renegotiations with British Guyana, Venezuela, Columbia and Peru (Hecht and Cockburn 1989). By the 1950's, the Amazon became a particular area of concern for the Brazilian government. Because much of it was located far from urban centers and populated by mostly indigenous groups that did not consistently recognize the political boundaries nor readily identify themselves with the country of Brazil, the land was seen as virtually empty and extremely vulnerable to challenges that could emerge from adjacent countries. Furthermore, concern was building over the possible emergence of communist strongholds in the region.

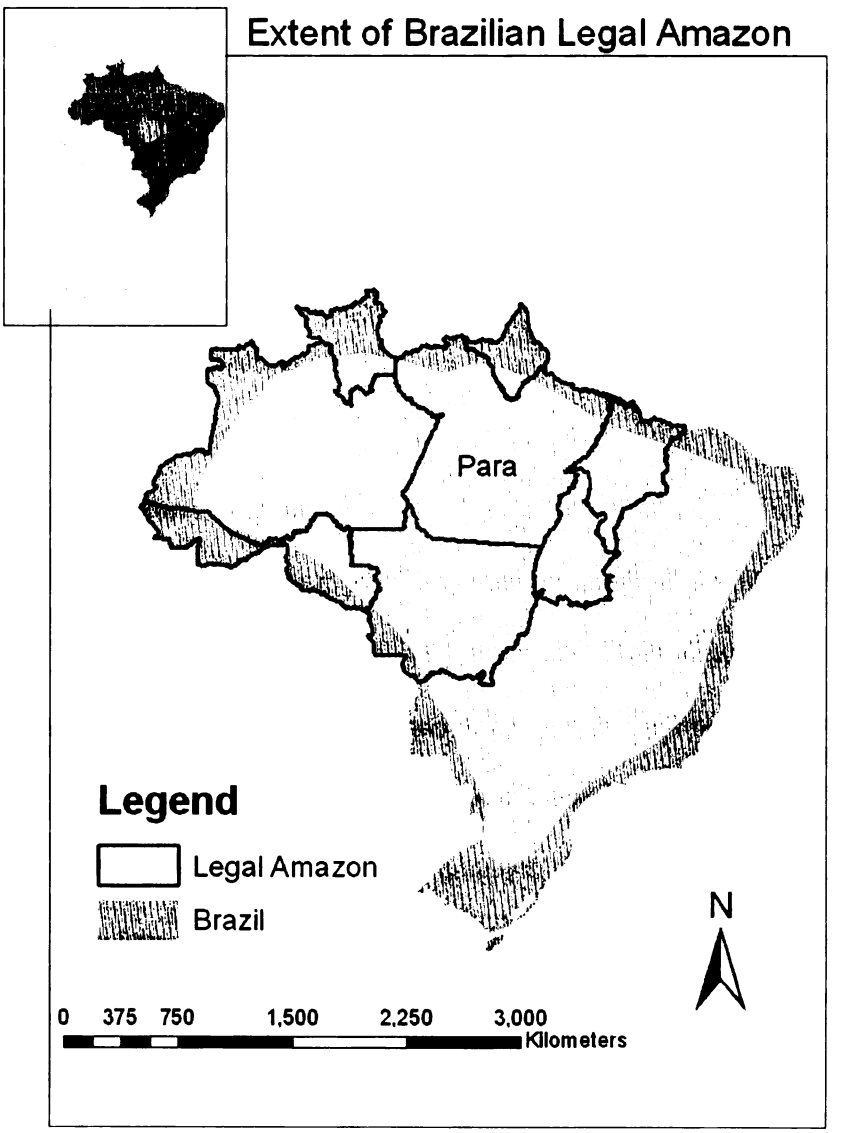
The Amazon was also seen as a largely untapped source of natural resource wealth. The vast forested lands offered a seemingly interminable source for timber

products in addition to unknown quantities of valuable minerals. As the economies of the Amazon region and the rest of Brazil were largely disconnected, economic integration also served as a potential boost for the national economy as a whole, which struggled with high rates of inflation and unemployment (Schmink and Wood 1992). Commercial interests would therefore be a driver in many of the development projects that would emerge from the new national policy.

By the mid-twentieth century, Brazil's major cities were struggling under swelling numbers of impoverished people and were feeling the strains of growth as rural to urban migration increased (Hecht and Cockburn 1989). As time went on and unrest among the landless population grew, demands for agrarian reform began (Branford and Rocha 2002). Since the Amazon region was viewed as empty land, relocation would become a means for the government to offer an outlet for these populations. In addition to the attempts at appeasing people, resettlement served geopolitical objectives to secure borders as well as economic objectives by bringing uncultivated wilderness into production. By populating the region, Brazil could secure claims to the land as well as provide the labor needed to support emerging commercial interests.

In 1953, the first agency in charge of Amazon development, known as the Superintendency for the Economic Valorization of the Amazon (SPVEA), was created (Hecht and Cockburn 1989). For the purposes of improving the coordination of development projects in the region, one of its first acts was to create the administrative unit referred to as the Legal Amazon (Anon. 2008a). Occupying about 60% of the total area of the country, the administrative unit extends over and slightly beyond the Amazon River Basin, and includes the nine states of Acre, Amazonas, Roraima, Pará, Amapá,

Maranhão (excepting a small eastern portion), Tocantins, Rondônia, and Mato Grosso. (Simmons 2002) As the State of Pará is of particular interest to this thesis, it is shown on Figure 3.3A. The Amazonian development initiatives that will be discussed were enacted in the designated Legal Amazon, although most of them focused on development in the eastern portion of the Amazon and heavily affected activities in the South of Pará.



(Figure 3.3A) Extent of Brazilian Legal Amazon

In addition to designating the Legal Amazon, the SPVEA also secured financing for development programs by appropriating the rubber bank, *Banco de Credito de Borracha*, to transform it into a regional development bank (Hecht and Cockburn 1989). The SPVEA additionally implemented the construction of the Belém-Brasilia Highway, which opened the eastern Amazon to extended commerce and prompted the first land boom in the region as millions of acres of public lands in Pará were transferred to private holders in just a few years. Started in 1956, the construction for the Belém-Brasilia Highway did not reach the South of Pará until 1960. While many small farmers had migrated to the region to settle upon the newly accessible land, they were soon expelled by larger, more powerful commercial interests, reinforcing a pattern of land conflict and consolidation (Schmink and Wood 1992).

3.3.1 Operation Amazonia

While the SPVEA has had a prevailing impact on Amazonian development, it was also notorious for corruption, leading to its abolishment in 1964 when the incoming military government took control of the country (Hecht and Cockburn 1989). It was replaced in 1966 with the Superintendency of Amazonian Development (SUDAM), which directed the first major development program for the Legal Amazon, Operation Amazonia. Lasting from 1966 through 1970, a major component of Operation Amazonia was the First National Development Plan (PDN I) that promoted managed in-migration and provided extensive fiscal incentives for development that included tax exemptions and subsidized credit for land acquisition and agricultural development. One of the laws, Decree 5.174 of 1966, allowed companies to obtain up to 100 % tax exemptions for up to

15 years on income derived from projects approved by SUDAM. Additionally, low interests rates and a 6-year grace period for credit gave substantial subsidies to borrowers (Browder 1988).

However, the main beneficiaries of the laws passed during Operation Amazonia were commercial and speculative interests, particularly those involved in the livestock sector (Simmons 2002). During this time, the World Bank and the InterAmerican Development Bank invested heavily in the third-world livestock sector, causing SUDAM to put a special emphasis on funding cattle ranching, resulting in a jump from 4 to 162 projects between 1966 and 1969 (Hall 1989). Cattle ranching was seen as an activity that carried few risks, given that there was always a market for meat and that production required relatively low labor inputs compared with planting crops (Hecht and Cockburn 1989). The results of Operation Amazonia favored almost exclusively the large commercial interests and promoted rampant land consolidation (Simmons 2002).

3.3.2 The National Integration Program (PIN)

In the wake of a severe drought that affected the Northeast in 1970, the Brazilian government attempted to take a different approach to Amazonian development with a shift of attention from economic to social interests through the *National Integration Program* (PIN) (Miller 1983). This program was publically acclaimed as a solution to the problems of underemployment and landlessness in the Northeast and other regions in Brazil, however a current of strategic geopolitical and economic development objectives also remained beneath it (Moran 1983a). To make a larger amount of territory available for settlement, PIN initiated the construction of an extensive highway network, including

the Transamazon highway that would run west from where the Tocantins and the Araguaia rivers converged at Marabá through Itaituba and then to Porto Velho. During this period, the government also set up credit for small farmers and initiated settlement programs that involved providing the settlers with transport to the Amazon, a 100 ha plot with title, guaranteed credit for the planting of rice, corn and beans, a six-month household subsidy to support the family over the initial difficult months, and food subsidies as insurance against disaster. In addition to that, housing, schools, medicine and technical assistance were promised (Moran 1983a).

To administer the extensive settlement program, the Institute for Colonization and Agrarian Reform (INCRA) was created in 1970. The agency continues to work throughout Brazil on agrarian reform projects and presently retains great importance in the Amazon. The purpose of INCRA is specifically to maintain the national registry of rural properties and to manage the distribution of public lands. In the creation of settlements, it is INCRA's obligation to make sure that the needs of the settlers are met, which include providing basic infrastructure to the settlement as well as extending individual credit for housing and the initiation of productive activities. It is also INCRA's responsibility to carry out agrarian reform and oversee the process of expropriation of land that does not satisfy the lawful requirements of beneficial use, which will be discussed in greater detail later in this chapter (INCRA 2006b).

In the wake of these efforts several different types of colonization schemes emerged. State-led colonization was implemented by the government with regional development plans, while spontaneous settlements arose opportunistically where new access to land was granted. Private colonization sponsored by corporations and

cooperatives also proliferated beginning in the early 1970s, however, this was mostly in the southern portion of the Legal Amazon in the state of Mato Grosso (Jepson 2006).

Despite the benefits offered to settlers, it became apparent within a few years after the program's initiation that the government had difficulty meeting all of its promises. Diseases, isolation, and the unfamiliar land took their toll on recent immigrants. Very few settlers were successful in the state-led settlement projects early on, and many abandoned their lots (Hecht and Cockburn 1989; Moran 1983a). As subsidies offered to small farmers were also open to commercial interests, the program again mainly benefited those interests and furthered land consolidation (Simmons 2002).

3.3.3 POLOAMAZONIA

As the oil crises emerged in the early 1970s and the failure of the state-led settlements became evident, development strategies changed again in 1975 as focus shifted away from social concerns present in PIN, and refocused specifically on export-oriented development centered on mining, timber and cattle production with the creation of the Second National Development Plan (PND II), which was heavily influenced by the ideas of the French economist, François Perroux (Serra and Fernández 2004). Under this plan, a new program called POLOAMAZONIA designated fifteen development 'poles' in the Amazon where infrastructure and fiscal investment would be concentrated on exploration and to prepare raw materials for export markets (Miller 1983; Serra and Fernández 2004). Perroux invented the term 'pole' to explain a process of economic development that included propulsive sites of economic growth. With fiscal incentives and subsidies, these poles would attract the industries that in themselves would drive

further growth in other sectors, once they were established. The desired result would be a spatial network of development that would satisfy geopolitical goals as well as initiate economic growth for the whole region, that would ultimately boost the Brazilian national economy (Serra and Fernández 2004).

3.3.4 Grand Carajás Plan

POLOAMAZONIA caused a surge of economic growth for large industries. However, Brazil's increasing foreign debt in 1980 prompted the creation of a new national development agenda of intensification (Hall 1987). At this time, the government established a two-part project known as the Grand Carajás Program (PGC), which promoted export-oriented, capital-intensive mineral and agricultural exploration on a large scale, particularly in the eastern Amazonian sub-region. Of particular interest of this program was to develop the infrastructure needed to extract and transport iron ore from the area (Moran 1983a). While one part of the program focused on mineral exploration, the other part, known as the Programa Grande das Carajás Agricola (PGCA), centered on increasing agricultural production opportunities for employment within the PGC region by encouraging the creation of smaller family farms (Hall 1987). However, despite the expressed intent to include the needs of small farmers, the heart of the PGC was based on extensive, capital-intensive projects and soon became dominated with large landholdings, resulting in 0.7 % of the PGCA landowners owning 51 % of the land in 1987 (Hall 1987).

While a democratic government took charge of Brazil in 1985, the strategies for economic development remained focused on investing in large projects with the

assumption that the economic benefits would eventually be spread through the rest of the population to address issues of poverty (Simmons 2002). The Calha Norte program took effect during this year, covering a zone that equaled nearly a quarter of the Legal Amazon. With particular areas of interest for this project were on securing the frontier and the rivers, the program included the improvement of military installations in the area, defining an appropriate indigenous policy, expanding highway infrastructure, improvement of the production of hydropower and integration of the development poles (Hecht and Cockburn 1989; Browder 1988).

3.3.5 Recent Amazonian Development

The trajectory of large scale development projects in the Amazon has continued into the present through the new constitution in 1988. This constitution included a four year overlapping planning cycle to be undertaken by successive federal administrations, known as the *Plano Plurianual* (PPA). The PPA first went into effect with Itamar Franco's administration from 1991 to 1995 (Walker et al. 2009). Subsequent PPAs have allocated significant amounts of money to massive infrastructure development, particularly in the Amazon region. While the name of the plan changes every four years, the overall focus and action has stayed the same. In accordance with the PPA, the Cardoso administration initiated *Brasil em Ação* (1996 and 1999), which created several ambitious dam-building and highway paving projects in the Amazon (Fearnside 2002). *Avança Brasil* succeeded it from 2000 until 2003 with over US$40 billion in infrastructure and energy projects to support export ventures.

From 2004 through 2007, the administration of Luiz Inácio Lula da Silva (Lula) implemented *Brasil de Todos,* furthering the goals of the previous plans by initiating projects to link the soybean producers of north-central Brazil to Amazon River ports, develop new sources of hydroelectric energy for aluminum processing, and exploit gas reserves in the remote western part of the basin (Kirby et al. 2006; Reid and Sousa Jr 2005). Also under Lula's administration, the *Programa de Aceleração do Crescimento* running from 2007 through 2010, focuses on the completion of projects initiated under previous plans. Additionally, it involves multi-billion dollar hydroelectric projects such as the Belo Monte Dam, the Santo Antonio Dam and the Jirau Dam, as well as the building of the Highway to the Pacific, which would link the western Amazonian state of Acre to Peru, creating a cheaper transportation route to Pacific ports to access Asian markets (Anon. 2008b).

3.4 Consequences and Responses to Brazilian Development Initiatives

While Brazil's development efforts in the Amazon have perhaps succeeded at meeting the nation's geopolitical goals, many of the other envisioned benefits of the development projects have not come to fruition. Through the successive years of capital-intensive programs in the Amazon, development indicators, such as rates of infant mortality and malnutrition, have not shown improvement and in some instances have worsened to rates that rival sub-Saharan Africa (Moran 1983b; Simmons et al. 2002). Additionally, land concentration in the North has consistently remained the highest of any region in Brazil, with a 1998 gini coefficient of .871 (Hoffman 1998), and reports of labor abuses and systems that resemble slavery continue (CPT 2004). Confusion and

dishonesty have become normalized in the titling process, and patterns of violent land conflict have also emerged. Meanwhile, deforestation has followed investments and migration to form what is commonly referred to as the 'arc of deforestation' that wraps around the south and eastern portions of the Legal Amazon (Walker, Moran, and Anselin 2000; Walker 2004; Kirby et al. 2006). As development funding from SUDAM has been largely concentrated in the South of Pará, it stands to reason that some of the worst cases of these adverse consequences have also been in this region (Simmons et al. 2007).

The consequences occurring at local and regional levels have not gone unnoticed. On all scales, many groups have formed to lobby the Brazilian government to address social and environmental issues in the Amazon region. As a response to both domestic and international pressure, the government enacted several regulations including the enforcement of agrarian reform laws and the creation and tightening of environmental laws within the region. However, in some cases the goals of environmental regulation conflict with the social goals of some organizations, leading to an adjustment of social justice objectives to environmental justice.

3.4.1 Social Consequences: *Latifundia* and Conflict

As discussed earlier in this chapter, property consolidation into large landholdings has been a historic pattern in Brazil. Known as *latifundia*, land ownership has been characterized throughout Brazil by large and frequently unproductive properties that were often tied to labor abuses as well as poverty associated with landlessness (Alston, Libecap, and Mueller 1999). Beginning as early as the 1850s, this trend resulted in popular demands for agrarian reform, which included a provision that land meet a social

function, and demanded the redistribution of both large private landholdings and areas that were still in the public domain, such as those still found in the Amazon region (Fearnside 2001). However, those with the largest landholdings also tend to be the most politically powerful, and therefore frontier expansion was historically relied upon for pacification of the populous (Alston, Libecap, and Mueller 1999).

By the 1960s, the majority of the land outside the Amazon region had been transferred to private ownership, and Brazil had one of the highest levels of land concentration in the world (Alston, Libecap, and Mueller 1999). As the national economy struggled through the late 1950s and early 1960s, pressure for agrarian reform mounted because it was viewed as a solution that would increase rural employment, mitigate conflicts over land, and augment agricultural productivity. Immediately after the coup that placed the military government in power, congress passed the Land Statute of 1964, an attempt at agrarian reform that regulated the rights and obligations of the government and defined the qualifications for property expropriation that were based on meeting a vaguely defined social function or beneficial use (Branford and Rocha 2002). The Land Statute of 1964 was very influential, and would serve as the foundation for later land reform laws. However, as many of the richest people still held political control, the Land Statute was largely ineffective and trends of consolidation continued into the Amazon region. In the South of Pará, for example, the majority of large landholdings in the late 1960s were around 5,000 acres, while a few were as large as 24,000 acres (Alston, Libecap, and Mueller 1999).

Conflict over land in the Amazon escalated with increased investments in development projects. Multinational companies that were drawn to the area by fiscal

incentives from the Brazilian government hired gunmen to burn houses, to terrorize communities and to assassinate leaders in the attempt to drive away the thousands of poor families that had migrated to the region from the northeast (Schmink and Wood 1992). The rapid and poorly coordinated transfer of property from the public domain to the private also contributed to conflict by resulting in unstable titles and the invention of numerous ways to circumvent the legal system that prevail through the present (Alston, Libecap, and Mueller 1999). Document falsification, for example, has become commonplace by large land-grabbers known as *grileiros,* creating extensive problems with legal titling. In Portuguese, *grilo* means cricket, and so *grileiros* earned their name for the crickets they put in drawers with title documents to damage the paper and make them appear older (Fearnside 2008). Brazil uses a multitude of public and private land registry offices, linked to either state or federal agencies. As there is no standardized connection system between them, overlapping land claims are frequently made, and titles may also be registered for people who do not exist (Fearnside 2001).

3.4.2 Agrarian Reform and the Rise of Direct Action Land Reform (DALR)

By 1975, conflict had become so prevalent in the region that the Roman Catholic Bishops of the Amazon basin organized the *Commisão Pastoral da Terra,* or Pastoral Land Commission (CPT), to bring attention to the issues and provide assistance for the rural poor that worked in near-slavery conditions and were often the target of violence (Branford and Rocha 2002). As violence and land conflict have persisted in the region through the present, the CPT has kept records of it. According to their records, about half of all murders related to land conflict between 1988 and 2004 in Brazil occurred in the

Amazon. Of those, 83 % occurred in the state of Pará (Simmons et al. 2007). In an analysis of CPT data from 1964 to 2004, Simmons et al. (2007), further assert that the historical gravity centers of the land conflict violence have been concentrated in the South of Pará.

Since its inception, the CPT has provided peasant farmers help with legal support of land claims, technical assistance in developing effective farming methods, and by calling attention to rural violence through communication with international human rights organizations and the publication of annual reports (Adriance 1995). Additionally, the CPT has played a vital role in supporting the rise of various direct action land reform (DALR) organizations that have been actively involved in the processes of agrarian reform in the South of Pará and throughout Brazil (Branford and Rocha 2002).

By definition, DALR is a social and political process involving mobilization of the poor, the contentious occupation of public or private lands, and the formalization of land holdings in the wake of occupation (Simmons 2005b; Simmons et al. 2007). Recognized presently throughout Brazil, DALR is pursued by social movement organizations using tactics that ultimately call attention to *latifundia* and compel the government into enforcing agrarian reform laws. These tactics often include elaborate demonstrations, where participants may block roadways or camp for long periods of time on the land desired for expropriation. Sometimes activists may even camp on INCRA property for attention. DALR is distinctly different from spontaneous efforts at settlement in that it involves the organization and coordination between many settlers and a social movement organization (Simmons 2005b).

Because agrarian reform laws have gone largely unenforced by the Brazilian government, groups of landless peasants, as they call themselves, began to mobilize in many parts of Brazil, starting around the mid-1970s. However, such DALR organizations did not begin to appear in the Amazon region until the end of the 1980s, after the government-initiated settlement programs had largely ceased (Branford and Rocha 2002). The modern processes of settlement in the Brazilian Amazon have therefore become very different from the previous state-led settlement projects that were characteristic of programs such as PIN. Today, agrarian reform is usually carried out in response to groups that have called attention to land that that they deem ripe for expropriation, in accordance to constitutional law (Fernandes 2000). In Article 186 of the 1988 constitution, land becomes vulnerable for expropriation if it does not meet social function and opportunity is first given to those to reside on the land to legally occupy it in a settlement. In order to fulfill its social function, the land must be rationally and adequately used. Appropriate use includes the owner using available natural resources in compliance with environmental regulations, abiding by labor regulations, and land must be put to beneficial use of both the owners and the laborers. Because these conditions are vaguely defined, the process of land contestation is frequently complicated and agreements are sometimes difficult to reach between parties.

There are several steps involved in the process of expropriation, and it frequently begins with landless peasant 'squatters' establishing camps on roadsides in front of properties that the movement groups wish to press the government to expropriate (Fearnside 2001). The process continues when INCRA initiates a field inspection, survey, and an appraisal of the land. If INCRA decides that the property fails to meet the

requirements of beneficial use, then it will submit the proposed expropriation to the court to obtain authorization for title transfer to the agency for subsequent distribution to squatters and the previous owner will be compensated in Agrarian Debt Bonds (Alston, Libecap, and Mueller 2001). Moreover, if the process goes through and expropriation occurs, then an INCRA settlement will be established on the land. Otherwise, the people are offered plots of land in settlements elsewhere in the area (Fearnside 2001).

3.4.2.1 Components of DALR Organization

Different agrarian reform organizations have varying procedures for the pursuit of land, but it often starts with the organization identifying a piece of property eligible for expropriation. These could be done through consultation with a human rights organization, such as the CPT, through communication with INCRA about properties that they are investigating, or it may even be done by simply following the local news (Wright and Wolford 2003). Once a property is identified, the organization will proceed to recruit people interested in participating in a land occupation. This frequently occurs in the cities, creating an urban link to the rural movement (Simmons 2005a). Once people are recruited and organized, they generally form camps on or near the property and begin agitation to have the property expropriated. Sometimes this process takes several months or possibly more than a year (Wright and Wolford 2003).

In addition to the CPT, a variety of rural syndicates are also active in the region, offering networks of assistance and support to rural workers and working with DALR organizations to settle landless migrants. Several different DALR organizations exist in Brazil and regionally in the Amazon. While many of them have diverse ideas regarding

settlement formation and functions, they all strive to secure the land rights of small farmers. In the south of Pará, the *Federação de Trabalhadores na Agricultura,* or the Federation of Workers in Agriculture (FETAGRI) is the largest. Nationally, however, the *Movimento dos Trabalhadores Rurais Sem Terra*, or Landless Rural Workers Movement (MST), is the largest and one of the most well-known DALR groups (Fearnside 2001). Evolving out of the Brazilian state of Rio Grande do Sul in the late 1970s, the organization typically encouraged agricultural land redistribution within the south and the northeast regions, instead of promoting migration to the frontier areas. However, national policies favoring development in the Amazon enticed millions of people to relocate there and the MST consequently became involved in the region in 1989 and has largely been credited with bringing attention to land reform in Pará (Wright and Wolford 2003; Alston, Libecap, and Mueller 1999; Branford and Rocha 2002).

3.4.3 Environmental Consequences: A Changing Landscape

Development efforts in the Brazilian Amazon have also caused profound environmental change within the last half-century. While there are many different environmental impacts associated with these development efforts, the most profound is the high rate of tropical deforestation (Fearnside 1987). Between 1995 and 2000, the average rate of forest loss was equivalent to more than 3.6 hectares per minute (Laurance, Albernaz, and Da Costa 2001: 306). Between 1992 and 2002, it was estimated that the total area of deforestation in Brazil was around 156,873 km^2. By 2007, roughly 18% of the original forest cover estimated in 1500 has been cleared (Fearnside 2008). Since the 1970's, studies have shown that deforestation rates have trended upwards and are

expected to continue in that direction through the next several decades (Laurance, Albernaz, and Da Costa 2001). The increasing Amazonian deforestation is widely considered to be linked with economic development programs, particularly with components that involve transportation improvements, fiscal incentives and land tenure issues (Fearnside 2005; Browder 1988; Pfaff 1999).

Infrastructure development projects can directly cause deforestation, such as dam reservoirs that may inundate thousands of hectares of forested lands. However, deforestation is also intensified by large ranchers, colonists, and speculators who increase their activities because of the benefits brought in by the highways and other infrastructure established for development projects (Fearnside 1987). One of the greatest benefits brought by improvements on existing infrastructure, particularly the paving of roads, is the expansion of accessibility to otherwise remote areas. As transportation costs go down, households find it more profitable to expand their production because of increased ability to market the goods produced (Walker et al. 2002).

Indeed, roads have been shown to be the strongest predictor of frontier expansion and accompanying deforestation in tropical forest regions (Nepstad et al. 2001). The expansion and improvement of roads seems to initiate a feedback loop for the continuation of deforestation, since roads facilitate the entry of migrants who make claims beyond the road network and create political pressure to improve and extend roads out to their claims, thus initiating more road building (Fearnside 1987). Examples of this have been evident along the Transamazon highway as well as Belém-Brasilia highway, where the completion of roads facilitated land accessibility and consequent high rates of deforestation (Browder 1988). Models have confirmed that roads tend to initiate wide

areas of deforestation in the Amazon (Pfaff et al. 2007), and more than two-thirds of deforestation has taken place within 50 km of major paved highways (Nepstad et al. 2001).

Besides improving accessibility to land claims, extension and improvements of roads also provides accessibility for timber exploitation that may cause further impacts. The construction of logging roads, for example, is heavily associated with highway expansion. While logging itself may go undetected, timber extraction frequently increases forest flammability by leaving unwanted and dead debris from the process. Understory fires start a cycle of tree mortality that fuels further fires, eventually causing damage to a much larger area of forest than was originally disturbed (Cochrane et al. 1999).

Fiscal incentives that have accompanied economic development projects have also been a historic impetus for furthering deforestation, particularly by large-landholders such as ranchers. In the 1970's, many of the projects included tax and credit incentives for private corporations to invest in the Legal Amazon. One of the greatest beneficiaries of the investment tax credits and subsidized rural credit loan disbursements was the livestock sector. Between 1973 and 1983, it is estimated that 30% of deforestation in the Legal Amazon was due to pasture subsidized by SUDAM (Browder 1988: 265). In 1991, a decree was issued that stopped new tax subsidies, yet the old ones continue and have created stable foundation for many previous investments. As rates of deforestation continue to fluctuate with global beef prices, large-scale ranchers are considered by some to be the principle contributor to Amazonian deforestation (Fearnside 2008).

Unstable land tenure has also been considered a mechanism for deforestation (Fearnside 2001, 2005; Simmons et al. 2002). As discussed in section 3.4.2 of this chapter, land that is said not to meet its social function and is not put to beneficial use is vulnerable to expropriation under Brazilian law. In Amazonia, forest is not considered a productive land use and does not serve a social function. However, pasture does fulfill that requirement and so land owners may deforest in order to avoid expropriation. Additionally, if a landowner is fairly certain that the property will be expropriated, he may deforest as much as possible before expropriation to extract the maximum worth from valuable timber on the property and to receive a higher compensation price from INCRA, since pasture is more valuable than forest (Alston, Libecap, and Mueller 1999).

Since 1999, INCRA has not been permitted to issue settlements on forested land with the enactment of an operating directive (INCRA/ IBAMA Portaria 88/98), which requires INCRA to choose only areas without forest for new settlements (Fearnside 2001). Despite this, new settlements have continued to be established in forested areas. This is particularly so in the South of Pará, where INCRA infrequently chooses the sites for new settlement areas. Instead, organized agrarian reform groups, such as the MST, select the locations of agrarian reform by deciding on the ranches to be invaded, and INCRA's subsequent role then lies with the legalization of these sites. Additionally, INCRA has no control over the expansion of settlements, which often abut forested areas (Fearnside 2001).

3.4.4 Environmental Laws

Environmental legislation has existed in the Legal Amazon since the enactment of the Forestry Code (Law 4.771/65) in 1965. This law mandated throughout Brazil that forested buffer zones be maintained and permanently protected along streams as well as on slopes and hills. Additionally, it required a proportion of tree cover on each property to be protected as 'legal reserve.' In the Legal Amazon, this originally required 50 % of the forest cover to be maintained. However, the military government only gave very reluctant, if any, enforcement to these laws throughout early development in the Amazon because they were essentially counter to the geopolitical goals (Baer and Mueller 1996). In fact, other laws were made to circumvent the Forestry Code in the pursuit of development initiatives. For example, Legal Decrees 1.413 and 76.3689 of 1975 revoked state and local government rights to interfere with economic activities that threatened the environment (Simmons 2002). While Brazil participated in environmental debates and developed legislation that acknowledged environmental concerns, policy continued to favor economic development projects at the expense of environmental conservation (Simmons 2005a)

In the late 1980's however, Brazil became a focus in the international environmental debates because of the rapid deforestation in Amazonia and growing concerns over possible global repercussions. It was during this time that discussion about biodiversity and possibilities for sustainable development entered global discussion and began to influence international funding agencies, such as the World Bank. As a large proportion of funds used for development programs were from international sources, the

Brazilian government changed policies as new conditions, such as environmental impact statements were required from these sources (Simmons 2005a).

Partly in response to growing international pressure, the Forestry Code was revised in 1989 to require 80% of forested areas in the Legal Amazon to be preserved. This same year, a body of environmental monitoring and enforcement was created, known as the *Instituto Brasileiro do Meio Ambiente e Recursos Naturais e Renóvais,* or the Brazilian Institute for the Environment and Natural and Renewable Resources (IBAMA). IBAMA works in collaboration with the *Conselho Nacional do Meio Ambiente,* or the National Advisory on the Environment (CONAMA), in charge of passing environmental legislation. The goals of IBAMA are specifically to preserve and rehabilitate environmental quality, in addition to promoting economic development based upon the rational natural resource use (IBAMA 2008). However, actual enforcement of regulations remains difficult because of the immense area that needs to be monitored, creating a high cost for enforcement (Baer and Mueller 1996).

3.4.5 SMO's and the Environment

It was during the late 1980s that social movement organizations also began to have a voice internationally, and many of them paired social dilemmas with environmental problems. One of the most widely known cases was the plight of the rubber tappers in the Amazonian state of Acre as they battled against the destruction of rubber trees as land was rapidly being bought up by ranchers and speculators. Because most of the rubber tappers didn't have title to the lands that they worked on, the loss of rubber trees meant a destruction of their livelihoods as well. As ranchers moved into the

area, consolidated and cleared land for pasture, many violent confrontations ensued (Hecht and Cockburn 1989; Brown and Rosendo 2000). The rubber tappers eventually organized themselves against the loss of forest to ranchers, and petitioned the government to create forested extractive reserves that would be publicly owned and used as a commons. Soon, the rubber tapper movement gained international support from human rights groups as well as conservation organizations, which gave them added political power (Brown and Rosendo 2000). Eventually the government would concede the extractive reserves, but not before conflict culminated with the murder of Chico Mendes, an important leader in the movement (Hecht and Cockburn 1989).

Many indigenous movements also became organized in the late 1980s to counter competing claims and deforestation of the lands that they depended on, but to which they had no legal right. As efforts progressed through the 1990s, indigenous movements began to align their cause with environmental movements and petition support from international conservation organizations (Conklin and Graham 1995). Often, these alliances are hinged upon the ideology of indigenous peoples as natural stewards. While it has been pointed out that indigenous peoples do significantly alter the ecology of their environment (Redford and Stearman 1993), there also seems to be evidence supporting claims to forest cover protection in the Amazon. A study using satellite data taken between the years 1997 and 2000 compared the deforestation rate and incidences of fire in inhabited extractive reserves, national forests and indigenous reserves and uninhabited parks in areas of greater than 25,000 acres. While it concluded that there were no strong differences in the inhibition of fire or deforestation for the majority of the study areas, the

indigenous reserves created in areas of frontier expansion often prevented deforestation despite high rates of deforestation along their boundaries (Nepstad et al. 2006).

In both the struggles of the rubber tappers and indigenous movement, aligning their causes with environmental movements and forming relationships with international conservation NGOs has reciprocal benefits. From the indigenous and rubber tapper perspective, third-party support is crucial in efforts to influence the state institutions because they are now able to circumvent going through local officials who may not see the value in their claims (Conklin and Graham 1995). By involving themselves in local struggles, international conservation activists can portray themselves with a moral argument of defending the human rights of politically marginalized people and effectively evade accusations of environmental imperialism (Conklin and Graham 1995).

However, global concerns about Amazonian deforestation continue, particularly in regards to the release of carbon from forest destruction and its potential aggravation of global warming (Fearnside 1996). Additional provisions to the Forestry Code have been added to prohibit Brazil nut trees from being cut (Portaria 48/95 of IBAMA; 11.7.95) and requiring deforested legal reserve to be replanted (Law No 6424/05). While large ranchers are considered to contribute the most to deforestation in overall area in Amazonia, it has been suggested that they have less of an impact on forests per square kilometer than small holders, who tend to deforest more intensely (Fearnside 1993, 2005). Environmental legislation such as the Forestry Code could have severe impacts on smallholders if enforced. As many smallholder settlers may have less than 100 ha, surviving off of 20 % of the total area of their property without any productive

integration with the legal forest reserve would be of a significantly greater challenge to them.

To the contrary of rubber tapper groups and indigenous groups, landless movement settlers in the Amazon have no historic claim to the land. As their productive activities frequently involve clearing land to raise cattle and crops, they are also implicated in contributing to deforestation. That could reduce political support, despite a social justice agenda. In the likely attempt to both gain support of the international environmental community as well as seek alternatives to the strictly preservationist environmental standpoint, many groups have also began to adopt an environmental justice stance alongside their social justice stance for livelihoods, and have developed and promoted productive systems intended to have less environmental impact.

The MST, for example, heavily promotes a production system called agro-ecology. The main goal of agro-ecology stems from the desire to keep people on their land once they have obtained it. In particular, the soils in the Amazon are very poor and subject to exhaustion after a couple of years in production. Settlements practicing agro-ecology create systems of agricultural production that are site specific, and use a variety of chemical free techniques to boost production and maintain soil fertility (Wright and Wolford 2003). People are educated about these practices through training programs sponsored by the MST. As this idea has grown in popularity, the MST with support from the Brazilian national government has recently opened up an official school for education on agro-ecology practice (Nórcio 2005).

Agro-ecology is highly promoted as a form of sustainable development, and the MST has joined with international organizations such as the UN-FAO to encourage

INCRA to enact new settlements that are compatible with the system. On the basis of environmental justice, the landless movement groups are therefore trying to shape the future trajectory of Amazonian development so that it serves the social justice objectives of land redistribution and ending *latifundia*. While at shifting negative focus of environmental impacts away from the movement, the environmental justice focus promotes the small holders as stewards of the land.

3.5 Chapter Summary

Trends of land consolidation in Brazil began in the colonial period and were repeated in the development patterns of the Amazon region in various systems of production, including rubber tapping and Brazil nut gathering. In the mid-20th century, massive investments in industrial and infrastructure projects, fueled by geopolitical, social and economic motives, continued to follow this pattern on a much larger scale in the region. As changes rapidly occurred, social conflicts emerged and drew human rights groups and later agrarian reform organizations to the region. Additionally, international concern over environmental degradation in the Amazon region spurred the creation of environmental legislation. Both concerns with agrarian reform and the environment have been integrated into many development policies, and have been used by SMOs to further gain support for their causes.

This chapter sets a foundation for understanding the involvement of DALR organizations and the formation of agrarian reform settlements in the Brazilian Amazon, which are the focus of this thesis. Additionally, this chapter introduces incongruities

between conservation and development policies that these settlements must attempt to address.

Chapter IV

Data and Methodology

4.1 Introduction

The establishment of agrarian reform settlements in the South of Pará is a product of the region's historical context, in which economic development policies encouraged patterns of land consolidation. Consequently, Direct Action Land Reform (DALR) groups began to organize in the region, and have frequently succeeded in convincing the government to enforce agrarian reform laws and expropriate *latifundia* to create settlements. As international concern has been growing over the potential environmental impacts of economic growth in the Amazon region, the Brazilian government has been generating new conservation policies and many DALR organizations are following suite, requiring settlers to address conservation goals alongside development goals.

The main objective of my thesis is to examine how settlers in rural agrarian reform settlements in the eastern Brazilian Amazon have negotiated between conservation and development objectives. To address this, I employ a political ecology framework that recognizes that local level decisions and actions about conservation and development are influenced by forces and interests interacting across multiple scales. Additionally, I focus my analysis on a case study of Primeiro de Março (PDM), a DALR settlement located in the South of Pará. My investigation of the settlement is broken into a series of secondary questions, including: (1) How do various influences of actors at multiple scales impact policy in PDM in terms of how conservation and development

objectives are defined? (2) What do settlers in PDM consider as their conservation and development objectives? (3) What have been the outcomes of the approaches taken to meeting conservation and development objectives in the settlement? and (4) what have been the primary factors that have contributed to these outcomes? In assessing these questions, I used both qualitative methodologies that include key informant interviews, as well as quantitative methodologies that include remote sensing and statistical analyses.

4.2 Qualitative Analyses

Ideas about conservation and development and their relationship to each other are important because they influence the ways that conservation and development are pursued. The purpose of the qualitative data analyses in this thesis is to 1) identify how conservation and development objectives are defined by actors at different scales, as well as 2) to identify the approaches to conservation and development that have been pursued in PDM as a result of these definitions. In addition to my qualitative analyses, I identified potential factors that influence development outcomes. I use these later as indicators in an empirically based model of development.

The broader goal of the analyses is to illuminate larger scale objectives of conservation and development in agrarian reform settlements and their relationship to local level objectives and approaches to meeting them. Using official websites and key informant interviews[1], I begin by examining two national agencies, the *Instituto Nacional de Colinização e Reforma Agraria* (INCRA) and the *Movimento dos Trabalhadores*

[1] Because my research required the use of human subjects, I obtained research approval from the Institutional Review Boards (IRB) at Michigan State University. It was granted under the status of Exempt on June 14, 2007.

Rurais Sem Terra (MST). Both of these agencies are highly influential in the creation of settlement projects throughout Brazil, the eastern Amazon, and particularly in the case study site of PDM. I then examined the *Plano do Assentamento* (PDA) of PDM, which is a document outlining the official objectives for the settlement influenced by both the MST and INCRA. Finally, I examine key informant interviews of the residents of the case study settlement. Within the analyses of INCRA, the MST, the PDA and the settlers of PDM, I seek to identify the objectives of conservation and development, focusing on priorities, challenges and relationships identified among reoccurring themes.

To perform my analyses, I utilized data from key informant interviews, the PDA and explicit reports from internet archives of INCRA and the MST. For the key informant interviews, I conducted a total of seven in PDM and four at the INCRA headquarters. All of the interviews were conducted with the help of a local field assistant who had knowledge of the physical area as well as local agricultural practices. All of the interviews were prepared with open-ended questions, allowing respondents to meaningfully respond in their own words instead of being provided with specific response options (Montello and Sutton 2006). I created standardized questions that varied depending on the group affiliation of the person being interviewed to PDM. After the initial response to the standardized questions, I used free format follow-up questions to further clarify the meaning of the responses (Montello and Sutton 2006). I conducted the interviews in Portuguese and took field notes summarizing the main themes of discussion and quoting the emphasized points. After each interview, I discussed the contents of the interview with my assistant.

I commuted to PDM multiple times during a period of twelve days to conduct the interviews in the settlement. Informants in the settlement were selected by the 'snowballing' style of sampling, in which I asked informants at the conclusion of interviews for referrals to other potential contacts (Cloke et al. 2004). I chose this method of conducting interviews because of the time constraints on my fieldwork, and I strategically selected individuals especially knowledgeable about the settlement. All interviews were done per the availability and convenience of the informant. More specifically, the interview questions in the settlement focused around several aspects of the settlement history, including information about PDM's initial occupation and expropriation as well as how organizational and development strategies emerged and changed over the past several years. Additionally, I asked questions about how the conservation regulations had affected or contributed to the creation of specific strategies, and what challenges there were to maintain the conservation reserve. My informants included three women and four men.

At the INCRA headquarters, I conducted interviews with four representatives that included the person directly in charge of initiating and monitoring different programs for development in the PDM settlement. The interviews at INCRA were focused on the government agency's strategies and approaches to development and conservation within the settlement. Specifically, questions focused on the evolution and changes in strategy and objectives of INCRA for development in the settlement, but also the reasons for success or failure of different development strategies. Additionally, I asked questions about the value and the methods of incorporating conservation goals in to development strategies and its current challenges to success.

Two main types of documents were collected and used for the qualitative analyses, including the official PDA of PDM, and the internet archival publications from the MST and INCRA. The PDA was generously supplied by the Mixed Cooperative of Agrarian Reform Settlements of the South and Southeast of Pará (COOMARSP), an independent agency that was contracted jointly by INCRA and the settlers of PDM to develop the plan. This document is specific to PDM and is intended to direct the development efforts of the settlement. The PDA contains information about development strategies and discusses concerns that must be addressed within the settlement in order for it to be a success. It also includes extensive information about the settlement derived from interviews, surveys and public records.

In addition to the PDA, documents and information from the websites for INCRA as well as the MST were heavily utilized during the course of this study. Internet sources were extremely valuable in supplementing broader information about the objectives and standpoints on conservation and development issues of the national governmental agency of INCRA, as well as the national organization of MST, whose relationship to the settlement is elaborated upon further in the description of the case study.

I broke the data analyses into four distinct groups: INCRA, the MST, the PDA and the settlers of PDM. In both the key informant interviews and the information from the official websites, I sought to identify information in each group that addressed the topics of:

- The objectives for conservation and development
- The priorities of development and conservation objectives
- The challenges to the success meeting conservation and development objectives
- The relationship between conservation and development objectives

The specific process for analyzing the INCRA and the MST websites was similar. I began on both websites by reviewing their mission statements and objectives, identifying how (or if) they referred to development, conservation or environment. I then followed up by reviewing various articles available on the websites about conservation or development and how they relate to the organization. I then identified various themes that were reiterated in the articles about conservation and development, using examples from them for discussion in the results section.

The PDA is one unified document arranged that discusses the objectives, current conditions and future plans of action for the settlement. For analysis, I started at the beginning of the document examining the objectives. Because the document is organized into sections specifically addressing the environment and aspects of development, I reviewed these sections and identify the themes addressing the bulleted topics.

I analyzed both the INCRA and PDM settler key informant interviews by first identifying the portions of the interviews where they were discussing either the environment or development. I then classified each one of those portions into one of the specific topics bullet-listed above. Following that, I looked for recurring themes in each topic and included them in the results.

4.3 Quantitative Data Analyses

The quantitative data assessments in this thesis address local level outcomes of conservation and development objectives as informed by the definitions and approaches of conservation and development as identified in the qualitative data analysis. The chapter addressing the quantitative data analyses consists of two parts. In the first, I

specify an empirically based model to examine factors that influence development. I use insight from my field research and quantitative analyses to identify key factors that influence development outcomes, and then utilize secondary data from the NSF supported survey to create variables for those factors. I then apply those variables to a logistic regression model to identify the most important influences to improvements in household wealth, a proxy for development. The information derived from these analyses is then used to further explain the outcomes of development in PDM.

The second part assesses the outcomes of development and conservation objectives in PDM through a land cover change analyses utilizing remotely sensed imagery. The land cover change analyses demonstrate forested versus non-forested area from key years in PDM's history. By using an image differencing technique, the results show the locations and quantities of land cover change within the settlement between years.

4.3.1 Statistical Analyses and Logistic Regression Model

The statistical analyses seek to address the factors influencing actual development outcomes in PDM. To gain more insight on the dynamics of development of PDM, I specified a logistic regression model to assess factors affecting development outcomes using indicator variables from my qualitative analyses. I then test the model using a subset of data (n=238) derived from a larger survey of over 700 households in the Amazon region. These surveys were collected in Simmons et al. (2005) collaborated NSF funded research award (0522062) between Michigan State University and the University of Florida, investigating DALR groups active in the Brazilian Amazon. They include

over 100 questions that address several different dimensions of the settlements, including household characteristics, agricultural production characteristics, education and ownership history, and perceived environmental challenges. The subset of data I used for analysis was from nine DALR settlements located in the South of Pará, including 27 surveys from the case study site of PDM.

The development variable, representing the dependent variable, indicated whether the household improved in terms of wealth. To calculate wealth, I used an asset-based approach used by Caldas et. al (2007) in a study performed in Uruará in the Brazilian Amazon, located further west along the Transamazon than the study site of PDM. In this method, household possession of durable goods is used to determine different categorical ranks of wealth. The goods assessed in this method include a stove, chainsaw, refrigerator, generator, television, satellite dish and motorcycle. The poorest households fit into category one, and did not possess any of the surveyed goods. In category two, the household possessed a stove or a chainsaw. In addition to meeting the criteria of category two, households in category three possessed a refrigerator, generator, television, satellite dish or motorcycle. Those households in category four were considered the wealthiest and met the requirements of category three and additionally owned either a car or a tractor (Caldas et al. 2007).

The 2006 secondary survey data contained the same necessary information about the goods used in Caldas et al. (2007), enabling me to create similar wealth categories. In addition, the survey data that I use asked about the assets owned by the household when they first arrived in the settlement, and the assets that they owned at the time of the

survey in 2006. From this data, I determined if there was a change in the level of wealth in the household. By determining if there had been an increase in wealth from when they arrived to the time of the survey, I created a binary variable of development, where 1 represented improvement in wealth and 0 represented no improvement.

From key informant interviews and a review of the secondary data, I identified a number of factors that were suggested as important influences on the success of meeting development and conservation goals, which represent the variables of my empirically based model of development. I examine each of these in turn, providing a brief review of the related literature and a discussion of how each may promote or impede development and/or conservation goals. The independent variables include (1) market engagement, (2) lot turnover, (3) social capital, (4) the presence of uncontrolled fires, (5) the diversity in annual and (6) perennial crops, (7) the number of cattle owned, Additionally, the model contains a number of control variables identified as important in literature on Amazonian development, including the years in residence, the possession of a title document, and the distance to market. In my discussion of these variables, I present descriptive statistics using the secondary data. I then show the results for a variety of t and z tests to compare the households in PDM to the other DALR settlements in the South of Pará.

Because the foci of the statistical analyses are to gain greater understanding of development in PDM, I applied the variables to a logistic regression model using development as the dependent variable, and the factors of development as independent variables. The purpose of the logistic regression model was to uncover the most significant factors contributing to development. Because it does not require normally distributed variables, homoscedasticity, or a linear relationship between the independent

variables and the dependent, the logistic regression analysis is appropriate for the data. Additionally, independent variables control for one another in a logistic regression model (Rogerson 2001). I conducted all of the statistical analyses utilizing the Systat 10 software package.

4.3.2 Remote Sensing Analysis Methods

To perform the remote sensing analysis, I used classified imagery previously processed for use in Simmons et al. (2007). The process used for classifying the image data began by importing raw Landsat TM and Landsat ETM imagery of the area, which were then atmospherically corrected and georectified, with an RMSE consistently below 1 pixel and generally below 0.5. During this process, the data also went through bilineal resampling which resulted in a pixel resolution of 30m. Next, the data underwent an unsupervised classification by clustering through the ISODATA function in Erdas Imagine, which produced 255 classes through 20 iterations with a .098 convergence. Categories were eliminated using Transformed Divergence, removing classes that had values of less than 1950. On average, the 255 classes were pared down to approximately 55 on each image.

Following that process, the resulting classes were used as a signature in Imagine's "Supervised Classification" routine using a Maximum Likelihood classifier. The resulting classified image containing approximately 55 statistically dissimilar pixel classes was then collapsed further through visual inspection into four discrete classes of Forest, Non-forest, Water, and Clouds. Small inclusions of less than three pixels were eliminated, which left behind empty pixels classified as 'no data.' These pixels generally make up

less than one percent of each image. The end product resulted in five classified images with a 30m resolution, from the years of 1984, 1988, 1996, 2000, and 2003. However, for the analysis I only used the images from the years 1988, 1996 and 2003.

The remote sensing analysis investigates the question, what has been the physical outcome on the landscape from the conservation and development objectives? To conduct the analyses of the classified images, they were then further processed using ArcGIS software. In order to quantitatively assess the land cover of PDM, I first needed to distinguish the settlement site from the rest of the images. I accomplished this by making a mask by using the polygon of PDM's settlement boundaries that was created by INCRA. However, the polygon did not contain interior parcel information, including the boundaries of the environmental reserve present in PDM.

In order to estimate the land cover change that had taken place inside the environmental reserve, I decided to create boundaries based upon a digital image of a detailed 2002 settlement map that I received from INCRA. I first registered the image in ArcGIS, matching the exterior boundaries to fit closely with the boundaries of the polygon produced by INCRA. During this process, I soon discovered that the map boundaries and the polygon boundaries did not perfectly align, as a small portion of the settlement's eastern boundary found on the map was not present in the polygon. Nonetheless, I chose 10 ground control points on the boundary that corresponded to distinct corners in the settlement boundary. Next, I created a new polygon in ArcGIS and began to draw in the missing boundaries. As the environmental reserve is bounded by the full northern boundary and also ran the full east and west extent of the settlement, I therefore only needed to draw in the southern boundary, and clipped the polygon to the

boundary provided by INCRA. I then created a masked area that included only the environmental reserve.

As each image had discrete classes, I was able to examine the attribute table to determine how many pixels of each class existed. I then multiplied the number of pixels by $30m^2$ to arrive with the area of the class in square meters and then subsequently performed conversions into hectares. Determining the type of change between classes, however, was slightly more difficult. To do this, I created a set of reclassified images, multiplying the old values by 10 to arrive at the new values and setting the empty pixels originally valued at 0 to NULL, thus simplifying analysis by removing them. I then used the Raster Math function to subtract the older image from the newer one. The resulting output appeared as a series of values, each representing a specific type of change. For example, the value of 2 was designated on the 1996 image as non forest, while non forest on the 2003 image was reclassified as 20. Therefore, when the two images were subtracted, areas that did not change were given the value of 18, while areas that went from forest in 1996 (value of 1) to non forest in 2003 (value of 20) appeared as 19. I then examined the attribute table to determine the area of that particular change.

4.4 Chapter Summary

For this thesis, the investigation of research questions is focused on the case study of PDM. Both quantitative and qualitative data analyses were undertaken in the investigation of the research questions, which were comprised of three main components: key informant interviews, and analyses of statistical data and remotely sensed imagery.

The qualitative data analyses seek to understand the conservation and development objectives of different groups that then influence and set parameters to the objectives of the settlers and the pursuit of conservation and development in the settlement. These analyses call attention to common themes utilized in key informant interviews, web sources, and documents that discuss objectives and priorities for conservation and development goals.

The quantitative data analyses are informed by the results of the qualitative data analyses to assess the outcomes of the conservation and development objectives in PDM. To assess the outcomes of development, I created a development variable based on categorical wealth used in Caldas et al. (2007) and used it to compare PDM with other DALR settlements in the South of Pará. In an effort to gain further understanding of the mechanisms affecting development in PDM, I examined several factors of development that were informed by key informant interviews and secondary sources in comparison to other DALR settlements. I then applied these factors to a logistic regression model to determine which of the independent variables had the greatest influence on development, or the dependent variable. Then, focusing on conservation, I conducted a land cover change analysis of the case study settlement using remotely sensed imagery and image differencing techniques.

Chapter V

Overview of the Case Study: Primeiro de Março

5.1 Introduction

This thesis primarily focuses on the settlement project of Primeiro de Março (PDM), which was chosen as the case study site because it 1) was created as a result of efforts by a DALR organization, 2) is located in a regional focal point for early economic development initiatives, and 3) has included within its plans a specific effort to incorporate conservation policy with the creation of an official community environmental reserve. Thus, it makes an ideal location to investigate how settlers in a DALR settlement have negotiated between conservation and development objectives.

In any location, knowledge of history is important to understanding processes influencing its present conditions. While it has its own peculiarities, the general history of the settlement PDM is not unlike many of the other agrarian reform settlements located in the South of Pará. The creation of a settlement is a complicated and politically charged process that is both constrained and enabled by government support. In order to gain government support and eventual status as a settlement project, strong leadership, strategic organization and perseverance are required on the part of the DALR participants in each stage of the process as they call INCRA's attention to the area, and endure the sometimes violent reactions of landholders attempting to resist the expropriation of their property.

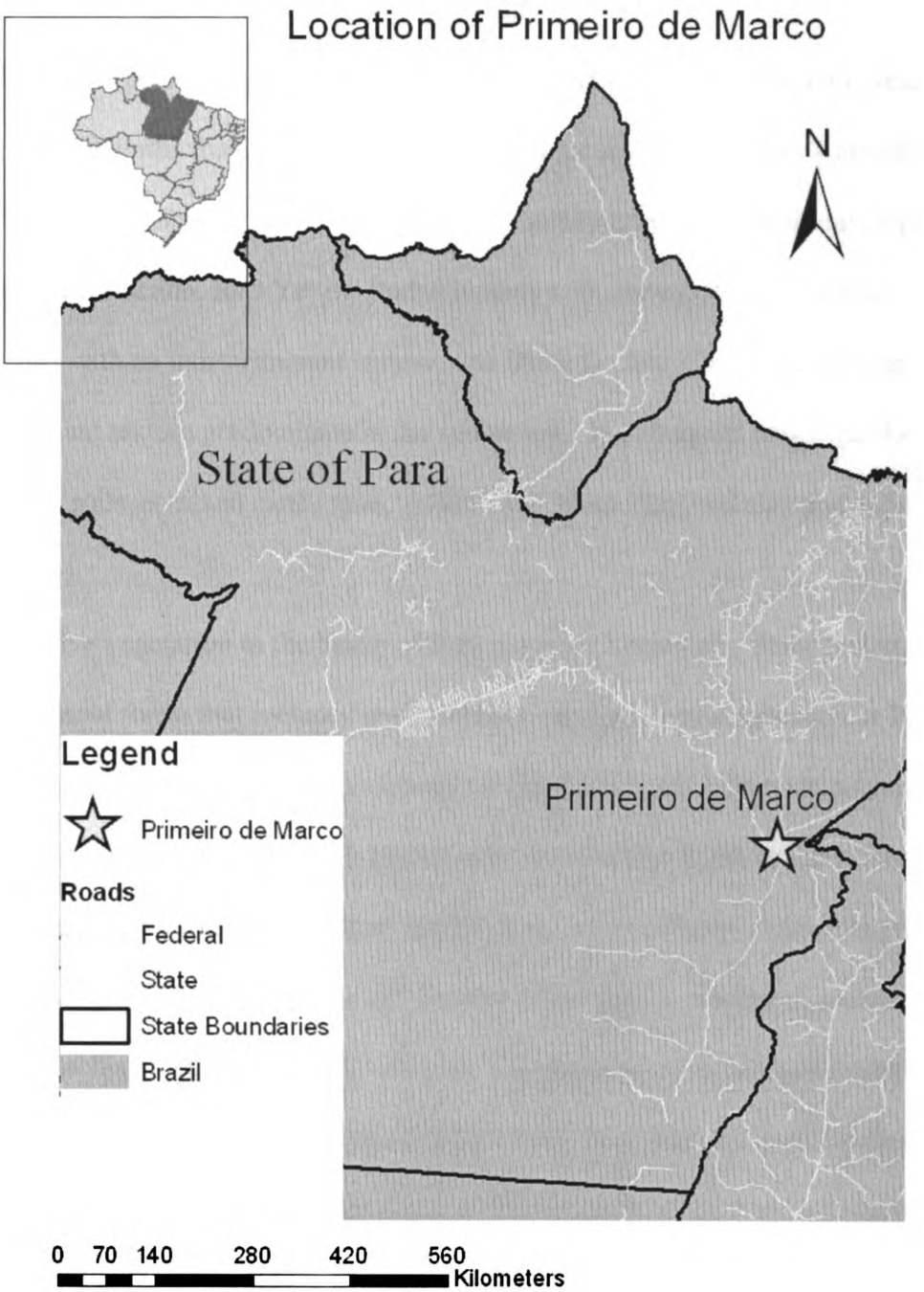
However, the complexity, politics and struggle do not end when the settlement project is formed. Instead, they continue as members of the settlement work to negotiate and define their own collective objectives, as well as negotiate those requirements and objectives defined by the government in order to secure funding for infrastructure and development projects. As discussed in Chapter III, conservation initiatives in the Amazon have evolved to address environmental issues linked with economic development. Social movement organizations involved in agrarian reform efforts (such as the MST) as well as the government institutions in charge of settlement in the Amazon region both have explicit ideas and objectives regarding the role of conservation in development, which is evident in the history of PDM. This chapter places PDM in context and details the evolution of the settlement from its beginning in 1996 until 2007.

5.2 Location

Primeiro de Março (PDM) is an INCRA settlement project established through agrarian reform efforts that were initiated by the MST about a decade ago. As described in Chapter III, the settlement is located in the region known as the South of Pará, recognized for its complex history of economic development based on resource extraction, exploitive labor relationships and particularly violent land conflict (Simmons et al. 2007). More specifically, however, PDM is located in the *município*[2] São João do Araguaia, at the absolute location of 05 19'21" South and 48 59'06" West. Belém, the capital city of Pará, is roughly 516 km to the north, and the nearest city, Marabá, is roughly 23 km east of the settlement and is accessible by the BR-230, a paved federal

[2] A município functions similarly to a county division in the USA

road commonly known as the Transamazon highway. (See Figure 4.3A).



(Figure 4.3A) Location of Primeiro de Março

Climatic conditions in the area where the settlement is located vary annually both in temperature and humidity. The temperature generally ranges between 26 and 30 degrees Celsius, and the relative humidity varies between 77% and 88% throughout the year. The rains occur in well defined periods through the year with the rainy season lasting seven months from October to May and a drier season from June through September. According to the Ministry of Mines and Energy of the National Department of Mineral Production, Red-Yellow Podzalic soils with clayey or gravel texture, Distrofic Lithic soils with an indiscriminant texture, and Distrofic Alic Cambissol with an indiscriminant texture predominate in the settlement. In colloquial language, the settlers classify the soils as mixed earth, sand, yellow clay, black clay, red clay and *piçarra*[3] (PDA 2005).

Native vegetation to the South of Pará has been historically described as closed canopy tropical forest that included economically valuable hardwoods such as Brazil Nut (*bertholletia excelsa*), mahogany (*swietenia macrophylla*), and rubber trees (*hevea brasiliensis*) (Simmons et al. 2007). Historically the area that PDM occupies was heavily forested and located within the 'Brazil nut Polygon,' an area renowned for its production of Brazil nuts in the first half of the 20th century (PDA 2005). However, pasture began rapidly replacing forest in the 1980s when the previous owner of the land started ranching operations. The PDA (2005) indicates that there may have been a link between the installation of the Transamazon highway and the change in land cover to pasture with the establishment in the general area of cattle ranches, known as *fazendas*. This trend toward

[3] *Piçarra* is a gravel of mixed consistency that is frequently used for road construction.

pasture has been carried on by settlers in agrarian reform settlements and has continued through to the present.

5.3 The Early History of PDM

The settlement PDM was formed on property that had been previously known as the Fazenda São Tomé, a large ranch focused on cattle production. The occupation and eventual expropriation of this property, also frequently called Fazenda Pastoriza, was the direct result of initiatives set forth by the MST in collaboration with the CPT. In this area, it was common for land reform movement leaders to work with the CPT, who employed lawyers that helped identify properties with a history of conflict, and particularly problems with violence. Fazenda São Tomé had gained attention from the CPT particularly because it carried a history of violence against labor. In 1995, for example, several newspapers covered the deaths of three workers on the *fazenda*, who were killed by police following a misunderstanding with the owner. After consultation with the CPT, local leaders connected with the MST agreed to target Fazenda São Tomé for occupation and expropriation.

Once the site for occupation had been targeted, recruitment efforts were focused on *favelas,* or poor squatter settlements within cities. Some of the sites for recruitment were local, from Marabá or São Felix, but others were recruited from great distances away, from states such as Maranhão, Pernambuco, and Mato Grosso. Stations were set up in the cities, and information was spread through announcements on the radio, trucks with loud speakers driving through the streets, and by word of mouth. The vast majority of people, about 42%, came from Maranhão (PDA 2005). The occupations of the settlers

before arriving in PDM included farmers (54%), self employed workers (13%), housewives (7.5%), and employees of 'diverse jobs' (24%) such as carpenters or field hands at *fazendas*. However, a settlement leader commented in an interview that the efforts were targeted at people who were unemployed, many of whom had previously been small holders who lived in rural areas before relocating to cities.

The planning for occupation itself was carefully done, partially occurring during the period of recruitment. Fazenda São Tomé was observed by members of the MST for a few months from a neighboring settlement project, Araras. During that time, the plan for occupation was formed. On December 17, 1996, approximately 1,200 families coordinated by the MST met at the headquarters of INCRA in Marabá, where they created an encampment, organized into groups and appealed to INCRA for the expropriation of the land.

On December 24, 1996, the families broke camp from INCRA's headquarters and made a new encampment on the border of the settlement project Araras with Fazenda São Tomé. While they stayed in the encampment, the people met their needs by demanding and receiving a *cesta básca*, or a bundle of basic food staples distributed as a part of a rural welfare program, from INCRA. The families waited for months, until finally, on March 1st, 1997, they moved to occupy the Fazenda. The location of the new encampment was chosen by MST militants, who symbolically cut the Fazenda's fences to initiate the occupation. The settlement would later gain its namesake in honor of this event.

However, not all of the families in the original encampment stayed to see that moment. Many of the families exhausted from waiting and hunger gave up and returned

to INCRA in the early morning before the occupation. Those families were directed to a government settlement site called Campo do Tapirapé, near the towns of Novo Repartimento and Pacajá, more that 100 km further west along the Transamazonian highway. In this isolated region, those families were afflicted by disease, particularly malaria. After a few months, some of the families tried to return to the camp. However, they could not be registered with INCRA by that time and were forced to leave.

Typical of the MST's regimented style, affairs were managed through strict organization in the encampment. Families organized themselves in 15 large groups, containing between 16 and 43 families. Each group had a coordinator trained by the MST who organized the collaboration of different labor sectors of the encampment, including sectors that managed production, education, health, food, discipline, security and leisure. Each family group had a representative in every sector to raise issues and participate in larger coordination meetings of the encampment.

After creating a new encampment on the Fazenda, the largest obstacle was getting food in the settlement. Food was scarce because the *cestas basicas* were not regularly delivered. When they were delivered, many people became sick with gastrointestinal illness, causing them to suspect contamination of the food. Although the settlers began preparing an area of 335 ha to plant crops such as rice, corn, manioc and beans in June of 1997, this did not solve the problem of food scarcity. People from the encampment turned to holding up and robbing trucks transporting food along the Transamazon Highway, which stirred up enough attention to get INCRA to open an investigation of Fazenda São Tomé, followed by negotiations for expropriation.

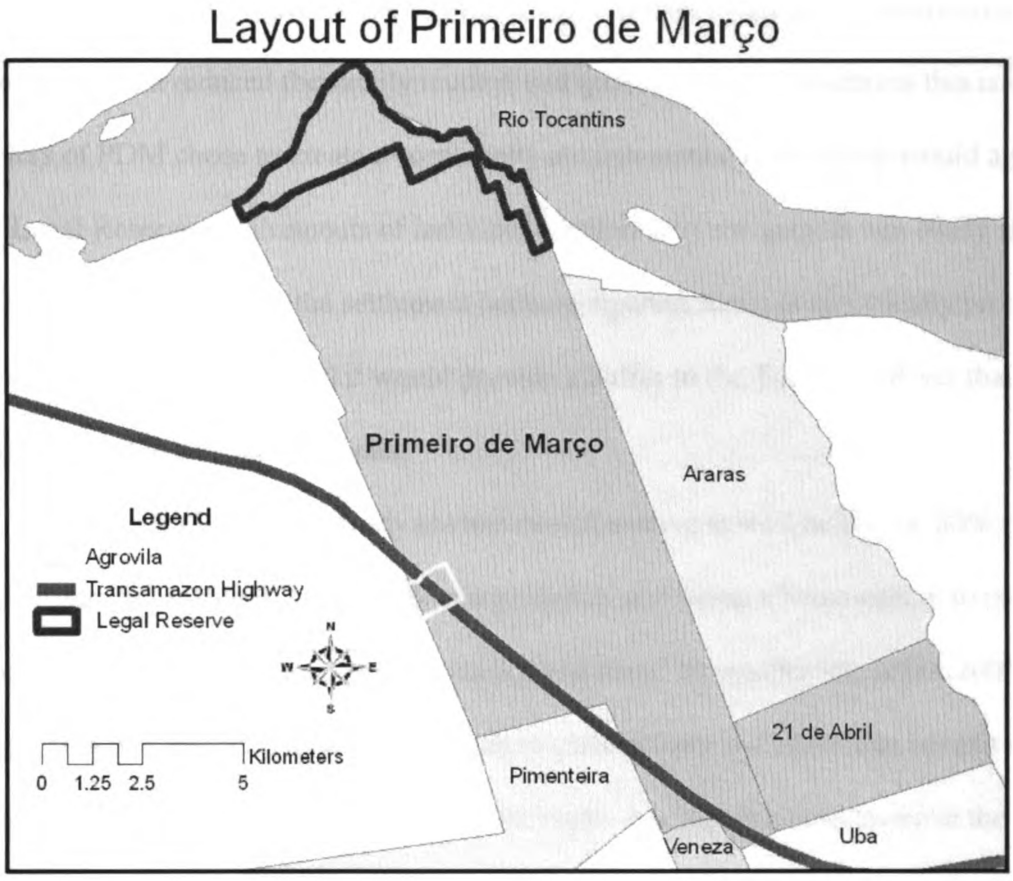
By regulation, the creation of a community organizing body is necessary in order to proceed with the formation of a settlement. This is usually done by members of a settlement creating a community association, which serves as a forum to discuss the process of development and to determine the routes to pursue it by (INCRA 2006d). Similarly, a cooperative is an association of at least 20 people with the same economic activities and an objective to promote their social well-being. It has characteristics of a mercantile society, and they seek competitive involvement in market activities (INCRA 2006d).

As soon as the negotiations had begun between INCRA and the owner of Fazenda São Tomé, the settlers in conjunction with the MST founded the first producer's organization, the Association of Production and Commercialization of the Rural Workers of PDM (APROCTRAM).

5.3.1 The Achievement of Settlement Status

In August 1998, the negotiations between INCRA and the previous owner of Fazenda São Tomé were finally complete and the area was officially recognized as the settlement project PDM. The settlement was created on an area that encompasses a total area of 11,050 ha, and was split into 340 lots at that time. Each family received an agricultural lot that ranged in area from 25 to 31 ha as well as a lot measuring 20m by 30m in the settlement village (PDA 2005). Known as the *agrovila*, the purpose of the settlement village is to cluster the houses in order to more easily provide services to residents, as well as facilitate a sense of community (PDA 2005). Initially, there was disagreement among the settlers over where the *agrovila* should be located. Many of the

settlers believed that the *agrovila* should have been established at the site of the old headquarters of Fazenda São Tomé on the northern border near the Tocantins River. After much debate, however, the *agrovila* was finally located on the Transamazon Highway to facilitate transportation, as shown in Figure 5.3.1A (PDA 2005).



(Figure 5.3.1A) Layout of Primeiro de Março

Alternatively, the area on the northern boundary of the settlement was designated as an environmental reserve encompassing 947 ha, or 8% or the total area of the settlement (PDA 2005). The law 4771 of September 15, 1965, known as the Forestry Code, required that 50% of forest cover on a property must be preserved in an area known as *Reserva Legal*, or Legal Reserve. The law was altered in 1989, augmenting the

area required for Legal Reserve to 80% in the Amazon and leaving 20% for alternative use in production.

Because lots are relatively small in agrarian reform settlements, keeping 80% of land in Legal Reserve means a significant reduction in small farmer productive capacity. According to the PDA (2005), the limited amount of land available for cultivation translates into a reduced the family income and quality of life. To address this issue, the settlers of PDM chose to create a community environmental reserve that would aggregate the Legal Reserve requirements of individual settlers into one area. It was likely situated on the northern border of the settlement because riparian forest is specifically protected under the Forestry Code, and it would provide a buffer to the Tocantins River that is most likely subject to occasional floods.

The area of the community environmental reserve is well below the 80% that is required to be protected; however, it is regarded as still being a better option to protect biodiversity than to fragment smaller portions of forest on smaller lots (PDA 2005). This larger area was intended to provide habitat to diverse flora and fauna that benefit not just families in the settlement, but also the entire region because it would improve the quality of the air and water, contribute to cooler microclimate, and provide a source for medicinal plants as well as a source for food in the form of fruit and bushmeat.

Gaining status from INCRA as a settlement project meant that the settlers became eligible for government credit to invest in community development projects. After two years of encampment, the settlers were running out of money and were facing financial difficulties (PDA 2005). However, credit was made available for them by INCRA with the finalization of negotiations (PDA 2005), including *Crédito Alimentação* for general

foods needed for household subsistence, *Crédito Habitação* to construct housing, and *Crédito Fomento* for tools and supplies to initiate productive activities within the settlement (INCRA 2006d).

Soon after the creation of the settlement, a series of disagreements began among the settlers. One of the first large ones involved the directors of the Production Sector with the coordinators and director of APROCTRAM about the financing in the credit line PROCERA TETO II, which was supposed to be collectively used for infrastructure to develop production in the settlement. However, the investments that were made only benefited a small minority of the settlers. The management of APROCTRAM was later accused in 1999 of embezzling resources. In response to these issues, some of the settlers formed the 'Virgulino[4] Group' to ensure accountability in the management of funds. Soon after these issues arose the settlement was awarded with housing credit. Not long after that, the Virgulino Group officially broke their relationship with the MST and founded a new association called the Association of the Rural Producers of the Virgulino Group (APROVIR).

In March of 2000, funding from the credit line PRONAF A was approved by INCRA for investments in agriculture and livestock, and so efforts in the settlement focused on implementation of economic development projects that were divvied up between designated working groups. However, many individual members of the groups did not work cooperatively with each other, creating conflict that made the implementation and completion of collective projects difficult. Negative outcomes

[4] Virgulino is likely a reference to a popular folk hero from the Brazilian state of Pernambuco, known for his strength of character and honesty.

included late harvest and loss of crops, as well as settlers abandoning their work. Additionally, the finance team did not properly manage spending, and too many resources were allocated to some projects, while not enough were allocated to others.

5.3.2 Organizational Rifts Open in PDM

In 2001, the problems in the settlement between different associations became severe as contrasting politics encouraged divisions within the community, further contributing to the failure of collective projects. By 2002, with continuation of internal problems, the Association of the Rural Producers of PDM (ASPRAM) was created without links to the MST. By May of 2003, dissidents of the MST and associates of ASPRAM founded another group in the settlement, known as the Cooperative of the Rural Producers of the Settlement PDM (COOPERPRAM). By October of that year, the coordinated working groups formed by the MST had dissolved, and disputes broke out in the settlement that created a tense climate.

The following year in October of 2003, PDM became the site of a gun battle and violence ensued. Various buildings were destroyed, power lines were knocked down and even a few cattle were shot. One newspaper article claimed that the settlement had turned into a 'barrel of gunpowder,' implying that it didn't take much to ignite the conflicts (Sousa 2003). A representative of the MST claimed that in the months leading up to the incident, members of the organization frequently received death threats from dissenting groups. Additionally, the representative claimed that the conflicts were due to the high turnover rates and the consolidation of lots to create 'small ranches.' He went on to state that ranchers were even buying up lots in the settlement and placing their employees on

them, pretending to occupy the land in order to put cattle on it. Furthermore, he asserted, squatters had occupied the Environmental Reserve, and were renting out the land to ranchers (MST_Pará. 2003). It appeared from the articles that the MST had confronted some of the perpetrators of these violations, which may have started the conflict.

A week after the incident, IBAMA, with the help of the military police, investigated the settlement to find dozens of illegal charcoal ovens in the environmental reserve. Additionally, many of these ovens were operated by children who were forced to work up to 10 hours a day for just one plate of food (Santos 2003a). While some of the owners were from the settlement, others reportedly lived in Marabá. In any case, the owners of the ovens were therefore guilty of both environmental crimes as well as crimes for exploiting child labor. Brazil nut trees were among the species being illegally cut. When one of the violators was questioned about it, he simply replied that he did not know what kind of tree it was, but he was sure that it wasn't Brazil nut (Santos 2003a).

After the violations were discovered in the settlement in October of 2003, INCRA proceeded to repossess many of the lots and remove the people who were not registered as clients of agrarian reform. Additionally, the people who had cattle in the environmental reserve were given notification to remove the animals within a month. At that time, INCRA also stated that there was no agriculture of any type that existed in the settlement (Santos 2003b).

5.4 The Settlement in Recent Years

Today, PDM is one of numerous agrarian reform settlements that have been formed in the area (PDA 2005). The settlement in 2005 consisted of approximately 338

families, constituting a population of 1,690 persons (PDA 2005). Less than half of these residents have chosen to live in the *agrovila*, due to the large size of the settlement. Because many of the agricultural lots were located several kilometers from the *agrovila*, a lot of the families sold or rented their agricultural lots and remained in the *agrovila.* Conversely, others sold or rented their houses and moved primarily to live on the agricultural lot.

In the *agrovila,* the acquisition of habitation credit supported the construction of 247 residential houses of wood or cinder block measuring 6m by 8m. In addition to the homes, the *agrovila* consists of a variety of stores, two churches, several bars and a school that educates children from first through eighth grade. Residents have access to simple utilities such as electricity and well water within the community.

As summarized in Figure 5.4A from the 2006 secondary survey data, families are comprised on average of less than five people and consist of more men than women. The mean number of years that residents have inhabited their lots is just over six. Nearly 75% are the owners of the lot, while the other 25 % are either renting the land or are have been hired to manage the lot. The household head had an average of less than two years of formal schooling.

(Table 5.4A) Household Characteristics of Primeiro de Março

Characteristics	Mean (n=27)
Number of families on property	1
Number of people on property	4.48
No. of Men	1.37
No. of Women	0.93
No. of Children (under 18)	2.07
No. of Elderly (65 and over)	0.15
Period of residence (yrs)	6.08
Age of household head (yrs)	45.96
Education of household head (yrs)	1.88
Owner resides on the lot (%)	74.07
History of urban to rural migration (%)	53.85

Overwhelmingly, production in PDM is focused on cattle. According to the 2006 secondary data survey, about 81% of the residents of the settlement own cattle, with the average number being about 30 animals (see Table 5.4B). A little over half of the agricultural lots are dedicated to pasture, with mean area of pasture being 16 ha, or about half of the average lot size. A small portion of the survey respondents, 7.69 %, also said that they had rented pasture to others in 2005.

(Table 5.4B) Cattle Production in Primeiro de Março

Cattle Production	Mean (n=27)
Raise Cattle (%)	81.48
Number of cattle owned (head)	30.31
Area of pasture/household (ha)	16.48
Households that rented out pasture 2005 (%)	7.69

Agriculture production appears limited in PDM. While many settlers have small gardens near their homes, the principle purpose of raising crops is for subsistence. About

15% of the households from the 2006 survey responded that they did not produce any type of crop. Between annual and perennial crops, more households (70%) produced perennial crops than did annual crops (66%). Of those households that raised annual crops, the top three most common were rice, corn and cassava, while the top three perennial crops included banana, citrus and cashew. Table 5.4C demonstrates the proportion of the people who cultivated annual and perennial crops.

(Table 5.4C) Most Important Crops for PDM (2005)

Annuals	Proportion cultivated (%) (n=27)	Mean Area of cultivation (ha)
Rice	62.96	1.09
Corn	62.96	0.94
Cassava	42.30	0.38

Perennials	Proportion cultivated (%) (n=27)	Mean Area of cultivation (ha)*
Banana	40.74	N/A
Citrus	18.52	N/A
Cashew	11.11	N/A

*Because of inconsistent measurements used by settlers of crop areas, the information on crop area is not available.

The trends of financial support reflect those of production in PDM. Nearly 80% of all private and government financial support for production went towards livestock, while less than 20% of funds supported investments in perennial or annual crops. From key informant interviews, several different development projects have been initiated by INCRA in the settlement, but have been met with limited success. For example, a key informant described extensive funding was allocated to commence pork production in the settlement, but was largely unsuccessful because of lack of water. More recently,

however, credit to initiate banana production had been allocated to several settlers, and those projects seemed to be going very well. (jovenilsen)

At present, maintenance of the environmental reserve continues to be challenge in PDM. People have remained in the environmental reserve, occupying lots that were illegally demarcated. Cattle also continue to graze in the environmental reserve, and illegal timber harvest for charcoal persists despite attempted enforcement of environmental laws. The reserve is estimated to be approximately 40% pasture and other infrastructure that was left by the previous owner of the property, and 20% secondary forest. The remaining 40% was reported to be closed-canopy forest (PDA 2005).

5.5 Chapter Summary

PDM is one of many DALR INCRA agrarian reform settlement projects in the South of Pará, an area that has traditionally been a focal point for economic development efforts. In addition to these characteristics, PDM was chosen as a case study site because it has specifically incorporated environmental objectives into its planning. This chapter sets the historical and site specific context of the settlement, outlining its evolution and characteristics. Through this narrative, this chapter additionally identifies the major groups instrumental in creating development and environmental policy, including INCRA, the MST, and the settlers themselves. In the following chapter, I will investigate how conservation and development are defined by those groups as well as how those definitions have influenced approaches to conservation and development within the settlement.

Chapter VI

Qualitative Data Assessment
Examining Conservation and Development Objectives

6.1 Introduction

As discussed in the overview of the case study in Chapter V, the Direct Action Land Reform (DALR) organization of the *Movimento dos Trabalhadores Rurais Sem Terra* (MST) and the government agency of *Instituto Nacional de Colonizção e Reforma Agraria* (INCRA) are two national organizations that are vital in initiating and forming the settlement project. In their roles, they have both heavily contributed to the creation of local, site specific policy for Primeiro de Março (PDM) that is manifested in the *Plano do Assentamento* (PDA) and also discussed in this chapter. As local level actors, the settlers of PDM are largely responsible for interpreting and then implementing plans for conservation and development.

This chapter focuses on qualitative data assessment to identify the conservation and development objectives of different actors at multiple scales for agrarian reform settlements, focusing on the South of Pará and particularly in the case study site of PDM. Presented here are analyses within four different categories at different scales including INCRA and the MST at national and regional scales, and the PDA and the settlers of PDM at the local scale. For each one of these categories, I identify the objectives of conservation and development, focusing on priorities, challenges and relationships identified in reoccurring themes within key informant interviews and reports. I also identify factors that potentially influence development success, which are then included

in my empirical model of development presented in Chapter VII. I conclude this chapter with a comparison of the objectives between categories.

6.2 *Instituto Nacional de Colonização e Reforma Agraria* (INCRA)

INCRA is the government agency responsible for the creation and development of agrarian reform settlement projects that works throughout Brazil. As described in Chapter IV addressing methods, the information for this section was acquired from INCRA's official website as well as key informant interviews with INCRA personnel at the Marabá headquarters, which is the office responsible for the region in which PDM is located. While only one of the interviews was with an engineer who worked directly on the economic development initiatives of the settlement PDM, all three of the key informants, Ana, Vagner, and Saulo,[5] worked primarily at the local office.

INCRA's goals are prioritized by its mission. According to INCRA's official website, the agency's specific mission is to carry out agrarian reform, maintain the national registry of rural property, and administer the public lands of the Union (INCRA 2006b). A significant part of fulfilling this mission is through the creation and management of agrarian reform settlements. The *Projecto do Assentamento*, or Settlement Project (PA) is described as an embodiment of agrarian reform, defined as

[5] Pseudonyms, were used to protect the anonymity of key informants, by Human Subjects Institutional Review Board (IRB) at Michigan State University.

"promoting better distribution of the land ... to attend to the principles of social justice and to increase [the land's] productivity" (INCRA 2006d).[6]

Information on the INCRA website further states that settlements are formed through agrarian reform with the "goal that [the settlers] cultivate the land and promote their economic development" (INCRA 2006d).[7] The ultimate objective of INCRA is to emancipate each agrarian reform settlement from their supervision, which occurs when the settlement "finds a stable path toward economic development and is able to integrate itself into the life of the *municipio*[8] where it is located" (INCRA 2006d).[9] As land is assumed to be given to people who will begin small farming operations, the search for the stable economic path to development focuses largely on agricultural production.

These objectives are further supported by key informant interviews at the INCRA headquarters in Marabá. When discussing the function of INCRA and of its settlement projects, Ana reinforced the information from the website by stating that the purpose behind creating settlements was to ensure that the land was being used productively. When asked to define productivity, she responded, "Productive is when [the land] attends to a social function, for example, it serves workers, and the majority are...employed."[10] She further elaborated upon that point to say that the ultimate goal for the settlement

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[6] *"É um conjunto de medidas que visa promover a melhor distribuição da terra,mediante modificação no regime de sua posse e uso, a fim de atender aos princípios da justiça social e ao aumento de produtividade".*

[7] *"...fim de que a cultivem e promovam seu desenvolvimento econômico."*

[8] A *municipio* functions similarly to a county division in the USA.

[9] *" ...conseguiu encontrar seu caminho de desenvolvimento econômico estando consolidado e apto a integrar-se a vida do município em que está implantado."*

[10] *"Productiva é cuando ela tem, atende uma parte social, por exemplo, tem um parte de empregados, tem a maioria.... trabahlando"*

projects was to equip residents to reach socio-economic development and to become autonomous.

The environment and concerns about the environmental impacts of its projects for socio-economic development have only recently been incorporated into INCRA's objectives for agrarian reform. It was not until 2003 that INCRA officially adopted the concept of *desenvolvimento sustentável,* or sustainable development, into its objectives. In discussing the concept, the INCRA website states that it has incorporated "between its priorities"[11] of social justice and socio-economic development, a new objective to "implant compatible models with the potentialities and biomes of every region of the country and to foster the spatial integration of the projects" (INCRA 2006b).[12]

These changes were also demonstrated in the key informant interviews at the INCRA headquarters in Marabá. When I asked if environmental considerations were incorporated into the planning of agrarian reform settlements, Ana said yes and made a point to explain that policy had shifted so that "presently, areas that have forest are no longer expropriated." [13] Previously, forested lands were viewed as "unproductive," and subject to expropriation. The specific shift in policy that Ana described involves the implementation of environmental licensing in from the *Conselho Nacional do Meio Ambiente* (CONAMA), the agency within Brazil's Ministry of the Environment that develops policy. The licensing focuses on the assessment of land cover to ensure that large areas of forest are no longer redistributed to settlement projects.

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[11] "*entre suas prioridades*"

[12] "*implanter modelos compatíveis com as potencialidades e biomas de cada região do País e fomenter a integração especial dos projetos.*"

[13] "*Hoje area tem mata não é disapropriada assim.*" Personal communication, 6/20/07

When asked about the reason for policy changes she stated, "Today, there is more global attention to the environment. People are more educated about biodiversity and global warming. We know that forests are valuable."[14] Besides demonstrating a change in policy to include environmental objectives into the creation of settlements, this statement also reflects an international influence in Brazilian conservation policy by expressing global concerns of biodiversity loss and global warming, following the trends discussed in Chapter III, Section 3.4.5. Moreover, it highlights a conservation focus on forests.

In addition to the licensing, other regional environmental regulations oriented towards preserving forest cover must be adhered to within the agrarian reform settlements. The Forest Code, as previously discussed in Section 3.4.5, requires that 80% of land must remain untouched in forest in the Amazon region and is one of such regulations. Another extension of that law was added in 2005, stipulating that properties that had been previously deforested and do not meet that regulation must reforest.

The style of implementation of these laws by INCRA reflects the agency's priorities. The type of system for reforestation and the tree species to be planted in reforestation projects remains unspecified by law. While INCRA suggests that reforestation projects should consider native species and fruit trees, it prioritizes reforestation with the most economically valuable species, either native or exotic (INCRA 2006c). Overall, Economic growth is prioritized over ecological concerns, and

[14] *"Hoje, existe mais attenção global ao meio ambiente. As pessoas são mais educadas da biodiversidade e a afeta da estufa.Sabe que a floresta tem valor"* Personal Communication 06/19/07

conservation is simplified to meeting land cover regulation. Unless geared towards market activities, conservation is largely treated separate.

Consequently, there have been several regional and local challenges related to synthesizing the concepts of development and conservation. A key informant, Saulo, directly linked the creation of local settlement projects with changes in livelihoods and deforestation in the area. He stated:

> In the past, there were forests around the city, with lots of wildlife. I used to see wildlife crossing the roads. Everything was forest, full of Brazil nut trees. People used to harvest and sell Brazil Nuts. When the question about the settlements, about agrarian reform started, all that stopped [15]

These changes are an indication that at least INCRA's conservation objectives as are not being met. Specific challenges as identified by INCRA officials can be further explored by examining the case study. As development and conservation objectives are predominantly approached separately by INCRA, I begin discussion by examining their challenges separately. In PDM, there are numerous challenges to productivity and consequently socio-economic development. According to Vagner, many different strategies to development had been attempted in PDM. One of the principle productive activities in the settlement is raising cattle. While heavily funded by credit made available through INCRA, there are problems in that it is not returning as much profit as anticipated to the settlement, and expansion is limited relative to lot size. As Vagner stated, "They have cattle, several different kinds of cattle, but the project is being thrown out because the area is too small. Only raising animals is not adequate enough for the

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[15] *"No passado, existiam florestas perto da cidade, com muitos animais. Via-os cruzando os caminhos. Era tuda mata, muito Castanha. Cuando comensou a questao do assentamento, da reforma agraria, acabou tudo."* Personal Communication, 06/20/07

settlement."[16] He also mentioned several other projects that were initiated in the settlement, but said that the majority of projects did not succeed. Specifically, he identified projects for chickens and pigs, as well as different types of agricultural crops such as pepper, banana and *cupuaçu*.

I then asked him why the many of the projects were not succeeding. Although his first response was "*por falta de sorte*," meaning because of bad luck, he then went on to further explain. He identified three main issues, including 1) poor investment of resources, 2) poor organization, and 3) lack of knowledge. Vagner began by stating, 'Project failure wasn't necessarily for lack of money because they had resources. Rather, it was invested poorly, badly employed." [17] As an example, he described money that was given to settlers to invest in planting fruit trees. Instead, that money was spent to pay other debts and the trees were never planted. Additionally, he described a lack of organization, saying "the projects did not succeed because they didn't have any type of social organization."[18] Related to this, Vagner went on to say the process of project implementation was difficult because many settlers did not have experience in the projects pursued. He stated that the settlers lacked the knowledge to manage the projects, saying "there isn't anyone giving [technical] assistance, giving them direction."[19] Explaining this idea further, he stated:

> Nor does everybody that is involved in agrarian reform necessarily have a past working with agriculture or working in fields. They may only have been employed at some other ranch with cattle, for example. Perhaps they have never

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[16] "*Tem boi, boi de varias, mais estão tirando o projeto de gado porque area pequena, pecuaria exclusiva não é adequado por o assentamento.*" Personal Communication, 06/19/07

[17] "*Nao foi necesariamente por falto de dineiro porque tem recurso, mais foi malinvestido, malempregado.*" Personal Communication, 06/19/07

[18] "*Não deu certo porque não teve ningum organização social.*" Personal Communication, 06/19/07

[19] "*Não tem alguem dando assistencia, dando orientção.*" Personal Communication, 06/19/07

planted *cupuaçu* or pepper, so they do not know what is goes into it. They never worked with pigs or chickens. How can they succeed in doing projects well?[20]

Difficulty meeting goals not only affects development objectives in PDM, but its conservation objectives as well. According to Vagner, the environmental projects are not succeeding within the settlement, either. The environmental reserve was of particular focus to Vagner regarding conservation. He commented that deforestation was a very large concern, primarily because "the people don't respect the reserve."[21] Explaining that the proximity of PDM to the city of Marabá attracts a lot of people to the settlement, he said that people have illegally broken the environmental reserve into lots. As a result, "in reality, there is no reserve...the best is if we could move them to a new settlement so they wouldn't continue to do harm there."[22] While the illegal squatters would be forced to move if land opens up somewhere else, Vagner also expressed concern that there would always be a steady stream of people to replace them.

Vagner went on to say that self-enforcement of regulations in the settlement was nearly impossible, further contributing to challenges of conservation in the settlement. "A problem there that we are working on is that there is a dispute over power between the different associations. We can't get anyone to work together and agree. Instead, it is just arguing, arguing, arguing."[23]

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[20] *"Nem todo mundo que é afetado por reforma agraria eles necessarimente nao tem um passado de trabalho agricultura ou trabalho de campo. Só trabalhou de empregado ou algúm otra Fazenda com gado, por exemplo, talvez nunca tem plantado cupaçu, nunca tem plantado pimenta. Ai não sabe a quantos é com aquilo, nunca trabalhou com porcos, galinhas. Ai como conseguir a fazer os projectos bem?"*

[21] *"eles não respetan a reserva"* Personal Communication, 06/19/07

[22] *"A realidade é que a reserve não existe... o melhor seria as mudar a outro lugar para que não façam mais dano."* Personal Communication, 06/19/07

[23] *"O problema la que a gente trabalhar e um questao das associacoes existe uma briga la de poder entre eles e que a gente não pode reconciliar. Só é briga, briga, briga."* Personal Communication, 06/19/07

Vagner also expressed frustration about efforts to implement reforestation programs. "We had seedlings shipped to PDM. They were left on the side of the road, or perhaps [the settlers] just didn't know how to plant them. We asked them why it did work out, if they had everything they needed. They said they didn't have adequate help." [24] When asked why not, Vagner shrugged his shoulders and said "The system takes a long time, the state takes a long time, INCRA takes a long time. We've been on strike now for four months, and we are stopped."[25]

In many ways, the challenges with economic development and conservation seem to intersect. The environmental reserve, for example, appeared to be considered somewhat of a constraint to economic development. In regards to the conservation requirements to keep 80% of lots in forest cover, Saulo commented, "It is difficult to cover environmental questions. Having a lot doesn't make you progress when you can't use it." [26] It also appeared that the INCRA officials viewed economic development as necessary priority in order for conservation to occur. Vagner commented that, "production needs to give a profit... people only dedicate themselves to 'that [environmental issues] when their other needs have been met."[27]

Fire also appeared as a challenge to both meeting conservation and development objectives. Burning is a common technique used to prepare and maintain pasture in throughout the region, and is also very prevalent in the settlement, despite being illegal.

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[24] *"As mudas foram enviado ai, deixaram na estada. Talvez eles não souberam como plantá-los. Cuando perguntei porque não deu certo, eles dizeram que não tem assistencia adequada."* Personal Communication, 06/19/07

[25] *"Porque a sistema demora, o estado demora, o INCRA aqui demora prevista aqui a greve ja tem quatro mes e a gente parou."* Personal Communication, 06/19/07

[26] *"Ai e dificil cobrar questaos ambientais. Nao adianta ter o lote cuando não pode usar."*

[27] *A produção tem que da lucro. Eles só se dedicarão a esso se supria as outras necessidades"* Personal Communication, 06/19/07

Although fire is utilized frequently, on many occasions in the past it has also gotten out of control, burning crops, infrastructure, and forest. "You can't tell them to stop [burning] because people need to survive...it's all they know," Ana commented.[28]

Based on information from INCRA, this section presents the objectives for development and conservation in agrarian reform settlements, including their priorities, challenges and relationships. Regarding objectives, INCRA's priority for settlements is socio-economic development, which is approached primarily through agricultural production. While social justice is also linked to development, the creation of the agrarian reform settlement itself could be viewed as a fulfillment of that mission.

Conservation objectives were predominately framed in terms of maintaining forest cover, and were largely held separate from development. Throughout the interviews, conservation objectives were held secondary to those of development. However, despite the separation of approaches to conservation and development, the belief was expressed by two of the key informants that conservation objectives cannot be achieved without economic development first. Additionally, there seems to be some broad challenges discussed by the key informants that overlap between both conservation and development in PDM. Particularly, INCRA failure of projects addressing either conservation or development were attributed to disorganization, lack of technical experience, and lack of integrating the objectives so that they do not hinder each other.

[28] "*Não pode dizer para, porque tem que sobrevivir... e todo que sabem.*" Personal Communication 6/19/07

6.3 *Movimento dos Trabalhadores Rurais Sem Terra* (MST)

Although the MST is no longer the principle organizing body of PDM at present, it was instrumental in organizing and establishing the settlement. Consequently, it also held great influence in forming early settlement objectives. While I did not have the opportunity to meet with any direct representative of the MST, the national organization's website contains information about the organizations viewpoints, which I am using as my main source of secondary data to identify their objectives regarding conservation and development.

'Development' is listed as one of the causes on the MST's official website. Their mission statement for this cause asserts that:

> ...economic development should be fundamentally based on the interests of improving the quality of life of the entire population, particularly the lives of the poorest people. Its mission is to produce goods that eliminate the level of poverty and social inequality that exists in our country. The organization of production should seek first to attend to the basic necessities of the entire Brazilian population. For this reason, we fight for an economy that stimulates the production of goods and enables the elimination of poverty and social inequality, that privileges the work and the quality of life of the Brazilian people, with growth and income distribution valuing a just and supportive economy (MST 2007a).[29]

There are several elements of this mission statement regarding development that draw attention. Like INCRA, development is also presented as economic growth through the production of goods. Additionally, one of the missions of INCRA is to promote social justice. However, the objective of social justice appears to be fulfilled simply by

[29] "*...desenvolvimento da economia devem estar baseadas fundamentalmente nos interesses de melhoria das condições de vida de toda a população, em especial dos mais pobres. Sua missão é produzir bens que eliminem o grau de pobreza e a desigualdade social existentes em nosso país. A organização da produção deve buscar em primeiro lugar o atendimento das necessidades básicas de toda a população brasileira. Por isso, lutamos por uma economia que estimule a produção de bens e possibilite a eliminação da pobreza e da desigualdade social. Que privilegie o trabalho e a qualidade de vida do povo brasileiro, com crescimento e distribuição de renda valorizando uma economia mais justa e solidária.*"

the expropriation of land. Unlike INCRA, the MST mission statement puts stipulations on economic growth, calling it development only if the modes of production also incorporate social justice. Although the environment is left out of the previous statement concerning development, connections between the environment and development are revealed in another cause statement from the MST website that demands popular national sovereignty, also a part of social justice.

> We need the politics and practice of government officials to guarantee the full sovereignty of our people, our territory, and our natural wealth of minerals, biodiversity, water and seeds. The state should have control with participation of society, workers, and strategic companies for already existent national development and to create those that are necessary to manage wealth (MST 2007b). [30]

According to the MST, notions about the environment and development are linked together through ideas about socially just production. This connection between environment, development and social justice are further asserted on the MST website in discussion about the mode of production known as *agroecologia*, or agroecology. This mode of production focuses on creating food sovereignty by encouraging small, diverse plots of agricultural production and opposing agribusiness and monoculture crops. In an article from the MST website, agroecology is described as:

> ...agriculture committed to the conservation of the environment, cultural ties and social justice relationships. Farmers are freed from pesticides as well as repossess their seeds, reconstruct their autonomy and the complex system of their lot in the settlement (Zarreff 2007).[31]

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[30] "*Precisamos de políticas e práticas dos governantes que garantam a pleno soberania de nosso povo, sobre nosso território, nossas riquezas naturais, minerais, nossa biodiversidade, a água e as sementes. O Estado deve ter o controle com a participação da sociedade e dos trabalhadores, e das empresas estratégicas para o desenvolvimento nacional que já existem e criar as que forem necessárias para gerirem as riquezas.*"

[31] " *...agricultura consignada à conservação do meio ambiente, aos laços culturais e as relações sociais justas. Na produção agroecológica o agricultor ou agricultura se vê, aos poucos, livres dos agrotóxicos, bem como readquire a posse de suas sementes, reconstrói sua autonomia e entende o sistema complexo que é o seu lote e o assentamento.*"

As found in INCRA's objectives for development and conservation, the influence of global relationships on the MST's objectives is also evident. However, the relationships presented by the MST are more oriented towards resistance of global influences as opposed to collaboration with them. An article from a supporting site of the organization states that "agroecological cultivation is an instrument of resistance against the model of 'global colonization.'" It goes on to assert that, "Brazil provides raw materials to sustain the consumption patterns of 'developed' countries, regardless of the misery and starvation of its people" (Informa 2007).

Emphasizing differences in approaches about conservation and development, the MST harshly criticizes the development and environmental ethic that INCRA promotes, especially in regards to their promotion of eucalyptus and pine forest monocultures, which they argue undermines agroecology's pillar of diversity. Instead, diversity is seen as "...fundamental for biological equilibrium" (Zarref 2007).[32] Agroecology offers an alternative to system is also seen as interacting with forest systems, which would allow native forest to be maintained to offer a "variety of environmental advantages, such as the protection of water resources, the control of pests, the promotion of soil conservation and the protection from winds." Forests were further described in the article as "a source for food, natural medicines, leisure, crafts, and an important element of popular culture (Zarref 2007).[33] The agro-ecological system is therefore hailed as "the climax of environment sustainability, where all living organisms and natural elements are in

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[32] *"...é fundamental para o equilíbrio biológico do agroecossistema"*

[33] *"...fonte de complementação alimentar, remédios naturais, artesanato, lazer, além de ser elemento importante da cultura popular."*

dynamic equilibrium. It is through understanding the forest that the MST looks to develop agroecology to confront agribusiness" (Zarreff 2007). [34]

Conversely, INCRA is accused of "pillaging" natural resources under the "cloak of environmental preservation and 'sustainable development'" (Torres 2008).[35] The PDS and the PAF settlement projects are especially criticized because of their backing by lumber agribusiness companies. According to the MST, this model for settlement exploits the forest, ultimately at the expense of landless settlers (Umbelino 2008).

Based the information from the MST, it appears that the objective of development directly is linked to economic growth, but only economic growth that involves the priority of social justice. One of the tenets of social justice is sovereignty, including food sovereignty accomplished from socially just modes of production. Agroecology embodies that type of production, forest conservation becomes a necessity to development instead of being a negative constraint. Challenges to development and conservation are therefore both identified as economic growth without the social justice component.

6.4 *Plano do Assentamento* (PDA) for Primeiro de Março

Formalization of settlement projects is dependent on the creation of PDAs, which outlines the official objectives and recommended approaches to development projects. Since it is required to be created by a third-party agency, the PDA for PDM was created

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[34] *"O componente florestal é o clímax da sustentabilidade ambiental, onde todos os organismos vivos e elementos naturais estão em equilíbrio dinâmico. É compreendendo a floresta que o MST busca desenvolver a agroecologia e enfrentar o modelo do agronegócio."*

[35] *"... sob o manto da preservação ambiental e do axioma do 'desenvolvimento sustentável',"*

by the Mixed Cooperative of Agrarian Reform Settlements of the South and Southeast of Pará (COOMARSP). Interestingly, this agency was directly established by the MST, and manages the settlement plans for at least six other settlements nearby to PDM. Both general and specific objectives are presented within the PDA which directs the recommended strategies and actions of the settlement, reflecting specific discourse that conveys the objectives for development and conservation. The general objective of the settlement is "to make possible social, economic, environmental and ethno-cultural sustainability of the settlement families productive activities" (PDA 2005: 8).[36]

The specific objectives include:

- To achieve a process of transition from conventional agriculture to styles of agriculture with ecologic foundations that utilizes the scientific and popular knowledge of management and the utilization of agro-biodiversity and of the agro-ecosystems of the settlement.
- To promote the participation of families to achieve the desired goals.
- To propose alternatives so that household production can turn economically viable, generating income from the agricultural activities in the settlement.
- To seek partnerships with public and private agencies, county or state, and to instill an agreement about the necessities of the families of the Settlement projects to leverage the stimulus of the settlers in new productive or social activities (PDA 2005:8). [37]

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[36] *"...possibilitar a garantia da sustentabilidade social, econômica, ambiental e etnocultural das atividades produtivas das famílias assentadas."*

[37] *Objetivos específicos*

- *Realizar um processo de transição do estilo de agricultura convencional para estilos de agricultura de bases ecológicas que utilizam os conhecimentos científico e popular no manejo e na utilização da agrobiodiversidade, e dos agroecosistemas do Assentamento.*
- *Promover a participação das famílias perante as demandas levantadas para que se alcance às metas desejadas;*
- *Propor alternativas para que a produção familiar se torne viável economicamente, gerando renda nas atividades agrícolas e pecuárias trabalhadas no assentamento;*
- *Buscar parcerias junto aos órgãos públicos ou privados, municipais ou estaduais e implantar conforme as necessidades das famílias e do Assentamento projetos para alavancar o estímulo dos assentados em novidades tanto na parte produtiva quanto social;*

From these objectives, the themes of social development, economic development and environmental concern become visible. These three themes can be approached separately, yet they are also integrated, as demonstrated in the general objective, by the concept of 'production.' These ideas are revisited throughout the PDA in various sections to include, among others, projects aimed at promoting the "good integration of humans, production and nature" (PDA 2005: 63).[38]

The social aspect of development is important in the PDA, which is listed as one of the objectives for the settlement. Particularly, the PDA describes the coordination and cooperation of settlers as imperative to achieving projects within the settlement. These projects include economic development projects related to production, but also the improvement of community services and infrastructure. In order to facilitate community connections, there is a lengthy discussion about the need for leisure and sporting activities, community celebrations and the maintenance and creation of community cooperation. Interestingly, many of the suggested activities and celebrations are aimed at "avoiding the capitalist cultural invasion" (PDA 2005:62).[39]

The social aspect of development is also seen as a challenge that must be addressed, in that the PDA identifies a lack of social cohesion in the settlement. According to the PDA (2005: 30), "at present, the settlement is passing through difficulties with social organization."[40] That statement refers to the disagreements that have arisen between different political groups of settlers in PDM. Although the original

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[38] *"...boa integração homem x produção x natureza."*

[39] *...evitar a invasão cultural capitalista.*

[40] *"Atualmente o Assentamento está passando por dificuldades quanto a organização.*

organizing body of the settlement, the MST was thrown out of the settlement and consequently most coordinated efforts for projects in the settlement dissolved.

The aspect of production is described at length by the PDA, and is a major focus because it is assumed that the settlers will all be farmers. According to the document, it is a priority to implement diverse systems of production that are complimentary to the natural environment and focused on activities that will benefit everyone in the settlement to reduce income stratification. Furthermore, a goal for production includes marketing the products in the city of Marabá because of its close proximity and easy access. Specific suggestions were also given for improving production. Many of the suggestions focused on improvements in cattle production, such as improving fences, providing shade in pastures and getting sufficient food for livestock. For the cultivation of crops, specific suggestions included avoiding the use of fire or rotating fields in fallow.

In regards to the environment, the PDA uses the term 'conservation' only once, and that was in reference to the benefits that forests offer to soils. Instead, it more commonly frames environmental discourse as discussions about "environmental sustainability" or "preservation." Some of the environmental discussion addresses problems related to production, such as the management of waste, the degradation of pastures. Modes of production like monocultures are discouraged.

A significant part of the PDA also addresses preservation of forest cover with a particular concentration on the environmental reserve, which is depicted as a tribute to sustainability. It is described as valuable for its "vast biodiversity of plants and animals that benefit not just the settlement families, but the whole region. Improvement of the quality of the air and water, reduction of the temperature, supply of fruits and animals

that feed the population, medicinal plants, and the existence of ornamental plants are some of the benefits offered by nature and should be preserved" (PDA 2005: 19).[41] The reserve is further described as "a point of reference to other places, alerting society to the importance of the human-nature relationship and is an incentive for other settlements to also incorporate an environmental reserve in their area" (PDA 2005: 19).[42]

However, preservation is also cited as a challenge. Because the majority of the lots are still required to be kept legal reserve, "for the small producer, [this] abruptly reduces of the productive capacity and consequently diminishes the household income and quality of life" (PDA 2005:19).[43] This 'problem' was the incentive to create the community environmental reserve, so that individuals could cultivate a greater proportion of their lots, revealing a focus on forest cover in terms of conservation.

It is important to note that the PDA of PDM shows the incorporation of language from both INCRA as well as the MST. Since COOMARSP is directly affiliated to the MST, it is not unexpected that the discourse of the MST appears be more dominant in the language of the document, particularly in the representation of production in relationship to the environment. As previously discussed, INCRA tends to focus the production-

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[41] *"A reserva apresenta vasta biodiversidade vegetal e animal, que beneficia não apenas as famílias assentadas, mas toda região a sua volta. Melhoria na qualidade do ar e da água, redução da temperatura, fornecimento constante de frutos e animais que servem para alimentação da população, plantas medicinais para a fabricação de remédios caseiros e a existência de plantas ornamentais, são alguns benefícios oferecidos pela natureza e que devem ser preservados."*

[42] *"...é um ponto de referência a outras localidades e a população, alertando a sociedade para a importância da relação homem-natureza e incentivo para que outros assentamentos também incorporem em suas áreas uma reserva ambiental."*

[43] *"...a destinação de 80% do lote para conservação como Reserva Legal, significa para o pequeno agricultor, brusca redução da capacidade produtiva e consequentemente diminuição da renda familiar e da qualidade de vida."*

environment relationship on what it calls sustainable development, which could include separating conservation goals from development as long as conservation regulations were met. Conversely, the MST promotes full integration of conservation and development objectives in agroecology. In the PDA, a system of agroecology is proclaimed several times as an ideal method to reach goals of production for the settlement. Additionally, environmental concerns were also discussed in terms such as disrupting 'environmental equilibrium,' a term rarely used on the INCRA site. Furthermore, the PDA discusses monoculture tree planting as a potential threat to their goals, while monoculture tree planting was seen as a viable environmental and economic strategy in an interview with an INCRA official.

While the language of the MST is very strong in the document, many of the strategies proposed for development fit more with INCRA. For instance, the economic viability household production is one of PDM's particular objectives. Specifically, increased market engagement is discussed as a necessary component of promoting economic viability. At the same time, however, the document also dissuades the adoption of a capitalist culture. In regards to conservation, the document discusses at length the benefits of incorporating agro-ecology. As discussed in section 6.3, forest should be adoptable into agro-ecological systems, yet forest conservation also discussed as a challenge to production within the PDA. Therefore, instead of incorporating forest conservation within their productive systems, they have focused on the strategy of separating forest conservation by creating the environmental reserve. These mixed approaches to development and conservation result in incongruities within the PDA, burdening the agrarian reform settlers to reconcile the differences.

6.5 The Residents of Primeiro de Março (PDM)

The residents of PDM are the ones who ultimately manage the settlement lands. However, their objectives for conservation and development are informed by the PDA, and their approaches to meeting those objectives are constrained by federal regulations and the objectives of INCRA, which governs their technical and financial support. Therefore, settlers must ultimately negotiate their own objectives between these different elements. The information for this section was obtained through seven key informant interviews that I conducted with residents while visiting the PDM settlement.

When I interviewed the residents of PDM most of the discussion focused on struggles of meeting environmental regulations and creating successful productive projects. Because of the split from the MST that occurred in 2004, the settlers didn't share the exact priorities of the MST as described in the PDA, but they also seemed frustrated by the approaches that INCRA had taken to improve their livelihoods and meet land cover regulations.

INCRA had provided funding for roads, electricity, and for building the school in the settlement, but many of the settlers seemed unsatisfied with their current status in the settlement. While their basic needs were met through the *cesta basica*, it seemed difficult for settlers to meet their needs or wants above them on their own. Four of the people interviewed discussed their personal desires for improvement in living standards including housing. However, these key informants seemed to be having trouble earning an income, and blamed it on the many failed economic development projects implemented by INCRA.

One resident who had lived in PDM since its beginning, Joao, discussed a series of projects that ended in failure.

> The projects that were implemented didn't succeed. They were implemented: an aviary, raising pigs and cows, and a plantation of *cupaçu* and banana. All of them failed, because the fields were burned, the seedlings were planted outside of the season, and the poultry and pigs died without assistance. [44]

The assistance lacking for the poultry and pigs, said Joao, was that the settlers did not have the means to feed and properly care for the animals once they were brought to PDM. Furthermore, Joao claimed that INCRA didn't provide an adequate amount of technical assistance for the projects implemented. He said that settlers were given supplies, INCRA would tell them what to do, but then they would never return.

In the previous quote, Joao also mentioned fire as being a problem. Fire is the settler's primary method of preparing fields for either planting or pasture in PDM and in the region as a whole. However, fire is illegal and uncontrolled fire threatens crops as well as forest cover. Later, when asking a different settler why he chooses not to cultivate crops, he commented, "Why plant if it is going to get burned up?"[45] Because of the risk of loss, wildfire can also be understood as a limiting component to productive activities. This has been recognized by INCRA and COOMARSP as a problem, and seminars on fireless cultivation have been scheduled in the past. However, when I asked COOMARSP how the seminars went, I was told that none of them had actually taken place yet.

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[44] *"Os projetos que foram realizados não deram certo. Foram realizados, uma aviario, pocilga e criação de bovinos e plantação de cupu e banana. Todos fracassaram, porque pasto foi queimado, as mudas das plantas foram trazidas fora da época e as aves e porcos morreram sem assistência."* Personal Communication 6/22/07.

[45] *"Porque planta se só vai quemar?"*Personal communication 6/22/07.

Joao also showed me an abandoned building in PDM that used to be a manioc flour mill. According to Joao, "A lot of money was given by the government to construct the mill, lots of money. It shut down a failure because the cooperative bought the produce before it was planted. When it was brought to the mill, the expenses couldn't be paid. It didn't have any income, just expenses, so production stopped for being was managed poorly."[46]

I asked another resident, Igor, what people in the settlement did to earn an income. He commented that many people in the past had turned to cutting trees and turning them into charcoal that was then sold to the local aluminum plant. However, he then said that there had been greater enforcement of the regulations against that recently, so it was no longer an option for the residents. "We are in a transition for production right now,"[47] stated Igor. When I asked him where the transition was going, he replied "Who knows? But it has to change."[48]

Regarding conservation, informants framed their discussion of the environment in terms of meeting the environmental regulations for forest cover. While settlers discussed at length benefits such as fruit and shade that were associated with forest cover, they also discussed the difficulty of meeting the required area of forest cover on the lots. When asked if he followed any regulations, one informant, Marco replied, "Words exist, that say that 20% of your land can be utilized, and 80% is [forest] reserve. But, the average

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[46] *"Foi recebido dinheiro do governo para a construção da fabrica, muito dinheiro. A fabrica acabou fracassando, porque a cooperativa comprava a produção antes de plantar e quando trazia para a fabrica nao dava para pagar os gastos, não tinha lucros, só gastos.Assim parou a produção, por ser mal administrada"* Personal communication 6/22/07.

[47] *"A gente está numa transição da produção."* Personal communication 6/22/07.

[48] *"Sé la, mas tem que mudar."* Personal communication 6/22/07.

size of the lots [that can be used] is 6 alquieres.[49] It is difficult to produce something with a small amount of land."[50]

While settlers seemed concerned about forest regulation, there seems to be some general controversy over it. The PDA presents the results of a survey that was done in PDM, asking settlers their concerns over environmental regulation.

The results indicated that:

- 55% were interested in preserving forest on their lots
- 48% wanted to preserve whatever forest still exists in the settlement as a whole
- 28% didn't have to preserve because their lots are all pasture
- 17% were against reforestation, claiming that their entire portion was preserved in the environmental reserve
- 7% were interested in replanting deforested areas with forest or fruit species (PDA 2005:20).

These results indicate that a very large proportion of settlers do not necessarily agree with the regulations on forest cover. Most surprisingly, reforestation got very little support from settlers, with only 7% saying that they would support it. Reforestation was discussed because settlers were being required by INCRA to recuperate deforested areas. Some people in the settlement wanted to pursue reforestation efforts with native fruit trees, citing concerns over the equitable distribution of work and benefits of a community tree plantation that was only good for cash-cropping.

The settlers of PDM appear to have some very severe challenges in meeting the conservation objectives laid out for them in the PDA and by INCRA. Many of the settlers also appear to be failing at their own objectives of providing for their own needs

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[49] One alquiere equals about 2.4 hectares

[50] *" Existem palavras, dizem que tem que se utilizar 20% e 80% de reserva. Em média os lotes sao de 6 alqueires. Fica dificil produzir com pouca terra."* Personal communication 6/22/07.

and wants. It appears that setters would not have a preference about the means to achieve economic improvement, but many of the projects pursued for development, such as the funding of ranching projects, are not compatible with the goals of maintaining forest cover. As the economic development projects have failed, the problems with maintaining forest cover per regulation has been compounded, and many of the settlers have gone to rely directly on cutting trees for charcoal because the market exists to sell it.

6.6 Chapter Summary

In this chapter, I have used qualitative data to identify the conservation and development objectives, priorities, challenges and relationships of INCRA, the MST, the PDA of PDM, and the settlers of PDM. I conducted the analyses to gain further understanding of the different influences affecting the approaches taken by settlers in PDM in pursuit of development and conservation goals.

On a superficial level, it appears that the objectives for development by INCRA, the MST and the settlers of PDM are compatible. Each of the groups expressed desire for development in agrarian reform settlements that includes economic growth, enabling settlers to meet their personal needs. Regarding conservation, in each of the categories, objectives tended to focus on maintaining forest cover.

Aside from these basic similarities, however, there are also some major differences between the different analysis categories. Regarding development, INCRA tended to prioritize and separate economic development objectives from conservation objectives. The means to achieving economic development were left undecided as long as conservation regulations were met, which seemed to stress a separation between

conservation and development strategies. Areas of forest preservation were designated within settlements where settlers could pursue no alternative uses of the land. However, in the areas that were not designated as forest reserve, nearly any type of economic production was supported, resulting in activities that were incompatible with forest preservation, such as cattle ranching. Conversely, the MST appeared to integrate conservation and development objectives with its discourse. According to the data from the MST, conservation and economic growth objectives needed to be fully integrated in order for development to occur within a settlement.

Because the PDA must satisfy the objectives of INCRA and was created with the backing of the MST, it reflects ideas from both. However some incongruities arise because of this. While denouncing capitalist culture, it also supports deepening involvement in local markets. Besides promoting the benefits of the environmental reserve, it also discusses the challenges to development with maintaining forest cover. In this way, many incongruities appear in the approaches to meeting conservation and development goals outlined in the PDA, contributing additional challenges that the settlers of PDM must confront.

The objectives of the settlers of PDM seemed to be formed partly in reaction to regulation. The development goals of the settlers seemed to center around personal socio-economic status improvements as well as improvements in community infrastructure and service. Although settlers may have practiced activities that could be thought of as conservation, the term conservation itself was strictly associated with regulations. As soon as I mentioned conservation in the key informant interviews, all seven of them referred to the Forest Code and the environmental reserve. Their

conservation objectives therefore centered on meeting regulations, and it was a secondary priority to meeting their other development objectives. The settlers' approaches to meeting either development or conservation seemed to be open, and they tended to pursue modes of production that they were supported for by INCRA, or with which they were already familiar.

Using the case study site of PDM, the purpose of this chapter is to generate further knowledge of the objectives of development and conservation in agrarian reform settlements in the eastern Brazilian Amazon. Additionally, this chapter presented several ideas that may influence development that will be explored further in the next chapter using statistical analysis. By examining the different influences that form objectives in settlement projects, a broader understanding is provided of the approaches chosen for conservation and development and the results of these approaches.

Chapter VII

Quantitative Data Assessment Examining Outcomes and Relationships of Conservation and Development Objectives

7.1 Introduction: A Quantitative Approach to Data Analysis

The conclusions of the qualitative analyses presented in Chapter VI are utilized to inform the quantitative analyses of conservation and development in this chapter. Presented here are empirical analyses to (1) test a model of development using logistic regression in order to identify important influences to improvements in rural livelihoods. This chapter is split the chapter into two sections to accomplish this, one addressing analyses of conservation and the other addressing development and (2) assess the land cover implications of development and conservation in Primeiro de Março (PDM) using remotely sensed data.

The first section comparatively examines PDM to other settlement projects supported by Direct Action Land Reform (DALR) in the region. As identified from the key informant interviews, a variety of factors that impact the ability of households to improve their rural livelihoods are assessed for statistical significance utilizing secondary survey data. I then apply these factors to a model of development using logistic regression to determine which factors were the most statistically significant in their impacts on the outcome of improvement among all observations from DALR settlements.

As discussed in the previous chapter, 'conservation' in the study area of PDM was consistently defined as the protection of forested area. Therefore, the second section evaluates the success of conservation through a remote sensing analysis of tree cover.

Using classified Landsat imagery dated from before the expropriation of the settlement, at the beginning of the land occupation, and six years after the creation of the settlement, I quantitatively estimate the amount, location, and type of land cover change that had successively occurred in PDM. The resulting data was useful for evaluating whether the condition of the settlement met the conservation objectives.

7.2 Section One: Statistical Analyses of Development Factors

From key informant interviews and a review of secondary data, I have identified a number of factors that may influence the success of development and conservation goals in PDM. In this section, I examine each of these factors in turn, providing a brief review of the related literature and a discussion of how each may promote or impede development and/or conservation goals. An empirically-based logistic regression model is next specified using indicators for each of the factors to determine which are the most influential to development outcomes. This analysis provides further insights into the economic dynamics present in PDM and other DALR settlements in the study region. Next, this model is tested using the NSF supported DALR data set described previously in Chapter IV.

Discussion begins with the dependent variable of the logistic regression model, development, and is followed by the key independent variables including (1) market engagement, (2) lot turnover, (3) social capital, (4) the occurrence of wildfires, the diversity in (5) annual and (6) perennial crops, and (7) the number of cattle owned. Next, important control variables are discussed, including (1) distance to market, (2) the years in residence, and (3) the possession of a document showing property ownership. For each

discussion of the variables, I provide descriptive statistics and t and z tests in order to determine whether significant differences exist between observations in PDM and other settlements initiated by DALR. Finally, in an effort to evaluate the factors, I discuss the results of the logistic regression model applied to all DALR observations.

7.2.1 Dependent Variable: Development as Wealth Improvement

A major focus of this thesis is the concept of development, which I use as the dependent variable in the logit regression model. Although sometimes ambiguously defined, development has long been associated with improvements in socioeconomic status, which frequently accompanies greater resource access and general well-being (Morris et al. 2000). In PDM, many of the settler's ideas about development focus on the improvements on their standards of living, which include housing and access to resources in addition to greater access to social services, such as education. These ideas can be associated with improvements in socioeconomic status (Morris et al. 2000).

Wealth is a very important factor in assessing socioeconomic status, and it is commonly measured by the aggregate household income. However, accurately assessing household wealth by income in developing nations is often more complicated because the vast majority of the population is not formally employed, and records of wages are not kept (Morris et al. 2000). Information from household surveys is not often reliable because the people frequently have several income sources, and the innumerable transactions and exchanges that take place in an informal economy make it nearly impossible for informants to know the data (Morris et al. 2000). Additionally, informants themselves are frequently reluctant to disclose that information to a stranger. However,

aside from monetary measurements of wealth and income, household wealth can be assessed and compared through an asset-based analysis.

Reiterating the methods outlined in section 4.3.2, the dependent variable indicated whether the household improved in terms of wealth. This was then used as a proxy for development. To calculate wealth, I used an asset-based approach used by Caldas et. al (2007) in a study performed in Uruará in the Brazilian Amazon, located further west along the Transamazon than the study site of PDM. In this method, household possession of durable goods is used to determine different categorical ranks of wealth. The goods assessed in this method include a stove, chainsaw, refrigerator, generator, television, satellite dish and motorcycle. The poorest households fit into category one, and did not possess any of the surveyed goods. In category two, the household possessed a stove or a chainsaw. In addition to meeting the criteria of category two, households in category three possessed a refrigerator, generator, television, satellite dish or motorcycle. Those households in category four were considered the wealthiest and met the requirements of category three and additionally owned either a car or a tractor (Caldas et al. 2007).

The NSF supported 2006 secondary survey data contained the same necessary information about the goods used in Caldas et al. (2007), enabling me to create similar wealth categories. In addition, the survey data that I use asked about the assets owned by the household when they first arrived in the settlement, and the assets that they owned at the time of the survey in 2006. From this data, I determined if there was a change in the level of wealth in the household. By determining if there had been an increase in wealth from when they arrived to the time of the survey, I created a binary variable of

development, where 1 represented improvement in wealth and 0 represented no improvement.

Overall, the results exhibited in Table 7.2.1A indicate that while most of the households would be initially categorized in wealth level one, the majority of households at the time of the 2006 survey were considered to be in wealth level three. Proportionately, 53.8% of the settlers in PDM experienced improvements from when they first arrived on the property to the time of the survey. Another large proportion, about 38.5% of the respondents from PDM, maintained their wealth level. Finally, the household wealth of roughly 7.7% of the settlers had declined. Similar to the results of PDM, improvements occurred in about 54.6% of the other observations from DALR settlements, while 39.0% of households remained at the same level, 6.4% experienced a decline in their wealth level. In comparing the proportions of settlers that experienced improvements, or development between PDM and the other observations from DALR settlements, it is demonstrated that there is no statistical difference between them.

(Table 7.2.1A) Wealth Distribution of Primeiro de Março

Wealth Level	Frequency Initial*	Proportion Initial (%)	Frequency Present¥	Proportion Present (%)
1	14	53.84	6	23.08
2	6	23.08	6	23.08
3	6	23.08	11	42.30
4	0	0.00	3	11.54
Total	**26**	**100.00**	**26**	**100.00**

*Number of households at time of arrival
¥At time of 2006 survey

(Table 7.2.1B) Change in Wealth

Condition	PDM (n=26) Proportion (%)	DALR (n=218) Proportion (%)
Improve	53.8	54.6
No Change	38.5	39.0
Worse	7.7	6.4
Total	**100.00**	**100.00**

(Table 7.2.1D) Z-test Results for Improvement

Group Comparison	P value	Significance
PDM and DALR	0.917	no

Key Independent Variables

7.2.3 Market Engagement

The first independent variable is a proportional measurement of market engagement. Increased market engagement has traditionally been a key objective of development plans in third-world nations, and has similarly been a focus of Brazilian development plans in the Amazon region, as discussed in Chapter III. This objective is also found in the development goals elaborated by the PDA and is voiced by both INCRA officials and residents of PDM. As stated on the agency's website, one of INCRA's primary objectives is the generation of income and employment opportunities for colonist farmers (INCRA 2006a). That objective is complimented by a goal in the PDA for PDM to promote the marketing of products in Marabá. Highlighting the proximity and access via the Transamazon highway, the PDA asserts that the products produced in PDM would be marketable in the city (PDA 2005). Selling crops at market would provide cash income that would allow a household to purchase materials that they cannot directly produce, improving their livelihoods. Therefore, it would be expected that

market engagement would also contribute to development, defined here as improvement in wealth.

The 2006 survey directly queries whether the household had sold any of their products at market in the previous year, as shown in Table 7.2.3B. The proportion of settlers that positively responded to the question from PDM and DALR settlements were very close, with 55.6 % of survey respondents from PDM and 55.7% of respondents from DALR settlements affirming that they do market what they produce. When comparing the proportions in a z-test, market engagement in PDM is not significantly different from the other DALR settlements (see Table 7.2.3A).

(Table 7.2.3A) Market Engagement Descriptive Statistics

Group	n	Marketing products (%)
PDM	27	55.6
DALR	244	55.7

(Table 7.2.3B) Z-test Results for Market Involvement

Sample Comparisons	P value	Significance
PDM and DALR	0.833	no

7.2.4 Lot Turnover

The next independent variable is lot turnover, which indicates whether or not a lot has had multiple owners. Lot turnover could be considered indicative of the success or failure of establishing a livelihood on a piece of land. If settlers are unable to sustain a livelihood on their lots, then they would likely sell or abandon the lot and move elsewhere (Ludewigs and Brondizio 2005).

Turnover and lot abandonment also have environmental implications and have been associated with furthering regional deforestation . In the case of farm failure, it can lead to a cycle of deforestation with farmers abandoning their lots in the region and pushing further into primary forest (Walker and Homma 1996; Wood 1983). Settlers intending to leave the land would likely attempt to extract as much value from their land as possible by removing and selling all valuable timber species (Futemma and Brondizio 2003). High rates of lot turnover in an area also enables the aggregation of properties, further promoting deforestation, as elaborated with reference to the "hollow frontier" by Aldrich et al. (2006).

Several factors have been identified that may contribute to lot turnover and assumed farm failure, including the lack of stable and suitable farm credit and adequate roads for market access (Futemma and Brondizio 2003). Additionally, since settlers may migrate from urban settings or different ecological regions, they may lack experience with and information about appropriate agricultural techniques for the area (Moran 1981; Fearnside 2001). It is also important to note that in the study region, bank debts are tied directly to the lots instead of the persons who received the loans to purchase them. This may give incentive for farmers to abandon the lot once the funds are received. It also makes it difficult for other people to purchase the lots later, since the purchaser would then inherit the debt of the former owner without the corresponding improvements on the land from the investments.

To make a comparison on lot turnover, I gathered responses from the 2006 survey question that asks if the current owner is the original owner of the lot. The data from the survey provide a means to characterize turnover rates from lots that have changed

owners. However, the survey doesn't account for the quantity of lots that have been completely abandoned, an occurrence reported by key informants in PDM. The descriptive statistics shown in Table 7.2.4A from the survey therefore represent the proportion of lots that have had more than one owner. In PDM and other DALR settlements, this proportion is nearly the same at about 36%, and, as shown in Table 7.2.4B, a z-test demonstrates that there is no significant difference of proportions between PDM and the other DALR settlements.

(Table 7.2.4A) Lot Turnover Descriptive Statistics

Group	n	Lot Turnover (%)
PDM	27	36.0
DALR	218	35.9

(Table 7.2.4B) Z-test Results of Lot Turnover

Sample Comparisons	P value	Significance
PDM and DALR	0.826	no

7.2.5 Social Capital

Another goal highlighted in the PDA is to generate a sense of community identity as well as to facilitate stronger cooperation and organization within PDM. In recognition of several community organizations already in existence in the settlement, the PDA suggests that communication and involvement should be improved between the groups. As discussed earlier, one of its specific objectives is to "*Promover a participação das famílias perante as demandas levantadas para que se alcance às metas desejadas,*" meaning to promote family participation to meet settlement goals (PDA 2005: 8). Ideas for building community are further elaborated in a portion of the PDA that recommends

settlement activities and celebrations that would foster a sense of shared community and culture. By creating a stronger sense of community and social organization within the settlement, the PDA suggests that the settlers will be better able to petition government officials for support as well as collaborate to achieve successful project outcomes (PDA 2005:32).

This goal could also be understood as the facilitation of social capital, which has been identified as an important ingredient in development successes. Because of the difficulty in observing and measuring social capital, its definition continues to evolve (Ostrom 1999). While details may vary between definitions, the general conception of social capital involves a network of internal bonds within a community that can be leveraged to accomplish collective goals (Coleman 1988). Social capital has also been described as connecting people in formal organization as well as in informal relationships that foster the reciprocation of favors through trust. Its presence is found in acts of sharing information between individuals, as well as the existence of shared norms that sanction behaviors (Coleman 1988).

While not the first to use the term social capital, its popularity can be credited to Putnam's (1993) study of Italian democracy, civic traditions and regional development (Bebbington 1999, 1996; Serageldin and Grootaert 2000). According to this research, regional variances in social structures and networks were vital factors in explaining differences in government effectiveness and economic performance. The areas with the most efficient and effective governments and economies were accompanied by high rates of participation in social organizations and networks that crossed the boundaries between different institutions and groups. Present within these groups were strong "horizontal

associations" based on trust and shared values, which Putnam identified as social capital. Putnam also suggested that the presence of social capital would have important economic implications as well. Although social capital processes are not explicitly investment activities, the coordination, cooperation and trust associated with social capital may facilitate economic partnerships and investments (Putnam, Leonardi, and Nanetti 1993).

Poverty alleviation, development success, and social capital have been linked in a variety of ways. Serageldin and Gootaert (1999) use an example of failed irrigation projects to argue that initiating and maintaining productive systems is less likely with a lack of social capital. Without social capital, formal or informal social mechanisms associated with it would be absent to enforce equitable agreements for sharing water, resulting in some farmers using water needed by others or some farmers failing to contribute to maintaining the project. Without the "internal coherence" of social capital, Serageldin and Gootaert (1999:44) claim that there "could be no talk of economic growth, environmental sustainability or human well-being."

Social capital is believed to be necessary in order to sustainably manage development initiatives because it provides an incentive for individual members to relinquish some individuality for a group objective (Bebbington 1997). In many conservation initiatives, regulations and economic incentives are commonly used to encourage behavior changes in regard to natural resource use. Such initiatives include the regulation of protected areas, incentives for erosion control, and conservation farming (Wetzel and Omi 1991). While these initiatives have shown to affect individual behavior, there is little evidence to suggest that individual attitudes change when there is no longer enforcement or incentives (Pretty and Ward 2001). Agrawal and Gibson (1999) suggest

that an individual's attitude is generally influenced much more strongly by social affiliations, therefore social capital could be an important factor in reaching resource conservation and development goals.

Social capital is heavily associated with certain types of relationships, such as within families, social interactions with neighbors and friends, and also organizations that demand trust and share a common sense of purpose (Collier 1998). A settlement that is effective in coordinating and establishing projects for the benefit of the whole community would be expected to have more social capital, and would also be likely to have greater capacity to establish formal organizations that could work outside the community to leverage support from government agencies and NGOs.

Social capital is notoriously difficult to measure, and innumerable variables could be included (Ostrom 1999). However, there is precedent to measure social capital in terms of the breadth of participation in local organizations, since it is assumed that participation in multiple organizations will facilitate coordination and enhance shared affiliation between community members (Putnam, Leonardi, and Nanetti 1993; Narayan and Pritchett 1999). From that approach, it is assumed that the more community affiliations that community members engage in, the stronger the social capital present in the community will be.

Because of the limited data available from the 2006 survey, I have chosen to measure social capital based on community affiliations. The survey specifically collected information regarding the involvement of respondents in different organizations. Respondents were asked if the household head participated in a rural worker syndicate, a producer's cooperative, a community association, or a church organization. Additionally,

respondents were asked if any family member was involved in a DALR organization, giving them a total possibility of five organizational affiliations. I created the social capital variable by simply summing the total number of different organizational affiliations for each observation.

According to descriptive statistics, the mode for PDM was two organizational affiliations for each respondent, which is similar to the other observations in DALR settlements. The Table 7.2.5A shows a slight variation in means, with 2.37 for PDM and 2.62 for the other DALR settlements. To determine if these results were significant, I did a t-test comparing PDM and the other DALR settlements, which indicated that there were no significant differences between them (see Table 7.2.5B).

(Table 7.2.5A) Social Capital Descriptive Statistics

Group	n	Mean	Std. Deviation	Min	Max	Mode
PDM	27	2.37	1.043	0.00	4.00	2
DALR	217	2.62	1.006	0.00	5.00	2

(Table 7.2.5B) T-test results for Social Capital

Sample Comparisons	P value	Significance
PDM and DALR	0.222	no

7.2.6 Wildfire

As discussed in the previous chapter, fire was an important concern of key informants in PDM and was a consideration in the productive activities that they pursued. One of the key informants explicitly said that he chose not to cultivate crops because of the risk of wildfire. To repeat his statement, *"Porque planta se só vai quemar?"* In

Amazonia, uncontrolled fires can have devastating economic as well as ecological impacts. Because natural forest fires are rare in the humid tropics due to the high moisture content of the vegetation, small-farmer agricultural practices have often been identified as a primary origin of fire (Denevan 2001). Although uncontrolled fire can cause severe property damage, subsistence farmers have relatively few options of available agricultural technology and frequently continue to practice slash-and-burn agriculture techniques despite laws that prohibit its use. By Brazilian law, inciting forest fires is punishable by a minimum sentence of six months to a maximum of four years in jail, depending on the intentions for setting the fire (Simmons et al. 2004).

In slash-and-burn agricultural systems, there are two intentional uses of fire, including the *deforestation fire* intended to remove primary forest to convert land to pasture or agricultural use, and *fire on deforested land* that is set to maintain pasture and agricultural plots by clearing them of weeds and fertilizing them with ashes (Nepstad et al. 1999). A variety of techniques can be employed to control fires, which include creating fire-breaks to maintain the burn in the intended area and seasonally timing burns for wetter periods (Sorrensen 2000). However, efforts for fire control are not consistent, and many times settlers simply rely on natural barriers, such as moist forest, to contain fires (Wetzel and Omi 1991). However, these natural breaks are not always reliable and the chances for a fire escaping control on a plot of land escalate with a higher frequency of burning (Cochrane et al. 1999). Although the dynamics of burning decisions are not fully understood, Simmons et al. (2004) suggest that social capital may play an important role in preventing wildfires in that members of a community with high social capital would be more likely to coordinate efforts to control burns.

Both deforestation fire and fire on deforested land frequently spawn accidental fires or fire contagion, identified by Nepstad et al (1999) as *forest surface fire* and more commonly known as wildfire. Wildfires begin at intentional burn sites and spread to unintended areas to possibly burn forest, crops, or even infrastructure and equipment. In addition to the loss of forested land and up-front economic loss, the threat of wildfire further limits conservation and development strategies.

The risk of wildfire entering their property from neighboring lots may cause farmers to hesitate to invest in planting crops, particularly perennial species because they require several years after planting before producing. Instead, settlers may be more likely to pursue production that minimizes losses from wildfire (Walker, Moran, and Anselin 2000). Frequently, this means converting and maintaining land in pasture for the purpose of raising cattle, which in turn requires the further use of fire for its maintenance.

The use of fire elevates the probability of accidentally deforesting an area through burning. Additionally, it limits methods in which conservation and development can be integrated. An agro-forestry project, for example, that integrates planting crops among native tree species which conserve the soil as well as provide other ecosystem benefits, would require investments in both time and money that settlers would be unwilling to make based on risk of loss to wildfires (Walker, Moran, and Anselin 2000; Simmons et al. 2004).

Similar to other Amazonian settlements, fire is commonly used in PDM, principally between the months of July and October, as indicated in the NSF supported secondary survey data. The PDA for PDM states that one of its goals is to reduce the use of fire in the settlement. Strategies for fire prevention included education programs about

the negative consequences of fire use, but also focused on the implementation of agricultural training programs that minimize fire usage in agriculture (PDA 2005).

The 2006 household surveys also show that the incidence of wildfire had escalated in the preceding years, up from 14% in 2003 to 30% in 2004, and about 48% of respondents in PDM reported wildfire damage on their properties in 2005. The most common source of fire during each of these years was reported to have come from the property of their neighbor. While respondents most often reported the fire to enter pasture on their land, they also frequently reported losses of annual and perennial crops, and occasionally reported the loss of forest.

Microclimate may vary throughout the region causing some places to be drier at certain times than others, which may affect the frequency of fire in a particular area, thus making comparisons between the incidences of fire complicated between observations. However, I have chosen to include one question from the 2006 survey that could be used to compare settlements asking the respondents if unintentional fire had ever entered their property within the last 10 years. The results from the entire survey show in Table 7.2.6A that 74.1 % of observations in PDM had experienced fire in that time period, while 56.5 % observations from DALR settlements reported fire. Results from a z-test show in Table 7.2.6B the difference in proportions is statistically significant.

(Table 7.2.6A) Wildfire Descriptive Statistics

Group	n	Experienced WildFire (%)
PDM	27	74.1
DALR	218	51.4

(Table 7.2.6B) Z-test Results for Wildfire

Sample Comparisons	P value	Significance
PDM and DALR	0.039	yes

7.2.7 Variables of Production

In an interview with Vagner, an INCRA official that works closely with PDM, we discussed the strategies for development that INCRA was planning on pursuing in the settlement. Vagner expressed a desire to expand and diversify the modes of production, claiming that a diversified system would offer greater sustainability. For example, he described a problem with raising chickens in the settlement. Although many residents were extended credit in order to purchase and start raising chickens, it was difficult and costly to obtain chicken feed. As a result, many of the settlers gave up on the project and got rid of the chickens altogether. However, he claimed the problem with the chickens could have been mitigated if someone in the community had planted crops for chicken feed. He then continued to say that INCRA was now in the process of encouraging diversification and complimentary projects of production, with the hope of greater success than the settlements that focused one particular project.

The desire and importance of diversification of productive activities was also discussed in the PDA (2005), with a particular emphasis on encouraging vegetable gardens and planting perennial crops. A common rationale for crop diversification is risk management (Pichon 1997; Barghouti et al. 2004). Crop or other production damage and loss can come from a variety of factors, such as extreme weather conditions, pests and diseases, as well as uncertainty in the market (Barghouti et al. 2004). Therefore, it has been argued that crop diversification contributes greater stability to rural household

security, since security is not determined only by the success or failure of one product (Adger 2000).

Besides risk management, benefits of production diversification include creating additional sources of income to a community as well as a source for broader training. Diversification of crops, especially those that are labor intensive such as horticulture, may offer additional sources of income to people who can be hired to manage the extra work. Diversification may also provide gains though "knowledge and technology spillovers" that promote adaptive skills to manage future changes (Barghouti et al. 2004:16). If a plan for diversification was complimented by training in different fields, increasing the breadth of knowledge for productive activities could be particularly beneficial to rural settlements like PDM, where the household head has less than an average of two years of formal education.

I created three variables addressing production that will be subsequently discussed, including a measurement in diversity of annual crops and a measurement in diversity of perennial crops. The other variable addresses cattle ranching. While other forms of livestock may exist in settlements throughout the region, information is lacking on the diversity of livestock. However, from observations and key informant interviews, it appears to be minimal.

According to the PDA (2005), agriculture is not nearly as extensively pursued as cattle production, and cultivation makes up only about 7% of the land area of PDM. The variables for crop diversity are measured by responses to questions from the 2006 survey that ask whether the household grew specific crops in 2005. This survey additionally asked open-endedly if the household planted any other crops that were not specifically

mentioned. The responses were divided into two categories: one for annual production and the other for perennial production. Based on this information, I determined that the most important crops in PDM that were raised with the most frequency were rice, corn and cassava for annual crops, and banana, citrus and cashew for perennial crops (see table 7.2.7A).

(Table 7.2.7A) Most Important Crops of PDM

Annual	**Proportion cultivated (%) n=27**
Rice	62.96
Corn	62.96
Cassava	42.30
Perennial	
Banana	40.74
Citrus	18.52
Cashew	11.11

7.2.7.1 Analysis of Crops

To compare between PDM and the other DALR observations, I summed the different types of crops in the annual and perennial categories from each observation. The mean number of annual crops per household observation in both PDM and the other DALR observations was about slightly higher than two (see table 7.2.7.2A), and the most frequent response was zero. To test the results for significance, I employed a t-test to compare means between the observations from PDM and the other DALR settlements. The results yielded were of no statistical significance (see table 7.2.7.2B).

(Table 7.2.7.1A) Diversity in Annual Crop Production Statistics

Group	n	Mean	Std. Dev.	Min.	Max.	Mode
PDM	27	2.26	1.97	0.00	6.00	0
DALR	218	2.08	1.90	0.00	7.00	0

(Table 7.2.7.1B) T-test Results for Diversity in Annual Crop Production

Sample Comparisons	P value	Significance
PDM and DALR	0.608	no

Perennial crops, including native fruit trees, were separated in this analysis from annuals because they have different development and conservation implications. Maintenance of perennial species may be an incentive for settlers to conserve forested lands or to re-plant trees on deforested land, which is acknowledged by INCRA (INCRA 2006c) Additionally, perennial crops differ from annual crops in that they represent a different type of investment. While annuals can be planted and harvested in the same year, it takes much longer to reap benefits from perennial crops that were planted, perhaps leading to a greater reluctance for farmers to plant perennials because there is a greater expanse of time in which they could lose their investments (Walker, Moran, and Anselin 2000). In that way, perennial crops may indicate, to an uncertain extent, long-term stability and security.

By examining the means from PDM and the other DALR settlements, it is revealed that PDM and DALR observations on average had fewer perennial crops than annual crops in 2005 (see Table 7.2.7.1C). No significant difference is found between PDM and the observations from DALR in a t-test (see Table 7.2.7.1D).

(Table 7.2.7.1C) Diversity in Perennial Production Statistics

Groups	n	Mean	Std. Dev.	Min.	Max.	Mode
PDM	27	1.30	1.27	0.00	5.00	1
DALR	218	1.12	1.47	0.00	5.00	0

(Table 7.2.7.1D) T-test Results for Diversity in Perennial Production

Sample Comparisons	P value	Significance
PDM and DALR	0.513	no

7.2.7.2 Cattle Production

Following the historical trends of production in the South of Pará, agriculture in PDM is heavily focused on raising cattle, as discussed in the key informant interviews and the PDA (2005) of the settlement. This may be due partly because of the support that is given for such activities. Like many other settlements, cattle production in PDM has been supported by INCRA, which has provided a credit called Pronaf-A that subsidizes beef production. Roughly 80% of the surveys in PDM reported that they received financial assistance for beef production.

On average, nearly half of the area of the agricultural lots is dedicated to pasture, as reported by both the PDA (2005) and from the survey statistical data. In PDM, 82.0% of households had cattle, while that proportion was 71.8% of observations from DALR settlements (Table 7.2.7.4A). The results from a z-test reveal that PDM is not statistically different from the observations in other DALR settlements (Table 7.2.7.4D). The mean number of cattle in PDM is approximately 25, while the average number of cattle owned per household in DALR settlements is about 22 (Table 7.2.7.4C). This difference is also not statistically significant (Table 7.2.7.4D). As discussed in Chapter V, the average

amount of pasture per household in PDM is 16.48 hectares, making the stocking density roughly 1.5 animals per hectare.

(Table 7.2.7.4A) Proportion of Households with Cattle

Group	n	Households with Cattle (%)
PDM	27	82.0
DALR	218	71.8

(Table 7.2.7.4B) Z-test Results for Households with Cattle

Sample Comparisons	P value	Significance
PDM and DALR	0.332	no

(Table 7.2.7.4C) Statistics for Sum of Cattle Owned

Group	n	Mean	Std. Dev.	Min.	Max.
PDM	27	24.70	26.44	0.00	100.00
DALR	218	21.89	24.82	0.00	118.00

(Table 7.2.7.4D) T-test Sum of Cattle Owned

Sample Comparisons	P value	Significance
PDM and DALR	0.581	no

Control Variables

7.2.8 Distance to Market

Distance to market, considered as the nearest town in which products can be sold to generate income, is associated with the Von Thunen spatial model and has been used as an important control variable in several studies connecting economic development and land cover and land use change (Chomitz and Gray 1995; Mertens and Lambin 2000;

Caldas et al. 2007). This variable reflects limits and opportunities for commercial activities pursued by smallholder agriculturalists and may have an impact on household wealth. Greater distance from market particularly adds transportation costs that in turn reduce net profits (Perz 2003; Caldas et al. 2007; Omamo 1998). Additionally, this variable may be related to the ability for a producer to expand or intensify productive activities by limiting the availability of labor that may be necessary for such projects (Nerlove and Sadka 1991; Walker and Homma 1996). Because distance to market may influence decisions about types of productive activities pursued by a small holder, it is also associated with land cover change, including patterns in the Brazilian Amazon where greater deforestation has been associated with market accessibility (Pfaff 1999; Walker, Moran, and Anselin 2000).

The distance to market variable utilized here refers to the distance in kilometers from the settlement to the principal city in the region. This principal city represents a major area where producers from the settlement would likely sell agricultural products to generate income. Although road conditions can vary so that physical distance may not equate with time or costs to market products, that information is unavailable and therefore accessibility to larger markets is estimated only with a measurement of physical distance.

Between PDM and the rest of the observations, PDM is just over 20 km from a major market, while the average for the DALR observations is near 75 km (see Table 7.2.8A). Because each observation received the same approximate distance based on the settlement from where it came, no further analysis was done with this variable.

(Table 7.2.8A) Distance to Market

Group	n	Mean (km)	Std. Dev.	Min.	Max.
PDM	27	20.05	------	------	-------
DALR	218	75.65	30.05	17.79	98.00

7.2.9 Length of Residence

Individual length of residence time on a lot is another important variable necessary in the logistic regression model as a control. The length of residence also has many connections to household wealth as well as decisions about land use. As time passes, the settlers would be expected to increase production through improvement in agricultural techniques with experience in the location, it would be expected that a household would begin to accumulate wealth consequently experience improvements in living standards. This is perhaps also to expand the area of production. Additionally, costly initial investments of both labor and capital would start to give returns over time (Walker et al. 2002; Moran 1989). Length of residence time has also been show relate to production choices. Walker and Homma (1996) for example show that households with shorter residence time tend to focus on annuals, while households with longer residencies may have more perennials and/or pasture, depending on their household labor availability.

Based on the theory of smallholder household lifecycles, residence time also has implications smallholder implications for land cover change. Household demographic change can turn into land cover and land use change, specifically through increased cultivation land area (Perz and Walker 2002). This begins with a family settling and using the land on a newly opened frontier. Annual subsistence crops are their first

strategy for survival, but as the soils degrade, a more land is progressively deforested for agricultural purposes. After a while, many of these farmers learn how to successfully farm and may also have more labor power available as their children grow. The households then have the opportunity to plant commercially oriented crops, which eventually lead into the greater expansion of agricultural area and a reduction of forest (Walker and Homma 1996).

Compared to the other observations from DALR settlements, the respondents of PDM had resided in the settlement on average of about six years, while the average in other DALR settlements was about ten years (see Table 7.2.9A). When compared in a t-test, these differences are statistically significant (see Table 7.2.9B).

(Table 7.2.9A) Length of Residence Descriptive Statistics

Group	n	Mean (yrs)	Std. Dev.	Min	Max
PDM	28	6.09	3.20	0.33	10.00
DALR	216	8.30	4.03	0.01	20.00

(Table 7.2.9B) T-test Residence Time

Sample Comparisons	P value	Significance
PDM and DALR	0.002	yes

7.2.10 Document of Property Rights (Tenure)

Land tenure may also play a role in household decisions in the Brazilian Amazon. (Walker and Homma 1996; Alston, Libecap, and Mueller 1999). Legal titles are generally respected, and therefore provide a reliable form of security to small landholders. According to Alston, Libecap and Mueller (1999), holding title reduces the costs associated with policing property, and also provides the incentives of security and

collateral for long-term investments. The same authors also found that the acquisition of a title dramatically increased the overall monetary value of their land.

Insecure land tenure may also have further implications for land cover change. Those without secure rights to land try to minimize investments and choose strategies that give initial high yields, yet may not be sustainable over a long period of time. For example, someone who perceived that they were insecure in their rights to land may opt to log as much timber as possible in order to extract the maximum value from the property (Fearnside 2001).

A question from the secondary survey data asked whether the settler had a document that justified their rights to the land, which may or may not have been a definitive title. According to the survey, 19.0% of the respondents from PDM had some type of documentation that justified their land rights, compared to 28.6% of the respondents from DALR settlements (see Table 7.2.10A). When comparing the proportions in a z-test, significance is not found between PDM and the other DALR settlements (see Table 7.2.10B).

(Table 7.2.10A) Proportion of Households with Tenure

Group	n	Tenure (%)
PDM	27	19.0
DALR	218	28.6

(Table 7.2.10B) Z-test Result of Tenure

Sample Comparisons	P value	Significance
PDM and DALR	0.166	no

7.2.11 Logistic Regression Model

All of the variables discussed are arguably important to the success of development, and each has been reviewed in this chapter for that reason. The descriptive analyses showed that PDM was largely similar to the other DALR settlements, excepting the variables of incidence of wildfire and length of residence. To further analyze the variables, a logistic regression analysis can be applied to determine which factors have the most importance. This type of analysis is ideal for furthering understanding of the relationship of a binary categorical dependent variable with several independent variables that can be either categorical or continuous. Furthermore, the logistic regression model is beneficial because reveals significance for each variable while simultaneously controlling for other variables in the model. In this case, the dependent variable is designated as development (yes/no) and the key independent variables are the main factors considered in the discussion, namely (1) market engagement, (2) lot turnover, (3) social capital levels, (4) incidence of wildfire, diversity of (5) annual crops, diversity of (6) perennial crops, and (7) number of cattle owned. The control variables are also included, specifically (1) the average distance to market, (2) the length of residence, and (3) tenure. I considered the factors with a probability of less than 0.05 as having significant influence on the outcome of the dependent variable.

The main objective of this effort is not to specify the best and most parsimonious model of development, but to instead specify an empirically-based model using the factors identified by the key informants and through my own field research experience that would enable each factor to be examined for statistical importance. Therefore, the

statistical significance of each variable is of greater importance to this analysis, than the overall model fit. The logistic regression model was tested by the Hosmer-Lemeshow equation for goodness of fit, which appeared as .494. As p-values above 0.05 generally indicate a strong fit, it appears that this model meets that criterion. Additionally, the chi-squared p-value of the log likelihood indicates that the fit is good at 0.007, as the value should be below 0.05 (Mertens and Lambin 2000).

Table 7.3A gives the results of the logistic regression. The most statistically significant factor affecting development is the duration of residence time, with a p-value of 0.001. For each year in the settlement, a household could be expected to increase their odds of improving by 1.15 times for each additional year of residence. This is not intuitively surprising, since those in residence the longest would have the most time to make investments and improvements on their property which would lead to an accumulation of wealth.

Also of interest are the documentation of property rights, the market engagement, and the perennial diversity variables. While not statistically significant, these variables had interesting results that merit discussion, particularly in social science research where controlled experiments are not possible. For the land tenure variable, the p-value is at 0.183, and the odds ratio is 0.646, meaning that households with documentation of property rights are 1.54 times less likely to experience development. While most of the literature indicates that title is very important for security reasons, there also may be some benefits for not having a title to the land. In agrarian reform settlements, the financial assistance and benefits end when settlers receive title and the settlement is emancipated. As discussed by some key informants, there may be incentive for some

settlers to try to maintain a status without title in order to continue receiving government support. The *cesta basica* provided by INCRA, for example, is designed to satisfy the basic subsistence needs of the household, perhaps allowing them to sell any excess of that they would produce.

The p-value for market engagement is 0.167 and the odds ratio is 0.673, indicating that families that sold crops in market the prior year were **less** likely to have experienced development. While this is counter to the hypothesis of market engagement making households more likely to experience improvements, it could also be an indication that the households may have already been experiencing difficulties and therefore sought to engage in market activities to seek improvements. Or, the more pertinent question may be the quantity sold at market, for which there was no available data. However, both PDM residents and INCRA key informants discussed the lack of any substantial production in the settlement, indicating that amounts sold in market are likely miniscule and wouldn't significantly contribute to improvement in household wealth.

The diversity of perennial species could also have been considered slightly suggestive, with a p-value of 0.162. While the hypothesis was that perennial species would be associated with development, the odds ratio indicates that every different perennial species owned would indicate the household was also **less** likely to have experience development. One possible reason for this could be the long lag time between planting and harvesting associated with many perennial species. However, there is no evidence of large investments being made into crop cultivation, and the overall lack of strong significance could also be reflective of the overall lack of crop diversity. As

discussed earlier, most credit had been provided for raising cattle, despite proposed ideas for agro-forestry programs in PDM.

Surprisingly, none of the remaining key independent factors were statistically significant, including the number of cattle owned, level of social capital, lot turnover, wildfire, and annual crops. However, the lack of significance is also of interest. The number of cattle owned is particularly interesting because raising cattle is a large part of production in settlements, with more than 80% of households owning cattle. However, the variable of the number of cattle owned by a household was not statistically significant, with a p-value of 0.985. This may be related to the limitations of herd expansion on individual lots. Many of the lots sizes are for DALR agrarian reform settlements are roughly 30 ha in size.

The factor of social capital is also not significant in the model. While studies of social capital have demonstrated its relationship with wealth accumulation (Putnam, Leonardi, and Nanetti 1993), it is possible that the baseline assumption that DALR settlements would already have fairly high amounts of social capital would mitigate significance between households. With regards to lot turnover, the lack of statistical significance could be reflective of a trend towards lot consolidation among small holders (Aldrich et al. 2006), which could mitigate the assumed negative influence of turnover on development. As described in the history of the settlement, PDM, for instance has experienced consolidation of lots for the creation of more pasture lands. Wildfire may not be statistically significant if it most frequently occurred in pasture areas, which would mitigate the damage caused by them. In PDM, for example, more than half of each property on average is dedicated to pasture. The lack of significance in the diversity of

annual and perennial crops might provide further support to the idea that quantity of production towards specific markets tends to provide more income than variety of production.

(Table 7.2.11A) Logistic Regression Results for Development

Dependent Variable Development (y/n) N: 238				
Variables	Estimate	Std. Error	Odds Ratio	P-value
Key Independent Variables				
Market engagement	-0.396	0.287	0.673	0.167
Lot turnover	-0.243	0.326	0.784	0.456
Social Capital	0.062	0.159	1.064	0.695
Incidence of Wildfire	0.187	0.285	1.205	0.512
Annual Crop Diversity	0.001	0.082	1.001	0.992
Perennial Crop Diversity	-0.146	0.104	0.864	0.162
Number of Cattle	-0.001	.006	0.999	0.876
Control Variables				
Distance to Market	-0.396	0.287	0.673	0.167
Length of Residence	**0.144**	**0.043**	**1.155**	**0.001**
Tenure	-0.437	0.328	0.646	0.183
Hosmer-Lemeshow p-value: 0.494 Chi squared p-value: 0.007 Log Likelihood: -152.004				

7.3 Section Two: Outcome Evaluation of Conservation Objectives

As concluded in the analysis from the previous chapter, I have found that conservation has been defined primarily as the preservation of forested areas, and goals corresponding to this definition have been pursued in PDM. Because of the Forest Code, which mandates that 80% of forested property in the Legal Amazon be preserved, the

Instituto de Colonização e Reforma Agraria (INCRA) and the settlers of PDM tend to interpret successful conservation as complying with this regulation. I have therefore chosen to evaluate the maintenance of forest areas through a land cover change analysis of the settlement as a whole, as well as the legal reserve.

I have chosen to compare classified land cover images of the study area from three different years. The first image, from 1988, would most likely depict clearing that was done strictly per decision of the owner of the fazenda. Since some of the forest clearing may be associated with the initial settler occupation, a second image from 1996 represents the year that the occupation of the fazenda occurred. The third image, from 2003, is the most recent imagery of the area available. Because detailed explanation of the processing and analysis methods of remotely sensed imagery were previously presented in Chapter IV, I will proceed with discussing the overall results land cover change evaluation of PDM, particularly highlighting the findings on PDM's environmental reserve.

7.3.1 Results and Discussion of Land Cover Change Analysis

Landless peasants first invaded Fazenda São Tomé in December of 1996, the future site of PDM. Because settlers are only lawfully required to maintain pre-existing forest on the settlement, this year gives a baseline from which to evaluate the conditions of the land cover change on the settlement. The summaries of the land cover classifications for 1988, 1996 and 2003 are given in table 7.3.3A. In 1988, about 64% (7,042 sq. ha) of the property was forested, while about 34% (3,705 sq. ha) of it was non forest. Assuming that the entire area had originally been forested, the Fazenda was in

compliance with the Forestry Code, which at the time still required only 50% of a property to maintain forest cover. This was prior to the 1989 change in regulation that mandated that 80% of forested property be maintained. Much of the deforested area was located along the southern boundary of the settlement, near the Transamazon highway (Table 7.3.1A). However, a larger section of deforestation also exists towards the north end of the settlement, where the previous owner reportedly had placed the headquarters of the operation.

(Table 7.3.1A) Land Cover of PDM

Land Cover Classification	1988 Proportion	1988 Area (ha)	1996 Proportion	1996 Area (ha)	2003 Proportion	2003 Area (ha)
(0) Empty Pixel	1.05%	114.75	0.93%	100.98	1.78%	193.86
(1) Forest	64.64%	7042.14	60.43%	6583.77	19.32%	2105.19
(2) Non Forest	34.01%	3705.39	38.39%	4181.94	54.88%	5978.88
(3) Water	0.29%	31.95	0.25%	27.54	0.13%	14.31
(4) Cloud	0.00%	0	0.00%	0	23.88%	2601.99
Total	100%	10894	100%	10894	100%	10894

By 1996, the area of deforestation extended further along the Transamazon Highway. The total area deforested between 1988 and 1996 was 376 ha. However, the proportions of the land cover classifications had not changed much since the 1988 image. Forest cover had decreased slightly to represent roughly 60% of the area's land cover, while the non forest classification increased slightly to represent about 38 % of the area. This is consistent with the reports of land cover from the 2005 Plan do Assentamento (PDA), which describes forested areas as comprising 59.23% of the total land cover of PDM in 1997. To maintain 80% of this forested area and comply with the Forestry Code, the settlement would need to keep 5,267 ha of that area in forest.

While nearly a quarter of the 2003 image is covered in clouds, it is still evident that major land cover changes have occurred in PDM. Areas of deforestation have become larger, loosely extending in lines that could be interpreted as the creation of a road network in the settlement. Non forest cover now dominates at least 54% of the settlement area. Of the area outside of the cloud cover, only about 20% of the image is forested. Looking at patterns of the deforestation, it appears likely that much of the land under the cloud cover is also deforested. This idea is supported in that the PDA reports that about 26%, or 2,161 ha, of the settlement was forested in 2005. However, even if the entire cloud covered area was assumed to be forest in 2003 and added to the identified forest cover, it would only amount to 5,103 ha, thus still falling short of the target area of 5,267 ha.

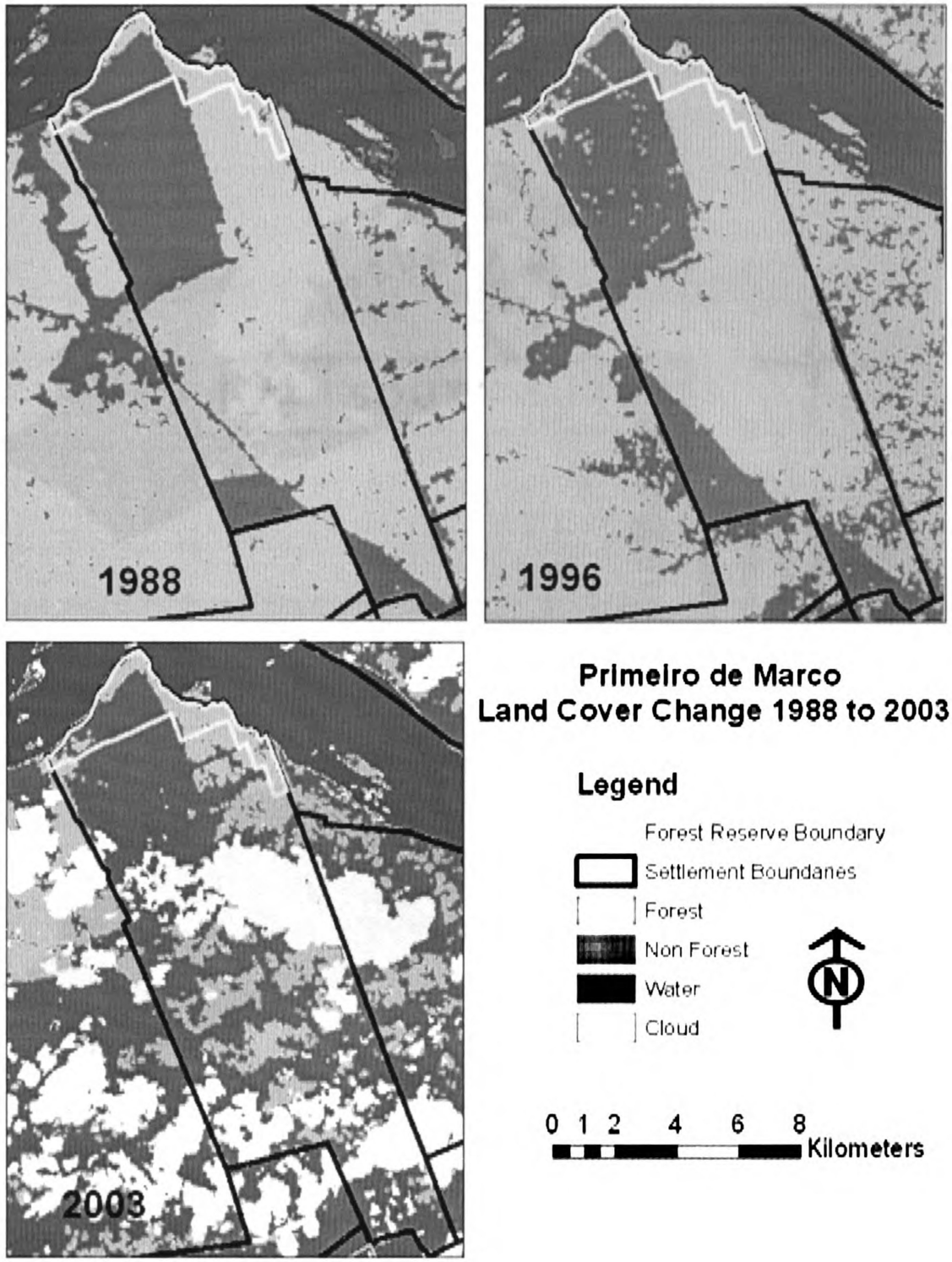
The environmental reserve is of particular interest for analysis because of its designation as an area dedicated to forest preservation, with no deforestation permitted. Interestingly, only a little over half of the environmental reserve began as forested land in 1996 (See Table 7.3.1B). As this area was also the former headquarters of the fazenda, it is understandable that the area would become attractive for those seeking land within the settlement.

(Table 7.3.1B) Land Cover of PDM Environmental Reserve

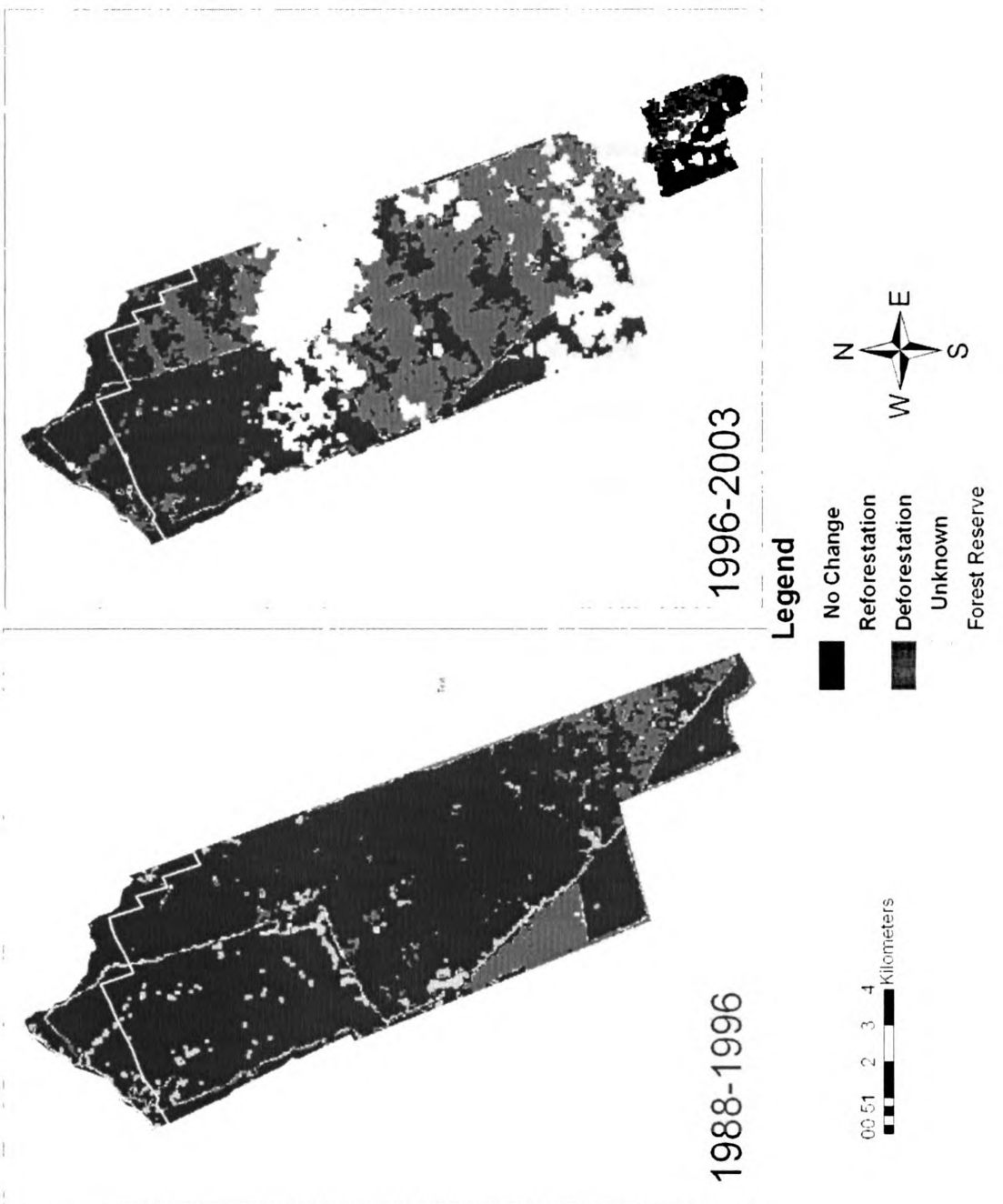
Land Cover Classification	1988 Proportion	1988 Area (ha)	1996 Proportion	1996 Area (ha)	2003 Proportion	2003 Area (ha)
(0) Empty Pixel	2.31%	20.75	1.63%	14.67	1.20%	10.8
(1) Forest	42.98%	385.83	52.26%	469.17	47.14%	423.18
(2) Non Forest	51.57%	462.96	43.53%	390.78	50.20%	450.63
(3) Water	3.15%	28.26	2.59%	23.22	1.34%	12.06
(4) Cloud	0.00%	0	0.00%	0	0.13%	1.17
Total	**100%**	**890**	**100%**	**890**	**100%**	**890**

According to this data, the forest cover within this area decreased by about 10% between 1996 and 2003, which is relatively low when compared to the deforestation that occurred in the rest of the settlement. While deforestation likely continued in the environmental reserve and elsewhere in the settlement after 2003, it nonetheless remains remarkable that the site of the environmental reserve that was intended to preserve biodiversity in the settlement was placed in an area that was already largely deforested.

It appears from this analysis that the maintenance of forest cover in the settlement in compliance with the Forest Code has largely been unsuccessful. Deforestation in the settlement as a whole has exceeded the regulation of 20%, and deforestation has also occurred in the designated environmental reserve despite a strict policy of preservation. The trends of deforestation observed in PDM seem to fit with the overall trends in agrarian reform settlements in the Legal Amazon. According to a study done by Imazon, an NGO active in Amazonian conservation, agrarian reform settlements in Pará on average showed 52% of their lands deforested in 2004 (Amintas Jr and Souza Jr 2006).



(Figure 7.3.3A) Primeiro de Março Land Cover Change 1988 to 2003



(Figure 7.3.3B) Primeiro de Março Land Cover Change Type

7.4 Summary of Quantitative Assessments

In this chapter, I present the results of quantitative analyses that evaluate conservation and development success and influences. Development, and several factors contributing to it as identified in Chapter VI, were evaluated using comparative analysis of household observations in PDM and household observations in other settlement throughout the region. This analysis showed that PDM was statistically similar to those settlements, with about half of the observations showing improvements. I then applied these factors to a logistic regression model to identify the most important factors in development. According to the model, the most statistically significant factor influencing development was length of residence. Surprisingly, none of the key independent variables were statistically significant, perhaps indicating that overall efforts to meet objectives tied to the factors are not succeeding.

I evaluated the success of conservation in the case study settlement, PDM, in terms of forest cover through a remote sensing analysis. The outcome of this analysis showed that the legal goals of maintaining 80% of the forest cover in the settlement had largely failed, and it also showed that deforestation had also taken place in the permanent environmental reserve. Interestingly, it also uncovered that much of the environmental reserve was already deforested long before the settlement was created, despite the fact that the reserve was created under the pretense of biodiversity protection and to help meet legal forest cover standards. This may indicate stronger political considerations in conservation initiatives as opposed to ecological ones.

Chapter VIII

INTERSECTIONS OF CONSERVATION AND DEVELOPMENT: CONCLUSIONS

8.1 Introduction

Recently, agrarian reform settlements in the Brazilian Amazon have been declared a top contributor to deforestation by the Brazilian government (DPA 2008). Both INCRA as well as many of the social movement organizations that have been instrumental in establishing agrarian reform settlements incorporate environmental discourse into their objectives for development. Yet, they are widely viewed and being unsuccessful in their endeavors to make conservation and development objectives compatible. Concentrating this issue, the purpose of this thesis is to examine the dimensions of development and conservation in agrarian reform communities related to environmental change.

As local level actors are often viewed as the primary agents of land cover change, this thesis addresses how settlers in rural agrarian reform settlements in the Brazilian Amazon negotiated between conservation and development objectives. In order to investigate this, I applied it to a case study of one agrarian reform settlement, Primeiro de Março (PDM), located in an region in the eastern Brazilian Amazon known as the South of Pará. Besides being a historical hub of government supported economic development initiatives, numerous agrarian reform settlements have been established in this region. Additionally, it is also notable for its high rates of deforestation. I chose PDM as a case study particularly because it incorporated a large conservation reserve into its settlement

design, and was established as a result of efforts directed by a social movement organization.

Because the main question is broad, I divided it into a series of secondary questions and applied them to the case study. These include: (1) How do various influences of actors at multiple scales impact policy in PDM in terms of how conservation and development objectives are defined? (2) What do settlers in PDM consider as their conservation and development objectives? (3) What have been the outcomes of the approaches taken to meeting conservation and development objectives in the settlement? and (4) what have been the primary factors that have contributed to these outcomes? These questions are addressed using political ecology framework that examines influential connections of how development and conservation objectives have been defined across scales and then carried out in case study site. Situating the case study in context of local histories and ecologies, I focus on spatial and temporal interactions to examine conservation and development objectives and outcomes at the local scale.

Within this framework, I employed a fusionist methodology utilizing and linking both qualitative and quantitative methods. For my qualitative analyses, I utilized key informant interviews and representative documents to derive definitions of conservation and development at national, regional, and local scales. From insights provided by the key informants, I then defined an empirical model examining factors contributing to development success. Finally, I used remotely sensed imagery for a land cover change analysis to quantitatively gauge success of conservation at the local scale. In the

remainder of this chapter, I will discuss the major findings of the analyses, and conclude with the further implications of those.

8.2 The Intersections of Conservation and Development

In Chapter V, I specifically analyzed four different categories to identify the objectives of conservation and development, focusing on priorities, challenges and relationships identified in reoccurring themes within key informant interviews and reports. I also identify factors that potentially influence development success, which are then included in my empirical model of development. These categories include the Direct Action Land Reform (DALR) organization of the *Movimento dos Trabalhadores Rurais Sem Terra* (MST) and the government agency of *Instituto Nacional de Colonizção e Reforma Agraria* (INCRA), two national organizations that are vital in initiating and forming the settlement project. In their roles, they have both heavily contributed to the creation of local, site specific policy for Primeiro de Março (PDM) that is manifested in the *Plano do Assentamento* (PDA), another category of analysis. This document prescribes site-specific settlement objectives and methods to achieve them. Finally, I analyzed the settlers of PDM as a category. As local level actors, they are largely responsible for interpreting and then implementing plans for conservation and development.

The analyses demonstrated the influence of international forces on the conservation and development discourse on the objectives of INCRA and the MST. These objectives often framed conservation in terms of forest cover protection in the

Amazon region, which was justified as addressing international concerns over biodiversity loss or global warming due to loss of forests. In each of the categories, objectives regarding conservation then tended to focus on maintaining forest cover, whereas development objectives for agrarian reform settlements included economic growth and enabling settlers to meet their personal needs.

Aside from those basic similarities, however, major differences between the analysis categories also existed. Regarding development, INCRA tended to prioritize and separate economic development objectives from conservation objectives. The means to achieving economic development were left undecided as long as conservation regulations were met. Areas of forest preservation were designated within settlements where settlers could pursue no alternative uses of the land. However, in the areas that were not designated as forest reserve, nearly any type of economic production was supported, resulting in activities that were incompatible with forest preservation, such as cattle ranching. Conversely, the MST appeared to integrate conservation and development objectives with its discourse. According to the data from the MST, conservation and economic growth objectives needed to be fully integrated in order for development to occur within a settlement.

From the previous analyses, I gained further insight into how the settlers of PDM envision their conservation and development objectives, as well as form their expectations. Because the PDA must satisfy the objectives of INCRA and was created with the backing of the MST, it reflects ideas from both. As such, there were also several incongruities in strategy, contributing additional challenges that the settlers of PDM must confront. The objectives of the settlers of PDM seemed to be formed partly in reaction to

regulation, while the development goals of the settlers seemed to center around personal socio-economic status improvements as well as improvements in community infrastructure and service.

Although settlers may have practiced activities that could be thought of as conservation, the term conservation itself was strictly associated with regulations. As soon as I mentioned conservation in the key informant interviews, all seven of them referred to the Forest Code and the environmental reserve. Their conservation objectives therefore centered on meeting regulations, and it was a secondary priority to meeting their other development objectives. The settlers' approaches to meeting either development or conservation seemed to be open, and they tended to pursue modes of production that they were supported for by INCRA, or with which they were already familiar.

The quantitative analyses then evaluated the outcomes of these conservation and development objectives in PDM. A number of different factors contributing to development were mentioned in the key informant interviews, including (1) market engagement, (2) lot turnover, (3) social capital, (4) the occurrence of wildfires, the diversity in (5) annual and (6) perennial crops, and (7) the number of cattle owned. I examined each of these factors in turn, and then specified an empirically-based logistic regression model using indicators for each of the factors to determine which were the most influential to development outcomes. In this model, I also included important control variables, including (1) distance to market, (2) the years in residence, and (3) the possession of a document showing property ownership.

Interestingly, none of the key independent variables were shown to be significant in the analysis, although one of the control variables, length of residence appeared to be highly significant. As discussed in Chapter VII, the significance of this could be due to investments and improvements done on their property which over time would lead to an accumulation of wealth. The lack of statistical significance is interesting and indicates that there are likely other factors influencing actions based the pursuit of development.

One component may be technical and financial support. Similar to elsewhere in the region, the primary mode of production in PDM is raising cattle. In fact, on average more than half of each property in PDM is dedicated to pasture. According to various sources, the first credit that the settlement received after basic infrastructure and housing was for Pronaf A, which was used primarily for investments in raising cattle. It is unclear as to whether settlers chose to engage in raising cattle because the credit existed and there was a lack of other choices, or whether it was encouraged by INCRA. Decisions about conservation can also be viewed in a similar manner, as some of the complaints by key informants surrounding both development reforestation programs were on the lack of technical support provided to them.

Regionally, it also follows that cattle production would prosper because the system is so prevalent that market structures are developed in that sector. Aside from cattle, there seems to be a startling lack of other production in the settlement, although other projects had been pursued, which key informants indicated was based largely on funding offered by INCRA. As many settlers suffered from the apparent lack of other options for production and a market for charcoal existed in Marabá from a local aluminum smelting plant, settlers then turned to illegally harvesting trees for charcoal

from the environmental reserve, further indicating the influence of market viability in projects pursued by settlers

Several more links have also emerged between development and conservation objectives in the settlement. The first is that development and conservation are connected through the strategies pursued for both of them. Conservation and development were pursued as separate and so they were approached with separate strategies. Yet, when examined closer, it can be seen that they clearly affect one another. Because the settlers had a concern with maintaining 80% of the property in reserve, the environmental reserve was created in order to maximize the area available for alternative uses on individual lots.

Likewise, the type of productive activities that were pursued had a clear affect on the settlers' ability to maintain forest cover. As discussed earlier, primary strategy for development in PDM was raising cattle. This activity required large amounts of land to be cleared, and was thus actively counter to the goal of maintaining forest cover. However, in addition to being blatantly counter to the goals of forest cover maintenance through overt deforestation for pasture, the maintenance of pasture may have also caused some secondary effects that would hinder other forms of production, especially those that would be compatible with the goals of forest conservation in PDM.

As discussed in section 6.3.6 about Wildfire in Chapter VI, the use of fire that is associated with pasture maintenance also affects the types of other productive activities that can be pursued within the settlement. Because of the high risk of wildfire, settlers are reluctant to invest in planting crops, because they fear the risk of losing all investments. This may have particularly strong implications forest conservation, because alternative types of production that would encourage the maintenance of forest cover,

such as agro-forestry, become a tough challenge. Cattle ranching may therefore set limitations on other types of productive activities that can be pursued, which may have been an incentive for some of the settlers to turn to activities such as charcoal production.

Many of the approaches to conservation and development objectives appear contradictory instead of complimentary, and the effect can be seen on the landscape demonstrated by the remote sensing analysis. As discussed previously, the land cover requirements in PDM have failed to meet regulations for forest cover with deforestation increasing over time.

In my closing remarks, the purpose of this thesis was to shed further understanding of processes of land cover change by addressing how settlers in rural agrarian reform settlements in the Brazilian Amazon have negotiated between conservation and development objectives. By employing a political ecology framework, this thesis examined a case study in the South of Pará, Brazil and critically examines notions of inherent compatibility of sustainable development, revealing that influences at multiple scales have an impact on landscapes at the local level.

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